



# Hardware Integration Guide

## AirPrime HL7588 Accessory Board



**SIERRA**  
WIRELESS®

4119383  
1.1  
June 06, 2016

## Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

## Safety and Hazards

Do not operate the Sierra Wireless modem in areas where cellular modems are not advised without proper device certifications. These areas include environments where cellular radio can interfere such as explosive atmospheres, medical equipment, or any other equipment which may be susceptible to any form of radio interference. The Sierra Wireless modem can transmit signals that could interfere with this equipment. Do not operate the Sierra Wireless modem in any aircraft, whether the aircraft is on the ground or in flight. In aircraft, the Sierra Wireless modem **MUST BE POWERED OFF**. When operating, the Sierra Wireless modem can transmit signals that could interfere with various onboard systems.

---

*Note: Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. Sierra Wireless modems may be used at this time.*

---

The driver or operator of any vehicle should not operate the Sierra Wireless modem while in control of a vehicle. Doing so will detract from the driver or operator's control and operation of that vehicle. In some states and provinces, operating such communications devices while in control of a vehicle is an offence.

## Limitations of Liability

This manual is provided "as is". Sierra Wireless makes no warranties of any kind, either expressed or implied, including any implied warranties of merchantability, fitness for a particular purpose, or noninfringement. The recipient of the manual shall endorse all risks arising from its use.

The information in this manual is subject to change without notice and does not represent a commitment on the part of Sierra Wireless. SIERRA WIRELESS AND ITS AFFILIATES SPECIFICALLY DISCLAIM LIABILITY FOR ANY AND ALL DIRECT, INDIRECT, SPECIAL, GENERAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR REVENUE OR ANTICIPATED PROFITS OR REVENUE ARISING OUT OF THE USE OR INABILITY TO USE ANY SIERRA WIRELESS PRODUCT, EVEN IF SIERRA WIRELESS AND/OR ITS AFFILIATES HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR THEY ARE FORESEEABLE OR FOR CLAIMS BY ANY THIRD PARTY.

Notwithstanding the foregoing, in no event shall Sierra Wireless and/or its affiliates aggregate liability arising under or in connection with the Sierra Wireless product, regardless of the number of events, occurrences, or claims giving rise to liability, be in excess of the price paid by the purchaser for the Sierra Wireless product.

Customer understands that Sierra Wireless is not providing cellular or GPS (including A-GPS) services. These services are provided by a third party and should be purchased directly by the Customer.

**SPECIFIC DISCLAIMERS OF LIABILITY:** CUSTOMER RECOGNIZES AND ACKNOWLEDGES SIERRA WIRELESS IS NOT RESPONSIBLE FOR AND SHALL NOT BE HELD LIABLE FOR ANY DEFECT OR DEFICIENCY OF ANY KIND OF CELLULAR OR GPS (INCLUDING A-GPS) SERVICES.

## Patents

This product may contain technology developed by or for Sierra Wireless Inc.

This product includes technology licensed from QUALCOMM®.

This product is manufactured or sold by Sierra Wireless Inc. or its affiliates under one or more patents licensed from InterDigital Group and MMP Portfolio Licensing.

## Copyright

© 2016 Sierra Wireless. All rights reserved.

## Trademarks

Sierra Wireless®, AirPrime®, AirLink®, AirVantage®, WISMO®, ALEOS® and the Sierra Wireless and Open AT logos are registered trademarks of Sierra Wireless, Inc. or one of its subsidiaries.

Watcher® is a registered trademark of NETGEAR, Inc., used under license.

Windows® and Windows Vista® are registered trademarks of Microsoft Corporation.

Macintosh® and Mac OS X® are registered trademarks of Apple Inc., registered in the U.S. and other countries.

QUALCOMM® is a registered trademark of QUALCOMM Incorporated. Used under license.

Other trademarks are the property of their respective owners.

## Contact Information

Sales Desk:	Phone:	1-604-232-1488
	Hours:	8:00 AM to 5:00 PM Pacific Time
	Contact:	<a href="http://www.sierrawireless.com/sales">http://www.sierrawireless.com/sales</a>
Post:	Sierra Wireless 13811 Wireless Way Richmond, BC Canada V6V 3A4	
Technical Support:	<a href="mailto:support@sierrawireless.com">support@sierrawireless.com</a>	
RMA Support:	<a href="mailto:repairs@sierrawireless.com">repairs@sierrawireless.com</a>	
Fax:	1-604-231-1109	
Web:	<a href="http://www.sierrawireless.com/">http://www.sierrawireless.com/</a>	

Consult our website for up-to-date product descriptions, documentation, application notes, firmware upgrades, troubleshooting tips, and press releases: [www.sierrawireless.com](http://www.sierrawireless.com)

# Document History

Version	Date	Updates
1.0	June 01, 2016	Creation
1.1	June 06, 2016	Removed Power Up Sequence



# Contents

<b>1. INTRODUCTION .....</b>	<b>8</b>
<b>2. POWER INTERFACE .....</b>	<b>9</b>
2.1. Power Supply .....	9
2.2. Power Off Sequence .....	9
2.3. Sleep Mode Management .....	9
<b>3. RF INTERFACE.....</b>	<b>10</b>
3.1. Supported RF Bands .....	10
3.2. RF Connection.....	10
3.3. RF Performances .....	11
3.4. TX_ON Indicator .....	11
<b>4. ESD GUIDELINES.....</b>	<b>12</b>
4.1. SIM Card .....	12
4.2. USB .....	13
<b>5. FCC REGULATIONS .....</b>	<b>14</b>
<b>6. REFERENCES .....</b>	<b>16</b>
6.1. Reference Documents.....	16
6.2. Terms and Abbreviations.....	16



## List of Figures

Figure 1.	TX_ON State During Transmission .....	11
Figure 2.	EMC and ESD Components Close to the SIM .....	12
Figure 3.	ESD Protection for USB .....	13



# List of Tables

Table 1.	Power Supply .....	9
Table 2.	Supported Bands.....	10
Table 3.	RF Main Connection.....	10
Table 4.	RF Diversity Connection.....	10
Table 5.	Conducted RX Sensitivity (dBm) .....	11
Table 6.	TX_ON Indicator Description.....	11
Table 7.	TX_ON Characteristics.....	11



# 1. Introduction

The AirPrime HL7588 Accessory Board belongs to the AirPrime MC Series product family and provides data connectivity on wireless networks as listed in Table 2 Supported Bands.

The HL7588 Accessory Board supports a large variety of interfaces such as USB 2.0, UART, GPIOs, and SIM to provide customers with the highest level of flexibility in implementing high-end solutions.





## 2. Power Interface

### 2.1. Power Supply

The AirPrime HL7588 Accessory Board is supplied through the VBAT signal.

Table 1. Power Supply

Pin Numbers	Supply	Minimum	Typical	Maximum
2, 24, 39, 41, 52	VBAT voltage (V)	3.2*	3.7	4.5

\* This value has to be guaranteed during the burst.

---

*Note:* Load capacitance for VBAT is around  $32\mu\text{F} \pm 20\%$  embedded inside the accessory board.

---

### 2.2. Power Off Sequence

To power the HL7588 Accessory Board off:

1. Put the accessory board in low power mode (LPM) by sending either **AT+KSLEEP=1** or **AT+CPWROFF=1**.
2. Wait for at least 10 seconds.
3. Remove the power supply to VBAT.

### 2.3. Sleep Mode Management

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

When **AT+KSLEEP=2**, the accessory board will never enter sleep mode.

## 3. RF Interface

The RF interface of the HL7588 Accessory Board allows the transmission of RF signals. This interface has a 50Ω nominal impedance.

### 3.1. Supported RF Bands

The HL7588 Accessory Board supports the RF bands listed in the table below.

Table 2. Supported Bands

RF Band	Transmit Band (Tx)	Receive Band (Rx)	Maximum Output Power
LTE B2	1850 to 1910 MHz	1930 to 1990 MHz	22.5 dBm (+/- 2dBm) Class 3bis
LTE B4	1710 to 1755 MHz	2110 to 2155 MHz	22.5 dBm (+/- 2dBm) Class 3bis
LTE B5	824 to 849 MHz	869 to 894 MHz	22.5 dBm (+/- 2dBm) Class 3bis
LTE B13	777 to 787 MHz	746 to 756 MHz	22.5 dBm (+/- 2dBm) Class 3bis
LTE B17	704 to 716 MHz	734 to 746 MHz	22.5 dBm (+/- 2dBm) Class 3bis
UMTS B2	1850 to 1910 MHz	1930 to 1990 MHz	22.5 dBm (+/- 2dBm) Class 3bis
UMTS B5	824 to 849 MHz	869 to 894 MHz	22.5 dBm (+/- 2dBm) Class 3bis

### 3.2. RF Connection

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

Table 3. RF Main Connection

RF Signal	Impedance	VSWR Rx (max)	VSWR Tx (max)
RF_MAIN	50Ω	1.5:1	1.5:1

Table 4. RF Diversity Connection

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

### 3.3. RF Performances

RF performances are compliant with 3GPP recommendation TS 36.101.

*Note: Values in the table below are preliminary and subject to change.*

Table 5. Conducted RX Sensitivity (dBm)

Frequency Band		Primary (Typical)	Secondary (Typical)	SIMO (Typical)
LTE B2	Full RB; BW: 20 MHz*	-92.5	-92.5	-95.5
LTE B4	Full RB; BW: 20 MHz*	-94.5	-94.5	-97.5
LTE B5	Full RB; BW: 10 MHz*	-97.5	-98.5	-101.5
LTE B13	Full RB; BW: 10 MHz*	-97.5	-98.5	-101.5
LTE B17	Full RB; BW: 10 MHz*	-97.5	-98.5	-101.5

\* Sensitivity values scale with bandwidth:  $x\_MHz\_Sensitivity = 10\ MHz\_Sensitivity - 10 \cdot \log(10\ MHz/x\_MHz)$

### 3.4. TX\_ON Indicator

The AirPrime HL7588 Accessory Board provides a signal, 2G\_TX\_ON, for TX indication. 2G\_TX\_ON is a 2.3V signal and its status signal depends on the accessory board’s transmitter state.

Refer to the following table for the status of the 2G\_TX\_ON signal depending on the HL7588 Accessory Board’s state.

Table 6. TX\_ON Indicator Description

Pin Number	Signal Name	Function	I/O type	Power Supply Domain
42	2G_TX_ON	TX indicator	O	2.3V

Table 7. TX\_ON Characteristics

Parameter	Minimum	Typical	Maximum
T <sub>advance</sub>	30µs		
T <sub>delay</sub>		10µs	

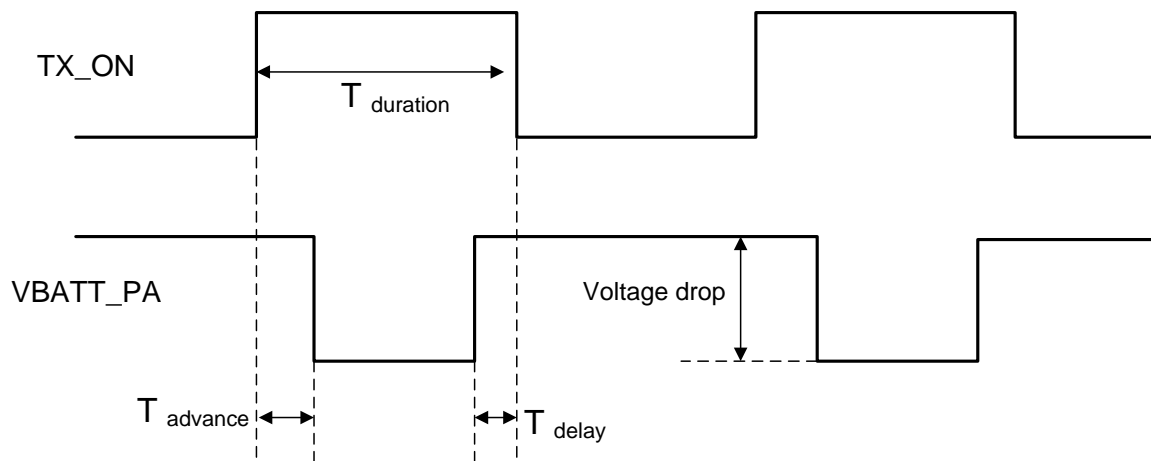


Figure 1. TX\_ON State During Transmission

# 4. ESD Guidelines

## 4.1. 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 and UIM1\_DATA 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.

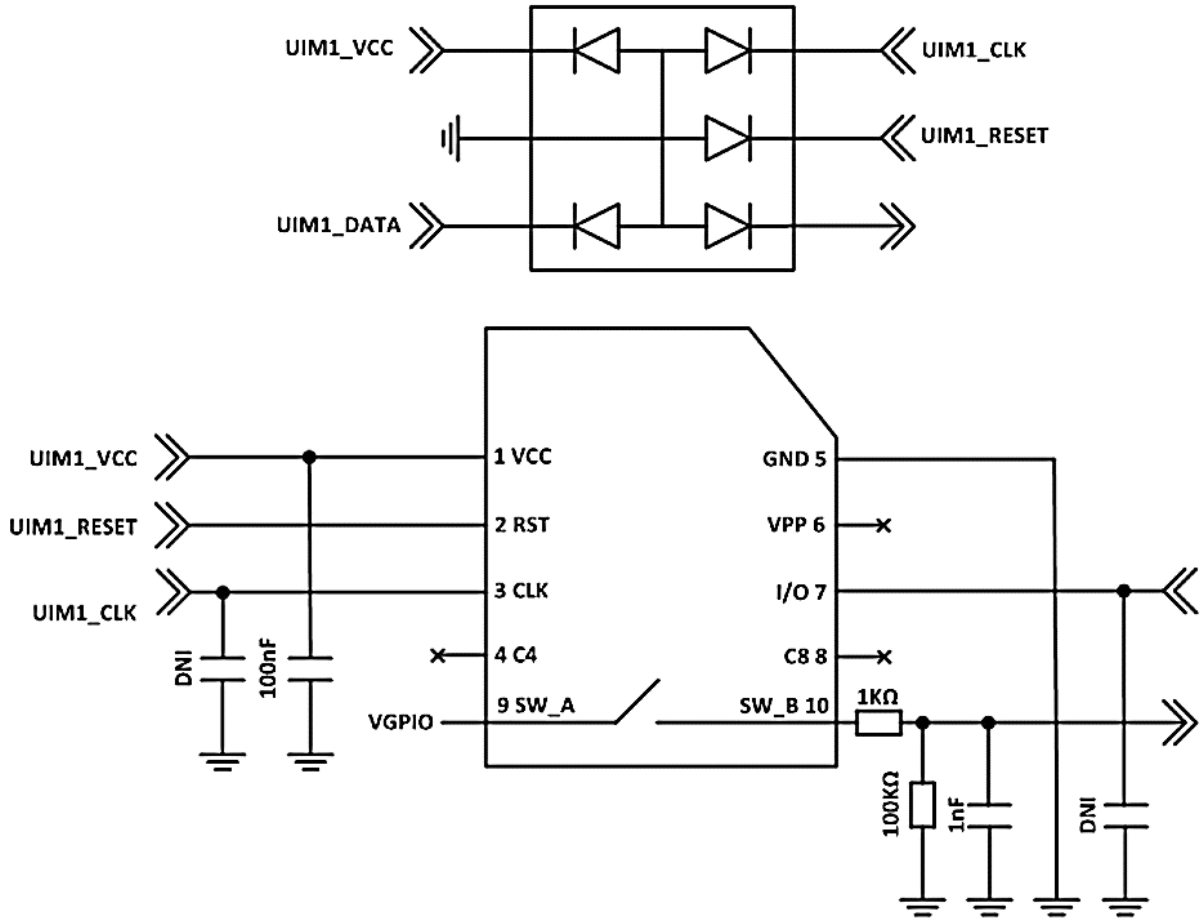


Figure 2. EMC and ESD Components Close to the SIM

## 4.2. USB

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

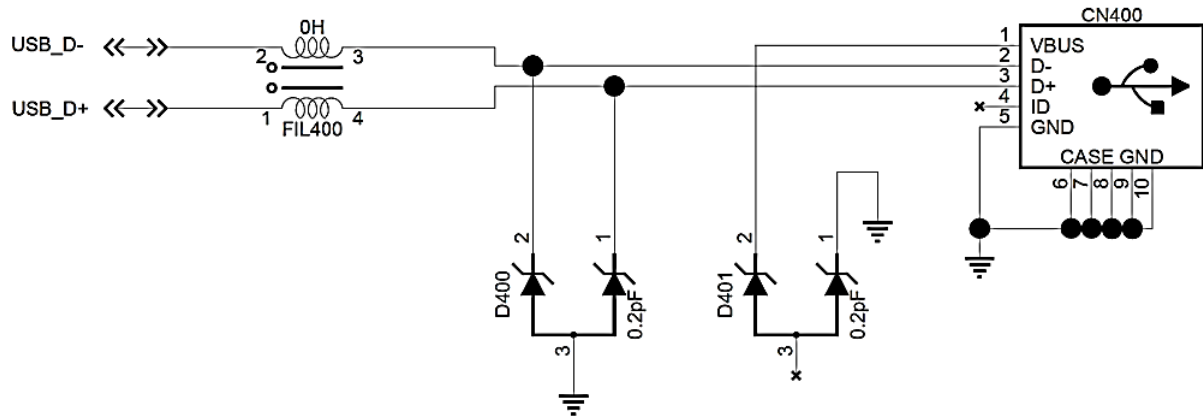


Figure 3. ESD Protection for USB

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

## 5. FCC Regulations

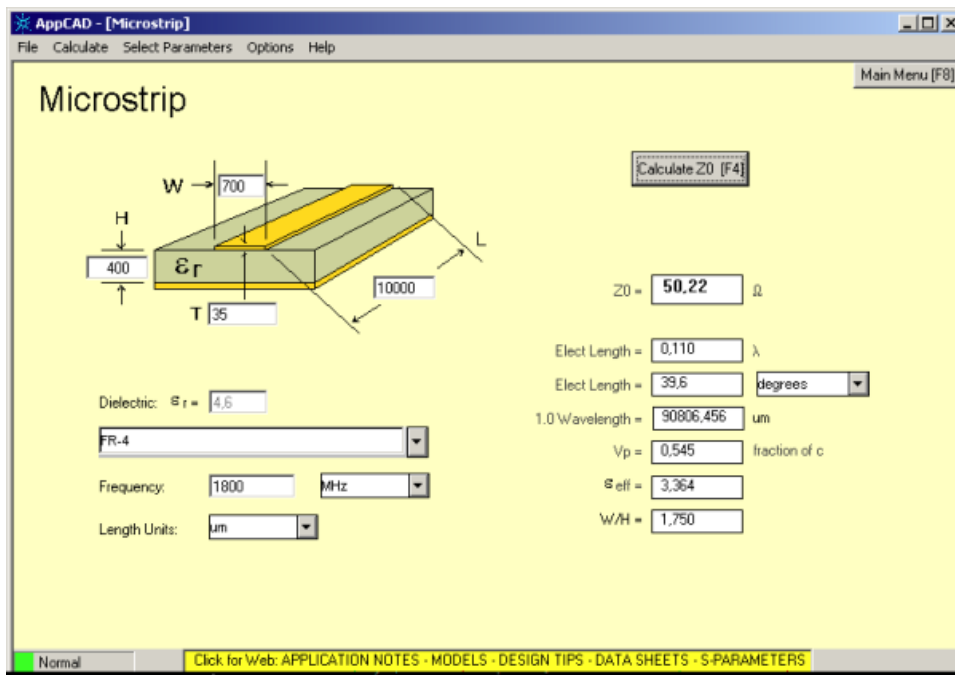
The HL7588 Accessory Board has been granted modular approval for mobile applications. Integrators may use the HL7588 Accessory Board in their final products without additional FCC certification if they meet the following conditions. Otherwise, additional FCC approvals must be obtained.

1. At least 20 cm separation distance between the antenna and the user's body must be maintained at all times.
2. To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed:
  - 7.5 dBi in Band 2
  - 5.0 dBi in Band 4
  - 9.0 dBi in Band 5
  - 9.0 dBi in Band 13
  - 9.0 dBi in Band 17
3. The **AR7552 modem may transmit simultaneously with other collocated radio transmitters within a host device, provided the following conditions are met:**
  - Each collocated radio transmitter has been certified by FCC / IC for mobile application.
  - At least 20 cm separation distance between the antennas of the collocated transmitters and the user's body must be maintained at all times.
  - The output power and antenna gain must not exceed the limits and configurations stipulated in the following table.

Device	Technology	Band	Frequency (MHz)	Maximum conducted power	Maximum antenna gain
HL7588 Module	LTE	2	1850-1910	24.5	6.5
		4	1710-1755	24.5	7.5
		5	824-849	24.5	7.5
		13	777-787	24.5	5.0
		17	704-716	24.5	6.5
	UMTS	2	1850-1910	24.5	6.0
		5	824-849	24.5	6.0
Collocated transmitters <sup>1</sup>	WLAN		2400-2500	29	5
			5150-580	29	5
	WiMAX		2300-2400	29	5
			2500-2700	29	5
			3300-3800	29	5
	BT		2400-2500	15	5

4. The HL7588 Accessory Board must not transmit simultaneously with other collocated radio transmitters within a host device.
5. The RF signal must be routed on the application board using tracks with a 50Ω characteristic impedance. Basically, the characteristic impedance depends on the dielectric, the track width and the ground plane spacing. In order to respect this constraint, Sierra Wireless recommends using MicroStrip or StripLine structure and computing the Tracks width with a simulation tool (like AppCad shown in the figure below and that is available free of charge at

<http://www.agilent.com>).



If a multi-layered PCB is used, the RF path on the board must not cross any signal (digital, analog or supply).

6. A label must be affixed to the outside of the end product into which the HL7588 Accessory Board is incorporated, with a statement similar to the following:

**This device contains FCC ID: N7NHL7588**

7. A user manual with the end product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.

The end product with an embedded HL7588 Accessory Board may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized per FCC Part 15.

---

*Note: If this accessory board is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093.*

---

## >> 6. References

### 6.1. Reference Documents

- [1] AirPrime HL7588 Accessory Board Product Technical Specification  
Reference number: 4119052

### 6.2. 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



<b>Abbreviation</b>	<b>Definition</b>
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
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