



AirPrime HL7539

Product Technical Specification



SIERRA
WIRELESS®

4118584
14.0
May 13, 2021

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Document History

| Version | Date | Updates |
|---------|--------------------|--|
| 1.0 | December 30, 2015 | Creation |
| 1.1 | January 04, 2016 | Updated: <ul style="list-style-type: none"> Table 2 General Features 1.5 Interfaces |
| 2.0 | February 26, 2016 | Updated: <ul style="list-style-type: none"> 3.10 POWER-ON Signal (PWR_ON_N) 5.2 Module Switch-Off Table 32 Ordering Information |
| 3.0 | May 31, 2016 | Added 5.5 Power Supply Design |
| 4.0 | September 14, 2016 | Added 5.9 Radio Integration |
| | | Updated: <ul style="list-style-type: none"> PWR_ON_N pull up resistor value from 47kΩ to 100kΩ Table 32 Ordering Information |
| 5.0 | February 09, 2017 | Updated the voltage range of USB_VBUS |
| 6.0 | May 05, 2017 | Updated Table 15 UART1 Pad Description |
| 7.0 | June 30, 2017 | Updated Table 13 Digital I/O Electrical Characteristics |
| 7.1 | July 04, 2017 | Updated Table 1 Supported Bands/Connectivity |
| 7.2 | July 20, 2017 | Deleted HSIC |
| | | Updated Table 1 Supported Bands/Connectivity |
| 8.0 | September 19, 2017 | Updated RESET_N to RESET_IN_N |
| 9.0 | February 21, 2018 | Added 5.6 Power Cycle |
| | | Updated 3.16 RF Interface |
| 9.1 | March 01, 2018 | Updated Table 29 Conducted RX Sensitivity (dBm) |
| 10.0 | May 07, 2018 | Updated: <ul style="list-style-type: none"> 1.8.2 RoHS Directive Compliance 3.9 Main Serial Link (UART1) |
| 11.0 | July 26, 2018 | Added Error! Reference source not found. Error! Reference source not found. |
| | | Updated Table 5 Pad Definition |
| | | Deleted section 6 X-Ray Exposure |
| 12.0 | February 08, 2019 | Updated 3.15 Debug Interfaces |
| 13.0 | June 12, 2019 | Updated 3.15.2 JTAG |
| 14.0 | May 13, 2021 | Added new note under Introduction |



Contents

| | |
|---|-----------|
| 1. INTRODUCTION | 9 |
| 1.1. Common Flexible Form Factor (CF ³) | 9 |
| 1.2. Physical Dimensions | 9 |
| 1.3. General Features..... | 10 |
| 1.4. Architecture..... | 11 |
| 1.5. Interfaces | 11 |
| 1.6. Connection Interface | 12 |
| 1.7. ESD | 12 |
| 1.8. Environmental and Certifications..... | 13 |
| 1.8.1. Environmental Specifications..... | 13 |
| 1.8.2. RoHS Directive Compliance | 13 |
| 1.8.3. Disposing of the Product..... | 13 |
| 1.9. References | 14 |
| 2. PAD DEFINITION | 15 |
| 2.1. Pad Configuration (Top View, Through Module) | 20 |
| 3. DETAILED INTERFACE SPECIFICATIONS | 21 |
| 3.1. Power Supply..... | 21 |
| 3.2. Current Consumption | 21 |
| 3.3. VGPIIO | 22 |
| 3.4. BAT_RTC | 22 |
| 3.5. SIM Interface | 22 |
| 3.5.1. UIM1_DET | 23 |
| 3.6. USB | 23 |
| 3.7. Electrical Information for Digital I/O | 24 |
| 3.8. General Purpose Input/Output (GPIO) | 24 |
| 3.9. Main Serial Link (UART1)..... | 25 |
| 3.10. POWER-ON Signal (PWR_ON_N)..... | 26 |
| 3.11. Reset Signal (RESET_IN_N)..... | 26 |
| 3.12. Analog to Digital Converter (ADC1) | 27 |
| 3.13. Clock Interface..... | 27 |
| 3.14. PCM..... | 28 |
| 3.15. Debug Interfaces | 30 |
| 3.15.1. USB..... | 30 |
| 3.15.2. JTAG..... | 31 |
| 3.15.3. Trace Debug..... | 31 |
| 3.16. RF Interface | 32 |
| 3.16.1. RF Connection..... | 32 |

| | | |
|-----------|-------------------------------------|-----------|
| 3.16.2. | RF Performances..... | 32 |
| 3.16.3. | TX_ON Indicator (TX_ON)..... | 32 |
| 4. | MECHANICAL DRAWINGS..... | 34 |
| 5. | DESIGN GUIDELINES..... | 37 |
| 5.1. | Power-Up Sequence..... | 37 |
| 5.2. | Module Switch-Off..... | 38 |
| 5.3. | Emergency Power OFF..... | 38 |
| 5.4. | Sleep Mode Management..... | 38 |
| 5.4.1. | Using UART1..... | 38 |
| 5.4.2. | Using USB..... | 39 |
| 5.5. | Power Supply Design..... | 39 |
| 5.6. | Power Cycle..... | 39 |
| 5.7. | ESD Guidelines for SIM Card..... | 40 |
| 5.8. | ESD Guidelines for USB..... | 40 |
| 5.9. | Radio Integration..... | 41 |
| 6. | ORDERING INFORMATION..... | 42 |
| 7. | TERMS AND ABBREVIATIONS..... | 43 |



List of Figures

| | | |
|------------|---|----|
| Figure 1. | Architecture Overview | 11 |
| Figure 2. | Mechanical Overview | 12 |
| Figure 3. | Pad Configuration..... | 20 |
| Figure 4. | PCM Master Mode Timing Waveform | 29 |
| Figure 5. | PCM Slave Mode Timing Waveform | 30 |
| Figure 6. | TX_ON State during Transmission..... | 33 |
| Figure 7. | Mechanical Drawing | 34 |
| Figure 8. | Dimensions Drawing | 35 |
| Figure 9. | Footprint | 36 |
| Figure 10. | PWR_ON_N Sequence with VGPIO Information..... | 37 |
| Figure 11. | VBATT Ramp Up Timing..... | 37 |
| Figure 12. | Power OFF Sequence for PWR_ON_N, VGPIO..... | 38 |
| Figure 13. | Voltage Limiter Example | 39 |
| Figure 14. | EMC and ESD Components Close to the SIM..... | 40 |
| Figure 15. | ESD Protection for USB | 40 |
| Figure 16. | GSM Antenna Connection with Antenna Detection | 41 |



List of Tables

| | | |
|-----------|--|----|
| Table 1. | Supported Bands/Connectivity | 9 |
| Table 2. | General Features | 10 |
| Table 3. | ESD Specifications..... | 12 |
| Table 4. | Environmental Specifications | 13 |
| Table 5. | Pad Definition | 15 |
| Table 6. | Power Supply | 21 |
| Table 7. | Current Consumption | 21 |
| Table 8. | VGPIO Electrical Characteristics..... | 22 |
| Table 9. | BAT_RTC Electrical Characteristics..... | 22 |
| Table 10. | UIM1 Pad Description | 23 |
| Table 11. | Electrical Characteristics of UIM1 | 23 |
| Table 12. | USB Pad Description..... | 23 |
| Table 13. | Digital I/O Electrical Characteristics | 24 |
| Table 14. | GPIO Pad Description | 24 |
| Table 15. | UART1 Pad Description | 25 |
| Table 16. | PWR_ON_N Electrical Characteristics | 26 |
| Table 17. | RESET_IN_N Electrical Characteristics..... | 26 |
| Table 18. | ADC Interface Pad Description | 27 |
| Table 19. | ADC Electrical Characteristics | 27 |
| Table 20. | Clock Interface Pad Description | 27 |
| Table 21. | PCM Interface Pad Description | 28 |
| Table 22. | PCM Master Mode Parameters..... | 28 |
| Table 23. | PCM Slave Mode Parameters..... | 29 |
| Table 24. | USB Pad Description..... | 30 |
| Table 25. | JTAG Pad Description..... | 31 |
| Table 26. | Trace Debug Pad Description | 31 |
| Table 27. | RF Main Connection..... | 32 |
| Table 28. | RF Diversity Connection..... | 32 |
| Table 29. | Conducted RX Sensitivity (dBm) | 32 |
| Table 30. | TX_ON Pad Description | 32 |
| Table 31. | TX_ON Characteristics..... | 33 |
| Table 32. | Ordering Information | 42 |



1. Introduction

This document is the Product Technical Specification for the AirPrime HL7539 Embedded Module. It defines the high-level product features and illustrates the interfaces for these features. This document is intended to cover the hardware aspects of the product, including electrical and mechanical.

Note: Sierra Wireless modules are shipped factory-programmed, with industry or mobile operator approved firmware, according to the specific SKU ordered. Periodically, newer firmware versions become available and can include new features, bug fixes, or critical security updates. Sierra Wireless strongly recommends that customers establish their own production capability for updating module firmware on their assembled end platform, in the event that a newer firmware must be installed before deployment. Sierra Wireless also recommends customers design their products to support post-deployment FOTA upgrades using the AirVantage cloud platform.

The AirPrime HL7539 belongs to the AirPrime HL Series from Essential Connectivity Module family. These are industrial grade Embedded Wireless Modules that provide data connectivity on wireless networks (as listed in Table 1 Supported Bands/Connectivity).

The HL7539 supports a large variety of interfaces such as USB 2.0, UART and GPIOs 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) | Maximum Output Power |
|---------|----------------------|----------------------|-------------------------------|
| LTE B1 | 1920 to 1980 MHz | 2110 to 2170 MHz | Class 3 (+23 dBm \pm 2 dBm) |
| LTE B19 | 830 to 845 MHz | 875 to 890 MHz | Class 3 (+23 dBm \pm 2 dBm) |
| LTE B21 | 1447.9 to 1462.9 MHz | 1495.9 to 1510.9 MHz | Class 3 (+23 dBm \pm 2 dBm) |

1.1. Common Flexible Form Factor (CF³)

The AirPrime HL7539 belongs to the Common Flexible Form Factor (CF³) 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 CF³ 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 as Socketability depending on customer needs

1.2. Physical Dimensions

AirPrime HL7539 modules are compact, robust, fully shielded modules with the following dimensions:

- Length: 23 mm
- Width: 22 mm
- Thickness: 2.5 mm
- Weight: 3.5 g

Note: Dimensions specified above are typical values.

1.3. General Features

The table below summarizes the AirPrime HL7539 features.

Table 2. General Features

| Feature | Description |
|-----------------------|---|
| Physical | <ul style="list-style-type: none"> • Small form factor (146-pad solderable LGA pad) – 23mm x 22mm x 2.5mm (nominal) • Complete body shielding • RF connection pads (RF main interface) • Baseband signals connection |
| Electrical | Single or double supply voltage (VBATT and VBATT_PA) – 3.2V – 4.5V |
| RF | Tri-band LTE: <ul style="list-style-type: none"> • LTE B1: 2100 MHz FDD • LTE B21: 1500 MHz FDD • LTE B19: 850 MHz FDD |
| SIM interface | <ul style="list-style-type: none"> • 1.8V/3V support • SIM extraction / hot plug detection • SIM/USIM support • Conforms with ETSI UICC Specifications • Supports SIM application tool kit with proactive SIM commands |
| Application interface | <ul style="list-style-type: none"> • Multiple non-multiplexed USB channel support • Dial-up networking • USB selective suspend to maximize power savings • AT command interface – 3GPP 27.007 standard, plus proprietary extended AT commands |
| Protocol Stack | Single mode LTE operation: <ul style="list-style-type: none"> • LTE FDD, bandwidth 5-20 MHz • System Release: 3GPP Rel. 9 • Category 4 (up to 150 MBit/s in downlink, 50 MBit/s in uplink) • MIMO 2x2 (Down Link) • Max modulation 64 QAM DL, 16 QAM UL • Intra-frequency and inter-frequency mobility |
| SMS | <ul style="list-style-type: none"> • SMS over SGs • SMS MO and MT • SMS Status Report • SMS storing rules (support of AT+CNMI) |
| Connectivity | <ul style="list-style-type: none"> • Multiple (up to 20) cellular packet data profiles • Sleep mode for minimum idle power draw • Mobile-originated PDP context activation / deactivation • Static and Dynamic IP address. The network may assign a fixed IP address or dynamically assign one using DHCP (Dynamic Host Configuration Protocol). • Supports PAP and CHAP authentication protocols • PDP context type (IPv4, IPv6, IPv4v6). IP Packet Data Protocol context • RFC1144 TCP/IP header compression |
| Environmental | Operating temperature ranges (industrial grade): <ul style="list-style-type: none"> • Class A: -30°C to +70°C • Class B: -40°C to +85°C |
| RTC | Real Time Clock (RTC) with calendar |

1.4. Architecture

The figure below presents an overview of the AirPrime HL7539's internal architecture and external interfaces.

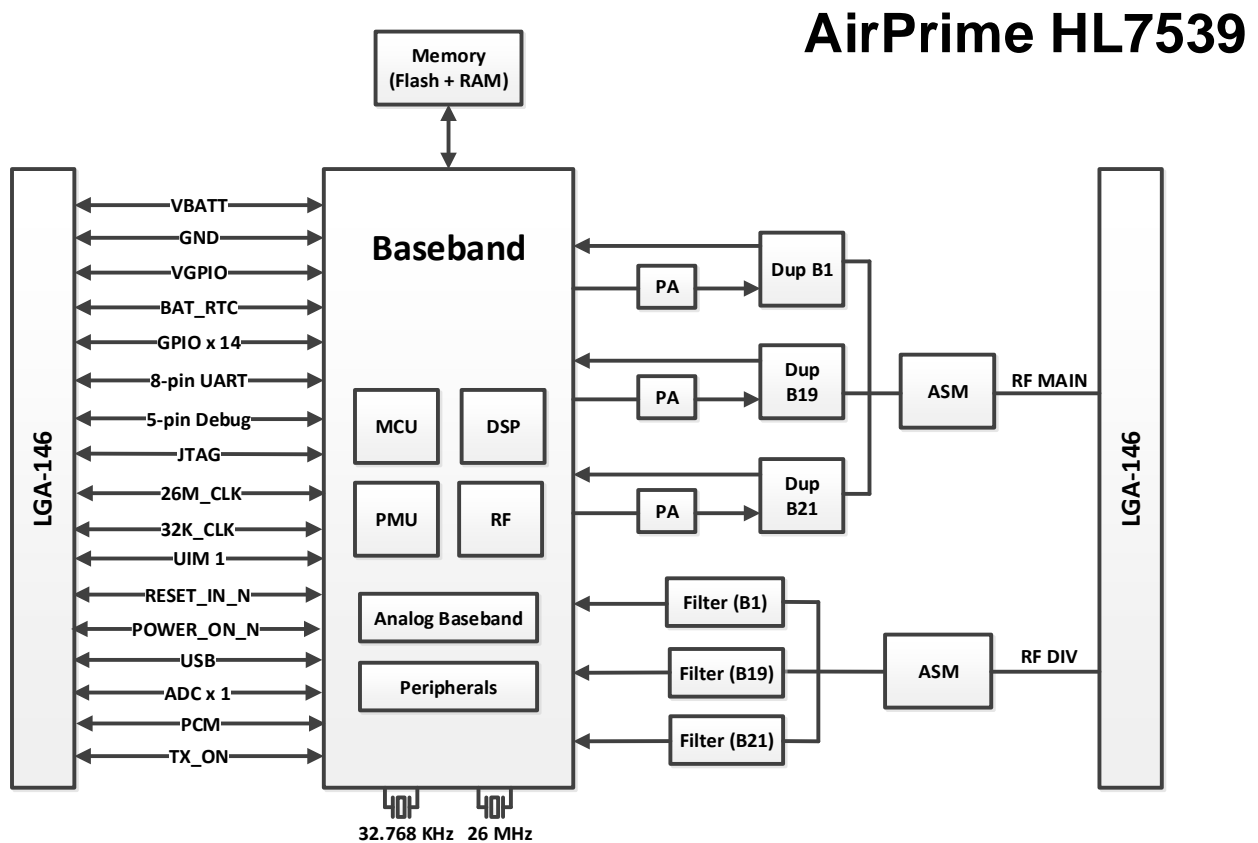


Figure 1. Architecture Overview

1.5. Interfaces

The AirPrime HL7539 module provides the following interfaces and peripheral connectivity:

- 1x – 8-wire 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 – JTAG Interface
- 14x – GPIOs (3 of which have multiplexes)
- 1x – Main Antenna
- 1x – RX Diversity Antenna
- 1x – VGPIO

- 1x – TX ON
- 1x – ADC
- 1x – PCM

1.6. Connection Interface

The AirPrime HL7539 module is 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.

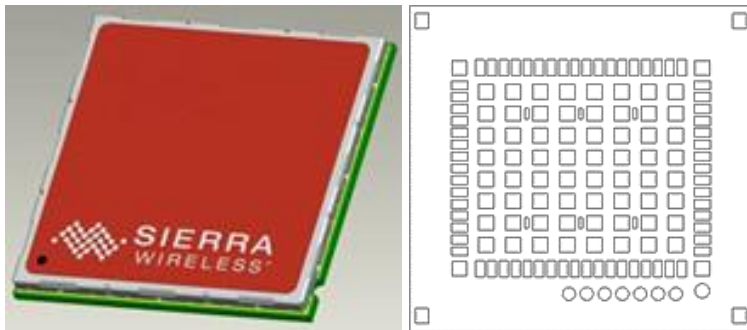


Figure 2. Mechanical Overview

The 146 pads have the following distribution:

- 66 inner signal pads, 1x0.5mm, pitch 0.8mm
- 1 reserved test point (do not connect), 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

1.7. ESD

Refer to the following table for ESD Specifications.

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"> • JESD22-A114 ± 2kV Human Body Model • JESD22-A115 ± 200V Machine Model • JESD22-C101C ± 500V Charged Device Model |
| Signals | SIM connector | Adding 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 | |

1.8. Environmental and Certifications

1.8.1. 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 |

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 an 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.

1.8.2. RoHS Directive Compliance

AirPrime HL7539 modules are compliant with RoHS Directive 2011/65/EU, including directive 2015/863 amending annex II, which sets limits for the use of certain restricted hazardous substances. This directive states that electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), polybrominated diphenyl ethers (PBDE), Bis (2-ethylhexyl) phthalate (DEHP), Butyl benzyl phthalate (BBP), Dibutyl phthalate (DBP) or Diisobutyl phthalate (DIBP) above threshold limits.

1.8.3. 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.



1.9. References

- [1] AirPrime HL Series Customer Process Guidelines
Reference Number: 4114330
- [2] AirPrime HL7539 AT Commands Interface Guide
Reference Number: 4118453



2. Pad Definition

AirPrime HL7539 pads are divided into 2 functional categories.

- Core functions and associated pads cover all the mandatory features for M2M connectivity and will be available by default across all CF³ family of modules. These Core functions are always available and always at the same physical pad locations. A customer platform using only these functions and associated pads is guaranteed to be forward and/or backward compatible with the next generation of CF³ modules.
- Extension functions and associated pads bring additional capabilities to the customer. Whenever an Extension function is available on a module, it is always at the same pad location.

Other pads marked as “not connected” or “reserved” should not be used.

Table 5. Pad Definition

| Pad # | Signal Name | Function | I/O | Active Low / High | Reset State* | Power Supply Domain | Recommendation for Unused Pads | Type |
|-------|-------------------------|--|-----|-------------------|--------------|---------------------|--------------------------------|-----------|
| 1 | GPIO1 | General purpose input/output | I/O | | T | 1.8V | Left Open | Extension |
| 2 | UART1_RI / TRACE_DATA3 | UART1 Ring indicator / Trace data 3 | O | | L | 1.8V | Connect to test point | Core |
| 3 | UART1_RTS | UART1 Request to send | I | L | T/PU | 1.8V | Connect to test point | Core |
| 4 | UART1_CTS | UART1 Clear to send | O | L | T/PU | 1.8V | Connect to test point | Core |
| 5 | UART1_TX | UART1 Transmit data | I | | T/PD | 1.8V | Connect to test point | Core |
| 6 | UART1_RX | UART1 Receive data | O | | T/PU | 1.8V | Connect to test point | Core |
| 7 | UART1_DTR | UART1 Data terminal ready | I | L | T/PD | 1.8V | Connect to test point | Core |
| 8 | UART1_DCD / TRACE_DATA1 | UART1 Data carrier detect / Trace data 1 | O | L | L | 1.8V | Connect to test point | Core |
| 9 | UART1_DSR / TRACE_DATA0 | UART1 Data set ready / Trace data 0 | O | L | H | 1.8V | Connect to test point | Core |

| Pad # | Signal Name | Function | I/O | Active Low / High | Reset State* | Power Supply Domain | Recommendation for Unused Pads | Type |
|-------|---------------------|---|-----|-------------------|--------------|---------------------|--------------------------------|---------------|
| 10 | GPIO2 / TRACE_DATA2 | General purpose input/output / Trace data 2 | I/O | | L | 1.8V | Connect to test point | Core |
| 11 | RESET_IN_N | Input reset signal | I | L | N/A | 1.8V | Left Open | Core |
| 12 | USB_D- | USB Data Negative (Low / Full Speed) | I/O | | T | 3.3V | Connect to test point | Extension |
| | | USB Data Negative (High Speed) | | | | 0.38V | | |
| 13 | USB_D+ | USB Data Positive (Low / Full Speed) | I/O | | T | 3.3V | Connect to test point | Extension |
| | | USB Data Positive (High Speed) | | | | 0.38V | | |
| 14 | NC | Not Connected | | | | | | Not connected |
| 15 | NC | Not Connected | | | | | | Not connected |
| 16 | USB_VBUS | USB VBUS | I | | N/A | 3.3V – 5.5V | Connect to test point | Extension |
| 17 | NC | Not Connected (Reserved for future use) | | | | | Left Open | Not connected |
| 18 | NC | Not Connected (Reserved for future use) | | | | | Left Open | Not connected |
| 19 | NC | Not Connected (Reserved for future use) | | | | | Left Open | Not connected |
| 20 | NC | Not Connected (Reserved for future use) | | | | | Left Open | Not connected |
| 21 | BAT_RTC | Power supply for RTC backup | I/O | | N/A | 1.8V | Left Open | Extension |
| 22 | 26M_CLKOUT | 26MHz System Clock Output | O | | T/PD | 1.8V | Left Open | Extension |
| 23 | 32K_CLKOUT | 32.768kHz System Clock Output | O | | T/PD | 1.8V | Left Open | Extension |
| 24 | ADC1 | Analog to digital converter | I | | N/A | 1.2V | Left Open | Extension |
| 25 | NC | Not Connected (Reserved for future use) | | | | | Left Open | Not connected |
| 26 | UIM1_VCC | 1.8V/3V SIM1 Power supply | O | | N/A | 1.8V/3V | Mandatory connection | Core |
| 27 | UIM1_CLK | 1.8V/3V SIM1 Clock | O | | L | 1.8V/3V | Mandatory connection | Core |
| 28 | UIM1_DATA | 1.8V/3V SIM1 Data | I/O | | L | 1.8V/3V | Mandatory connection | Core |
| 29 | UIM1_RESET | 1.8V/3V SIM1 Reset | O | L | L | 1.8V/3V | Mandatory connection | Core |
| 30 | GND | Ground | 0V | | N/A | 0V | Mandatory connection | Extension |
| 31 | RF_DIV | RF Input - Diversity | | | N/A | | Mandatory connection | Extension |

| Pad # | Signal Name | Function | I/O | Active Low / High | Reset State* | Power Supply Domain | Recommendation for Unused Pads | Type |
|-------|-------------------------|--|-----|-------------------|--------------|---------------------|--------------------------------|---------------|
| 32 | GND | Ground | 0V | | N/A | 0V | Mandatory connection | Extension |
| 33 | PCM_OUT | PCM data out | O | | T/PD | 1.8V | Left Open | Extension |
| 34 | PCM_IN | PCM data in | I | | T/PD | 1.8V | Left Open | Extension |
| 35 | PCM_SYNC | PCM sync out | I/O | | T/PD | 1.8V | Left Open | Extension |
| 36 | PCM_CLK | PCM clock | I/O | | T/PD | 1.8V | Left Open | Extension |
| 37 | GND | Ground | 0V | | N/A | 0V | Mandatory connection | Core |
| 38 | NC | Not Connected (Reserved for future use) | | | | | Left Open | Not connected |
| 39 | GND | Ground | 0V | | N/A | 0V | Mandatory connection | Core |
| 40 | GPIO7 | General purpose input/output | I/O | | T/PD | 1.8V | Left Open | Core |
| 41 | GPIO8 / MIPI2_TRACE_CLK | General purpose input/output / Trace clock | I/O | | L | 1.8V | Connect to test point | Core |
| 42 | NC | Not Connected (Reserved for future use) | | | | | Left Open | Not connected |
| 43 | NC | Not Connected (Reserved for future use) | | | | | Left Open | Not connected |
| 44 | GPIO13 | General purpose input/output | O | | T/PU | 1.8V | Left Open | Extension |
| 45 | VGPIO | GPIO voltage output | O | | N/A | 1.8V | Left Open | Core |
| 46 | GPIO6 | General purpose input/output | I/O | | T/PD | 1.8V | Left Open | Core |
| 47 | NC | Not Connected (Reserved for future use) | | | | | Left Open | Not connected |
| 48 | GND | Ground | 0V | | N/A | 0V | Mandatory connection | Core |
| 49 | RF_MAIN | RF Input/output | | | N/A | | Mandatory connection | Core |
| 50 | GND | Ground | 0V | | N/A | 0V | Mandatory connection | Core |
| 51 | GPIO14 | General purpose input/output | I | | T/PU | 1.8V | Left Open | Extension |
| 52 | GPIO10 | General purpose input/output | I/O | | T/PD | 1.8V | Left Open | Extension |
| 53 | GPIO11 | General purpose input/output | I/O | | T/PD | 1.8V | Left Open | Extension |
| 54 | GPIO15 | General purpose input/output | I/O | | T/PU | 1.8V | Left Open | Extension |

| Pad # | Signal Name | Function | I/O | Active Low / High | Reset State* | Power Supply Domain | Recommendation for Unused Pads | Type |
|-----------|--|---|-----|-------------------|--------------|--|--------------------------------|---------------|
| 55 | NC | Not connected | | | | | Left Open | Not connected |
| 56 | NC | Not connected | | | | | Left Open | Not connected |
| 57 | NC | Not connected | | | | | Left Open | Not connected |
| 58 | GPIO12 | General purpose input/output | I/O | | L | 1.8V | Left Open | Extension |
| 59 | PWR_ON_N | Active Low Power On control signal | I | L | N/A | 1.8V | Mandatory connection | Core |
| 60 | TX_ON | TX indicator | O | | | 2.3V | Left Open | Core |
| 61 | VBATT_PA | Power supply (refer to section 3.1 Power Supply for more information) | I | | N/A | 3.2V (min) 3.7V (typ) 4.5V (max) | Mandatory connection | Core |
| 62 | VBATT_PA | Power supply (refer to section 3.1 Power Supply for more information) | I | | N/A | 3.2V (min) 3.7V (typ) 4.5V (max) | Mandatory connection | Core |
| 63 | VBATT | Power supply | I | | N/A | 3.2V (min) 3.7V (typ) 4.5V (max) | Mandatory connection | Core |
| 64 | UIM1_DET / GPIO3 | UIM1 Detection / General purpose input/output | I/O | H | T/PD | 1.8V | Left Open | Core |
| 65 | GPIO4 | General purpose input/output | I/O | | T/PD | 1.8V | Left Open | Extension |
| 66 | GPIO5 | General purpose input/output | I/O | | T | 1.8V | Left Open | Extension |
| 67-70 | GND | Ground | GND | | N/A | 0V | | Core |
| 71 - 166 | <i>Note: These pads are not available on the AirPrime HL7539 module.</i> | | | | | | | |
| 167 - 234 | GND | Ground | GND | | N/A | 0V | | Core |
| 236 | JTAG_RESET | JTAG RESET | I | L | N/A | 1.8V | Left Open | Extension |
| 237 | JTAG_TCK | JTAG Test Clock | I | | PD | 1.8V | Left Open | Extension |
| 238 | JTAG_TDO | JTAG Test Data Output | O | | T | 1.8V | Left Open | Extension |
| 239 | JTAG_TMS | JTAG Test Mode Select | I | | PU | 1.8V | Left Open | Extension |

| Pad # | Signal Name | Function | I/O | Active Low / High | Reset State* | Power Supply Domain | Recommendation for Unused Pads | Type |
|-------|-------------|--------------------------|-----|-------------------|--------------|---------------------|--------------------------------|-----------|
| 240 | JTAG_TRST | JTAG Test Reset | I | L | PD | 1.8V | Left Open | Extension |
| 241 | JTAG_TDI | JTAG Test Data Input | I | | PU | 1.8V | Left Open | Extension |
| 242 | JTAG_RTCK | JTAG Returned Test Clock | O | | PD | 1.8V | Left Open | Extension |

* PU = Pull up, PD = Pull down, H = High, L = Low, T = High impedance, N/A = Not applicable

2.1. Pad Configuration (Top View, Through Module)

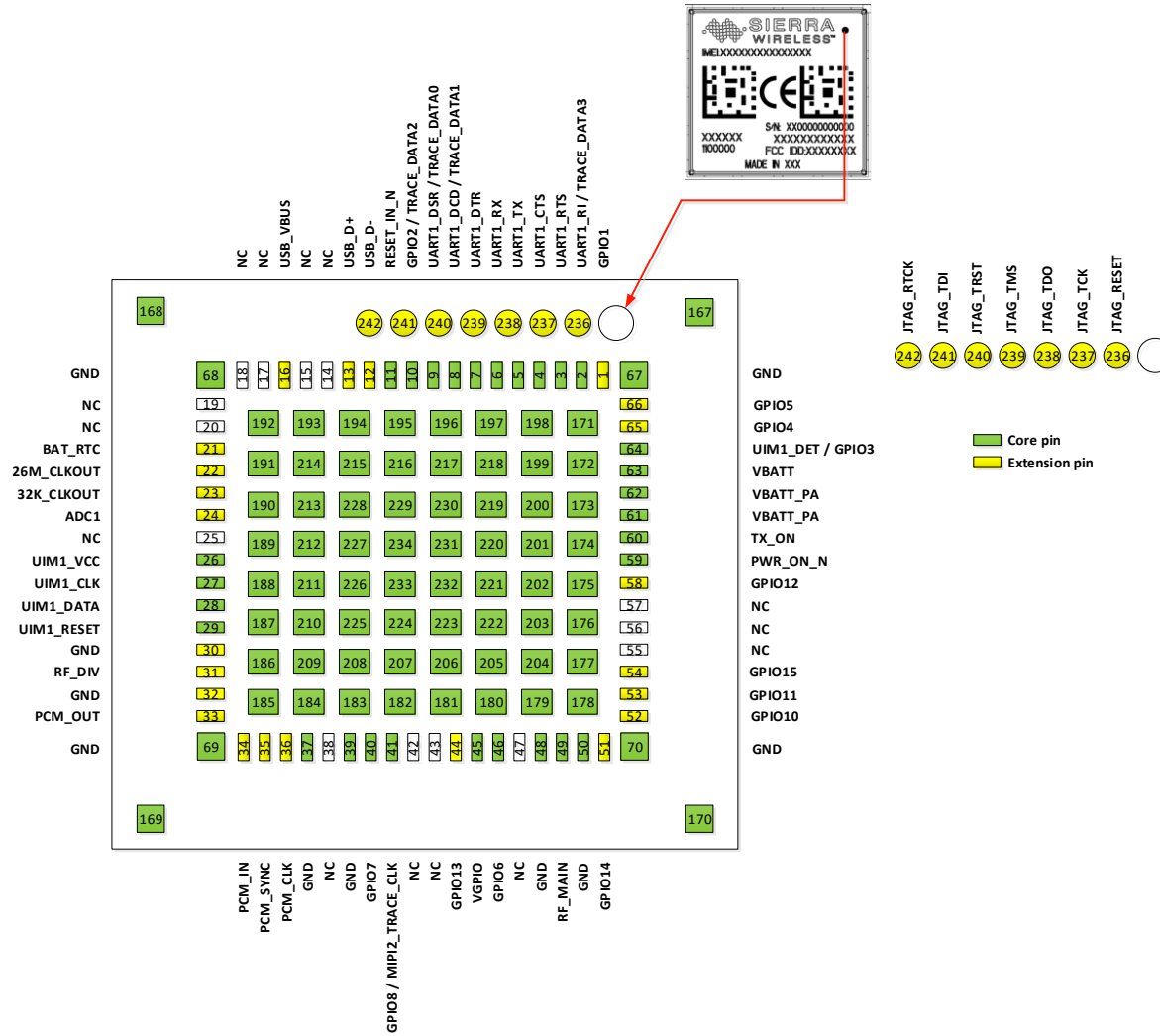


Figure 3. Pad Configuration

3. 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 HL7539 module supports separate VBATT and VBATT_PA connection if requirements below are fulfilled.

3.1. Power Supply

The AirPrime HL7539 module is supplied through the VBATT signal with the following characteristics.

Table 6. Power Supply

| Supply | Minimum | Typical | Maximum |
|---|---------|---------|---------|
| VBATT voltage (V) | 3.2* | 3.7 | 4.5 |
| VBATT_PA voltage (V) Full Specification | 3.2* | 3.7 | 4.5 |

* This value should be guaranteed during the burst.

*Note: Load capacitance for VBATT is around 32μF ± 20% embedded inside the module.
Load capacitance for VBATT_PA is around 10μF ± 20% embedded inside the module.*

3.2. Current Consumption

The following table lists the current consumption of the AirPrime HL7539 at different conditions.

Table 7. Current Consumption

| Parameter | Minimum | Typical | Maximum | Unit | |
|--|---------|---------|---------|------|----|
| Off mode | 95.0 | 110 | 202.0 | μA | |
| Sleep mode – LTE DRX = 1.28s USB = suspended | Band 1 | 1.2 | 1.4 | 6.2 | mA |
| | Band 21 | 1.2 | 1.4 | 6.2 | mA |
| | Band 19 | 1.2 | 1.4 | 6.2 | mA |
| LTE in communication mode (TX Max) | Band 1 | 530 | 640 | 700 | mA |
| | Band 21 | 510 | 530 | 570 | mA |
| | Band 19 | 520 | 540 | 580 | mA |

3.3. VGPIO

The VGPIO output can be used to:

- Pull-up signals such as I/Os
- Supply the digital transistors driving LEDs

The VGPIO output is available when the AirPrime HL7539 module is switched ON.

Table 8. VGPIO Electrical Characteristics

| Parameter | Minimum | Typical | Maximum | Remarks |
|-------------------------|---------|---------|---------|---------------------------------|
| Voltage level (V) | 1.7 | 1.8 | 1.9 | Both active mode and sleep mode |
| Current capability (mA) | - | - | 50 | |
| Rise Time (ms) | - | - | 1.5 | Start-Up time from 0V |

3.4. BAT_RTC

The AirPrime HL7539 module provides an input/output to connect a Real Time Clock power supply.

This pad 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.

Table 9. BAT_RTC Electrical Characteristics

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

3.5. SIM Interface

The AirPrime HL7539 has one physical SIM interfaces, UIM1.

UIM1 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 UIM1 are as follows:

- UIM1_VCC: power supply
- UIM1_CLK: clock
- UIM1_DATA: I/O port
- UIM1_RESET: reset
- UIM1_DET: SIM detection

Table 10. UIM1 Pad Description

| Pad # | Signal Name | Description | Multiplex |
|-------|-------------|---------------------------|-----------|
| 26 | UIM1_VCC | 1.8V/3V SIM1 Power supply | |
| 27 | UIM1_CLK | 1.8V/3V SIM1 Clock | |
| 28 | UIM1_DATA | 1.8V/3V SIM1 Data | |
| 29 | UIM1_RESET | 1.8V/3V SIM1 Reset | |
| 64 | UIM1_DET | UIM1 Detection | GPIO3 |

Table 11. Electrical Characteristics of UIM1

| Parameter | Minimum | Typical | Maximum | Remarks |
|---|---------|---------|---------|---|
| UIM1 Interface Voltage (V) (VCC, CLK, IO, RST) | - | 2.9 | - | The appropriate output voltage is auto detected and selected by software. |
| | - | 1.80 | - | |
| UIM1 Detect | - | 1.80 | - | 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 (μ s) from power down | - | 10 | - | |

3.5.1. 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 SIM interface. 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.

Enabling or disabling either SIM detect feature can be done using the `AT+KSIMDET` command. For more information about this command, refer to document [2] AirPrime HL7539 AT Commands Interface Guide.

3.6. USB

The AirPrime HL7539 has one USB interface.

Table 12. USB Pad Description

| Pad Number | Signal Name | I/O | Function |
|------------|-------------|-----|-------------------|
| 12 | USB_D- | I/O | USB Data Negative |
| 13 | USB_D+ | I/O | USB Data Positive |
| 16 | USB_VBUS | I | USB VBUS |

Note: When a USB supply is not available, connect USB_VBUS to VBATT to supply the USB interface. USB_VBUS will have a voltage range of 3.3V to 4.5V when connected to VBATT.

3.7. Electrical Information for Digital I/O

The table below enumerates the electrical characteristics of the following digital interfaces:

- UART
- GPIOs
- JTAG
- RESET

Table 13. Digital I/O Electrical Characteristics

| Parameter | Symbol | Minimum | Maximum |
|--------------------------------------|----------|---------|---------|
| Input Current-High (μA) | I_{IH} | - | -240 |
| Input Current-Low (μA) | I_{IL} | - | 240 |
| DC Output Current-High (mA) | I_{OH} | - | 6 |
| DC Output Current-Low (mA) | I_{OL} | -6 | - |
| Input Voltage-High (V) | V_{IH} | 1.33 | 1.90 |
| Input Voltage-Low (V) | V_{IL} | -0.20 | 0.34 |
| Output Voltage-High (V) | V_{OH} | 1.45 | - |
| Output Voltage-Low (V) | V_{OL} | - | 0.35 |

3.8. General Purpose Input/Output (GPIO)

The AirPrime HL7539 modules provide 14 GPIOs, 3 of which have multiplexes.

Table 14. GPIO Pad Description

| Pad Number | Signal Name | Multiplex | I/O | Power Supply Domain |
|------------|-------------|-----------------|-----|---------------------|
| 1 | GPIO1 | | I/O | 1.8V |
| 10 | GPIO2 | TRACE_DATA2 | I/O | 1.8V |
| 40 | GPIO7 | | I/O | 1.8V |
| 41 | GPIO8 | MIPI2_TRACE_CLK | I/O | 1.8V |
| 44 | GPIO13 | | I/O | 1.8V |
| 46 | GPIO6 | | I/O | 1.8V |
| 51 | GPIO14 | | I/O | 1.8V |
| 52 | GPIO10 | | I/O | 1.8V |
| 53 | GPIO11 | | I/O | 1.8V |
| 54 | GPIO15 | | I/O | 1.8V |
| 58 | GPIO12 | | I/O | 1.8V |
| 64 | GPIO3 | UIM1_DET | I/O | 1.8V |
| 65 | GPIO4 | | I/O | 1.8V |
| 66 | GPIO5 | | I/O | 1.8V |

3.9. Main Serial Link (UART1)

The main serial link (UART1) is used for communication between the AirPrime HL7539 module 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 and 3250000 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.

UART1 pad description is summarized in the table below.

Table 15. UART1 Pad Description

| Pad # | Signal Name* | I/O* | Description |
|-------|--------------|----------------|--|
| 2 | UART1_RI | O | Signal incoming calls (data only), SMS, etc. |
| 3 | UART1_RTS | I | Request to send |
| 4 | UART1_CTS | O | AirPrime HL7539 is ready to receive AT commands |
| 5 | UART1_TX | I | Transmit data |
| 6 | UART1_RX | O | Receive data |
| 7 | UART1_DTR | I (active low) | Prevents the AirPrime HL7539 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.

Note: UART1 input signal pins (UART1_RTS, UART1_TX and UART1_DTR) are internally pulled up by an 8kΩ resistor when the module is ON.

3.10. POWER-ON Signal (PWR_ON_N)

A low-level signal must be provided to switch the AirPrime HL7539 module ON.

It is internally connected to the permanent 1.8V supply regulator inside the HL7539 via a pull-up resistor. Once VBAT is supplied to the HL7539 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 16. PWR_ON_N Electrical Characteristics

| Parameter | Minimum | Typical | Maximum |
|---|---------|---------|---------|
| 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 100kΩ, an open collector or open drain transistor must be used for ignition.

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

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

Note: PWR_ON_N signal cannot be used to power the module off. To power the module off, use AT command **AT+CFUN=0**.

3.11. Reset Signal (RESET_IN_N)

To reset the module, a low-level pulse must be sent on the RESET_IN_N pad for 20ms. This action will immediately restart the AirPrime HL7539 module 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, an open collector or open drain transistor should be used to control this signal.

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 VRTC (200kΩ pull-up resistor to VRTC 1.8V) an open collector or open drain transistor should be used to control this signal.

Table 17. RESET_IN_N Electrical Characteristics

| Parameter | Minimum | Typical | Maximum |
|--|---------|---------|---------|
| Input Voltage-Low (V) | | - | 0.51 |
| Input Voltage-High (V) | 1.33 | - | 2.2 |
| Reset assertion time (ms) | 20 | - | - |
| Power-up period (ms) from RESET_IN_N falling edge* | 2000 | - | - |

* With the PWR_ON_N Signal at low level

3.12. Analog to Digital Converter (ADC1)

One Analog to Digital Converter input, ADC1, is provided by the AirPrime HL7539 module. This converter is a 10-bit resolution ADC ranging from 0 to 1.2V.

The following table describes the pad description of the ADC interface.

Table 18. ADC Interface Pad Description

| Pad Number | Signal Name | I/O | Description |
|------------|-------------|-----|-----------------------------|
| 24 | ADC1 | I | Analog to digital converter |

Typical ADC1 use is for monitoring external voltage; such as in an application to safely power OFF an external supply in case of overvoltage.

ADC1's electrical characteristics are listed in the table below.

Table 19. ADC Electrical Characteristics

| Parameter | Minimum | Typical | Maximum | Remarks |
|-------------------------------|---------|---------|---------|-----------------------|
| ADC1 Resolution (bits) | - | 10 | - | |
| Input Voltage Range (V) | 0 | - | 1.2 | General purpose input |
| Update rate per channel (kHz) | - | - | 125 | |
| Integral Nonlinearity (bits) | - | - | ± 2 | LSB |
| Offset Error (bits) | - | - | ± 1 | LSB |
| Gain | 849 | 853 | 858 | |
| Input Resistance (MΩ) | 1 | - | - | |
| Input Capacitance (pF) | - | 1 | - | |

3.13. Clock Interface

The AirPrime HL7539 modules support two digital clock interfaces.

The following table describes the pad description of the clock out interfaces.

Table 20. Clock Interface Pad Description

| Pad Number | Signal Name | I/O | I/O Type | Description |
|------------|-------------|-----|----------|--------------------------------|
| 22 | 26M_CLKOUT | O | 1.8V | 26MHz Digital Clock output |
| 23 | 32K_CLKOUT | O | 1.8V | 32.768kHz Digital Clock output |

Enabling or disabling the clock out feature can be done using AT commands. For more information about AT commands, refer to document [2] AirPrime HL7539 AT Commands Interface Guide.

3.14. PCM

The Digital Audio (PCM) Interface allows connectivity with standard audio peripherals. It can be used, for example, to connect an external audio codec.

The programmability of this interface allows addressing a large range of audio peripherals.

The signals used by the Digital Audio Interface are as follows:

- PCM_SYNC: The frame synchronization signal delivers an 8 kHz frequency pulse that synchronizes the frame data in and the frame data out.
- PCM_CLK: The frame bit clock signal controls data transfer with the audio peripheral.
- PCM_OUT: The frame “data out” relies on the selected configuration mode.
- PCM_IN: The frame “data in” relies on the selected configuration mode.

The following table describes the pad description of the PCM interface.

Table 21. PCM Interface Pad Description

| Pad Number | Signal Name | I/O | Description |
|------------|-------------|-----|--------------|
| 33 | PCM_OUT | O | PCM data out |
| 34 | PCM_IN | I | PCM data in |
| 35 | PCM_SYNC | I/O | PCM sync out |
| 36 | PCM_CLK | I/O | PCM clock |

Refer to the following table for the electrical characteristics of the digital audio interface in master mode.

Table 22. PCM Master Mode Parameters

| Signal | Symbol | Minimum | Typical | Maximum | Unit |
|--|--------|---------------|---------|------------------------|------|
| PCM_CLK period | t_1 | $T - 4$ | T | - | ns |
| PCM_CLK low time | t_2 | $T/2 - 20$ | $T/2$ | - | ns |
| PCM_CLK high time | t_3 | $T/2 - 20$ | $T/2$ | - | ns |
| PCM_SYNC high begin after PCM_CLK high begin | t_4 | -24 | - | $2 \times t_{cp} + 12$ | ns |
| PCM_SYNC high end after PCM_CLK low end | t_5 | -24 | - | $2 \times t_{cp} + 12$ | ns |
| PCM_OUT invalid before PCM_CLK low end | t_6 | - | - | 24 | ns |
| PCM_OUT valid after PCM_CLK high begin | t_7 | - | - | $t_{cp} + 12$ | ns |
| PCM_IN setup time before PCM_CLK high end | t_8 | $t_{cp} + 50$ | - | - | ns |
| PCM_IN hold time after PCM_CLK low begin | t_9 | 12 | - | - | ns |

T = corresponds to the audio sampling rate (48KHz, 44.1KHz, 32KHz, 24KHz, 22.05KHz, 16KHz, 12KHz, 11.025KHz and 8KHz) and to the frame rate length (17 bit, 18 bit, 32 bit, 48 bit or 64 bit).

$t_{CP} = 9.6ns$ (clock period test condition)

The following figure shows the PCM timing waveform.

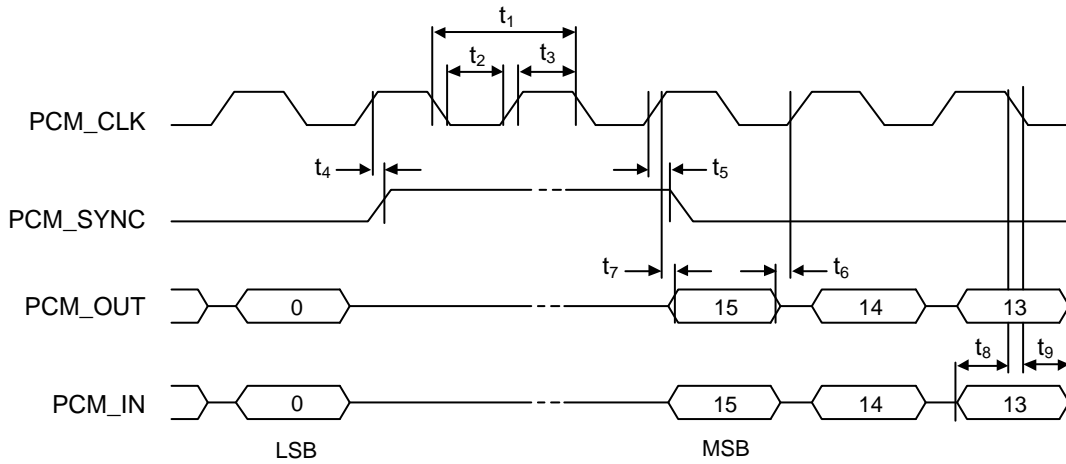


Figure 4. PCM Master Mode Timing Waveform

Refer to the following table for the electrical characteristics of the digital audio interface in slave mode.

Table 23. PCM Slave Mode Parameters

| Signal | Symbol | Minimum | Typical | Maximum | Unit |
|---|--------|------------------------|---------|------------------------|------|
| PCM_CLK period | t_1 | T | -- | -- | ns |
| PCM_CLK low time | t_2 | 120 | -- | -- | ns |
| PCM_CLK high time | t_3 | 120 | -- | -- | ns |
| PCM_SYNC high begin before PCM_CLK low begin (latching edge of PCM_CLK) | t_4 | $2 \times t_{cp} + 17$ | --- | --- | ns |
| PCM_SYNC low begin before PCM_CLK low begin (latching edge of PCM_CLK) | t_5 | $2 \times t_{cp} + 17$ | --- | --- | ns |
| PCM_OUT invalid before PCM_CLK rising edge (shifting edge of PCM_CLK) | t_6 | --- | --- | 12 | ns |
| PCM_OUT valid after PCM_CLK rising edge (shifting edge of PCM_CLK) | t_7 | --- | --- | $3 \times t_{cp} + 50$ | ns |
| PCM_IN setup time before PCM_CLK falling edge | t_8 | $t_{cp} + 12$ | --- | --- | ns |
| PCM_IN hold time after PCM_CLK falling edge | t_9 | 24 | --- | --- | ns |

T = corresponds to the audio sampling rate (48KHz, 44.1KHz, 32KHz, 24KHz, 22.05KHz, 16KHz, 12KHz, 11.025KHz and 8KHz) and to the frame rate length (17 bit, 18 bit, 32 bit, 48 bit or 64 bit).

t_{CP} = 9.6ns (clock period test condition)

The following figure shows the PCM slave mode timing waveform.

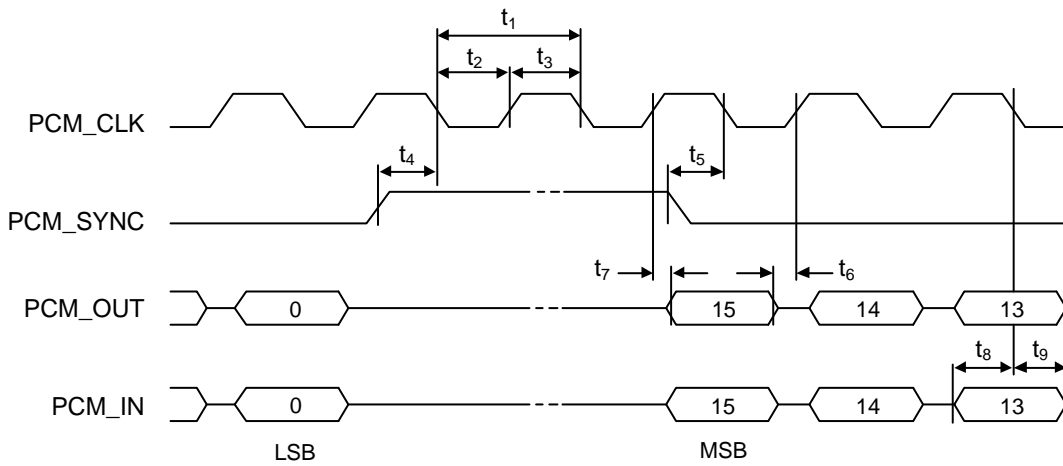


Figure 5. PCM Slave Mode Timing Waveform

3.15. Debug Interfaces

The AirPrime HL7539 module provides 3 interfaces for a powerful debug system.

3.15.1. USB

The USB interface is the primary debug interface for customers to collect traces.

Table 24. USB Pad Description

| Pad Number | Signal Name | I/O | Function |
|------------|-------------|-----|-------------------|
| 12 | USB_D- | I/O | USB Data Negative |
| 13 | USB_D+ | I/O | USB Data Positive |
| 16 | USB_VBUS | I | USB VBUS |

Note: It is strongly recommended to reserve test points to collect traces in case USB is not used.

3.15.2. JTAG

Note: This interface is reserved for Sierra Wireless' internal debug use (for customer support).

The JTAG interface provides debug access to the core of the HL7539. These JTAG signals are accessible through solder-able test points.

Table 25. JTAG Pad Description

| Pad Number | Signal Name | Function |
|------------|-------------|--------------------------|
| 236 | JTAG_RESET | JTAG RESET |
| 237 | JTAG_TCK | JTAG Test Clock |
| 238 | JTAG_TDO | JTAG Test Data Output |
| 239 | JTAG_TMS | JTAG Test Mode Select |
| 240 | JTAG_TRST | JTAG Test Reset |
| 241 | JTAG_TDI | JTAG Test Data Input |
| 242 | JTAG_RTCK | JTAG Returned Test Clock |

Note: It is recommended to provide access through Test Points to this interface (for Failure Analysis debugging). All signals listed in the table above should be outputs on the customer board to allow JTAG debugging.

3.15.3. Trace Debug

In addition to the USB and JTAG interfaces, the AirPrime HL7539 module provides a Trace Debug interface, providing real-time instruction and data trace of the modem core.

Table 26. Trace Debug Pad Description

| Pad Number | Signal Name | Function | Multiplex |
|------------|-----------------|--------------|-----------|
| 2 | TRACE_DATA3 | Trace data 3 | |
| 8 | TRACE_DATA1 | Trace data 1 | |
| 9 | TRACE_DATA0 | Trace data 0 | |
| 10 | TRACE_DATA2 | Trace data 2 | GPIO2 |
| 41 | MIPI2_TRACE_CLK | Trace clock | GPIO8 |

Note: It is strongly recommended to provide access to this interface through Test Points for Sierra Wireless' internal debug use (for customer support). Access to the USB debug interface described in section 3.15.1 USB should also always be provided when using this interface.

3.16. RF Interface

The RF interface of the HL7539 module allows the transmission of RF signals. This interface has a 50Ω nominal impedance.

Contact Sierra Wireless technical support for assistance in integrating the AirPrime HL7539 on applications with embedded antennas.

3.16.1. RF Connection

A 50Ω stripline can be used to connect to standard RF connectors such as SMA, UFL, etc. for antenna connection.

Table 27. RF Main Connection

| Pad Number | RF Signal | Impedance | VSWR Rx (max) | VSWR Tx (max) |
|------------|-----------|-----------|---------------|---------------|
| 49 | RF_MAIN | 50Ω | 1.5:1 | 1.5:1 |

Table 28. RF Diversity Connection

| Pad Number | RF Signal | Impedance | VSWR Rx (max) | VSWR Tx (max) |
|------------|-----------|-----------|---------------|---------------|
| 31 | RF_DIV | 50Ω | 1.5:1 | --- |

3.16.2. RF Performances

RF performances are compliant with 3GPP recommendation TS 36.101.

Table 29. Conducted RX Sensitivity (dBm)

| Frequency Band | | Primary (Typical) | Secondary (Typical) | SIMO (Typical) |
|----------------|----------------------|-------------------|---------------------|----------------|
| LTE B1 | Full RB; BW: 20 MHz* | -94.0 | -96.0 | -97.5 |
| LTE B21 | Full RB; BW: 15 MHz* | -97.0 | -98.5 | -100.5 |
| LTE B19 | Full RB; BW: 15 MHz* | -97.0 | -97.5 | -99.5 |

* Sensitivity values scale with bandwidth: $x_MHz_Sensitivity = 10\text{ MHz_Sensitivity} - 10 \cdot \log(10\text{ MHz}/x_MHz)$

3.16.3. TX_ON Indicator (TX_ON)

The AirPrime HL7539 module provides a signal, TX_ON, for TX indication. The TX_ON is a 2.3V signal and its status signal depends on the module transmitter state.

Refer to the following table for the status of the TX_ON signal depending on the embedded module's state.

Table 30. TX_ON Pad Description

| Pad # | Signal Name | Function | I/O Type | Power Supply Domain |
|-------|-------------|--------------|----------|---------------------|
| 60 | TX_ON | TX indicator | O | 2.3V |

Table 31. TX_ON Characteristics

| Parameter | Minimum | Typical | Maximum |
|----------------------|---------|---------|---------|
| T _{advance} | 30μs | | |
| T _{delay} | | 10μs | |

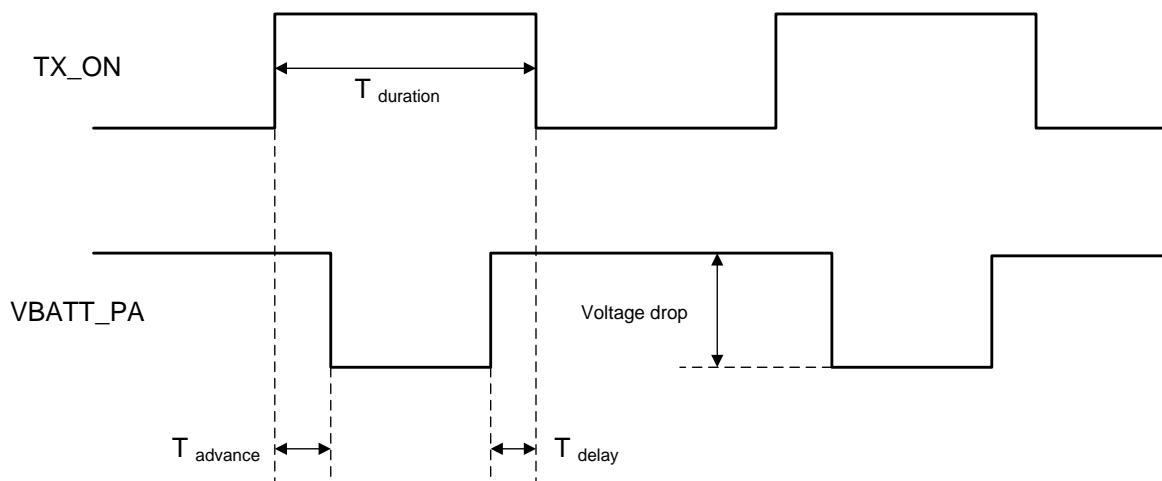


Figure 6. TX_ON State during Transmission

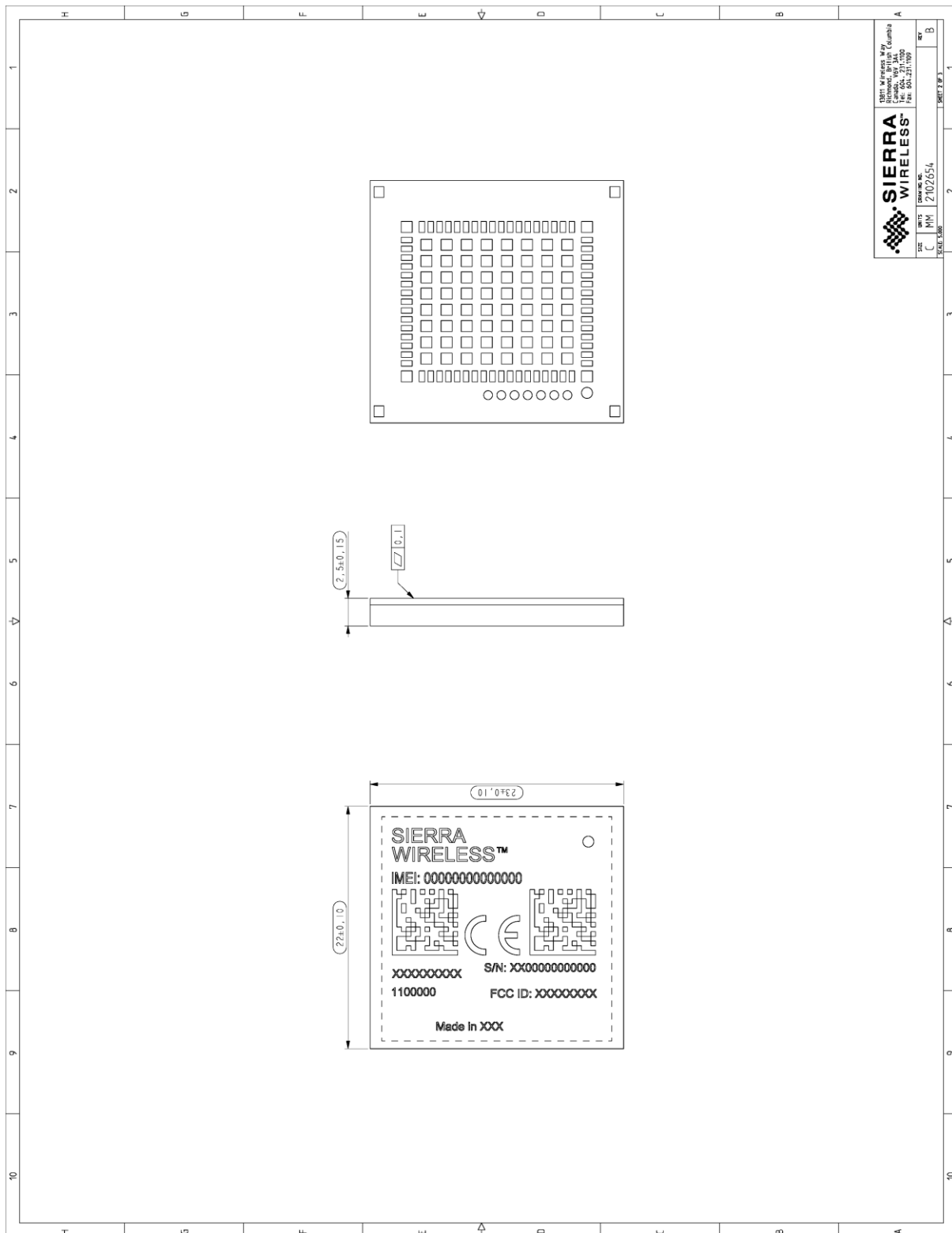
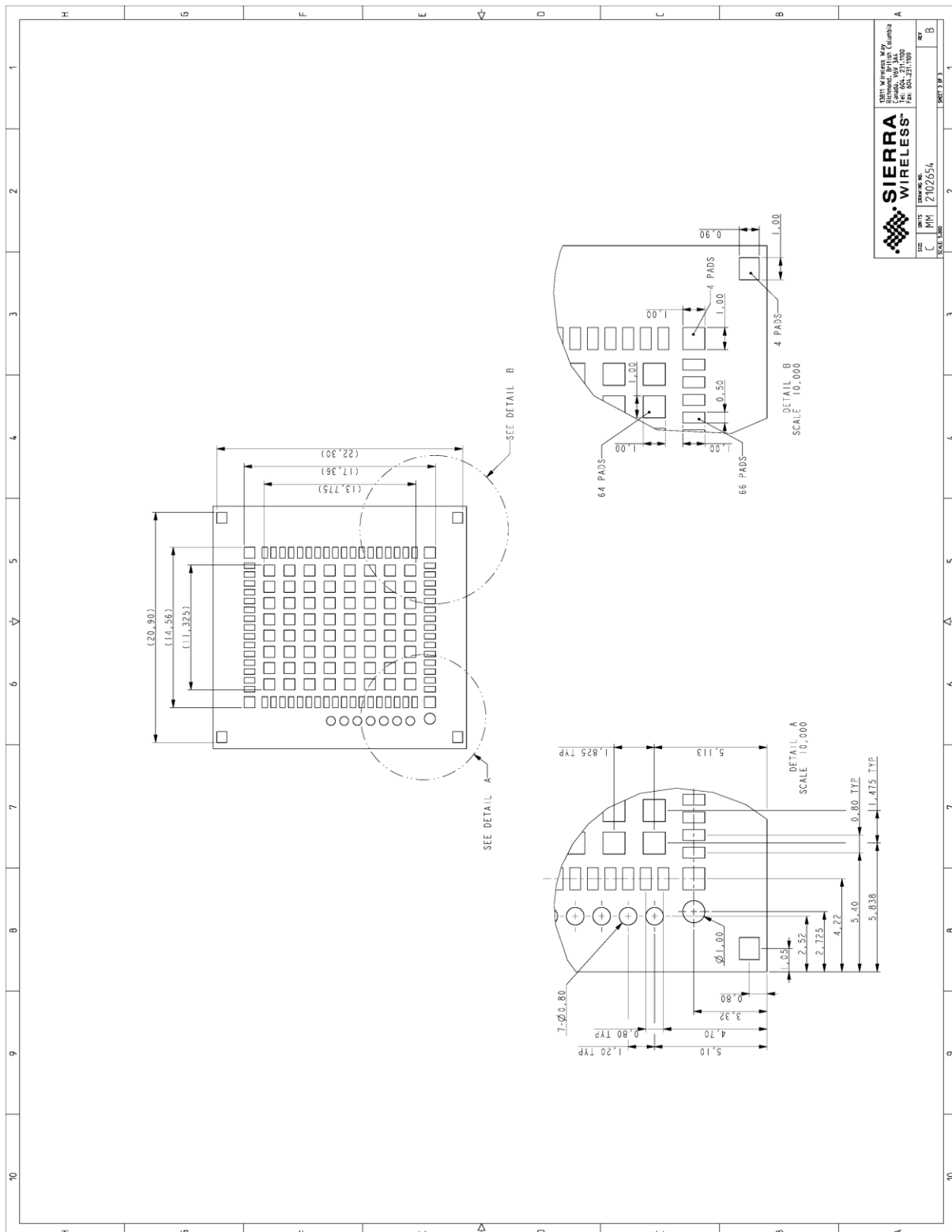


Figure 8. Dimensions Drawing



SIERRA WIRELESS
 1000 Wireless Way
 Alhambra, CA 91806
 Tel: 626.271.1000
 Fax: 626.271.1009

SCALE: 10.000
 SHEET: 308
 DRAWING NO: 2102654
 REV: B

Figure 9. Footprint

>> 5. Design Guidelines

5.1. Power-Up Sequence

Apply a low-level logic to the PWR_ON_N pad (pad 59); within approximately 25ms, VGPIO will appear to be at 1.8V. Either UART1 or the USB interface could be used to send AT commands. The AT command interface is available in about 7 seconds after PWR_ON_N for either UART1 or USB.

When using UART1, the AT command interface is available after the transition of UART1_CTS from high to low level.

When using a USB connection, the HL7539 will start communicating with the host after USB enumeration. The time when AT commands can be sent will depend on the initialization time on the USB host.

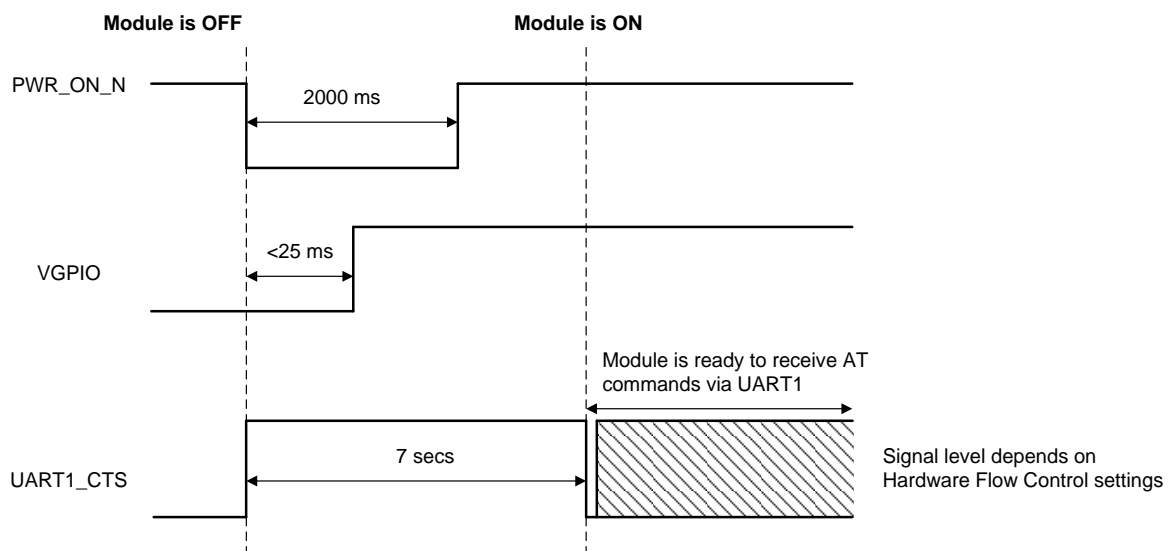


Figure 10. PWR_ON_N Sequence with VGPIO Information

Note: As PWR_ON_N is internally pulled up with 100kΩ, an open collector or open drain transistor must be used for ignition.

The PWR_ON_N pad has the minimum assertion time requirement of 25ms, with LOW active. Once the valid power on trigger is detected, the PWR_ON_N pad status can be left open.

The maximum VBATT ramp up time to 3.2V is 32ms

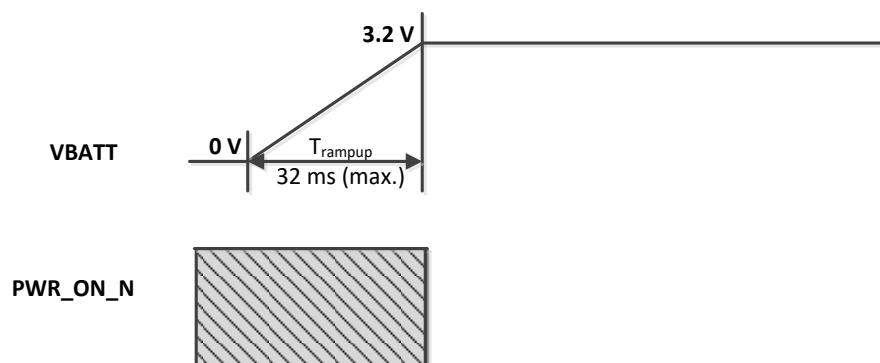


Figure 11. VBATT Ramp Up Timing

5.2. Module Switch-Off

AT command `AT+CFUN=0` enables the user to properly switch the AirPrime HL7539 module off.

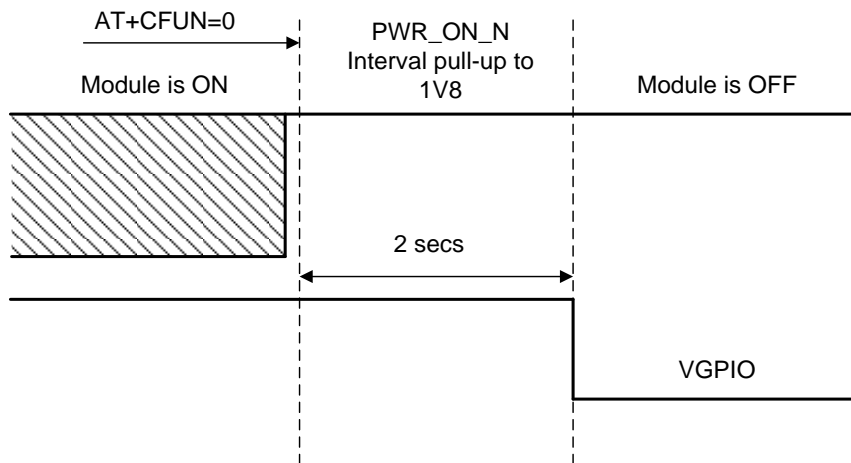


Figure 12. Power OFF Sequence for PWR_ON_N, VGPI0

Note: PWR_ON_N is internally pulled up by 100kΩ to 1.8V.

5.3. Emergency Power OFF

If required, the module can be switched off by controlling the RESET_IN_N pad (pad 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 pad for 20ms while the PWR_ON_N signal is inactive (high level). This action will immediately shut the HL7539 module down and the registers of the CPU and RAM memory will be reset for the next power on.

5.4. Sleep Mode Management

5.4.1. Using UART1

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

`AT+KSLEEP=0:`

- The AirPrime HL7539 module is active when DTR signal is active (low electrical level).
- When DTR is deactivated (high electrical level), the AirPrime HL7539 module enters sleep mode after a while.
- On DTR activation (low electrical level), the AirPrime HL7539 module wakes up.

AT+KSLEEP=1:

- The AirPrime HL7539 module determines when it enters sleep mode (when no more tasks are running).
- “0x00” character on the serial link wakes the AirPrime HL7539 module up.

AT+KSLEEP=2: The AirPrime HL7539 module never enters sleep mode.

5.4.2. Using USB

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

5.5. Power Supply Design

The AirPrime HL7539 module 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.

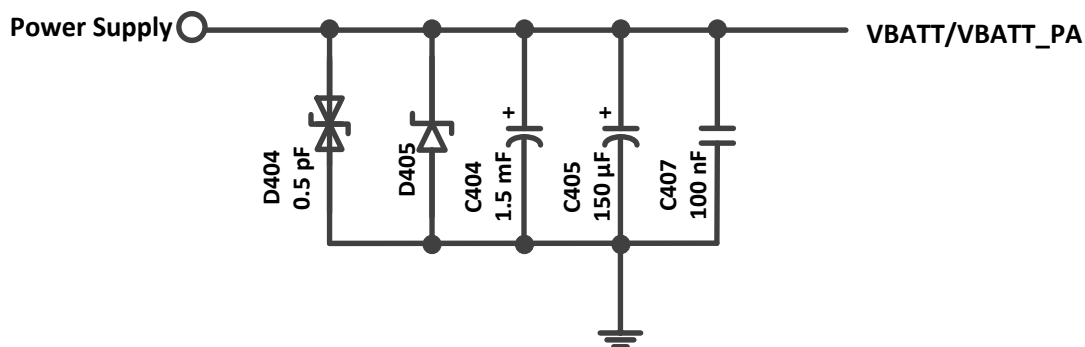


Figure 13. Voltage Limiter Example

5.6. Power Cycle

In addition to Sierra Wireless’ reliable recovery mechanisms, it is highly recommended that the ability for a power cycle to reboot the module be included in the design in case the module becomes blocked and stops responding to reset commands.

5.7. ESD Guidelines for SIM Card

Decoupling capacitors must be added according to the drawings below as close as possible to the SIM card connectors on UIM1_CLK, UIM1_RST, UIM1_VCC, UIM1_DATA and UIM1_DET signals to avoid EMC issues and to comply with the requirements of ETSI and 3GPP standards covering the SIM electrical interface.

A typical schematic including SIM detection is provided below.

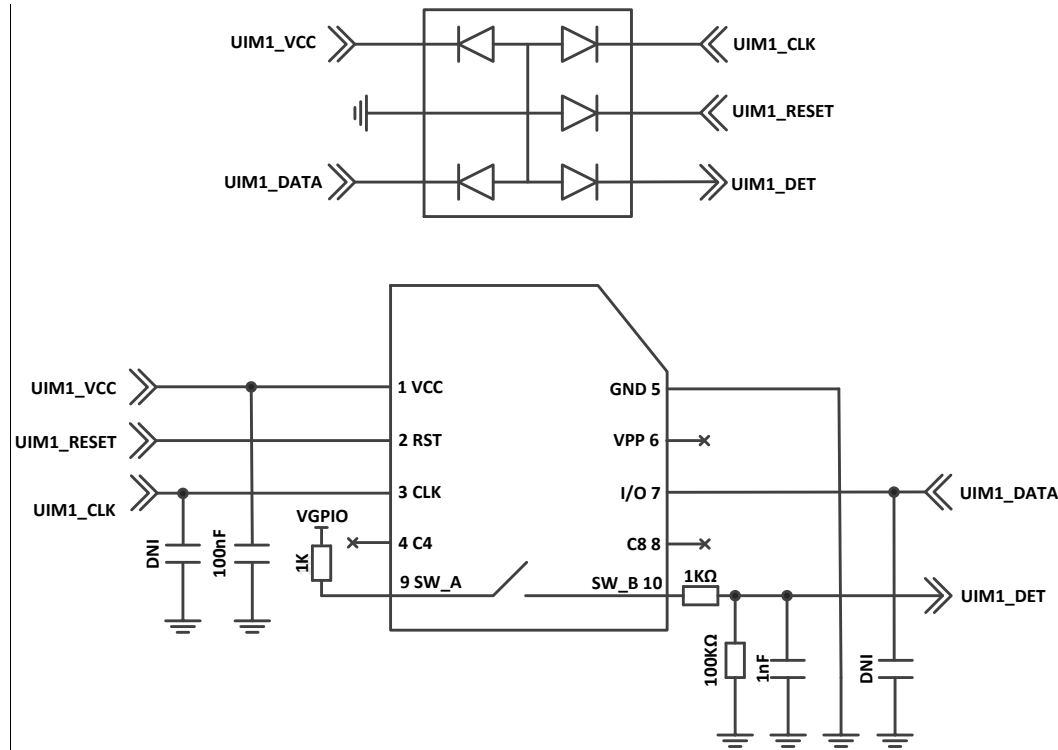


Figure 14. EMC and ESD Components Close to the SIM

5.8. 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.

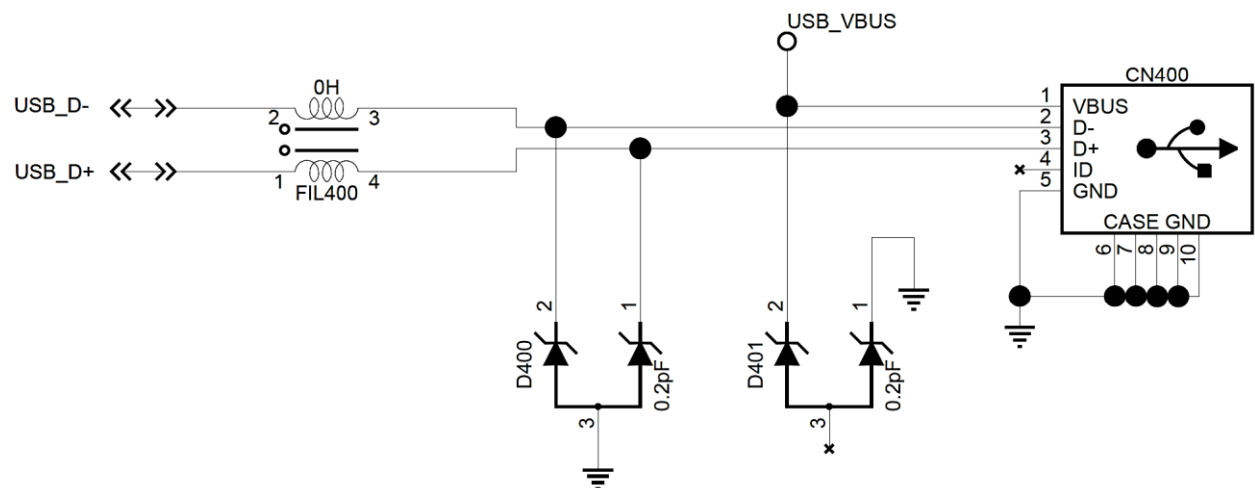


Figure 15. ESD Protection for USB

Note: It is not recommended to have an ESD diode with feedback path from USB_VBUS to either USB_D+ or USB_D-.

Sierra Wireless recommends using a 90Ω DLP0NSN900HL2L EMC filter and an RCLAMP0503N or ESD5V3U2U-03LRH ESD diode.

5.9. Radio Integration

The AirPrime HL7539 is equipped with an external antenna. A 50Ω line matching circuit between the module, the customer’s board and the RF antenna is required, for the GSM feed path, as shown in the example below.

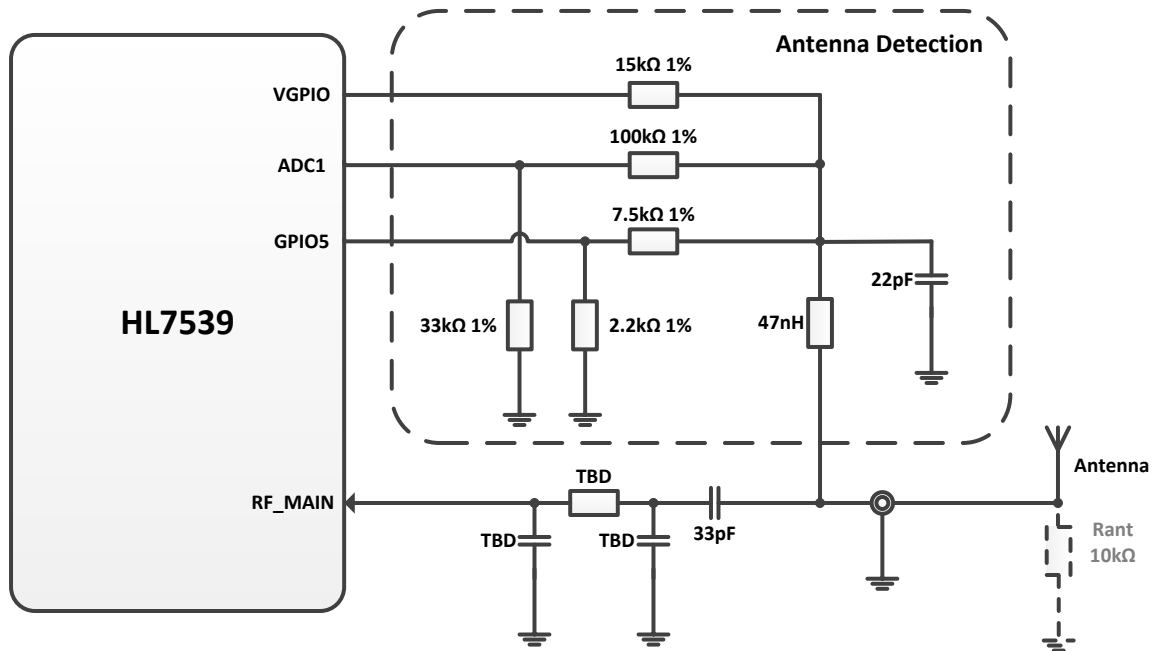


Figure 16. GSM Antenna Connection with Antenna Detection

Note: Antenna detection circuit is optional. Rant is the equivalent DC terminating resistor of the antenna. Rant should be close to 10 kΩ.



6. Ordering Information

Table 32. Ordering Information

| Model Name | Description | Part Number |
|------------|---------------------------|--|
| HL7539 | HL7539 embedded module | Contact Sierra Wireless for the latest SKU |
| DEV-KIT | HL Series Development Kit | 6000620 |



7. 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 |
| QZSS | Quasi-Zenith Satellite System |

| Abbreviation | Definition |
|---------------------|--|
| 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 |