



# Product Specification

## AirPrime AR Series

Confidential



**SIERRA**  
WIRELESS

Preliminary  
0.5  
June 21, 2010

## 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 blasting is in progress, where explosive atmospheres may be present, near medical equipment, near life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the Sierra Wireless modem **MUST BE POWERED OFF**. 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.

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*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.*

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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.

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

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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
0.1	December 9, 2009	Creation
0.2	December 14, 2009	Updates for Preliminary release

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# 1. Overview

This document is the Hardware Product Specification for the AirPrime AR series of intelligent embedded modules. 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 series, including electrical and mechanical.

The AirPrime AR series of intelligent embedded modules are designed for the automotive industry and any market with similar quality and life-time support requirements. They support several air interface standards but share a common form-factor and electrical interface. All versions also have Global Navigation Satellite System (GNSS) capabilities via GPS.

The AirPrime AR series of intelligent embedded modules are based on the Qualcomm MDM6200 and MDM6600 wireless chipsets. The term AirPrime AR series addresses all of the following specific products.

Table 1: AirPrime AR series intelligent embedded modules

Product	Description	Band Support
AR3550	CDMA2000 1xRTT intelligent embedded module	BC0, BC1
AR5550	CDMA2000 1xEVDO intelligent embedded module	BC0, BC1

## 1.1. Reference Specifications

The table below lists the reference specifications for this product.

Table 2: Reference specifications

Ref	Title	Rev	Issuer
[1]	Recommended Minimum Performance Standards for cdma2000 High Rate Packet Data Access Terminal – C.S0033	A v1.0	3GPP2
[2]	Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Mobile Stations – C.S0011 (IS-98D)	A	3GPP2
[3]	Universal Serial Bus Specification	2.0	USB Implementers Forum
[4]	Universal Serial Bus CDC Subclass Specification for Wireless Mobile Communication Devices	1.0	USB Implementers Forum
[5]	Universal Serial Bus Class Definitions for Communication Devices	1.1	USB Implementers Forum
[6]	AirPrime AR Series LGA Specification	0.5	Sierra Wireless



## 2. Features

This chapter highlights the features of the AirPrime AR series intelligent embedded modules.

### 2.1. Modes of Operation

The AR3550 and AR5550 support CDMA 1xRTT operation in the US Cellular (BC0) and US PCS (BC1) frequency Bands. All models also support Standalone GNSS operation. For complete details, refer to the tables below.

Table 3: AR3550 modes of operation

Mode	Band	Frequency (MHz)	
		RX	TX
CDMA2000 1xRTT	Band Class 0	869 – 894	824 – 849
	Band Class 1	1930 – 1990	1850 – 1910
GNSS	GPS L1	1574.42 – 1576.42	---

Table 4: AR5550 modes of operation

Mode	Band	Frequency (MHz)	
		RX	TX
CDMA2000 1xRTT & 1xEVDO	Band Class 0	869 – 894	824 – 849
	Band Class 1	1930 – 1990	1850 – 1910
GNSS	GPS L1	1574.42 – 1576.42	---

### 2.2. Communications Functions

The AirPrime AR series provides the following communications functions via the CDMA networks.

Table 5: Communications functions

Communications Function		AR3550 / AR5550
Voice		EVRC, QCELP, EVRC-B
Data	Circuit Switch (CSD)	✓
	Packet	✓
Short Message Service (SMS)		✓
OTA	OTAPA	✓
	OTASP	✓
DTMF	Forward link only	✓

### 2.3. Block Diagrams

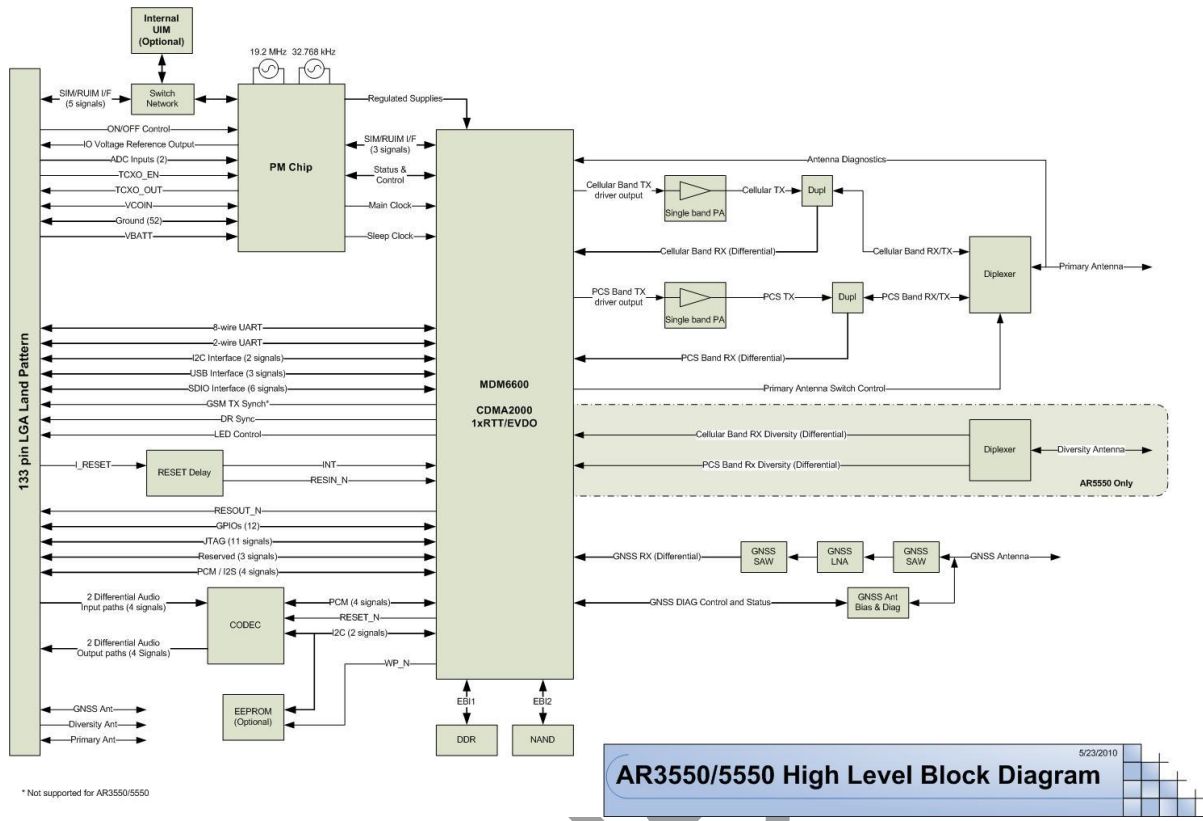


Figure 1. AR3550/5550 Block Diagram

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## 3. Hardware Specification

### 3.1. Environmental Specification

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

Table 6: Environmental specifications

Parameter	Temperature Range
Ambient Operating Temperature	-30°C to +75°C (Class A)
	-40°C to +85°C (Class B)
Ambient Storage Temperature	-40°C to +90°C
Ambient Humidity	95% or less

### 3.2. ESD Specification

The AirPrime AR series devices are sensitive to Electrostatic Discharge. ESD countermeasures and handling methods must be used when handling the AirPrime AR series devices.

Table 7: ESD ratings

Signal Pads	ESD Rating
Primary, Diversity and GNSS antenna pads	8 kV
All other signal pads	Tbd

### 3.3. Absolute Maximum Ratings

This section defines the Absolute Maximum Ratings of the AirPrime AR series devices. If these parameters are exceeded, even momentarily, damage may occur to the device.

Table 8: Absolute Maximum ratings

Parameter	Min	Max	Units	
VBATT   Power Supply Input	-	5.0	V	
VIN   Voltage on any digital input or output pin	-	VCC_1v8+0.5	V	
IIN   Latch-up current	-100	100	mA	
<i>Maximum Voltage applied to antenna interface pins</i>				
VANT	Primary Antenna	-	30	V
	Diversity Antenna	-	25	V
	GNSS Antenna	-	25	V

## 4. RF Specification

The section presents the RF interface of the AirPrime AR series intelligent embedded module. The specifications for the CDMA interfaces are defined.

### 4.1. CDMA RF Interface

This section presents the CDMA RF Specification for the AirPrime AR3550 and AR5550. These AirPrime AR series devices are designed to be compliant with 3GPP2 C.S0011 Rev A and additionally 3GPP2 C.S0033 Rev A v1.0 for the AR5550. Parameters specified differently for the reference standard are identified below.

#### 4.1.1. CDMA Antenna Interface

The specification for the CDMA Antenna Interface is defined in the table below.

Table 9: CDMA antenna characteristics

Characteristics		US Cellular (BC0)	US PCS (BC1)
Frequency (MHz)	TX	824-849	1850-1910
	RX	869-894	1930-1990
Impedance	RF	50 Ohm	
	DC	10 kOhm $\pm$ 1k	
VSWR max	RX	1.5: 1	
	TX	1.5: 1	
Polarization		Linear, vertical	
Maximum Voltage	Primary Antenna	30 V	
	Diversity Antenna	25 V	



## 5. GNSS Specification

The AirPrime AR series intelligent embedded module includes optional Global Navigation Satellite System (GNSS) capabilities via the Qualcomm gpsOne Gen8 Engine, capable of operation in assisted and stand-alone GPS modes.

### 5.1. GPS

The GPS implementation supports GPS L1 operation centered at 1575.42 MHz (+/- 1 MHz).

## 6. Baseband Specification

### 6.1. Power Supply

The AirPrime AR series is powered via a single regulated DC power supply, 4.0V ± 5%. The power supply requirements can be found in the following table.

Table 10: Power supply requirements

Power Supply	Min	Typ	Max	Units
Main DC Power Input Range	3.8	4.0	4.2	V
Power Supply Ripple	0 to 1kHz		200	mVpp
	>1kHz		50	mVpp
Maximum Current draw	AR3550/5550		800	mA

AirPrime AR series does not support USB self powered operation.

Table 11: Power supply pad

Pad	Name	Direction	Function	If Unused
S20	VBATT	Input	Power Supply Input	Required

### 6.2. Current Consumption

The table below summarizes some key current consumption values for various modes of the AR series devices.

Parameter		Typical	Max	Units
On Call AR3550 / AR5550	Maximum TX Output – 1xRTT	-	800	mA
	+0dBm TX Output – 1xRTT	tbd	-	mA
Idle	Registered	tbd	-	mA
	Searching	tbd	-	mA
Sleep Mode	Average current, SCI=2	-	tbd	mA
Off Mode Current	All AR Series devices	-	tbd	µA

## 6.3. USB

The AirPrime AR series has a High Speed USB2.0 compliant, peripheral only interface.

Table 12: USB pad details

Pad	Name	Direction	Function
R1	USB_VBUS	Input	USB Power Supply
V1	USB_D_P	In/Out	Differential data interface positive
T1	USB_D_M	In/Out	Differential data interface negative

The AirPrime AR series will not be damaged if a valid USB\_VBUS is supplied while the main DC power is not supplied.

Table 13: USB characteristics

USB		Value	Units
USB_VBUS	Voltage range	4.25 – 5.25	V
	Maximum Current draw	1	mA
	Maximum Input Capacitance (Min ESR = 50 mOhm)	10	μF

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## 7. RF Circuit Routing Constraints

### 7.1. General recommendations

To route the RF antenna signals, the following recommendations must be observed for PCB layout:

The RF signals must be routed using traces with a  $50\ \Omega$  characteristic impedance.

Basically, the characteristic impedance depends on the dielectric constant ( $\epsilon_r$ ) of the material used, trace width (W), trace thickness (T), and height (H) between the trace and the reference ground plane.

In order to respect this constraint, Sierra Wireless recommends that a MicroStrip structure be used and trace width be computed with a simulation tool (such as AppCAD, shown in the figure below and available free of charge at <http://www.avagotech.com>).

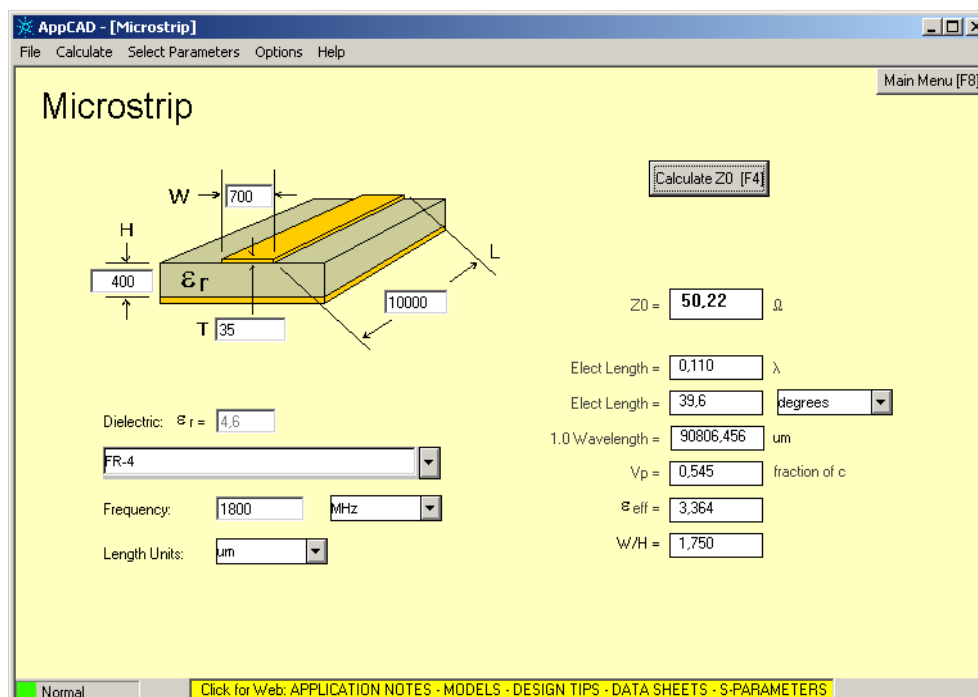


Figure 2. AppCAD screenshot for MicroStrip design power mode diagram

The trace width should be wide enough to maintain reasonable insertion loss and manufacturing reliability. Cutting out inner layers of ground under the trace will increase the effective substrate height; therefore, increasing the width of the RF trace.

**Caution:** It is critical that no other signals (digital, analog, or supply) cross under the RF path. The figure below shows a generic example of good and poor routing techniques.



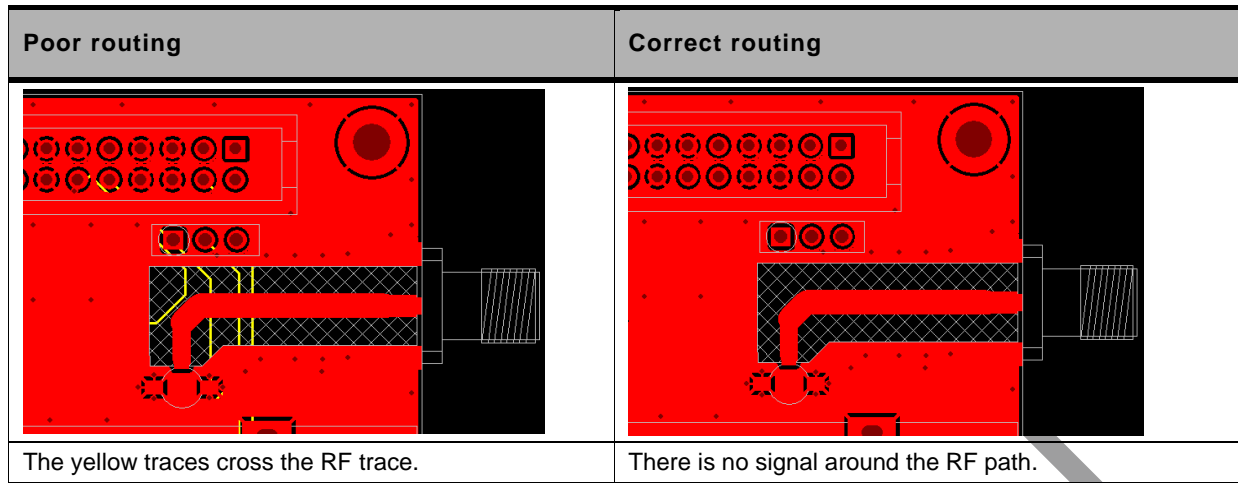


Figure 3. RF routing examples

- Fill the area around the RF traces with ground and ground vias to connect inner ground layers for isolation.
- Cut out ground fill under RF signal pads to reduce stray capacitance losses.
- Avoid routing RF traces with sharp corners. A smooth radius is recommended.
- The ground reference plane should be a solid continuous plane under the trace.
- The coplanar clearance ( $G$ , below) from the trace to the ground should be at least the trace width ( $W$ ) and at least twice the height ( $H$ ). This reduces the parasitic capacitance, which potentially alters the trace impedance and increases the losses. Note the figure below shows several internal ground layers cutout, which may not be necessary for every application.

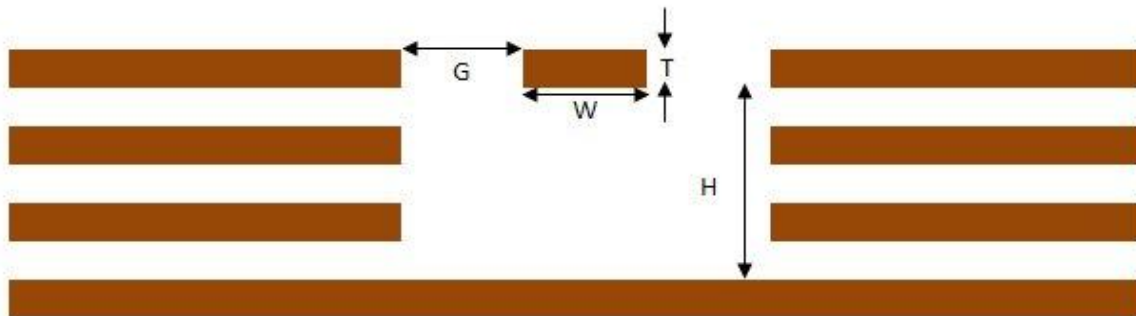


Figure 4. Coplanar clearance example

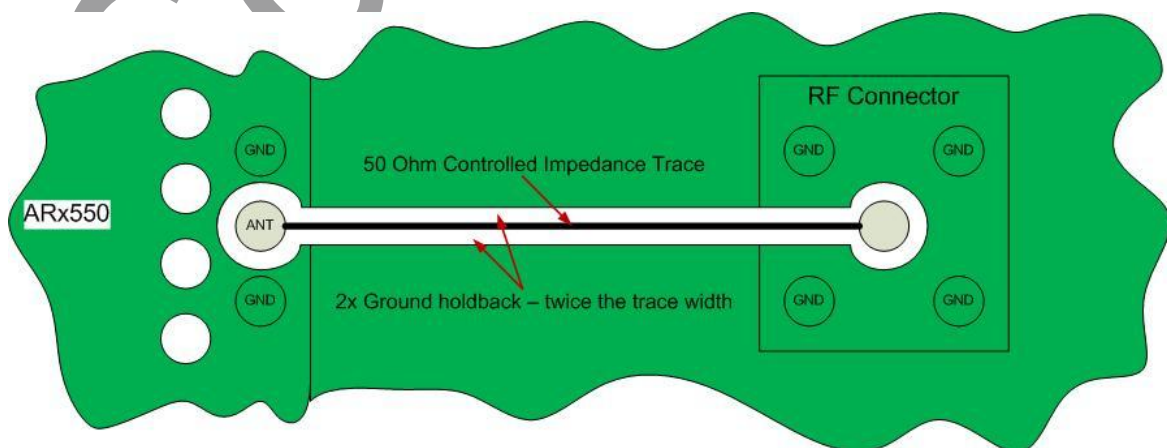


Figure 5. Antenna microstrip routing example

## 8. Regulatory Information

### Important Notice

Because of 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 and its affiliates accept no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

#### Safety and Hazards

Do not operate you AR3550/GMT-2 modem:

- In areas where blasting is in progress
- Where explosive atmospheres may be present including refueling points, fuel depots, and chemical plants
- Near medical equipment, life support equipment, or any equipment which may be susceptible to any form of radio interference. In such areas, the AR5550 modem **MUST BE POWERED OFF**. Otherwise, the AR5550 modem can transmit signals that could interfere with this equipment
- In an aircraft, the AR5550 modem **MUST BE POWERED OFF**. Otherwise, the AR3550/GMT-2 modem can transmit signals that could interfere with various onboard systems and may be dangerous to the operation of the aircraft or disrupt the cellular network. Use of cellular phone in aircraft is illegal in some jurisdictions. Failure to observe this instruction may lead to suspension or denial of cellular telephone services to the offender, or legal action or both.
- Some airlines may permit the use of cellular phones while the aircraft is on the ground and the door is open. The AR5550 modem may be used normally at this time.

### Important Compliance Information for USA OEM Integrators

The AR5550 modem is granted with a modular approval for mobile applications. Integrators may use the AR5550 modem in their final products without additional FCC/IC (Industry Canada) certification if they meet the following conditions. Otherwise, additional FCC/IC approvals must be obtained.

1. At least 20cm separation distance between the antenna and the user's body must be maintained at all times.
2. To comply with FCC/IC 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 4.25dBi for CDMA 800 band and 6.1dBi for CDMA PCS band.
3. The AR5550 modem and the antenna must not be co-located or operating in conjunction with any other transmitter or antenna within a host device.
4. A label must be affixed to the outside of the end product into which the AR5550 modem is incorporated, with a statement similar to the following:
  - a. For AR3550:

**This device contains FCC ID: N7NAR3550**

**This equipment contains equipment certified under IC: 2417C-AR3550**

b. For GTM-2:

**This device contains FCC ID: N7NGTM2**

**This equipment contains equipment certified under IC: 2417C-GTM2**

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/IC RF exposure guidelines.

The end product with an embedded AR5550 modem may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized.

Note: If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093 and IC RSS-102.

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