AirPrime HL7692

Product Technical Specification

SIERRA WIRELESS®

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1.2	August 09, 2016	Updated: • Table 1 Supported Bands/Connectivity • Figure 1 Architecture Overview
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6.0	December 03, 2018	Updated 3.15 Debug Interfaces
7.0	May 24, 2019	Updated 3.15.2 JTAG

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1. Introduction

This document is the Product Technical Specification for the AirPrime HL7692 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.

The AirPrime HL7692 belongs to the AirPrime HL Series from Essential Connectivity Module family. These are industrial grade Embedded Wireless Modules that provides data connectivity on GPRS, EDGE and LTE networks (as listed in Table 1 Supported Bands/Connectivity).

The HL7692 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 B3	1710 to 1785 MHz	1805 to 1880 MHz	23dBm ± 2dBm
LTE B8	880 to 915 MHz	925 to 960 MHz	23dBm ± 2dBm
LTE B20	832 to 862 MHz	791 to 821 MHz	23dBm ± 2dBm
E-GSM 900	880 to 915 MHz	925 to 960 MHz	2 Watts GSM, GPRS and EDGE
DCS 1800	1710 to 1785 MHz	1805 to 1880 MHz	1 Watt GSM, GPRS and EDGE

1.1. Common Flexible Form Factor (CF^3)

The AirPrime HL7692 belongs to the Common Flexible Form Factor (CF^3) 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^3 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 HL7692 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 HL7692 features.

Table 2. General Features

Feature	Description
Physical	• 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 (1800 MHz (B3), 900 MHz (B8) and 800 MHz (B20)) • Dual-band GSM/GPRS/EDGE (900 MHz and 1800 MHz)
Audio interface	• Digital interface (only) • 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 • MO and MT calling • Echo cancellation and noise reduction • Emergency calls (112, 110, 911, etc.) • Incoming call notification
SIM interface	• Dual SIM Single Standby (DSSS) • 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	• NDIS NIC interface support (Windows 7, Windows 8, Linux) • MBIM support • Multiple non-multiplexed USB channel support • Dial-up networking • USB selective suspend to maximize power savings • CMUX multiplexing over UART • AT command interface – 3GPP 27.007 standard, plus proprietary extended AT commands

Feature	Description
Protocol Stack	Dual-mode GSM/GPRS/EDGE/LTE operation • GSM/GPRS/EDGE ▪ GPRS/EDGE – Class 33 (296 kbits downlink and 236.8 kbits uplink) ▪ CSD (Circuit-switched data bearers) ▪ Release 4 GERAN Feature Package 1 ▪ SAIC / DARP Phase 1 ▪ Latency Reduction ▪ Repeated FACCH and Repeated SACCH ▪ GPRS ROHC ▪ Enhanced Operator Name String (EONS) ▪ Enhanced Network Selection (ENS) • LTE ▪ LTE FDD, bandwidth 1.4-20 MHz ▪ System Release: 3GPP Rel. 9 ▪ Category 1 (up to 10 Mbit/s in downlink, 5 Mbit/s in uplink) ▪ Max modulation 64 QAM DL, 16 QAM UL ▪ Intra-frequency and inter-frequency mobility ▪ SON ANR ▪ Public Warning System PWS
SMS	• SMS over SGs and IMS • SMS MO and MT • SMS saving to SIM card or ME storage • SMS reading from SIM card or ME storage • SMS sorting • SMS concatenation • SMS Status Report • SMS replacement support • SMS storing rules (support of AT+CNMI, AT+CNMA)
Connectivity	• Multiple (up to 20) cellular packet data profiles • Sleep mode for minimum idle power draw • Automatic GPRS attach at power-up • GPRS detach • Mobile-originated PDP context activation / deactivation • Support QoS profile ▪ Release 97 – Precedence Class, Reliability Class, Delay Class, Peak Throughput, Mean Throughput ▪ Release 99 QoS negotiation – Background, Interactive, and Streaming • 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 • Interaction with existing GSM services (MO/MT SMS voice calls) while: ▪ GPRS is attached, or ▪ In a GPRS data session (class B GPRS suspend/resume procedures)
Environmental	Operating temperature ranges (industrial grade): • 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 HL7692 internal architecture and external interfaces.

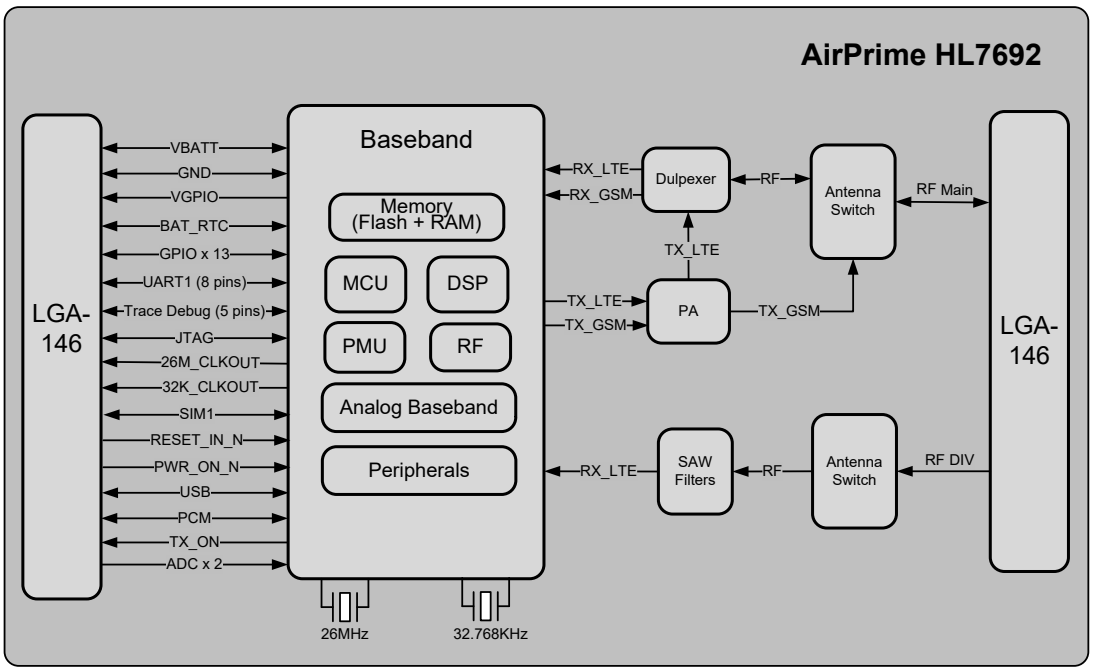


Figure 1. Architecture Overview

1.5. Interfaces

The AirPrime HL7692 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 - Digital Audio
- 1x - JTAG Interface
- 13x - GPIOs (3 of which have multiplexes)
- 1x - Main Antenna
- 1x - RX Diversity
- 1x - VGPIO
- 1x - TX ON
- 2x - ADC
- 1x - Debug Interface

1.6. Connection Interface

The AirPrime HL7692 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.

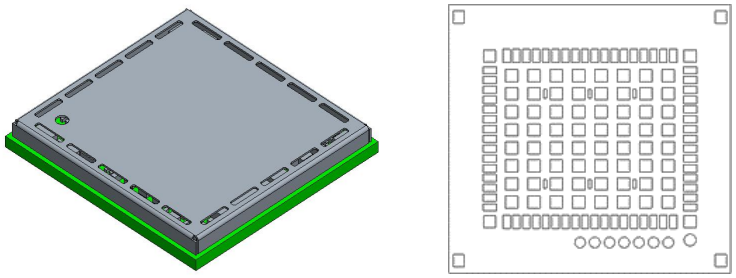


Figure 2. Mechanical Overview (Top View and Bottom View)

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: • JESD22-A114 ± 1kV Human Body Model • JESD22-A115 ± 200V Machine Model • JESD22-C101C ± 250V 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 HL7692 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 environmentally friendly manner.

1.9. References

[1] AirPrime HL Series Customer Process Guidelines
Reference Number: 4114330

[2] AirPrime HL76xx AT Commands Interface Guide
Reference Number: 4118395

[3] AirPrime HL Series Development Kit User Guide
Reference Number: 4114877

2. Pad Definition

AirPrime HL7692 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 CF[3] 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 CF[3] 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	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	ADC0	Analog to digital converter	I		N/A	1.2V	Left Open	Extension
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 / 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						Not connected
56	NC	Not connected						Not connected
57	NC	Not connected						Not connected
58	NC	Not connected						Not connected
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		N/A	2.3V	Left Open	Extension
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	GPIO3 / UIM1_DET	General purpose input/output / UIM1 Detection	I/O	H	T/PD	1.8V	Left Open	Core
65	GPIO4	General purpose input/output	I/O	H	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	*Note: These pads are not available on the AirPrime HL7692 module.*							
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)

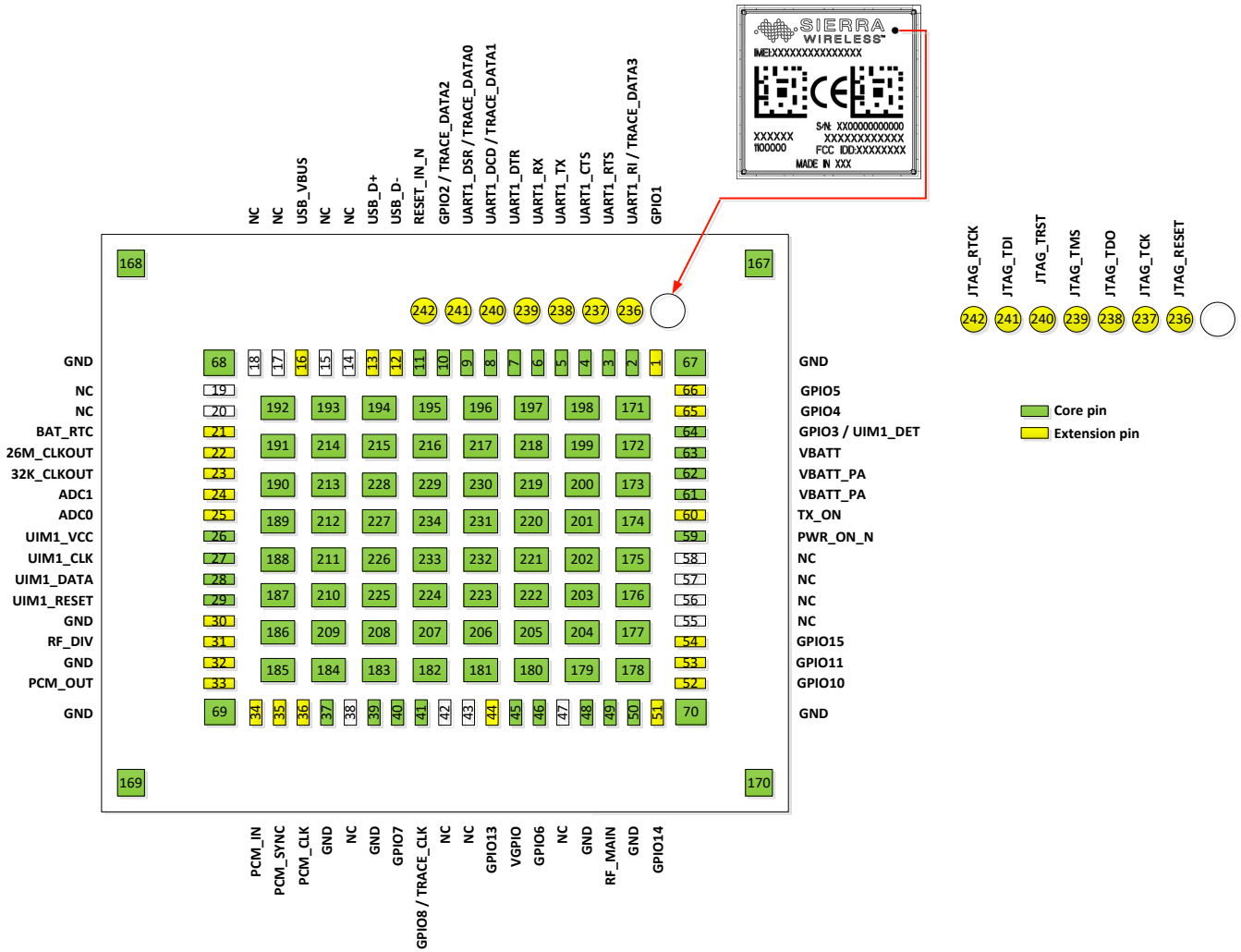


Figure 3. Pad Configuration

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 HL7692 module supports separate VBATT and VBATT_PA connection if requirements below are fulfilled.

3.1. Power Supply

The AirPrime HL7692 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
VBATT_PA voltage (V) Extended Range	2.8	3.7	4.5

* This value must be guaranteed during the burst.

Note: Load capacitance for VBATT is around 37µF ± 20% embedded inside the module.
Load capacitance for VBATT_PA is around 11µF ± 20% embedded inside the module.

3.2. Current Consumption

The following table lists the current consumption of the AirPrime HL7692 at different conditions.

Note: Typical values are defined for VBATT/VBATT_PA at 3.7V and 25°C, for 50Ω impedance at all RF ports. Maximum values are provided for VSWR3:1 with worst conditions among supported ranges of voltages and temperature.

Table 7. Current Consumption

Parameter		Typical	Maximum	Unit
Off mode		110.0	202.0	µA
Sleep mode – GSM DRX2 (registered to the network)	E-GSM 900	1.9	6.7	mA
	DCS 1800	1.9	6.6	mA
Sleep mode – GSM DRX9 (registered to the network)	E-GSM 900	1.2	5.7	mA
	DCS 1800	1.2	5.7	mA
Sleep mode – LTE DRX = 1.28 s USB = suspended	Band 3	1.7	6.3	mA
	Band 8	1.7	6.3	mA
	Band 20	1.7	6.3	mA
Sleep mode – LTE DRX = 2.56 s USB = suspended	Band 3	1.3	5.7	mA
	Band 8	1.3	5.7	mA
	Band 20	1.3	5.7	mA

Parameter		Typical	Maximum	Unit
GSM in communication mode	E-GSM 900 (PCL = 5)	222	267	mA
	DCS 1800 (PCL = 0)	149	192	mA
GPRS (4 TX, 1 RX)	E-GSM 900 (Gamma 3)	580	653	mA
	DCS 1800 (Gamma 3)	381	519	mA
EGPRS (4 TX, 1 RX)	E-GSM 900 (Gamma 6)	432	467	mA
	DCS 1800 (Gamma 5)	354	454	mA
LTE in communication mode • TX Max • BW = 10 MHz • UL RB = 50	Band 3	656	828	mA
	Band 8	603	637	mA
	Band 20	637	723	mA
Peak current consumption	E-GSM 900	1.8	2.4	A
	DCS 1800	1.6	1.8	A

Table 8. Current Consumption per Power Supply

Parameter (at nominal voltage, 3.7 V)			Typical	Unit
VBATT	Average current GSM in communication mode	E-GSM 900	49	mA
		DCS 1800	48	mA
	Average current GPRS (4 TX, 1 RX)	E-GSM 900 (Gamma 3)	90	mA
		DCS 1800 (Gamma 3)	90	mA
	Average current EGPRS (4 TX, 1 RX)	E-GSM 900 (Gamma 6)	91	mA
		DCS 1800 (Gamma 5)	90	mA
	LTE in communication mode (TX Max) USB = disconnected	Band 3	222	mA
		Band 8	227	mA
		Band 20	231	mA
VBATT_PA	Average current GSM in communication mode	E-GSM 900	174	mA
		DCS 1800	100	mA
	Average current GPRS (4 TX, 1 RX)	E-GSM 900 (Gamma 3)	482	mA
		DCS 1800 (Gamma 3)	286	mA
	Average current EGPRS (4 TX, 1 RX)	E-GSM 900 (Gamma 6)	338	mA
		DCS 1800 (Gamma 5)	260	mA
	LTE in communication mode (TX Max) USB = disconnected	Band 3	406	mA
		Band 8	323	mA
		Band 20	417	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 HL7692 module is switched ON.

Table 9. 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 Active Mode (mA)	-	-	50	Power management support up to 50mA output in Active mode
Current capability Sleep Mode (mA)	-	-	3	Power management support up to 3mA output in Sleep mode
Rise Time (ms)	-	-	1.5	Start-Up time from 0V

3.4. BAT_RTC

The AirPrime HL7692 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 10. 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 HL7692 has one physical SIM interface, UIM1, which has optional support for dual SIM application with an external SIM switch.

It 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 11. UIM1 Pad Description

Pad #	Signal Name	Description
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

Table 12. 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 (µs) 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.

3.6. USB

The AirPrime HL7692 has one USB interface.

Table 13. 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 the 5V USB supply is not available, connect USB_VBUS to VBATT to supply the USB interface.

3.7. Electrical Information for Digital I/O

The AirPrime HL7692 supports two groups of digital interfaces with varying current drain limits. The following list enumerates these interface groupings and the following table enumerates the electrical characteristics of each digital interface.

- Group 1 (6mA current drain limit)
  - GPIO2, GPIO3, GPIO4, GPIO6, GPIO8, GPIO10, GPIO11, GPIO13, GPIO14, GPIO15
- Group 2 (1mA current drain limit)
  - GPIO1, GPIO5, GPIO7
  - UART1
  - JTAG

Table 14. Digital I/O Electrical Characteristics

Parameter		Symbol	Minimum	Maximum	Remarks
Input Current-High (µA)		I_{IH}	-	240	
Input Current-Low (µA)		I_{IL}	-	240	
Group 1	DC Output Current-High (mA)	I_{OH}	-	6	
	DC Output Current-Low (mA)	I_{OL}	-6	-	
Group 2	DC Output Current-High (mA)	I_{OH}	-	1	
	DC Output Current-Low (mA)	I_{OL}	-1	-	
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	-	I_{OH} = -6 mA for Group 1
					I_{OH} = -1 mA for Group 2
		V_{OH}	1.60	-	I_{OH} = -0.1 mA
Output Voltage-Low (V)		V_{OL}	-	0.35	I_{OL} = 6 mA for Group 1
					I_{OL} = 1 mA for Group 2
		V_{OL}	-	0.2	I_{OL} = 0.1 mA

3.8. General Purpose Input/Output (GPIO)

The AirPrime HL7692 modules provide 13 GPIOs, 3 of which have multiplexes.

Table 15. GPIO Pad Description

Pad #	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	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
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 HL7692 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 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 500000, 750000, 921600, 1843200, 3000000, 3250000 and 3686300 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 16. 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 HL7692 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 HL7692 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 HL7692 module ON.

It is internally connected to the permanent 1.8V supply regulator inside the HL7692 via a pull-up resistor. Once VBATT is supplied to the HL7692 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 17. 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+CPWROFF**.*

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 HL7692 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 must 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 must be used to control this signal.

Table 18. 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 (ADC)

Two Analog to Digital Converter inputs, ADC0 and ADC1, are provided by the AirPrime HL7692 module. These converters are 10-bit resolution ADCs ranging from 0 to 1.2V.

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

Table 19. ADC Interface Pad Description

Pad Number	Signal Name	I/O	Description
24	ADC1	I	Analog to digital converter
25	ADC0	I	Analog to digital converter

ADC0 use is reserved for antenna detection, while typical ADC1 use is for monitoring external voltage; this is very useful for monitoring an application's voltage and can be used as an indicator to safely power the application OFF in case of overvoltage.

Table 20. ADC Electrical Characteristics

Parameter	Minimum	Typical	Maximum	Remarks
ADC 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 HL7692 modules support two digital clock interfaces.

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

Table 21. 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 HL76xx AT Commands Interface Guide.

3.14. Digital Audio (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 PCM interface is a high speed full duplex interface that can be used to send and receive digital audio data to external audio ICs. The digital audio interface also features the following:

- PCM master or slave
- 16 bits data word length, linear mode
- MSB first
- Configurable PCM bit clock rate on 256kHz, 384kHz or 512kHz
- Long frame sync

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

Table 22. 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.

Table 23. Digital Audio Electrical Characteristics

Signal	Description	Minimum	Typical	Maximum	Unit
Tsync_low + Tsync_high	PCM-SYNC period		125		µs
Tsync_low	PCM-SYNC low time		62.5		µs
Tsync_high	PCM-SYNC high time		62.5		µs
TCLK-cycle	PCM-CLK period (T)	1.95	2.6	3.9	µs
TIN-setup	PCM-IN setup time	59.6			ns
TIN-hold	PCM-IN hold time	12			ns
TOUT-delay	PCM-OUT delay time			21.6	ns
TSYNC-delay	PCM-SYNC output delay	-24		31.2	ns

The following figure shows the PCM timing waveform.

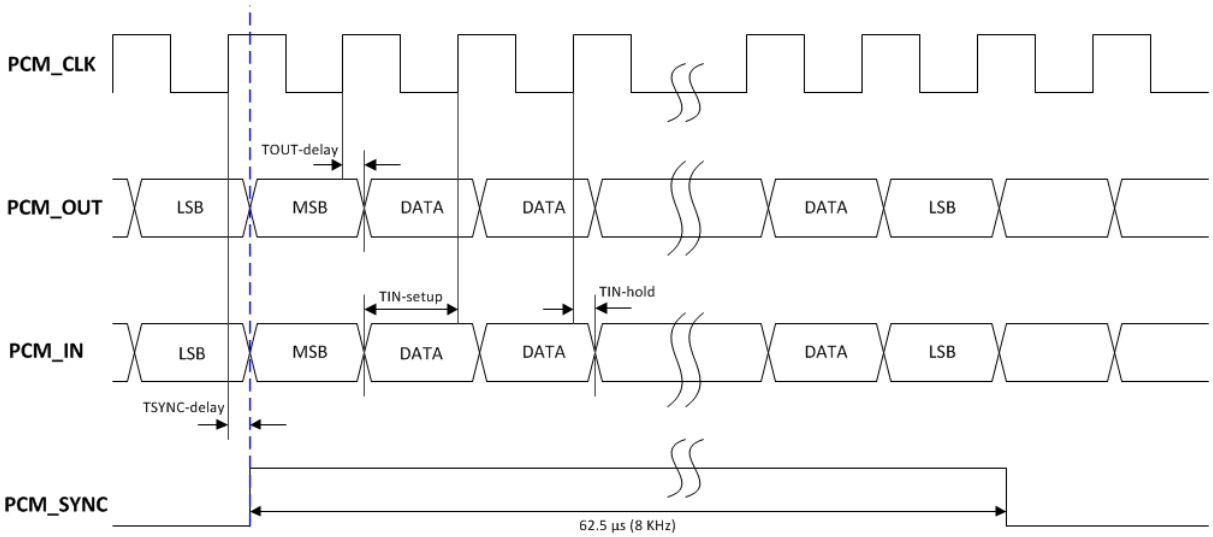


Figure 4. PCM Timing Waveform

3.15. Debug Interfaces

The AirPrime HL7692 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

Pad Number	Signal Name	I/O	Function
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 HL7692. 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 HL7692 module provides an extra 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
2	TRACE_DATA3	Trace data 3
8	TRACE_DATA1	Trace data 1
9	TRACE_DATA0	Trace data 0
10	TRACE_DATA2	Trace data 2
41	TRACE_CLK	Trace clock

Note: It is 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 HL7692 module allows the transmission of RF signals. This interface has a 50Ω nominal impedance.

Note that if the final application is a single antenna receiver (does not use the diversity antenna), it is recommended that the diversity antenna be disabled using AT command **AT+WMANTSEL=1**. Disabling the diversity antenna when not used:

- prevents any noise in the diversity antenna input from degrading the overall sensitivity performance of the main RF input, and
- reduces the power consumption of the module.

Refer to document [2] AirPrime HL76xx AT Commands Interface Guide for more information regarding **AT+WMANTSEL**.

Contact Sierra Wireless technical support for assistance in integrating the AirPrime HL7648 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)
E-GSM900		-109		
DCS 1800		-108		
LTE B3	Full RB; BW: 20 MHz*	-93	-94	-96
LTE B8	Full RB; BW: 10 MHz*	-96	-97	-99
LTE B20	Full RB; BW: 10 MHz*	-96	-98	-100

* Sensitivity values scale with bandwidth: x_MHz_Sensitivity = 10 MHz_Sensitivity – 10*log (10 MHz/x_MHz)

3.16.3. TX_ON Indicator (TX_ON)

The AirPrime HL7692 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 Indicator Pad Description

Pad Number	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	

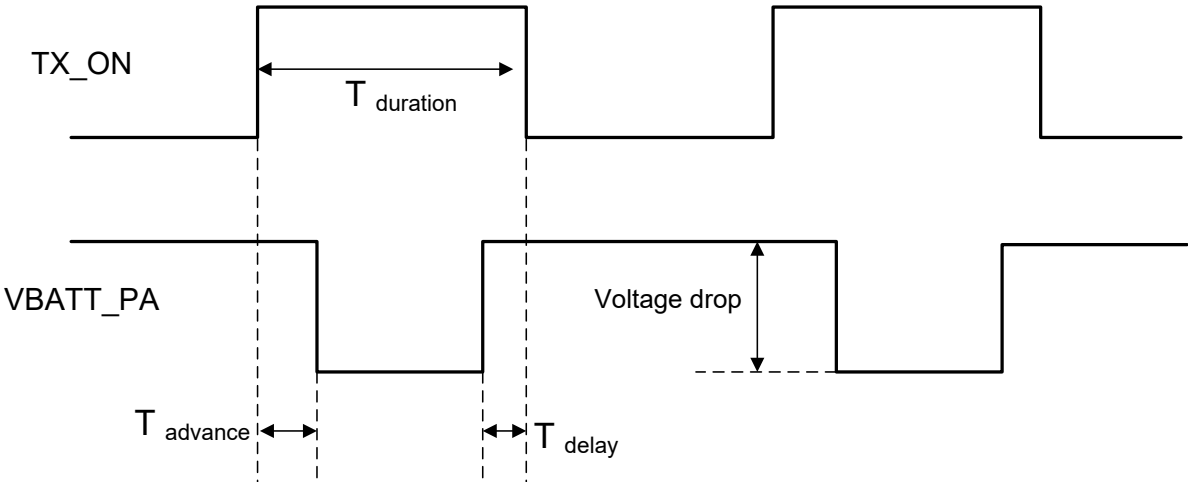


Figure 5. TX_ON State During Transmission

4. Mechanical Drawings

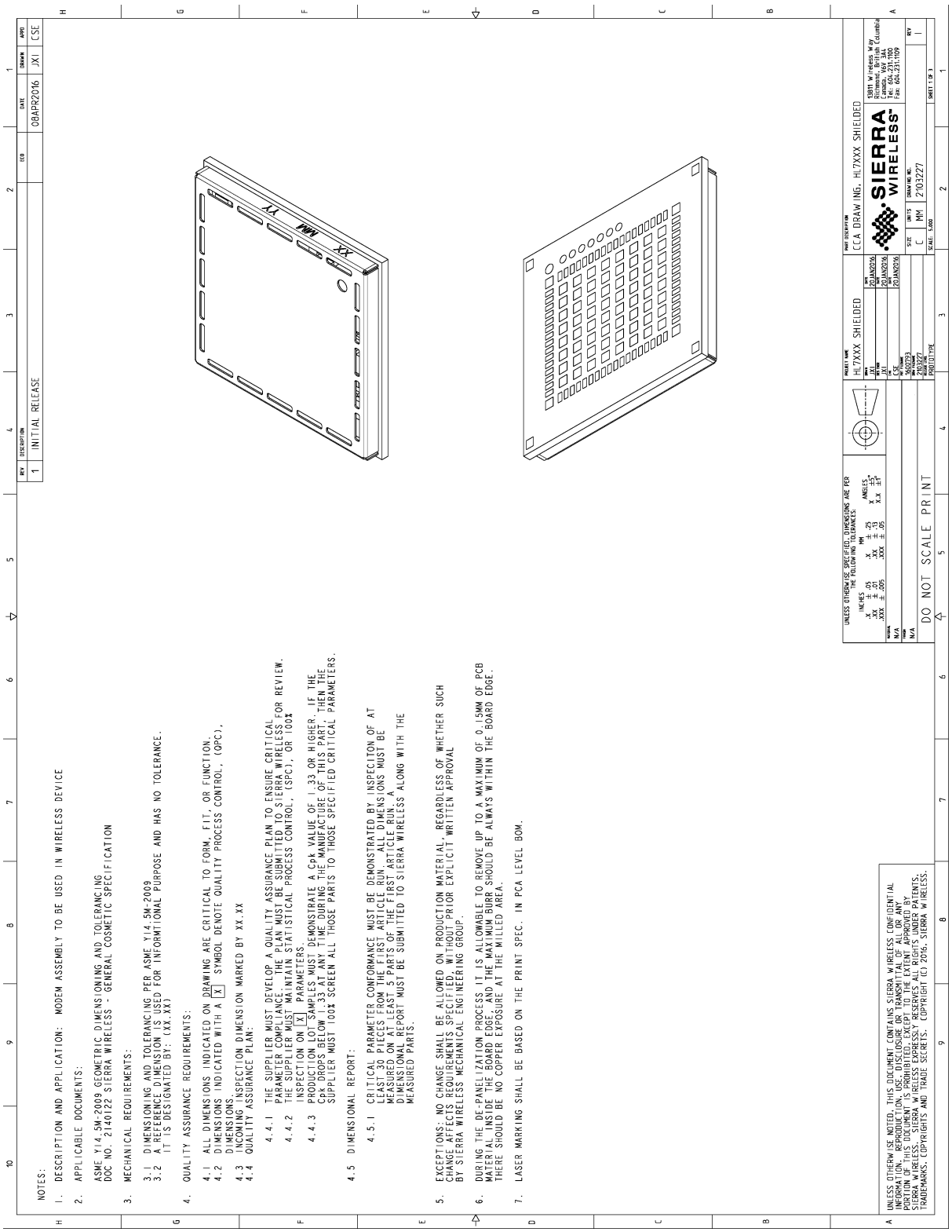


Figure 6. Mechanical Drawing

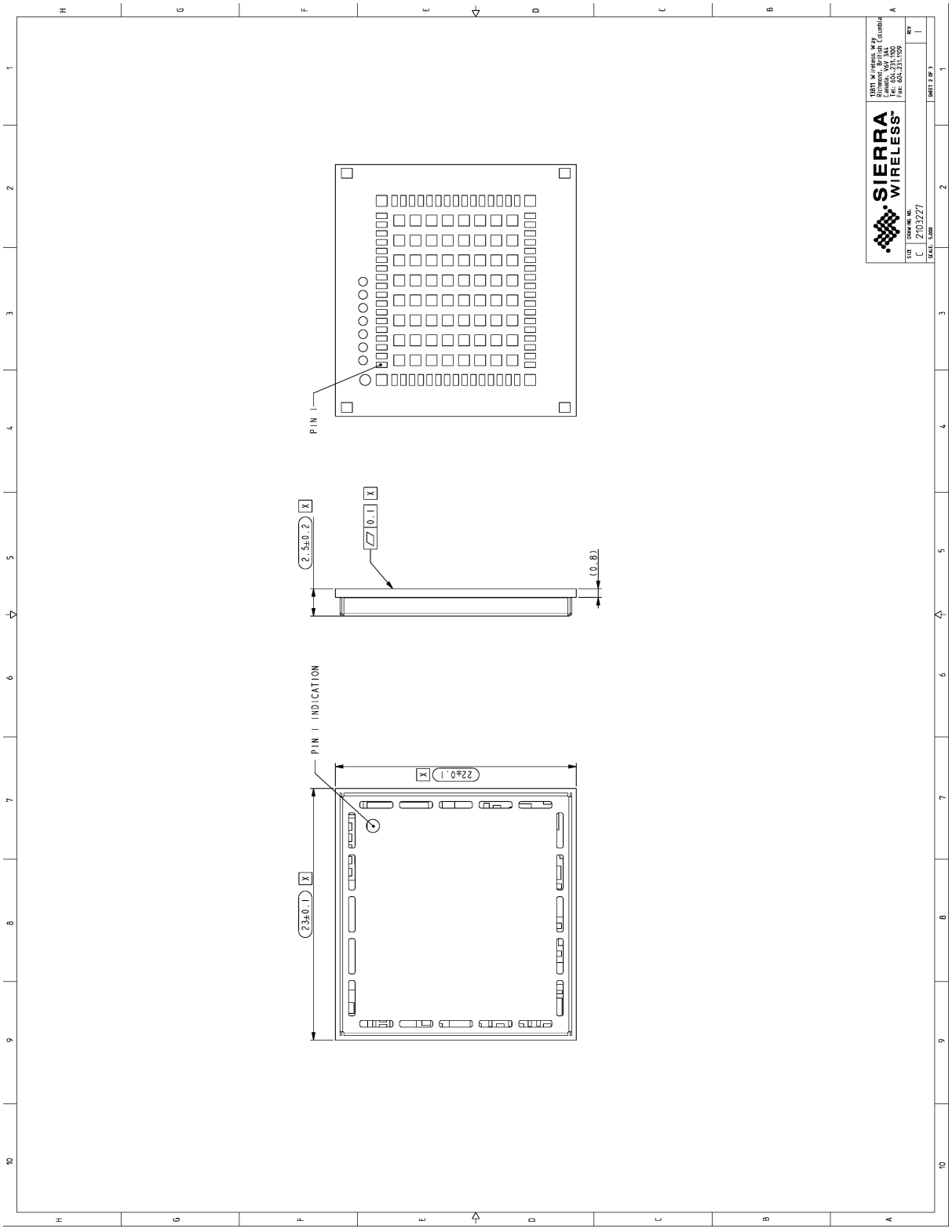


Figure 7. Dimensions Drawing

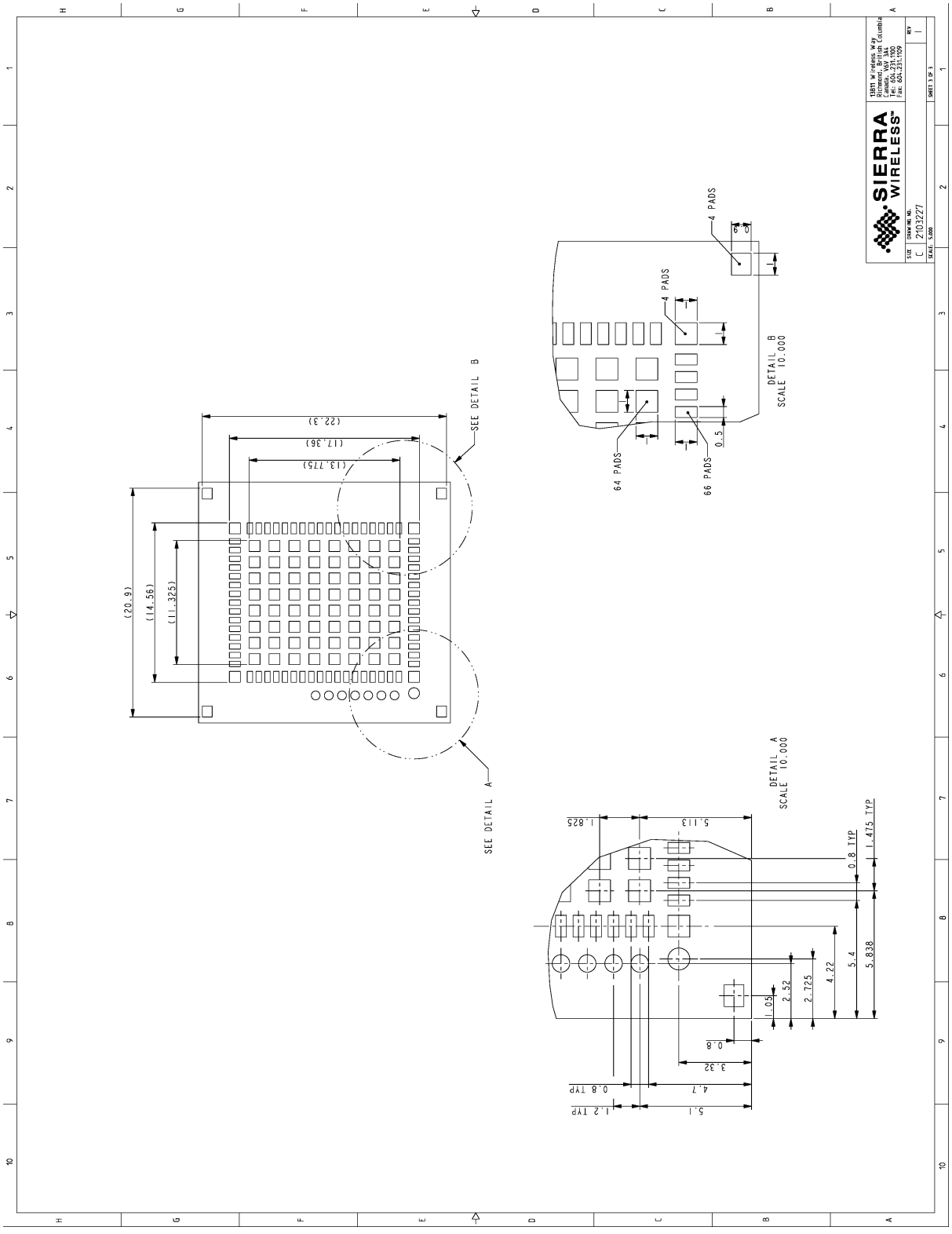


Figure 8. Footprint

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 UART or USB.

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

When using a USB connection, the HL7692 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.

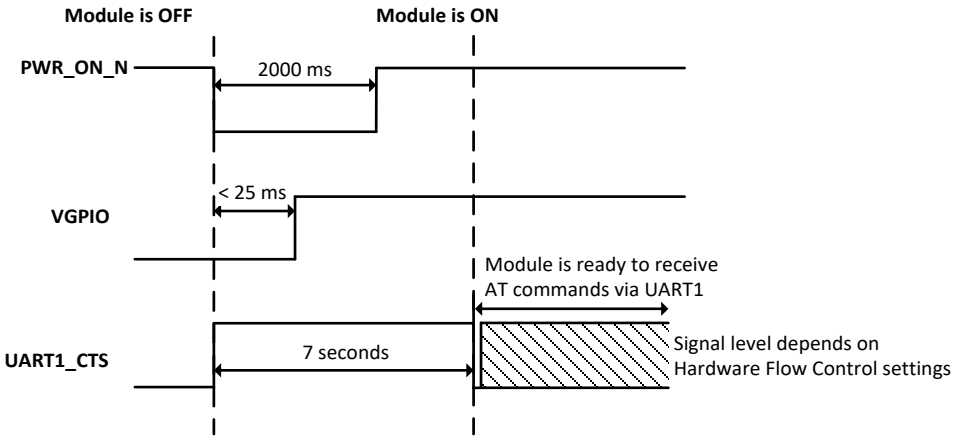


Figure 9. PWR_ON_N Sequence with VGPIO Information

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.

5.2. Module Switch-Off

AT command **AT+CPWROFF** enables the user to properly switch the AirPrime HL7692 module off.

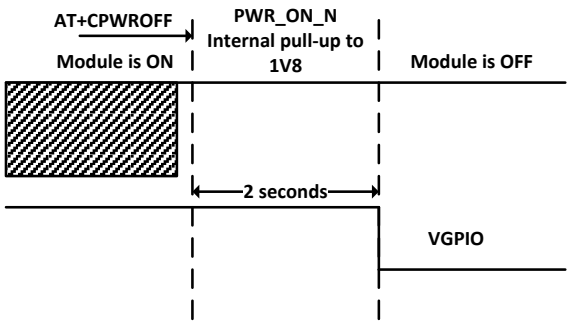


Figure 10. Power OFF Sequence for PWR_ON_N, VGPIO

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 HL7692 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 module is active when DTR signal is active (low electrical level).
- When DTR is deactivated (high electrical level), the module enters 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.

5.4.2. Using USB

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

5.5. Power Supply Design

The AirPrime HL7692 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.

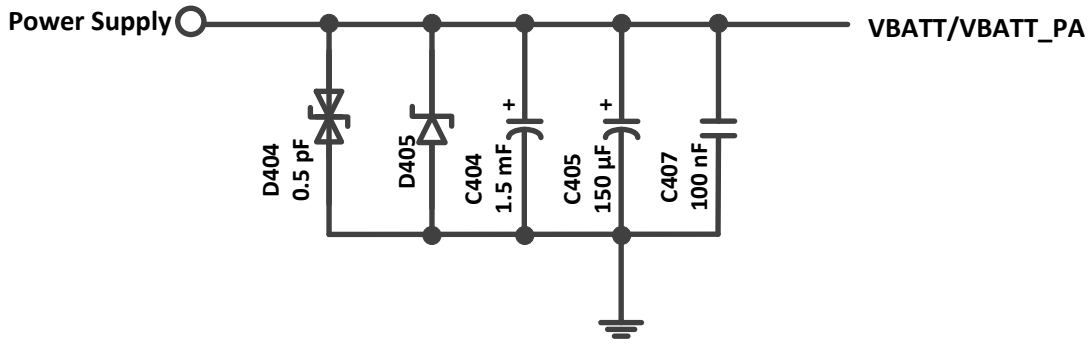


Figure 11. Voltage Limiter Example

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.

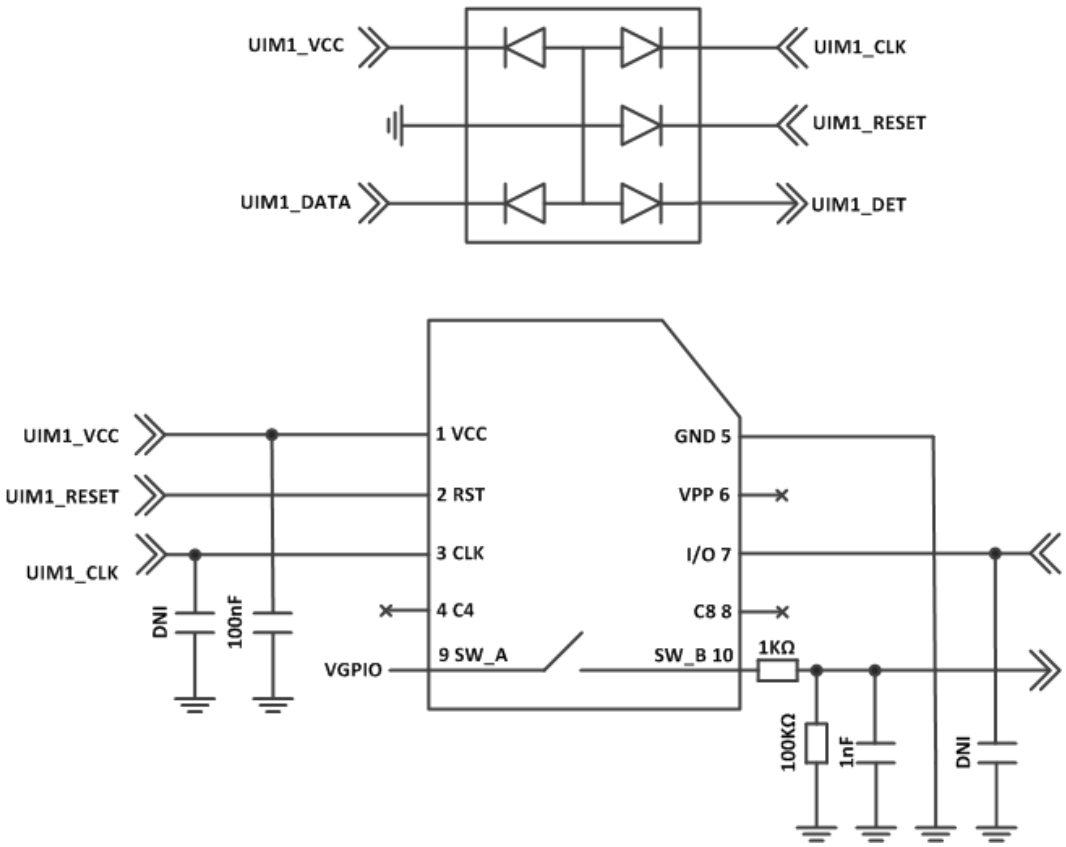


Figure 12. EMC and ESD Components Close to the SIM

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.

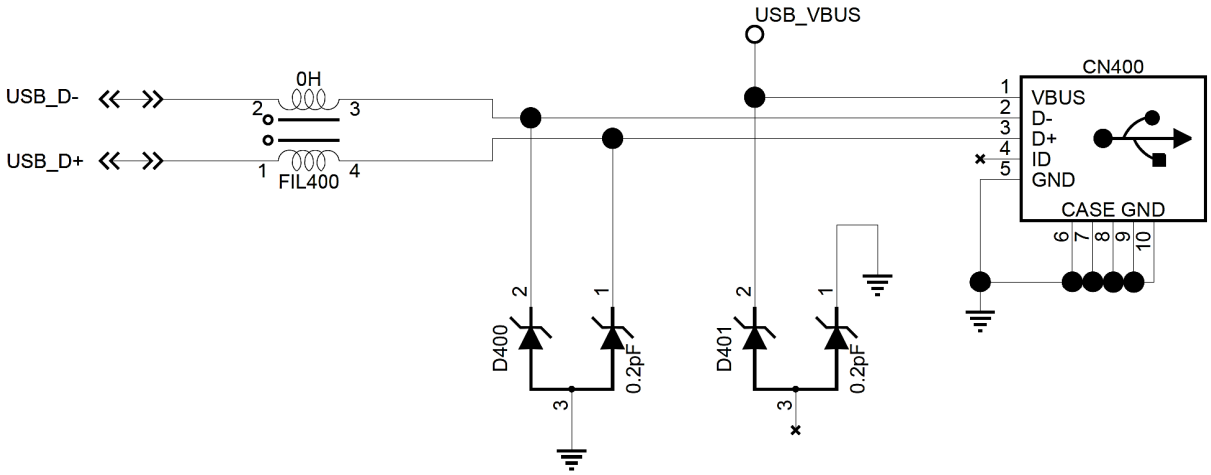


Figure 13. ESD Protection for USB

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. Antenna Detection

The AirPrime HL7692 is equipped with external antennas. A 50Ω line matching circuit between the module, the customer's board and the RF antennas is required as shown in the example below.

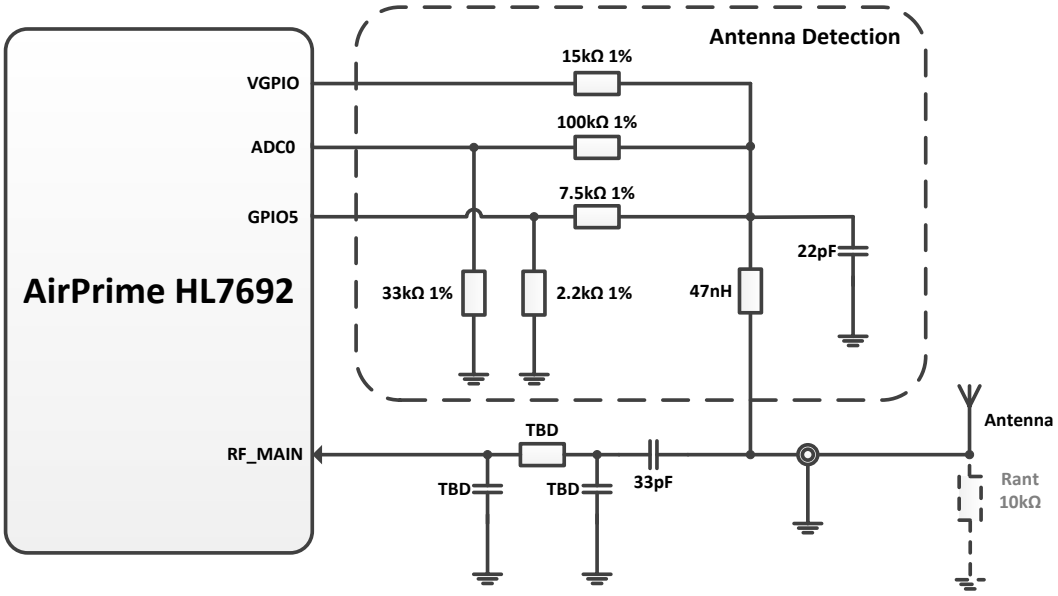


Figure 14. Antenna Connection with Antenna Detection

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

6. Reliability Specification

AirPrime HL7692 modules are tested against the Sierra Wireless Industrial Reliability Specification defined below.

6.1. Reliability Compliance

AirPrime HL7692 modules connected on a development kit board application are compliant with the following requirements.

Table 32. Standards Conformity

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

6.2. Reliability Prediction Model

6.2.1. Life Stress Test

The following tests the AirPrime HL7692 module's product performance.

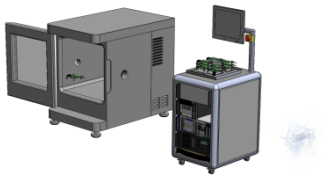
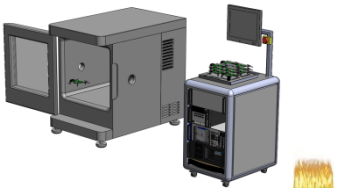
Table 33. Life Stress Test

Designation	Condition
Performance Test PT3T & PTRT 	Standard: N/A
	Special conditions: • Temperature: ▪ Class A: -30°C to +70°C ▪ Class B: -40°C to +85°C ▪ Rate of temperature change: ± 3°C/min • Recovery time: 3 hours
	Operating conditions: Powered
	Duration: 14 days

6.2.2. Environmental Resistance Stress Tests

The following tests the AirPrime HL7692 module's resistance to extreme temperature.

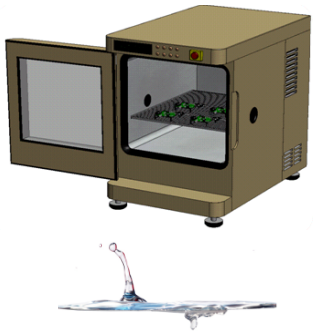
Table 34. Environmental Resistance Stress Tests

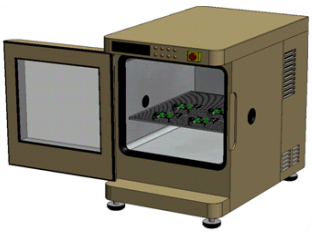
Designation	Condition
Cold Test Active **COTA** 	Standard: IEC 680068-2-1, Test Ad
	Special conditions: • Temperature: -40°C • Temperature variation: 1°C/min
	Operating conditions: : Powered ON with a power cycle of 1 minute ON and 2 minutes OFF
	Duration: 3 days
Resistance to Heat Test **RH** 	Standard: IEC 680068-2-2, Test Bb
	Special conditions: • Temperature: +85°C • Temperature variation: 1°C/min
	Operating conditions: Powered ON with a power cycle of 15 minutes ON and 15 minutes OFF
	Duration: 50 days

6.2.3. Corrosive Resistance Stress Tests

The following tests the AirPrime HL7692 module's resistance to corrosive atmosphere.

Table 35. Corrosive Resistance Stress Tests

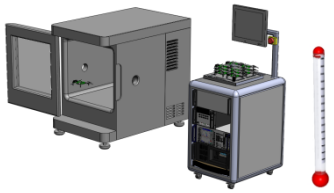
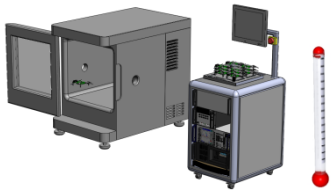
Designation	Condition
Humidity Test **HUT** 	Standard: IEC 60068-2-3, Test Ca
	Special conditions: • Temperature: +65°C • RH: 95% • Temperature variation: 3 ± 0.6°C/min
	Operating conditions: Powered on, DUT is powered up for 15 minutes and OFF for 15 minutes
	Duration: 10 days

Designation	Condition
Component Solder Wettability CSW 	Standard: JESD22 – B102, Method 1/Condition C, Solderability Test Method
	Special conditions: • Test method: Dip and Look Test with Steam preconditioning 8h ±15min. dip for 5 +0/-0.5 seconds
	Operating conditions: Un-powered
	Duration: 1 day
Moist Heat Cyclic Test MHCT  	Standard: IEC 60068-2-30, Test Db
	Special conditions: • Upper temperature: +40 ± 2°C • Lower temperature: +25 ± 5°C • RH: ▪ Upper temperature: 93% ▪ Lower temperature: 95% • Number of cycles: 21 (1 cycle/24 hours) • Temperature Variation: 3 ± 0.6°C/min
	Operating conditions: Powered ON for 15 minutes during each 3 hours ramp up and 3 hours ramp down (in middle) for every cycle
	Duration: 21 days

6.2.4. Thermal Resistance Cycle Stress Tests

The following tests the AirPrime HL7692 module's resistance to extreme temperature cycling.

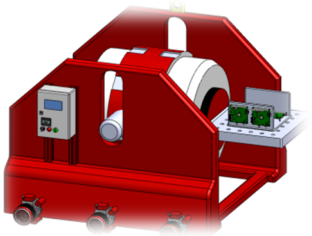
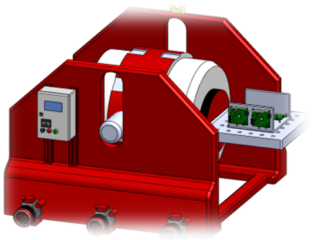
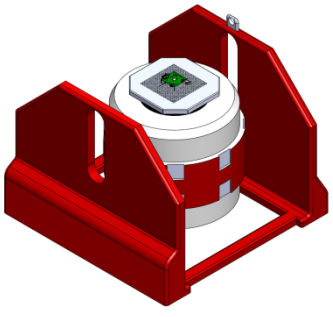
Table 36. Thermal Resistance Cycle Stress Tests

Designation	Condition
Thermal Shock Test TSKT 	Standard: IEC 60068-2-14, Test Na
	Special conditions: • Temperature: -30°C to +80°C • Temperature Variation: less than 30s • Number of cycles: 600 • Dwell Time: 10 minutes
	Operating conditions: Un-powered
	Duration: 9 days
Temperature Change TCH 	Standard: IEC 60068-2-14, Test Nb
	Special conditions: • Temperature: -40°C to +90°C • Temperature Variation: 3 ± 0.6°C/min • Number of cycles: 400 • Dwell Time: 10 minutes
	Operating conditions: Un-powered
	Duration: 29 days

6.2.5. Mechanical Resistance Stress Tests

The following tests the AirPrime HL7692 module's resistance to vibrations and mechanical shocks.

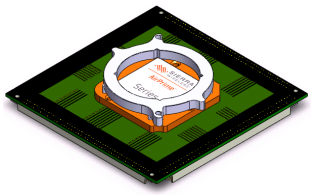
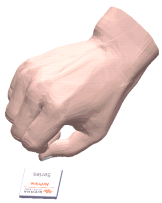
Table 37. Mechanical Resistance Stress Tests

Designation	Condition
Sinusoidal Vibration Test SVT 	Standard: IEC 60068-2-6, Test Fc
	Special conditions: • Frequency range: 16 Hz to 1000 Hz • Displacement: 0.35mm (peak-peak) • Acceleration: ▪ 5G from 16 to 62 Hz ▪ 3G from 62 to 200 Hz ▪ 1G from 200 to 1000 Hz • Sweep rate: 1 octave / cycle • Number of Sweep: 20 sweeps/axis • Sweep direction: ±X, ±Y, ±Z
	Operating conditions: Un-powered
	Duration: 2 days
Random Vibration Test RVT 	Standard: IEC 60068-2-64, Test Fh
	Special conditions: • Frequency range: 10 Hz – 2000 Hz • Power Spectral Density in $[(m/s^2)^2/Hz]$ ▪ 0.1 g2/Hz at 10Hz ▪ 0.01 g2/Hz at 250Hz ▪ 0.005 g2/Hz at 1000Hz ▪ 0.005 g2/Hz at 2000Hz • Peak factor: 3 • Duration per Axis: 1 hr / axis
	Operating conditions: Un-powered
	Duration: 1 day
Mechanical Shock Test MST 	Standard: IEC 60068-2-27, Test Ea
	Special conditions: • Shock Test 1: ▪ Wave form: Half sine ▪ Peak acceleration: 30g ▪ Duration: 11ms ▪ Number of shocks: 8 ▪ Direction: ±X, ±Y, ±Z • Shock Test 2: ▪ Wave form: Half sine ▪ Peak acceleration: 100g ▪ Duration: 6ms ▪ Number of shocks: 3 ▪ Direction: ±X, ±Y, ±Z
	Operating conditions: Un-powered
	Duration: 72 hours

6.2.6. Handling Resistance Stress Tests

The following tests the AirPrime HL7692 module's resistance to handling malfunctions and damage.

Table 38. Handling Resistance Stress Tests

Designation	Condition
ESDC Test 	Standard: JESD22-A114, JESD22-A115, JESD22-C101
	Special conditions: • HBM (Human Body Model): 1KV (Class 1C) • MM (Machine Model): 200V • CDM (Charged Device Model): 250V (Class II)
	Operating conditions: Powered
	Duration: 3 days
ESD Test 	Standard: IEC 61000-4-2
	Special conditions: • Contact Voltage: ±2kV, ±4kV, ±6kV • Air Voltage: ±2kV, ±4kV, ±8kV
	Operating conditions: Powered
	Duration: 3 days
Free Fall Test **FFT 1** 	Standard: IEC 60068-2-32, Test Ed
	Special conditions: • Number of drops: 2 drops per unit • Height: 1m
	Operating conditions: Un-powered
	Duration: 6 hours

7. Ordering Information

Table 39. Ordering Information

Model Name	Description	Part Number
HL7692	HL7692 embedded module	Contact Sierra Wireless for the latest SKU
DEV-KIT	HL Series Development Kit	6000620

8. 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