



# Product Technical Specification

## AirPrime HL8518, HL8528 and HL8529



**SIERRA**  
WIRELESS®

4117047  
2.2  
December 18, 2015

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# Document History

| Version | Date              | Updates                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| 1.0     | May 20, 2015      | Creation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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|         |                   | Deleted HSIC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| 2.2     | December 18, 2015 | Updated Chapter 7 Regulatory Legal Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |



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# 1. Introduction

This document is the Product Technical Specification for the AirPrime HL8518, HL8528 and HL8529 Embedded Modules. It defines high level features and illustrates the interfaces for these features. This document is intended to cover hardware aspects, including electrical and mechanical, of the AirPrime HL8518, HL8528 and HL8529.

The AirPrime HL8518, HL8528 and HL8529 modules belong to the AirPrime HL Series from the Essential Connectivity Module family. These are industrial grade Embedded Wireless Modules that provide voice and data connectivity on GPRS, EDGE RX, WCDMA, HSDPA and HSUPA networks (as listed in Table 1 Supported Bands/Connectivity).

The HL8518, HL8528 and HL8529 modules support a large variety of interfaces such as Digital Audio, GPIOs and UART to provide customers with the highest level of flexibility in implementing high-end solutions.

Table 1. Supported Bands/Connectivity

| RF Band   | Transmit band (Tx) | Receive band (Rx) | HL8518 | HL8528 | HL8529 |
|-----------|--------------------|-------------------|--------|--------|--------|
| UMTS B1   | 1922 to 1978 MHz   | 2112 to 2168 MHz  | ✓      |        |        |
| UMTS B2   | 1852 to 1908 MHz   | 1932 to 1988 MHz  |        | ✓      | ✓      |
| UMTS B5   | 826 to 847 MHz     | 871 to 892 MHz    |        | ✓      | ✓      |
| UMTS B8   | 882 to 913 MHz     | 927 to 958 MHz    | ✓      |        |        |
| GSM 850   | 824 to 849 MHz     | 869 to 894 MHz    |        | ✓      |        |
| E-GSM 900 | 880 to 915 MHz     | 925 to 960 MHz    | ✓      |        |        |
| DCS 1800  | 1710 to 1785 MHz   | 1805 to 1880 MHz  | ✓      |        |        |
| PCS 1900  | 1850 to 1910 MHz   | 1930 to 1990 MHz  |        | ✓      |        |

## 1.1. Common Flexible Form Factor (CF<sup>3</sup>)

The AirPrime HL8518, HL8528 and HL8529 belong to the Common Flexible Form Factor (CF<sup>3</sup>) family of modules. This family consists of a series of WWAN modules that share the same mechanical dimensions (same width and length with varying thicknesses) and footprint. The CF<sup>3</sup> form factor provides a unique solution to a series of problems faced commonly in the WWAN module space as it:

- Accommodates multiple radio technologies (from 2G to LTE advanced) and band groupings
- Supports bit-pipe (Essential Module Series) and value add (Smart Module Series) solutions
- Offers electrical and functional compatibility
- Provides Direct Mount as well Socketability depending on customer needs

## 1.2. Physical Dimensions

The AirPrime HL8518, HL8528 and HL8529 modules are compact, robust, fully shielded modules with the following dimensions:

- Length: 23 mm
- Width: 22 mm
- Thickness: 2.5 mm
- Weight: 2.65 g

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*Note: Dimensions specified above are typical values.*

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## 1.3. General Features

The table below summarizes the AirPrime HL8518, HL8528 and HL8529 features.

Table 2. General Features

| Feature         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Physical        | <ul style="list-style-type: none"> <li>• Small form factor (146-pin solderable LGA pad) – 23mm x 22mm x 2.5mm (nominal)</li> <li>• Metal shield can</li> <li>• RF connection pad</li> <li>• Baseband signals connection</li> </ul>                                                                                                                                                                                                                               |
| Electrical      | Single or double supply voltage (VBATT and VBATT_PA) – 3.2V – 4.5V                                                                                                                                                                                                                                                                                                                                                                                               |
| RF              | <p>HL8518 (dual-band UMTS and dual-band GSM):</p> <ul style="list-style-type: none"> <li>• UMTS B1</li> <li>• UMTS B8</li> <li>• E-GSM 900</li> <li>• DCS 1800</li> </ul> <p>HL8528 (dual-band UMTS and dual-band GSM):</p> <ul style="list-style-type: none"> <li>• UMTS B2</li> <li>• UMTS B5</li> <li>• GSM 850</li> <li>• PCS 1900</li> </ul> <p>HL8529 (dual-band UMTS):</p> <ul style="list-style-type: none"> <li>• UMTS B2</li> <li>• UMTS B5</li> </ul> |
| Audio interface | <ul style="list-style-type: none"> <li>• Digital interface (ONLY)</li> <li>• Supports Enhanced Full Rate (EFR), Full Rate (FR), Half Rate (HR), and both Narrow-Band and Wide-band Adaptive Multirate (AMR-NB and AMR-WB) vocoders</li> <li>• MO and MT calling</li> <li>• Echo cancellation and noise reduction</li> <li>• Emergency calls (112, 110, 911, etc.)</li> <li>• Incoming call notification</li> <li>• DTMF generation</li> </ul>                    |

| Feature               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SIM interface         | <ul style="list-style-type: none"> <li>• Dual SIM Single Standby (DSSS) with fast network switching capability</li> <li>• 1.8V/3V support</li> <li>• SIM extraction / hot plug detection</li> <li>• SIM/USIM support</li> <li>• Conforms with ETSI UICC Specifications.</li> <li>• Supports SIM application tool kit with proactive SIM commands</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Application interface | <ul style="list-style-type: none"> <li>• NDIS NIC interface support (Windows XP, Windows 7, Windows 8, Windows CE, Linux)</li> <li>• Multiple non-multiplexed USB channel support</li> <li>• Dial-up networking</li> <li>• USB selective suspend to maximize power savings</li> <li>• CMUX multiplexing over UART</li> <li>• AT command interface – 3GPP 27.007 standard, plus proprietary extended AT commands</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Protocol Stack        | <p>Dual-mode UMTS (WCDMA) / HSDPA / HSUPA / EDGE RX / GPRS / GSM operation</p> <ul style="list-style-type: none"> <li>• GSM/GPRS/EDGE RX <ul style="list-style-type: none"> <li>▪ GPRS Class 12</li> <li>▪ EDGE RX</li> <li>▪ CSD (Circuit-switched data bearers)</li> <li>▪ Release 4 GERAN Feature Package 1</li> <li>▪ SAIC / DARP Phase 1</li> <li>▪ Latency Reduction</li> <li>▪ Repeated FACCH and Repeated SACCH</li> <li>▪ GPRS ROHC</li> <li>▪ Enhanced Operator Name String (EONS)</li> <li>▪ Enhanced Network Selection (ENS)</li> </ul> </li> <li>• WCDMA <ul style="list-style-type: none"> <li>▪ 3GPP WCDMA FDD Multimode Type II UE Protocol Stack</li> <li>▪ Configurable for data classes up to 384 kBit/s</li> <li>▪ Inter-RAT Handover and Cell Reselection</li> <li>▪ Supports two types of Compressed Mode</li> <li>▪ Network Assisted Cell Change from UTRAN to GERAN and GERAN to UTRAN</li> <li>▪ CSD (Circuit-switched data bearers) over WCDMA (transparent/non transparent up to 64 kBit/s; Support for Video Telephony)</li> </ul> </li> <li>• HSDPA (High Speed Downlink Packet Access) <ul style="list-style-type: none"> <li>▪ Compliant with 3GPP Release 5</li> <li>▪ HSDPA Category 8 data rate – 7.2 Mbps (peak rate)</li> <li>▪ IPv6 support</li> </ul> </li> <li>• HSUPA (High Speed Uplink Packet Access) <ul style="list-style-type: none"> <li>▪ Compliant with 3GPP Release 6</li> <li>▪ HSUPA Category 6 data rate - 5.76 Mbps (peak rate)</li> <li>▪ Robust Header Compression (RoHC)</li> <li>▪ Fractional DPCH</li> </ul> </li> </ul> |

| Feature                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Protocol Stack         | <ul style="list-style-type: none"> <li>• HSPA+ (Evolved High Speed Packet Access) <ul style="list-style-type: none"> <li>▪ Compliant with 3GPP Release 7</li> <li>▪ Higher-Order Modulation (HOM)</li> <li>▪ MAC-ehs support</li> <li>▪ Continuous Packet Connectivity (CPC)</li> <li>▪ Enhanced F-DPCH</li> <li>▪ Enhanced Cell FACH</li> <li>▪ Circuit Switched Voice over HSPA</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| SMS                    | <ul style="list-style-type: none"> <li>• SMS MO and MT</li> <li>• CS and PS support</li> <li>• SMS saving to SIM card or ME storage</li> <li>• SMS reading from SIM card or ME storage</li> <li>• SMS sorting</li> <li>• SMS concatenation</li> <li>• SMS Status Report</li> <li>• SMS replacement support</li> <li>• SMS storing rules (support of AT+CNMI, AT+CNMA)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Supplementary Services | <ul style="list-style-type: none"> <li>• Call Barring</li> <li>• Call Forwarding</li> <li>• Call Hold</li> <li>• Caller ID</li> <li>• Call Waiting</li> <li>• Multi-party service</li> <li>• USSD</li> <li>• Automatic answer</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Connectivity           | <ul style="list-style-type: none"> <li>• Multiple (up to 20) cellular packet data profiles</li> <li>• Sleep mode for minimum idle power draw</li> <li>• Automatic GPRS attach at power-up</li> <li>• GPRS detach</li> <li>• Mobile-originated PDP context activation / deactivation</li> <li>• Support QoS profile <ul style="list-style-type: none"> <li>▪ Release 97 – Precedence Class, Reliability Class, Delay Class, Peak Throughput, Mean Throughput</li> <li>▪ Release 99 QoS negotiation – Background, Interactive, and Streaming</li> </ul> </li> <li>• Static and Dynamic IP address. The network may assign a fixed IP address or dynamically assign one using DHCP (Dynamic Host Configuration Protocol).</li> <li>• Supports PAP and CHAP authentication protocols</li> <li>• PDP context type (IPv4, IPv6, IPv4v6). IP Packet Data Protocol context</li> <li>• RFC1144 TCP/IP header compression</li> <li>• Interaction with existing GSM services (MO/MT SMS voice calls) while: <ul style="list-style-type: none"> <li>▪ GPRS is attached, or</li> <li>▪ In a GPRS data session (class B GPRS suspend / resume procedures)</li> </ul> </li> </ul> |
| Environmental          | <p>Operating temperature ranges (industrial grade):</p> <ul style="list-style-type: none"> <li>• Class A: -30°C to +70°C</li> <li>• Class B: -40°C to +85°C</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| Feature            | Description                                                                              |
|--------------------|------------------------------------------------------------------------------------------|
| RTC                | Real Time Clock (RTC) with calendar and alarm                                            |
| Temperature Sensor | <ul style="list-style-type: none"> <li>Temperature monitoring</li> <li>Alarms</li> </ul> |

## 1.4. Encryption Support

The AirPrime HL8518, HL8528 and HL8529 supports the following encryption algorithms:

- Ciphering algorithms A51, A52 and A53
- GEA1/GEA2 and GEA3 algorithm for GPRS encryption
- Cyclic Redundancy Check (CRC) with programmable polynomial
- UMTS confidentiality algorithm f8 for message ciphering (Kasumi based UEA1)
- UMTS integrity algorithm f9 for message authentication (Kasumi based UIA1 and SNOW 3G based UIA2)

## 1.5. Architecture

The figure below presents an overview of the AirPrime HL8518, HL8528 and HL8529 modules internal architecture and external interfaces.

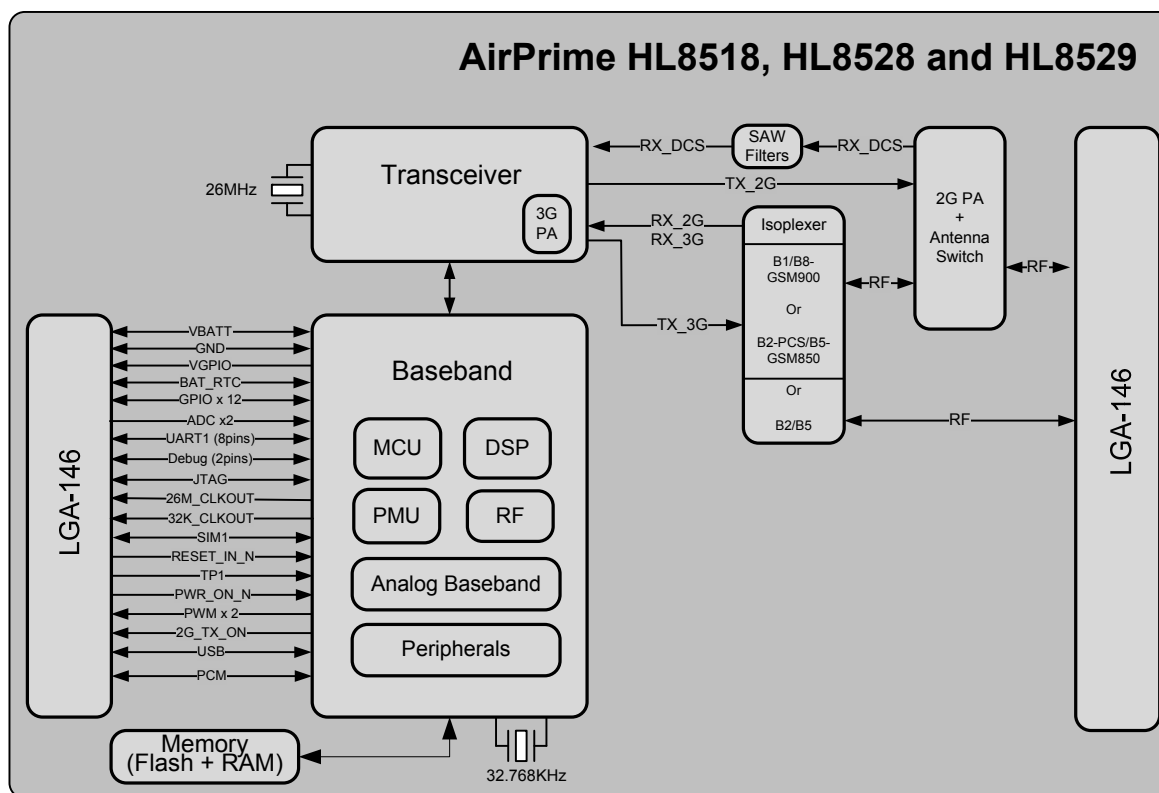


Figure 1. Architecture Overview

## 1.6. Interfaces

The AirPrime HL8518, HL8528 and HL8529 modules provide the following interfaces and peripheral connectivity:

- 1x – 8-pin UART
- 1x – Active Low RESET
- 1x – USB 2.0
- 1x – Backup Battery Interface
- 2x – System Clock Out
- 1x – Active Low POWER ON
- 1x – 1.8V/3V SIM
- 1x – Digital Audio
- 2x – ADC
- 1x – JTAG Interface
- 1x – Debug Interface
- 2x – PWM
- 12x – GPIOs
- 1x – 2G TX Burst Indicator
- 1x – GSM Antenna

## 1.7. Connection Interface

The AirPrime HL8518, HL8528 and HL8529 modules are an LGA form factor device. All electrical and mechanical connections are made through the 146 Land Grid Array (LGA) pads on the bottom side of the PCB.

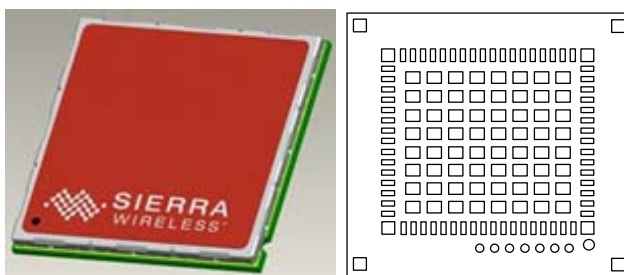


Figure 2. Mechanical Overview

The 146 pads have the following distribution:

- 66 inner signal pads, 1x0.5mm, pitch 0.8mm
- 1 reference test point (Ground), 1.0mm diameter
- 7 test point (JTAG), 0.8mm diameter, 1.20mm pitch
- 64 inner ground pads, 1.0x1.0mm, pitch 1.825mm/1.475mm
- 4 inner corner ground pads, 1x1mm
- 4 outer corner ground pads, 1x0.9mm

## 1.8. ESD

Refer to the following table for ESD Specifications.

*Note: Information specified in the following table is preliminary and subject to change.*

Table 3. ESD Specifications

| Category        | Connection               | Specification                                                                                                                                                                                                      |
|-----------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operational     | RF ports                 | IEC-61000-4-2 — Level (Electrostatic Discharge Immunity Test)                                                                                                                                                      |
| Non-operational | Host connector interface | Unless otherwise specified: <ul style="list-style-type: none"> <li>JESD22-A114 +/- 1kV Human Body Model</li> <li>JESD22-A115 +/- 200V Machine Model</li> <li>JESD22-C101C +/- 250V Charged Device Model</li> </ul> |
| Signals         | SIM connector            | ESD protection is highly recommended at the point where the USIM contacts are exposed, and for any other signals that would be subjected to ESD by the user.                                                       |
|                 | Other host signals       |                                                                                                                                                                                                                    |

## 1.9. Environmental and Certifications

### 1.9.1. Environmental Specifications

The environmental specification for both operating and storage conditions are defined in the table below.

Table 4. Environmental Specifications

| Conditions        | Range          |
|-------------------|----------------|
| Operating Class A | -30°C to +70°C |
| Operating Class B | -40°C to +85°C |
| Storage           | -40°C to +85°C |

*Note: The upper limit of Class A is subject to module PCB temperature. A progressive 3G output power reduction feature is implemented for when PCB temperatures are above +80°C. This leads to a calibrated 3G TX power output up to +80°C for the PCB temperature and automatic decrease at higher temperatures. Therefore, depending on module activity and customer design, the upper limit of Class A could be lower than 70°C.*

Class A is defined as the operating temperature ranges that the device:

- Shall exhibit normal function during and after environmental exposure.
- Shall meet the minimum requirements of 3GPP or appropriate wireless standards.

Class B is defined as the operating temperature ranges that the device:

- Shall remain fully functional during and after environmental exposure
- Shall exhibit the ability to establish a voice, SMS or DATA call (emergency call) at all times even when one or more environmental constraint exceeds the specified tolerance.
- Unless otherwise stated, full performance should return to normal after the excessive constraint(s) have been removed.

## 1.9.2. Regulatory

The AirPrime HL8518, HL8528 and HL8529 modules are compliant with the following regulations:

- R&TTE directive 1999/5/EC
- FCC
- IC

These compliances will be reflected on the AirPrime HL8518, HL8528 and HL8529 modules labels when applicable.

## 1.9.3. RoHS Directive Compliant

The AirPrime HL8518, HL8528 and HL8529 modules are compliant with RoHS Directive 2011/65/EU 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)”.

## 1.9.4. Disposing of the Product

This electronic product is subject to the EU Directive 2012/19/EU for Waste Electrical and Electronic Equipment (WEEE). As such, this product must not be disposed of at a municipal waste collection point. Please refer to local regulations for directions on how to dispose of this product in an environmental friendly manner.



## 1.10. References

- [1] AirPrime HL Series Customer Process Guidelines  
Reference Number: 4114330
- [2] AirPrime HL6 and HL8 Series AT Commands Interface Guide  
Reference Number: 4114680
- [3] AirPrime HL Series Dual SIM Single Standby Application Note  
Reference Number: 2174034

## 2. Detailed Interface Specifications

**Note:** If not specified, all electrical values are given for VBATT=3.7V and an operating temperature of 25°C.

For standard applications, VBATT and VBATT\_PA must be tied externally to the same power supply. For some specific applications, AirPrime HL8518, HL8528 and HL8529 modules support separate VBATT and VBATT\_PA connection if requirements below are fulfilled.

### 2.1. Power Supply

The AirPrime HL8518, HL8528 and HL8529 modules are supplied through the VBATT signal.

#### 2.1.1. Electrical Characteristics

The following table describes the electrical characteristics of the Power Supply interface.

Table 5. Power Supply

| Supply                                  | Minimum          | Typical | Maximum |
|-----------------------------------------|------------------|---------|---------|
| VBATT voltage (V)                       | 3.2 <sup>1</sup> | 3.7     | 4.5     |
| VBATT_PA voltage (V) Full Specification | 3.2 <sup>1</sup> | 3.7     | 4.5     |
| VBATT_PA voltage (V) Extended Range     | 2.8 <sup>2</sup> | 3.7     | 4.5     |

1 This value has to be guaranteed during the burst

2 No guarantee of 3GPP performances over extended range

**Note:** Load capacitance for VBATT is around 30µF ± 20% embedded inside the module.  
Load capacitance for VBATT\_PA is around 20µF ± 20% embedded inside the module.

#### 2.1.2. Pin Description

The following table describes the pin description of the Power Supply interface.

Table 6. Power Supply Pin Description

| Pin Number                 | Signal Name | I/O | Description                    |
|----------------------------|-------------|-----|--------------------------------|
| 63                         | VBATT       | I   | Power supply (base band)       |
| 61, 62                     | VBATT_PA    | I   | Power supply (radio frequency) |
| 37, 39, 48, 67-70, 167-234 | GND         |     | Ground                         |

### 2.1.3. Burst Transmission Current Requirements

The power supply must be able to deliver high current peaks in a short time due to the burst transmission nature of GSM. For supply filtering recommendations, please refer to section 2.3 Decoupling of Power Supply Signals.

The following table describes radio burst rates in connected mode. For detailed power consumption figures, refer to section 2.4 Current DC Power Consumption.

Table 7. Radio Burst Rates – Connected Mode

| GSM/GPRS Multislot Class | RF Power Amplifier Current | Slot Duration | Period   | Rising Time |
|--------------------------|----------------------------|---------------|----------|-------------|
| Class 10                 | 2.2A peak                  | 577 $\mu$ s   | 4.615 ms | 10 $\mu$ s  |
| Class 12                 |                            |               |          |             |

The corresponding radio burst rates in connected mode are as follows:

- GSM/GPRS class 2 terminals emit 577  $\mu$ s radio bursts every 4.615 ms
- GPRS class 10 terminals emit 1154  $\mu$ s radio bursts every 4.615 ms
- GPRS class 12 terminals emit 2308  $\mu$ s radio bursts every 4.615 ms

In connected mode, the RF Power Amplifier current (2.2A peak in GSM /GPRS mode) flows with a ratio of:

- 1/8 of the time (around 577  $\mu$ s every 4.615 ms for GSM /GPRS cl 2 – 2RX/1TX), and
- 4/8 of the time (around 2308  $\mu$ s every 4.615 ms for GSM /GPRS cl 12 – 4RX/1TX) with the rising time at around 10  $\mu$ s.

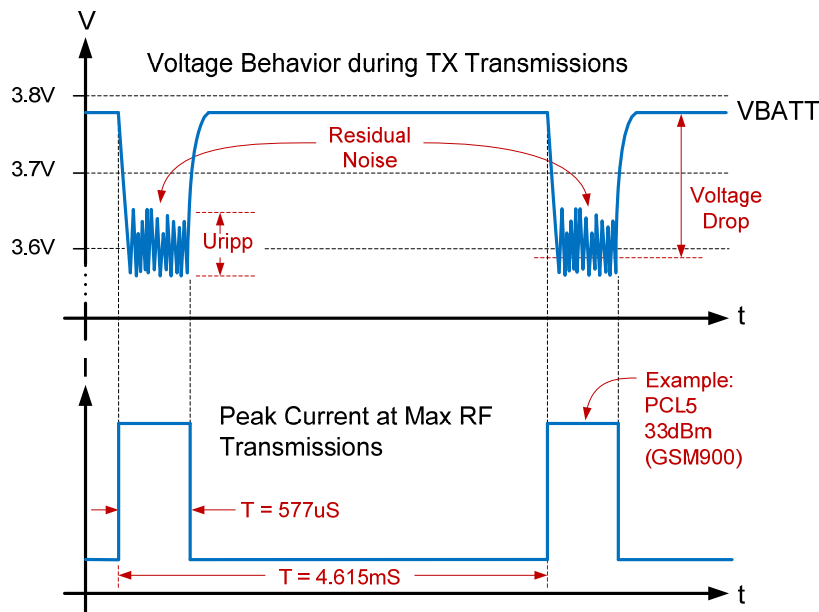


Figure 3. Power Supply During Burst Transmission

## 2.1.4. Power Input (VBATT)

An external power supply uses the VBATT pins to:

- Supply the AirPrime HL8518, HL8528 and HL8529 modules.
- Directly supply the RF components.
  - It is essential to keep the voltage ripple to a minimum at this connection to avoid any phase error or spectrum modulation degradation.
  - An inadequate power supply can significantly affect RF performance (TX power, modulation spectrum, EMC performance, spurious emission, frequency error, etc.).
- Provide reference voltage VGPI (through internal regulators) for the baseband signals.

When the AirPrime HL8518, HL8528 and HL8529 modules are supplied with a battery, the total impedance (battery + protections + PCB) should be such that the supply will be  $\geq 3.2$  V during GSM burst mode operation drawing a maximum peak current of 2.2 A for 577  $\mu$ s (one slot) or 1154  $\mu$ s (two slots) TX.

## 2.2. Ground Connection

The AirPrime HL8518, HL8528 and HL8529 modules shielding case is the grounding. The ground must be connected on the motherboard through a complete layer on the PCB.

The ground connection is made by soldering the LGA ground pins and rectangular ground pad to the ground plane of the application board.

## 2.3. Decoupling of Power Supply Signals

The ETSI standard defines specific requirements for phase error and spectrum modulation. Both are mandatory and can be affected by the choice of power supply filtering. It is highly recommended to provide multiple capacitor values to solve an eventual Amplitude and Phase Modulation issue.

AirPrime HL8518, HL8528 and HL8529 modules already have embedded decoupling capacitors on the VBATT lines, but additional external decoupling may be required.

- EMI/RFI issues – Add a capacitor (10pF~33pF) close to the VBATT pins.
- TDMA noise (217 Hz) – Place a low ESR decoupling capacitors (at least 100  $\mu$ F) as close to the module as possible to reduce noise.

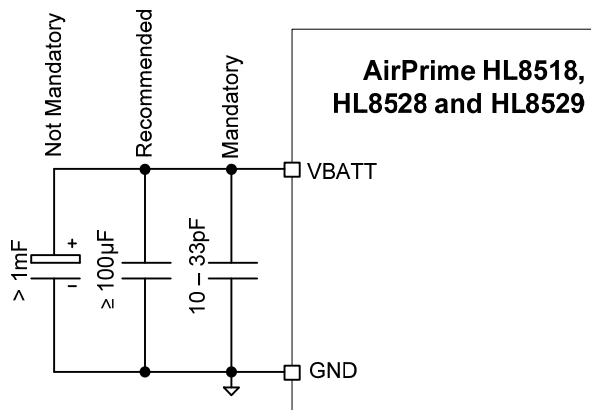


Figure 4. Power Supply Requirements

The figure below shows the power supply voltage drop shapes during GSM 2G transmission.

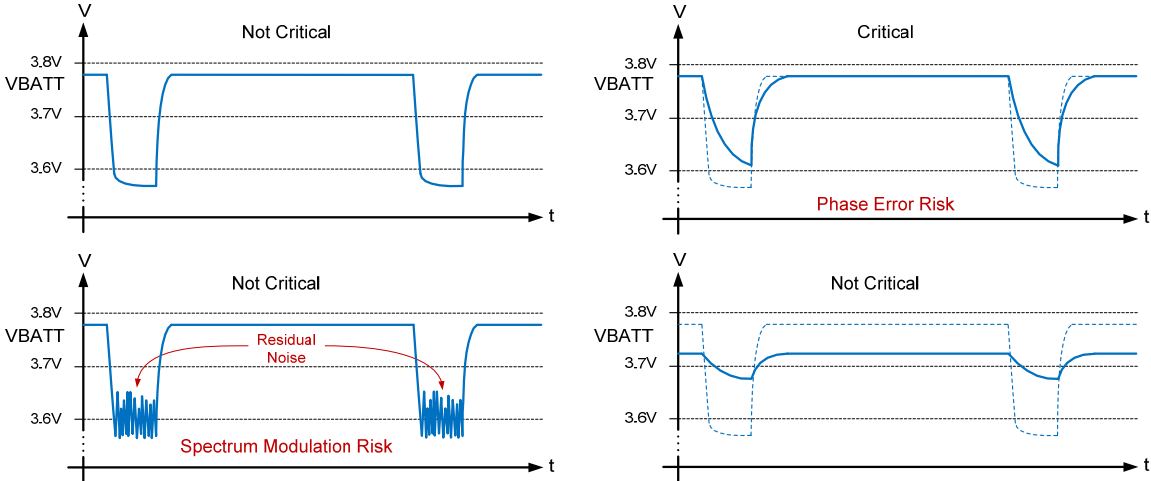


Figure 5. Power Supply Voltage Drops Shapes During Burst Transmission

## 2.4. Current DC Power Consumption

The following table lists the current consumption of the AirPrime HL8518, HL8528 and HL8529 modules at different conditions.

**Note:** The following data is under the setup recommended in section 3.5 Power Supply Design. The USB is disconnected for the lowest current consumption.

Typical values are measured at ambient temperature, and maximum values are measured over the entire operating temperature range. (The measurements are done with a CMU200 and with a 50Ω load.) For a description of input voltage requirements, see section 2.1 Power Supply.

Table 8. Current Consumption (at nominal voltage, 3.7V)

| Parameters                                             |         | Typical | Maximum |
|--------------------------------------------------------|---------|---------|---------|
| Off mode                                               |         | 50 µA   |         |
| Sleep mode - GSM DRX2<br>(registered to the network)   | GSM900  | 1.5 mA  | 3.15 mA |
|                                                        | DCS1800 | 1.5 mA  | 3.15 mA |
|                                                        | GSM850  | 1.6 mA  | 3.4 mA  |
|                                                        | PCS1900 | 1.6 mA  | 3.4 mA  |
| Sleep mode - GSM DRX9<br>(registered to the network)   | GSM900  | 1.15 mA | 2.7 mA  |
|                                                        | DCS1800 | 1.0 mA  | 2.7 mA  |
|                                                        | GSM850  | 1.3 mA  | 2.9 mA  |
|                                                        | PCS1900 | 1.25 mA | 2.95 mA |
| Sleep mode - WCDMA DRX6<br>(registered to the network) | Band 1  | 1.75 mA | 3.45 mA |
|                                                        | Band 2  | 2 mA    | 3.75 mA |
|                                                        | Band 5  | 2 mA    | 3.8 mA  |
|                                                        | Band 8  | 1.75 mA | 3.5 mA  |

| Parameters                                             |                         | Typical | Maximum |
|--------------------------------------------------------|-------------------------|---------|---------|
| Sleep mode - WCDMA DRX9<br>(registered to the network) | Band 1                  | 1.1 mA  | 2.7 mA  |
|                                                        | Band 2                  | 1.3 mA  | 2.9 mA  |
|                                                        | Band 5                  | 1.3 mA  | 3.2 mA  |
|                                                        | Band 8                  | 1.1 mA  | 2.7 mA  |
| WCDMA in communication mode<br>(Voice Call)            | Band 1                  | 620 mA  | 735 mA  |
|                                                        | Band 2                  | 620 mA  | 735 mA  |
|                                                        | Band 5                  | 500 mA  | 650 mA  |
|                                                        | Band 8                  | 500 mA  | 650 mA  |
| WCDMA in communication mode<br>(HSDPA)                 | Band 1                  | 700 mA  | 880 mA  |
|                                                        | Band 2                  | 680 mA  | 900 mA  |
|                                                        | Band 5                  | 550 mA  | 760 mA  |
|                                                        | Band 8                  | 580 mA  | 800 mA  |
| WCDMA in communication mode<br>(HSUPA)                 | Band 1                  | 700 mA  | 880 mA  |
|                                                        | Band 2                  | 665 mA  | 900 mA  |
|                                                        | Band 5                  | 550 mA  | 760 mA  |
|                                                        | Band 8                  | 580 mA  | 800 mA  |
| GSM in communication mode                              | GSM900 / GSM850 (PCL=5) | 220 mA  | 250 mA  |
|                                                        | DCS / PCS (PCL=0)       | 165 mA  | 175 mA  |
| GPRS (2 TX,3 RX)                                       | GSM900 / GSM850 (PCL=5) | 425 mA  | 460 mA  |
|                                                        | DCS / PCS (PCL=0)       | 300 mA  | 335 mA  |
| Peak current consumption                               | GSM900 / GSM850         | 1.9 A   | 2.2A    |
|                                                        | DCS / PCS               | 1.8 A   | 2.0A    |

Table 9. Current Consumption per Power Supply (VBATT\_PA and VBATT)

| Parameters |                                                          |                             | Typical | Maximum |
|------------|----------------------------------------------------------|-----------------------------|---------|---------|
| VBATT_PA   | Average current GSM in communication mode                | E-GSM 900 / GSM 850 (PCL=5) | 185 mA  | 210 mA  |
|            |                                                          | DCS 1800/ PCS 1900 (PCL=0)  | 130 mA  | 135 mA  |
|            | Average current GPRS (2 TX,3 RX)                         | E-GSM 900 / GSM 850 (PCL=5) | 370 mA  | 395 mA  |
|            |                                                          | DCS 1800/ PCS 1900 (PCL=0)  | 245 mA  | 270 mA  |
|            | Average current WCDMA in communication mode (Voice Call) | Band 1                      | 520 mA  | 615 mA  |
|            |                                                          | Band 2                      | 520 mA  | 615 mA  |
|            |                                                          | Band 5                      | 405 mA  | 530 mA  |
|            |                                                          | Band 8                      | 405 mA  | 530 mA  |
| VBATT      | Average current GSM in communication mode                | E-GSM 900 / GSM 850 (PCL=5) | 35 mA   | 40 mA   |
|            |                                                          | DCS 1800/ PCS 1900 (PCL=0)  | 35 mA   | 40 mA   |
|            | Average current GPRS (2 TX,3 RX)                         | E-GSM 900 / GSM 850 (PCL=5) | 55 mA   | 65 mA   |
|            |                                                          | DCS 1800/ PCS 1900 (PCL=0)  | 55 mA   | 65 mA   |
|            | Average current WCDMA in communication mode (Voice Call) | Band 1                      | 100 mA  | 120 mA  |
|            |                                                          | Band 2                      | 100 mA  | 120 mA  |
|            |                                                          | Band 5                      | 95 mA   | 120 mA  |
|            |                                                          | Band 8                      | 95 mA   | 120 mA  |

## 2.5. VGPIO

The VGPIO output can be used to:

- Pull-up signals such as I/Os
- Supply the digital transistors driving LEDs
- Act as a voltage reference for the ADC interfaces, ADC0 and ADC1

The VGPIO output is available when the AirPrime HL8518, HL8528 and HL8529 module is switched ON.

### 2.5.1. Electrical Characteristics

The following table describes the electrical characteristics of the VGPIO interface.

Table 10. VGPIO Electrical Characteristics

| Parameter                           | Min | Typ | Max | Remarks                                     |
|-------------------------------------|-----|-----|-----|---------------------------------------------|
| Voltage level (V)                   | 1.7 | 1.8 | 1.9 | Both active mode and sleep mode             |
| Current capability active mode (mA) | -   | -   | 50  | Power Management support up to 50mA output. |
| Rise Time(ms)                       | -   | -   | 1.5 | Start-Up time from 0V                       |

### 2.5.2. Pin Description

The following table describes the pin description of the VGPIO interface.

Table 11. VGPIO Pin Description

| Pin Number | Signal Name | I/O | I/O Type | Function                           |
|------------|-------------|-----|----------|------------------------------------|
| 45         | VGPIO       | O   | 1.8V     | (Power supply) GPIO voltage output |

## 2.6. BAT\_RTC

The AirPrime HL8518, HL8528 and HL8529 modules provide an input/output to connect a Real Time Clock power supply.

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

If VBATT is available, the back-up battery can be charged by the internal 1.8V power supply regulator.

## 2.6.1. Electrical Characteristics

The following table describes the electrical characteristics of the BAT\_RTC interface.

Table 12. BAT\_RTC Electrical Characteristics

| Parameter                          | Minimum | Typical | Maximum | Unit |
|------------------------------------|---------|---------|---------|------|
| Input voltage                      | -5%     | 1.8     | +5%     | V    |
| Input current consumption          | -       | 2.5     | -       | μA   |
| Output current capability          | 7       | -       | -       | mA   |
| Output voltage                     | -5%     | 1.8     | +5%     | V    |
| Max charging current (@VBATT=3.7V) | -       | 25      | -       | mA   |

*Note:* When used with the HL Series snap-in socket, or when compatibility with HL6528x is needed, Sierra Wireless recommends adding a 10μF capacitor to the BAT\_RTC pin.

## 2.6.2. Pin Description

The following table describes the pin description of the BAT\_RTC interface.

Table 13. BAT\_RTC Pin Description

| Pin Number | Signal Name | I/O | Function                    |
|------------|-------------|-----|-----------------------------|
| 21         | BAT_RTC     | I/O | Power supply for RTC backup |

## 2.7. SIM Interface

The AirPrime HL8518, HL8528 and HL8529 modules have one physical SIM interface, UIM1, which has optional support for dual SIM application with an external SIM switch. Refer to Section 3.8 Dual SIM Application for more information regarding dual SIM.

The UIM1 interface allows control of a 1.8V/3V SIM and is fully compliant with GSM 11.11 recommendations concerning SIM functions.

The five signals used by this interface are as follows:

- UIM1\_VCC: power supply
- UIM1\_CLK: clock
- UIM1\_DATA: I/O port
- UIM1\_RST: reset
- UIM1\_DET: SIM detection (optional)

## 2.7.1. Electrical Characteristics

The following table describes the electrical characteristics of the UIM1 interface.

Table 14. Electrical Characteristics of UIM1

| Parameter                                             |                                                  | Min     | Typ  | Max     | Remarks                                                                   |
|-------------------------------------------------------|--------------------------------------------------|---------|------|---------|---------------------------------------------------------------------------|
| UIM1 Interface Voltage : (V)<br>( VCC, CLK, IO, RST ) |                                                  | 2.7     | 3.0  | 3.15    | The appropriate output voltage is auto detected and selected by software. |
|                                                       |                                                  | 1.65    | 1.80 | 1.95    |                                                                           |
| UIM1 Interface Voltage: (V)<br>(VCC, CLK, IO, RESET ) | V <sub>IH</sub> : Input Voltage-High (VDD=1.8V)  | VDD*0.7 | -    | 1.95    |                                                                           |
|                                                       | V <sub>IL</sub> : Input Voltage-Low (VDD=1.8V)   | 0       | -    | VDD*0.2 |                                                                           |
|                                                       | V <sub>OH</sub> : Output Voltage-High (VDD=1.8V) | VDD*0.7 | -    | 1.95    |                                                                           |
|                                                       | V <sub>OL</sub> : Output Voltage-Low (VDD=1.8V)  | 0       | -    | VDD*0.2 |                                                                           |
|                                                       | V <sub>IH</sub> : Input Voltage-High (VDD=3.0V)  | VDD*0.7 | -    | 3.15    |                                                                           |
|                                                       | V <sub>IL</sub> : Input Voltage-Low (VDD=3.0V)   | 0       | -    | VDD*0.2 |                                                                           |
|                                                       | V <sub>OH</sub> : Output Voltage-High (VDD=3.0V) | VDD*0.7 | -    | 3.15    |                                                                           |
|                                                       | V <sub>OL</sub> : Output Voltage-Low (VDD=3.0V)  | 0       | -    | VDD*0.2 |                                                                           |
| UIM1 DET                                              |                                                  | 1.33    | 1.80 | 2.1     | High active                                                               |
| UIM1_VCC Current (mA)                                 |                                                  | -       | -    | 10      | Max output current in sleep mode = 3 mA                                   |
| UIM1_VCC Line Regulation (mV/V)                       |                                                  | -       | -    | 50      | At Iout Max.                                                              |
| UIM1_VCC Power-up Setting Time (μs) from power down   |                                                  | -       | 10   | -       |                                                                           |

## 2.7.2. Pin Description

The following table describes the pin description of the UIM1 interface.

Table 15. UIM1 Pin Description

| Pin Number | Signal Name | I/O | I/O Type | Function          | Multiplex |
|------------|-------------|-----|----------|-------------------|-----------|
| 26         | UIM1_VCC    | O   | 1.8V/3V  | UIM1 Power supply |           |
| 27         | UIM1_CLK    | O   | 1.8V/3V  | UIM1 Clock        |           |
| 28         | UIM1_DATA   | I/O | 1.8V/3V  | UIM1 Data         |           |
| 29         | UIM1_RESET  | O   | 1.8V/3V  | UIM1 Reset        |           |
| 64         | UIM1_DET    | I   | 1.8V     | UIM1 detection    | GPIO3     |

### 2.7.3. UIM1\_DET

UIM1\_DET is used to detect and notify the application about the insertion and removal of a SIM device in the SIM socket connected to the main SIM interface (UIM1). When a SIM is inserted, the state of UIM1\_DET transitions from logic 0 to logic 1. Inversely, when a SIM is removed, the state of UIM1\_DET transitions from logic 1 to logic 0.

The GPIO used for UIM1\_DET is GPIO3.

Enabling or disabling this SIM detect feature can be done using the **AT+KSIMDET** command. For more information about this command, refer to document [2] AirPrime HL6 and HL8 Series AT Commands Interface Guide.

### 2.7.4. Application

#### 2.7.4.1. Reference Schematic

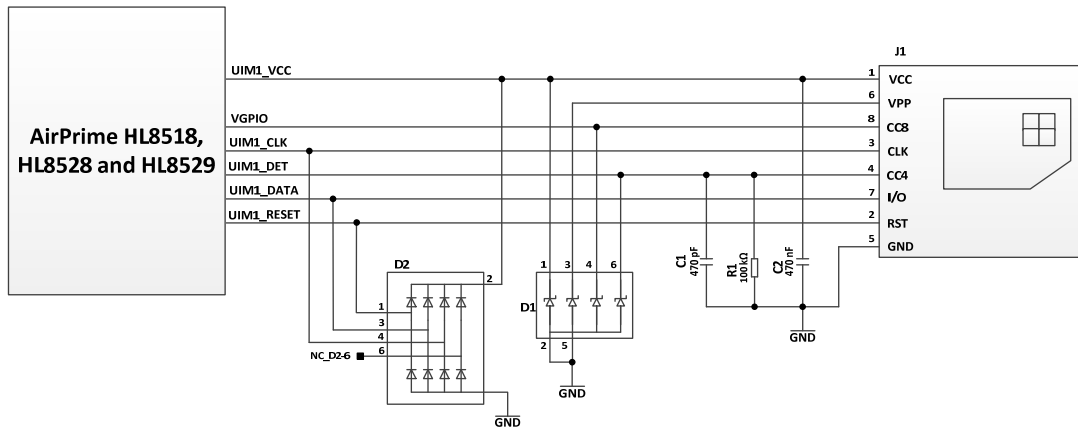


Figure 6. UIM1 Application Reference Schematic

#### 2.7.4.2. USIM Socket Pin Description

The following table describes the required USIM socket pins.

Table 16. USIM Socket Pin Description

| Pin Number | Signal Name | Description       |
|------------|-------------|-------------------|
| 1          | UIM1_VCC    | UIM1 Power supply |
| 2          | UIM1_RESET  | UIM1 Reset        |
| 3          | UIM1_CLK    | UIM1 Clock        |
| 4          | UIM1_DET    | UIM1 detection    |
| 5          | GROUND      | GND               |
| 6          | -           | -                 |
| 7          | UIM1_DATA   | UIM1 Data         |
| 8          | VGPIO       | Power supply      |

## 2.8. USB

The AirPrime HL8518, HL8528 and HL8529 modules have one USB interface.

### 2.8.1. Electrical Characteristics

The following table describes the electrical characteristics of the USB interface.

Table 17. Electrical Characteristics of USB

| Signal            | I/O | I/O Type | Parameter                                    | Min. | Typ. | Max. | Unit |
|-------------------|-----|----------|----------------------------------------------|------|------|------|------|
| USB_D+            | I/O | Analog   |                                              | 3.06 | 3.3  | 3.6  | V    |
| USB_D-            | I/O | Analog   |                                              | 3.06 | 3.3  | 3.6  | V    |
| USB data (DP, DM) | I/O | Analog   | V <sub>IH</sub> : Input Voltage-High         | 2    | -    | 3.2  | V    |
|                   |     |          | V <sub>IL</sub> : Input Voltage-Low          | -0.3 | -    | 0.8  | V    |
|                   |     |          | V <sub>OL</sub> : Static Output Voltage-Low  | -    | -    | 0.45 | V    |
|                   |     |          | V <sub>OH</sub> : Static Output Voltage-High | 2.45 | -    | -    | V    |
| USB_VBUS          | I   | Analog   | Voltage input                                | 4.75 | 5.0  | 5.25 | V    |
|                   |     |          | USB_VBUS Input current consumption           |      |      |      | mA   |

### 2.8.2. Pin Description

The following table describes the pin description of the USB interface.

Table 18. USB Pin Description

| Pin Number | Signal Name | I/O | I/O Type | Function                   |
|------------|-------------|-----|----------|----------------------------|
| 12         | USB_D-      | I/O | 3.3V     | USB data negative line pad |
| 13         | USB_D+      | I/O | 3.3V     | USB data positive line pad |
| 16         | USB_VBUS    | I   | 5V       | USB VBUS                   |

*Note:* When the 5V USB supply is not available, connect USB\_VBUS to VBATT to supply the USB interface.

## 2.9. Electrical Information I/O

The AirPrime HL8518, HL8528 and HL8529 modules support different groups of digital interfaces with varying current drain limits. The following table enumerates these interface groupings and enumerates the electrical characteristics of each digital interface.

The DC characteristics of the pads are compatible with CMOS JEDEC standard EIA/JESD8-5.

Table 19. Digital I/O Electrical Characteristics

| Parameter                                                   | Min  | Typ | Max     | Conditions |
|-------------------------------------------------------------|------|-----|---------|------------|
| V <sub>IL</sub> : Input voltage for general digital pad (V) | -0.2 | -   | VDD*0.2 |            |

| Parameter                                            | Min      | Typ | Max       | Conditions         |
|------------------------------------------------------|----------|-----|-----------|--------------------|
| $V_{IH}$ : Input voltage for general digital pad (V) | VDD*0.7  | -   | VDD + 0.2 |                    |
| Input / Output leakage Current ( $\mu A$ )           | -        | -   | $\pm 0.7$ |                    |
| VDD (V)                                              | 1.7      | 1.8 | 1.9       |                    |
| <b>Driver Pad Class A</b>                            |          |     |           |                    |
| $V_{OLA}$ : Output Voltage-Low (V)                   | -        | -   | 0.2       | $I_{OL} = + 0.1mA$ |
|                                                      | -        | -   | 0.35      | $I_{OL} = +6.0mA$  |
| $V_{OHA}$ : Output Voltage-High (V)                  | VDD-0.35 | -   | -         | $I_{OH} = - 6.0mA$ |
|                                                      | VDD-0.2  | -   | -         | $I_{OH} = - 0.1mA$ |
| <b>Driver Pad Class B</b>                            |          |     |           |                    |
| $V_{OLB}$ : Output Voltage-Low (V)                   | -        | -   | 0.2       | $I_{OL} = + 0.1mA$ |
|                                                      | -        | -   | 0.35      | $I_{OL} = +4.0 mA$ |
| $V_{OHB}$ : Output Voltage-High (V)                  | VDD-0.35 | -   | -         | $I_{OH} = - 4.0mA$ |
|                                                      | VDD-0.2  | -   | -         | $I_{OH} = - 0.1mA$ |
| <b>Driver Pad Class C</b>                            |          |     |           |                    |
| $V_{OLC}$ : Output Voltage-Low (V)                   | -        | -   | 0.2       | $I_{OL} = + 0.1mA$ |
|                                                      | -        | -   | 0.35      | $I_{OL} = +2.0mA$  |
| $V_{OHC}$ : Output Voltage-High (V)                  | VDD-0.35 | -   | -         | $I_{OH} = - 2.0mA$ |
|                                                      | VDD-0.2  | -   | -         | $I_{OH} = - 0.1mA$ |
| <b>Driver Pad Class D</b>                            |          |     |           |                    |
| $V_{OLD}$ : Output Voltage-Low (V)                   | -        | -   | 0.2       | $I_{OL} = + 0.1mA$ |
|                                                      | -        | -   | 0.35      | $I_{OL} = +1.0mA$  |
| $V_{OHD}$ : Output Voltage-High (V)                  | VDD-0.35 | -   | -         | $I_{OH} = - 1.0mA$ |
|                                                      | VDD-0.2  | -   | -         | $I_{OH} = - 0.1mA$ |
| <b>Driver Pad Class E</b>                            |          |     |           |                    |
| $V_{OLE}$ : Output Voltage-Low (V)                   | -        | -   | 0.2       | $I_{OL} = + 0.1mA$ |
|                                                      | -        | -   | 0.35      | $I_{OL} = +1.0mA$  |
| $V_{OHE}$ : Output Voltage-High (V)                  | VDD-0.35 | -   | -         | $I_{OH} = - 1.0mA$ |
|                                                      | VDD-0.2  | -   | -         | $I_{OH} = - 0.1mA$ |

## 2.10. General Purpose Input/Output (GPIO)

The AirPrime HL8518, HL8528 and HL8529 modules provide 12 GPIOs, 2 of which have multiplexes.

Table 20. GPIO Pin Description

| Pin Number | Signal Name | Multiplex | I/O | Power Supply Domain |
|------------|-------------|-----------|-----|---------------------|
| 1          | GPIO1       |           | I/O | 1.8V                |
| 10         | GPIO2*      |           | I/O | 1.8V                |
| 40         | GPIO7       |           | I/O | 1.8V                |
| 41         | GPIO8       |           | I/O | 1.8V                |
| 46         | GPIO6       |           | I/O | 1.8V                |
| 52         | GPIO10      |           | I/O | 1.8V                |

| Pin Number | Signal Name | Multiplex | I/O | Power Supply Domain |
|------------|-------------|-----------|-----|---------------------|
| 53         | GPIO11      |           | I/O | 1.8V                |
| 54         | GPIO15      |           | I/O | 1.8V                |
| 58         | GPIO12      | PWM2      | I/O | 1.8V                |
| 64         | GPIO3       | UIM1_DET  | I/O | 1.8V                |
| 65         | GPIO4       |           | I/O | 1.8V                |
| 66         | GPIO5       |           | I/O | 1.8V                |

\* This pin can be used to trigger the module to wake up from Sleep Mode.

## 2.11. Main Serial Link (UART1)

The main serial link (UART1) is used for communication between the AirPrime HL8518, HL8528 and HL8529 modules and a PC or host processor. It consists of a flexible 8-wire serial interface that complies with RS-232 interface.

The supported baud rates of the UART1 are 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 500000, 750000, 921600, 1843200, 3000000, 3250000 and 6000000 bit/s.

The signals used by UART1 are as follows:

- TX data (UART1\_TX)
- RX data (UART1\_RX)
- Request To Send (UART1\_RTS)
- Clear To Send (UART1\_CTS)
- Data Terminal Ready (UART1\_DTR)
- Data Set Ready (UART1\_DSR)
- Data Carrier Detect (UART1\_DCD)
- Ring Indicator (UART1\_RI)

*Note:* Signal names are according to PC view.

### 2.11.1. Pin Description

The following table describes the pin description of the UART1 interface.

Table 21. UART1 Pin Description

| Pin # | Signal Name* | I/O*              | Description                                                                                                         |
|-------|--------------|-------------------|---------------------------------------------------------------------------------------------------------------------|
| 2     | UART1_RI     | O                 | Signal incoming calls (voice and data), SMS, etc.                                                                   |
| 3     | UART1_RTS    | I                 | Wakes the module up when <b>AT+KSLEEP=1</b> is used                                                                 |
| 4     | UART1_CTS    | O                 | Ready to receive AT commands                                                                                        |
| 5     | UART1_TX     | I                 | Transmit data                                                                                                       |
| 6     | UART1_RX     | O                 | Receive data                                                                                                        |
| 7     | UART1_DTR    | I<br>(active low) | Prevents the module from entering sleep mode, switches between data mode and command mode, and wakes the module up. |
| 8     | UART1_DCD    | O                 | Signal data connection in progress                                                                                  |
| 9     | UART1_DSR    | O                 | Signal UART interface is ON                                                                                         |

\* According to PC view.

### 2.11.2. 8-wire Application

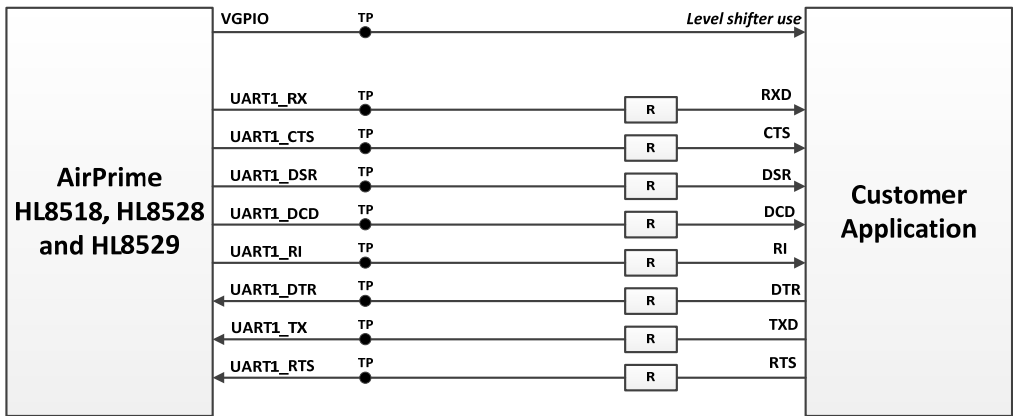


Figure 7. 8-wire UART Application Example

### 2.11.3. 4-wire Application

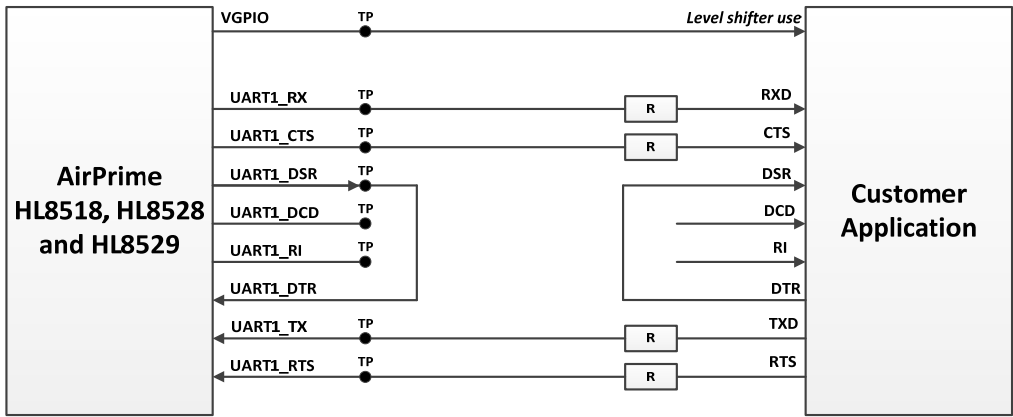


Figure 8. 4-wire UART Application Example

### 2.11.4. 2-wire Application

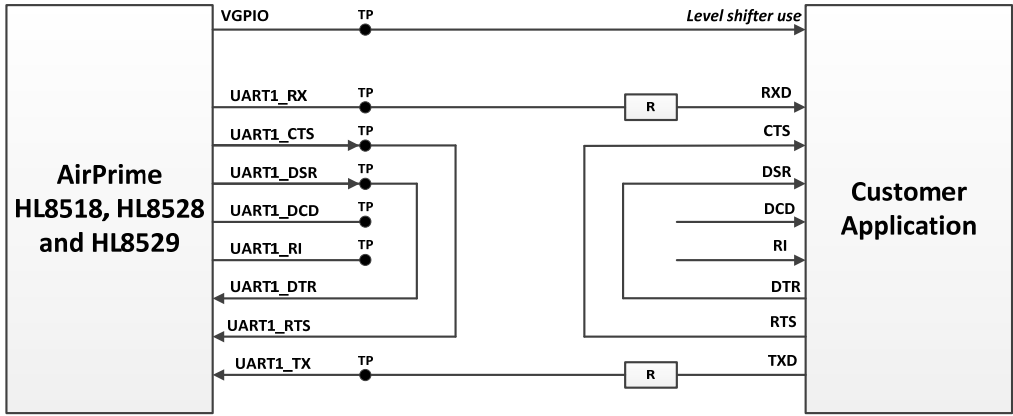


Figure 9. 2-wire UART Application Example

## 2.12. POWER ON Signal (PWR\_ON\_N)

A low level signal has to be provided to switch the AirPrime HL8518, HL8528 and HL8529 modules ON.

It is internally connected to the permanent 1.8V supply regulator inside the HL8518, HL8528 and HL8529 via a pull-up resistor. Once VBAT is supplied to the module, this 1.8V supply regulator will be enabled and so the PWR\_ON\_N signal is by default at high level.

The PWR\_ON\_N signal's characteristics are listed in the table below.

Table 22. PWR\_ON\_N Electrical Characteristics

| Parameter                                       | Min  | Typical | Max  |
|-------------------------------------------------|------|---------|------|
| Input Voltage-Low (V)                           |      | -       | 0.51 |
| Input Voltage-High (V)                          | 1.33 | -       | 2.2  |
| Power-up period (ms) from PWR_ON_N falling edge | 2000 | -       | -    |
| PWR_ON_N assertion time (ms)                    | 25   |         |      |

*Note:* As PWR\_ON\_N is internally pulled up with 200kΩ, a simple open collector or open drain transistor must be used for ignition.

The software starts operating when the module is ON, but “AT Command Ready” will depend on whether UART or USB is used.

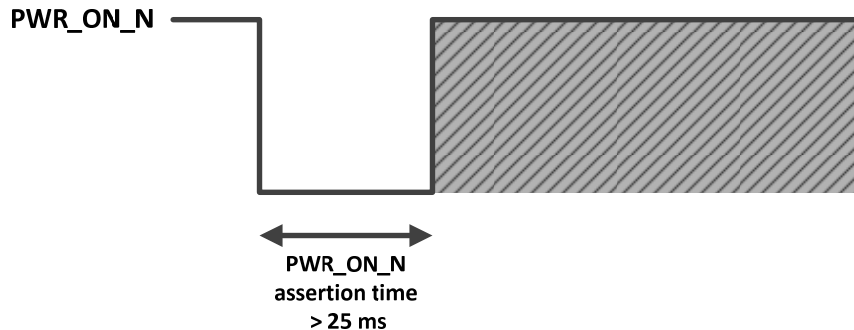


Figure 10. PWR\_ON\_N Assertion Time

VGPI0 is an output from the module that can be used to check if the module is active.

- When VGPI0 = 0V, the module is OFF.
- When VGPI0 = 1.8V, the module is ON (it can be in idle, communication or sleep mode)

*Note:* PWR\_ON\_N cannot be used to power the module off. To power the module off, use AT command **AT+CPOF**.

## 2.13. Reset Signal (RESET\_IN\_N)

To reset the module, a low level pulse must be sent on the RESET\_IN\_N pin for 10ms. This action will immediately restart the AirPrime HL8518, HL8528 and HL8529 modules with the PWR\_ON\_N signal at low level. (If the PWR\_ON\_N signal is at high level, the module will be powered off.) As RESET\_IN\_N is internally pulled up, a simple open collector or open drain transistor can be used to control it.

The RESET\_IN\_N signal will reset the registers of the CPU and reset the RAM memory as well, for the next power on.

---

**Note:** As RESET\_IN\_N is referenced to the VGPI0 domain (internally to the module), it is impossible to reset before the module starts or to try to use RESET\_IN\_N as a way to start the module.

Another more costly solution would be to use MOS transistor to switch the power supply off and restart the power up procedure using the PWR\_ON\_N input line.

---

**Table 23. RESET\_IN\_N Electrical Characteristics**

| Parameter                                          | Min  | Typical | Max  |
|----------------------------------------------------|------|---------|------|
| Input Voltage-Low (V)                              |      | -       | 0.51 |
| Input Voltage-High (V)                             | 1.33 | -       | 2.2  |
| Power-up period (ms) from RESET_IN_N falling edge* | 2000 | -       | -    |

\* With the PWR\_ON\_N Signal at low level



## 3. Design Guidelines

### 3.1. Power-Up Sequence

Apply a LOW level logic to the PWR\_ON\_N pin (pin 59); within 25ms, VGPIIO will appear to be at 1.8V. Either a USB or UART1 interface could be used to send AT commands. Note that for USB connections, the time when AT commands can be sent will depend on the initialization time used for the USB connection with the USB host.

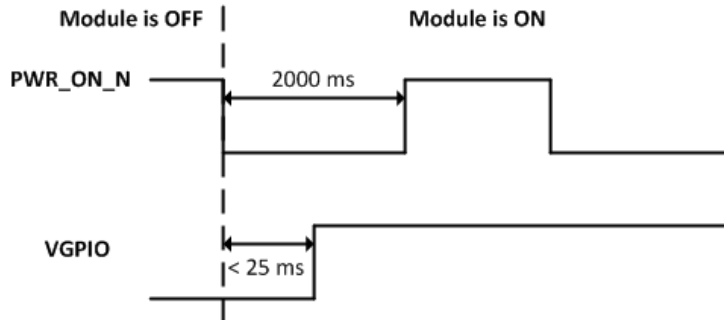


Figure 11. PWR\_ON\_N Sequence with VGPIIO Information

**Note:** As PWR\_ON\_N is internally pulled up with 200k $\Omega$ , a simple open collector or open drain transistor must be used for ignition.

The PWR\_ON\_N pin has the minimum assertion time requirement of 25ms, with LOW active. Once the valid power on trigger is detected, the PWR\_ON\_N pin status can be left open.

VBATT has to ramp up within 32 ms to reach the value of 3.2V; otherwise, the module may not power up.

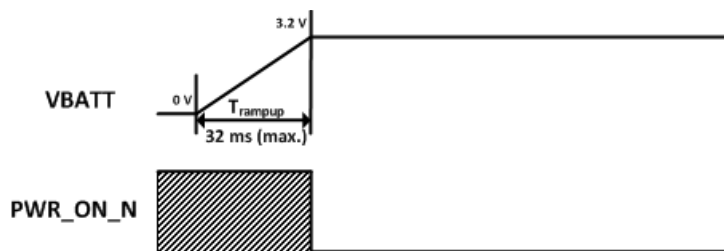


Figure 12. PWR\_ON\_N Sequence with  $T_{rampup}$

### 3.2. Module Switch-Off

AT command **AT+CP0F** enables the user to properly switch the AirPrime HL8518, HL8528 and HL8529 modules off. The PWR\_ON signal must be set to high (inactive) before the **AT+CP0F** command is sent.

**Note:** If the PWR\_ON signal is active (low level) when the **AT+CP0F** command is sent, the module will not power off.

If required, the module can be switched off by controlling the power supply. This can be used, for example, when the system freezes and no reset line is connected to the AirPrime HL8518, HL8528 and HL8529 modules. In this case, the only way to get control over the module back is to switch off the power line.

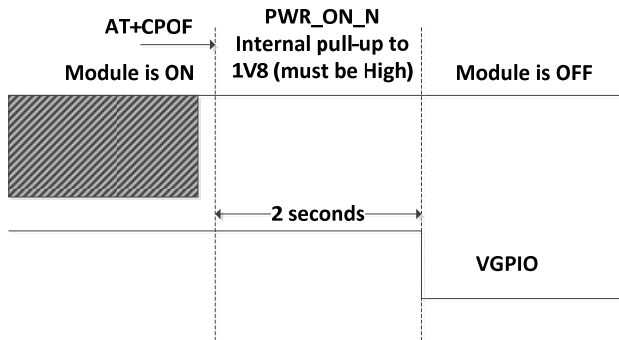


Figure 13. Power OFF Sequence for PWR\_ON\_N, VGPIO

**Note:** PWR\_ON\_N is internally pulled up by 200kΩ to 1.8V.

**Caution:** Ensure that no external pull-ups are applied on IO pins while the module is OFF.

### 3.3. Emergency Power OFF

If required, the module can be switched off by controlling the RESET\_IN\_N pin (pin 11). This must only be used in emergency situations if the system freezes (not responding to AT commands).

To perform an emergency power off, a low level pulse must be sent on the RESET\_IN\_N pin for 10ms while the PWR\_ON signal is inactive (high level). This action will immediately shut the HL8518, HL8528 and HL8529 modules down and the registers of the CPU and RAM memory will be reset for the next power on.

### 3.4. Sleep Mode Management

#### 3.4.1. Using UART

AT command **AT+KSLEEP** enables sleep mode configuration.

**AT+KSLEEP=0:**

- The module is active when DTR signal is active (low electrical level).
- When DTR is deactivated (high electrical level), the module will enter sleep mode after a while.
- On DTR activation (low electrical level), the module wakes up.

**AT+KSLEEP=1:**

- The module determines when it enters sleep mode (when no more tasks are running).
- "0x00" character on the serial link wakes the module up.

**AT+KSLEEP=2:**

- The module never enters sleep mode.

#### 3.4.2. Using USB

Use **AT+KSLEEP=1** to allow the module to automatically enter sleep mode while the USB interface is in use.

### 3.5. Power Supply Design

The AirPrime HL8518, HL8528 and HL8529 modules should not be supplied with voltage over 4.5V even temporarily or however briefly.

If the system's main board power supply unit is unstable or if the system's main board is supplied with over 4.5V, even in the case of transient voltage presence on the circuit, the module's power amplifier may be severely damaged.

To avoid such issues, add a voltage limiter to the module's power supply lines so that VBATT and VBATT\_PA signal pads will never receive a voltage surge over 4.5V. The voltage limiter can be as simple as a Zener diode with decoupling capacitors as shown in the diagram below.

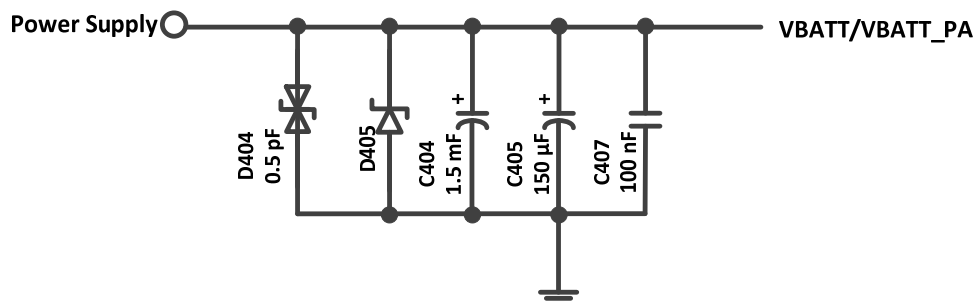


Figure 14. Voltage Limiter Example

### 3.6. ESD Guidelines for SIM Card

Decoupling capacitors must be added as close as possible to the SIM card connectors on UIM1\_CLK, UIM1\_RST, UIM1\_VCC and UIM1\_DATA signals to avoid EMC issues and to pass the SIM card type approval tests, according to the drawings below.

A typical schematic for hardware SIM detection is provided below.

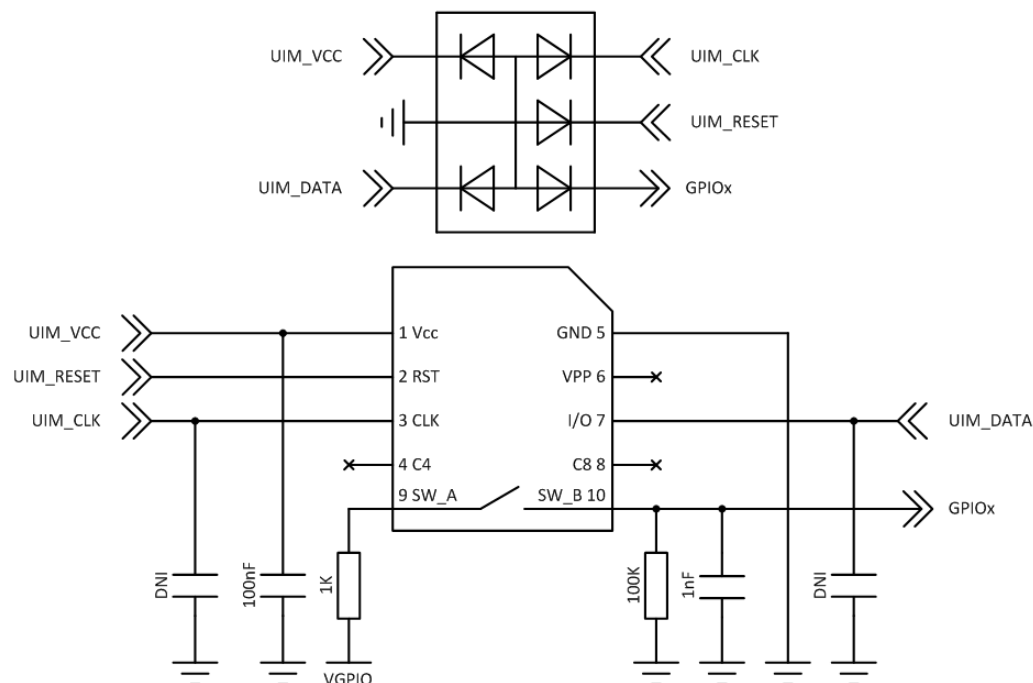


Figure 15. EMC and ESD Components Close to the SIM

### 3.7. ESD Guidelines for USB

When the USB interface is externally accessible, it is required to have ESD protection on the USB\_VBUS, USB\_D+ and USB\_D- signals.

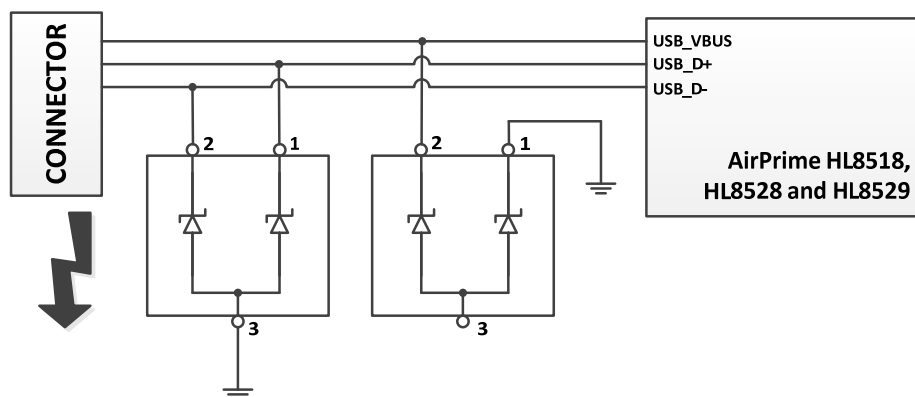


Figure 16. ESD Protection for USB

**Note:** It is not recommended to have an ESD diode with feedback path from USB\_VBUS to either USB\_D+ or USB\_D-.

### 3.8. Dual SIM Application

Using an external switch and GPIOs, the AirPrime HL8518, HL8528 and HL8529 modules can support Dual SIM Single Standby with fast network switching. Refer to document [2] AirPrime HL6 and HL8 Series AT Commands Interface Guide for related AT commands.

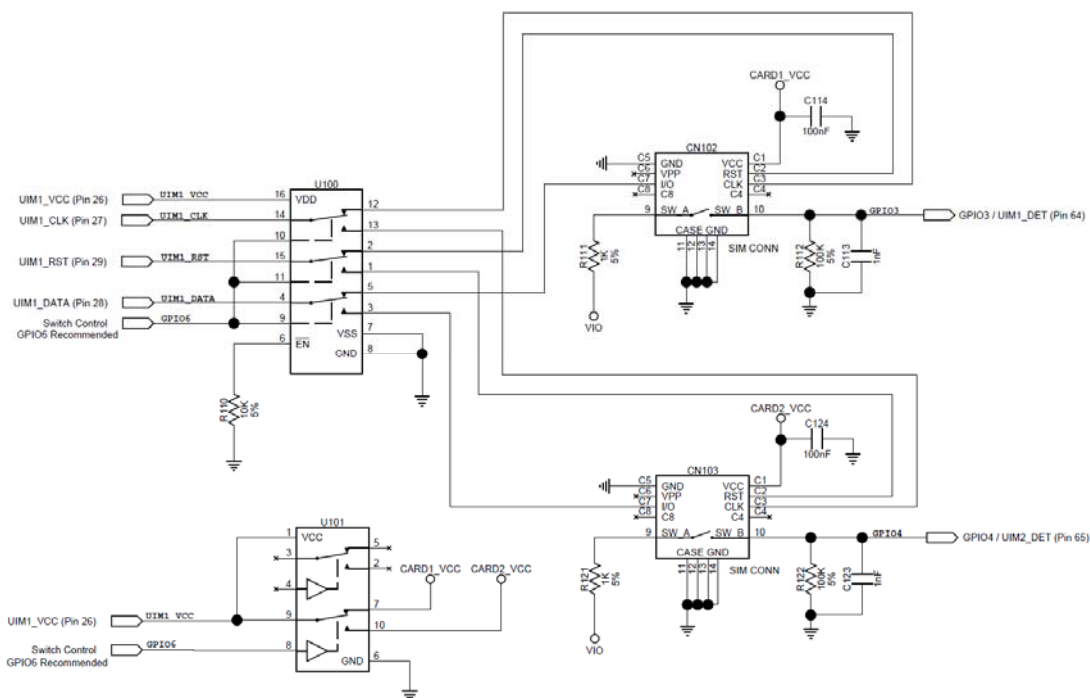


Figure 17. Reference Design for Dual SIM Application

### 3.9. Radio Frequency Integration

The AirPrime HL8518, HL8528 and HL8529 modules are equipped with an external antenna. A  $50\Omega$  line matching circuit between the module, the customer's board and the RF antenna is required, for GSM feed path, as shown in the example below.

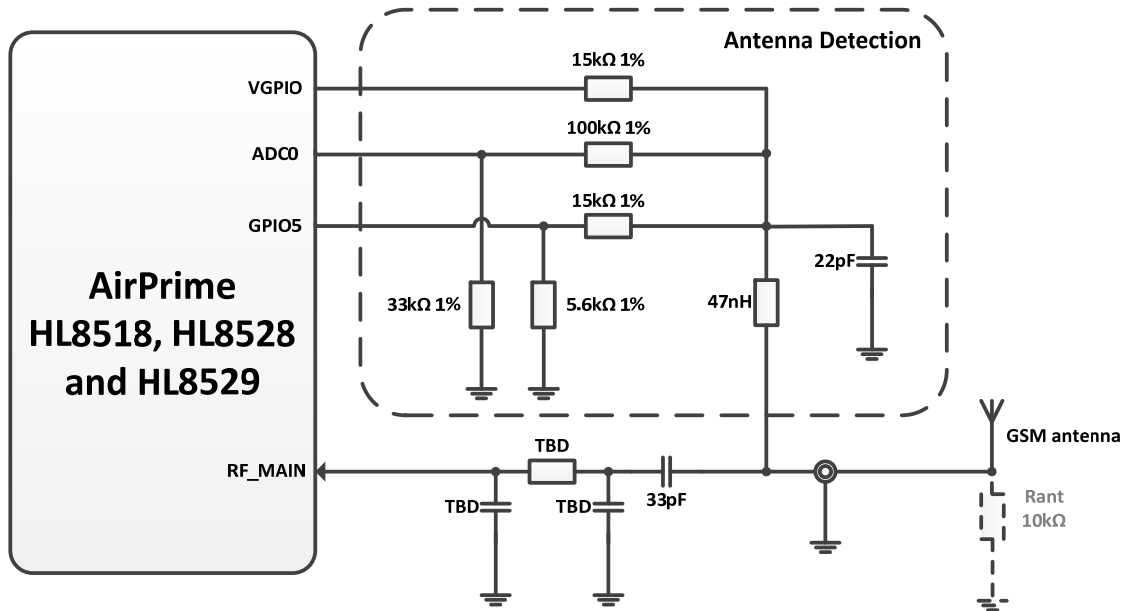


Figure 18. GSM Antenna Connection with Antenna Detection

**Note:** Antenna detection circuit is optional. Rant is the equivalent DC terminating resistor of the antenna. Rant should be close to  $10K\Omega$ .



## 4. Regulatory Legal Information

### 4.1. Label

The AirPrime HL852x module is labeled with its own FCC ID on the shield side. Each HL852x variant has its own FCC ID as listed in the table below.

Table 24. AirPrime HL852x FCC IDs

| Model Name | FCC ID    |
|------------|-----------|
| HL8528     | N7NHL8528 |
| HL8529     | N7NHL8529 |

When the module is installed in a customer's product, the FCC ID label on the module will not be visible. To avoid this case, an exterior label must be stuck on the surface of the customer's product to indicate the FCC ID of the enclosed module. This label can use wording such as the following: "Contains Transmitter module FCC ID: <FCC ID as listed in Table 24 AirPrime HL852x FCC IDs>" or "Contains FCC ID: <FCC ID as listed in Table 24 AirPrime HL852x FCC IDs>".

### 4.2. FCC Regulations

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

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

This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

1. Reorient or relocate the receiving antenna
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/TV technician for help.

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

### 4.3. RF Exposure Information

This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based time-averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of §2.1091.

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons, must not be collocated or operating in conjunction with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures.

The end user has no manual instructions to remove or install the device and a separate approval is required for all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily removed. Otherwise, a second label must be placed on the outside of the final device that contains the following text: —Contains FCC ID: <FCC ID as listed in Table 24 AirPrime HL852x FCC IDs>

### 4.4. IC Regulations

IC Radiation Exposure Statement:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

- a. this device may not cause interference, and
- b. this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'entraîner des comportements non-désirés

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p) is not more than necessary for successful communication.

Labeling Requirements for the Host Device (from Section 7.2, RSS RSP-100 issue 10, November 2014): The host device shall be properly labeled to identify the module within the host device. The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labeled to display the Industry Canada certification number of the module, preceded by the words — Contains transmitter module, or the word — Contains, or similar wording expressing the same meaning, as follows: Contains transmitter module IC: <IC as listed below>.

Table 25. AirPrime HL852x IC

| Model Name | IC           |
|------------|--------------|
| HL8528     | 2417C-HL8528 |
| HL8529     | 2417C-HL8529 |

This device complies with IC radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the IC radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

Cet appareil est conforme aux limites d'exposition aux rayonnements de la IC CNR-102 définies pour un environnement non contrôlé. Afin d'éviter la possibilité de dépasser les limites d'exposition aux fréquences radio de la IC CNR-102, la proximité humaine à l'antenne ne doit pas être inférieure à 20 cm (8 pouces) pendant le fonctionnement normal.

This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

## 4.5. CE Warning

The minimum distance between the user and/or any bystander and the radiating structure of the transmitter is 20cm.

Assessment of compliance of the product with the requirements relating to the Radio and Telecommunication Terminal Equipment Directive (EC Directive 1999/5/EC) was performed by Telefication BV (Notified Body No.0560)

**CE 0560**



## 5. Terms and Abbreviations

| Abbreviation | Definition                                        |
|--------------|---------------------------------------------------|
| ADC          | Analog to Digital Converter                       |
| AGC          | Automatic Gain Control                            |
| AT           | Attention (prefix for modem commands)             |
| CDMA         | Code Division Multiple Access                     |
| CF3          | Common Flexible Form Factor                       |
| CLK          | Clock                                             |
| CODEC        | Coder Decoder                                     |
| CPU          | Central Processing Unit                           |
| DAC          | Digital to Analog Converter                       |
| DTR          | Data Terminal Ready                               |
| EGNOS        | European Geostationary Navigation Overlay Service |
| EMC          | Electromagnetic Compatibility                     |
| EMI          | Electromagnetic Interference                      |
| EN           | Enable                                            |
| ESD          | Electrostatic Discharges                          |
| ETSI         | European Telecommunications Standards Institute   |
| FDMA         | Frequency-division multiple access                |
| GAGAN        | GPS aided geo augmented navigation                |
| GLONASS      | Global Navigation Satellite System                |
| GND          | Ground                                            |
| GNSS         | Global Navigation Satellite System                |
| GPIO         | General Purpose Input Output                      |
| GPRS         | General Packet Radio Service                      |
| GSM          | Global System for Mobile communications           |
| Hi Z         | High impedance (Z)                                |
| IC           | Integrated Circuit                                |
| IMEI         | International Mobile Equipment Identification     |
| I/O          | Input / Output                                    |
| LED          | Light Emitting Diode                              |
| LNA          | Low Noise Amplifier                               |
| MAX          | Maximum                                           |
| MIN          | Minimum                                           |
| MSAS         | Multi-functional Satellite Augmentation System    |
| N/A          | Not Applicable                                    |
| PA           | Power Amplifier                                   |
| PC           | Personal Computer                                 |
| PCB          | Printed Circuit Board                             |
| PCL          | Power Control Level                               |
| PLL          | Phase Lock Loop                                   |
| PWM          | Pulse Width Modulation                            |

| Abbreviation | Definition                                     |
|--------------|------------------------------------------------|
| QZSS         | Quasi-Zenith Satellite System                  |
| RF           | Radio Frequency                                |
| RFI          | Radio Frequency Interference                   |
| RMS          | Root Mean Square                               |
| RST          | Reset                                          |
| RTC          | Real Time Clock                                |
| RX           | Receive                                        |
| SCL          | Serial Clock                                   |
| SDA          | Serial Data                                    |
| SIM          | Subscriber Identification Module               |
| SMD          | Surface Mounted Device/Design                  |
| SPI          | Serial Peripheral Interface                    |
| SW           | Software                                       |
| PSRAM        | Pseudo Static RAM                              |
| TBC          | To Be Confirmed                                |
| TBD          | To Be Defined                                  |
| TP           | Test Point                                     |
| TX           | Transmit                                       |
| TYP          | Typical                                        |
| UART         | Universal Asynchronous Receiver-Transmitter    |
| UICC         | Universal Integrated Circuit Card              |
| USB          | Universal Serial Bus                           |
| UIM          | User Identity Module                           |
| VBATT        | Main Supply Voltage from Battery or DC adapter |
| VSWR         | Voltage Standing Wave Ratio                    |
| WAAS         | Wide Area Augmentation System                  |