Product Specification

AirPrime AR Series

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SIERRA WIRELESS

Preliminary
0.6
December 10, 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.

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.

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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

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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

1.1. Introduction

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
AR8550	WCDMA/HSPA/GSM Intelligent Embedded Module	3G – BAND II, IV, V 2G – 850/900/1800/1900
AR8552	WCDMA/HSPA/GSM Intelligent Embedded Module	3G – BAND I, VIII, VI 2G – 850/900/1800/1900

1.2. Reference Specifications

The table below lists the reference specifications for this product.

Table 2: Reference specifications

Ref	Title	Rev	Issuer
[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
[7]	AirPrime AR Series AT Command Interface Specification	006	Sierra Wireless

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2. Features

This chapter highlights the features of the AirPrime AR Series of Intelligent Embedded Modules.

2.1. Modes of Operation

The AR8550 supports quad band GSM operation and WCDMA/HSPA operation in Band II, IV and V.
The AR8552 supports quad band GSM operation and WCDMA/HSPA operation in Band I, VI and VIII.
All models also support Standalone GNSS operation. For complete details, refer to the tables below.

Table 3: AR8552 modes of operation

Mode	Band	Frequency (MHz)	
		RX	TX
GSM/GPRS/EDGE	850	869 – 894	824 – 849
	900	925 – 960	880 – 915
	1800	1805 – 1880	1710 – 1785
	1900	1930 – 1990	1850 – 1910
WCDMA/HSPA	I (2100/IMT)	2110 – 2170	1920 – 1980
	VI (800)	875 – 885	830 – 840
	VIII (900/GSM)	925 – 960	880 – 915
GNSS	GPS L1	1574.42 – 1576.42	---

Table 4: AR8550 modes of operation

Mode	Band	Frequency (MHz)	
		RX	TX
GSM/GPRS/EDGE	850	869 – 894	824 – 849
	900	925 – 960	880 – 915
	1800	1805 – 1880	1710 – 1785
	1900	1930 – 1990	1850 – 1910
WCDMA/HSPA	II (1900/PCS)	1930 – 1990	1850 – 1910
	IV (1700/AWS)	2110 – 2155	1710 – 1755
	V (850/CELL)	869 – 894	824 – 849
GNSS	GPS L1	1574.42 – 1576.42	---

2.2. Communications Functions

The AirPrime AR series provides the following communications functions via the CDMA, GSM and/or UMTS networks.

Table 5: Communications functions

Communications Function		AR8550/AR8552
Voice		FR, EFR, HR, AMR, AMR-WB
Data	Circuit Switch (CSD)	✓
	Packet	✓

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Communications Function		AR8550/AR8552
Short Message Service (SMS)		✓
OTA	OTAPA	
	OTASP	
DTMF	Forward link only	✓

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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 Contact
All other signal pads	1.5 kV Contact

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
Maximum Voltage applied to antenna interface pins				
VANT	Primary Antenna	-	30	V
	Diversity Antenna	-	25	V
	GNSS Antenna	-	25	V

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4. RF Specification

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

4.1. GSM/WCDMA Interface

This section presents the GSM/GPRS/EDGE/WCDMA RF Specification for the AirPrime AR8550 and AR8552.

4.1.1. GSM/WCDMA Antenna Interface

The specification for the GSM/WCDMA Antenna Interface is defined in the table below.

Table 9: GSM/WCDMA antenna characteristics – AR8550

Characteristics		GSM900	GSM850 – WCDMA Band V	GSM1800	GSM1900 – WCDMA Band II	WCDMA Band IV
Frequency (MHz)	TX	880 – 915	824-849	1710 – 1785	1850-1910	1710 – 1755
	RX	925 – 960	869-894	1805 – 1880	1930-1990	2110 – 2155
Impedance	RF	50 Ohm				
VSWR max	RX	1.5: 1				
	TX	1.5: 1				
Maximum Voltage		Primary Antenna – 30 Volts				
		Diversity Antenna – 25 Volts				

Table 10: GSM/WCDMA antenna characteristics – AR8552

Characteristics		GSM900 – WCDMA Band VIII	GSM850 – WCDMA Band VI	GSM1800	GSM1900	WCDMA Band I
Frequency (MHz)	TX	880 – 915	824-849	1710 – 1785	1850-1910	1920 – 1980
	RX	925 – 960	869-894	1805 – 1880	1930-1990	2110 – 2170
Impedance	RF	50 Ohm				
VSWR max	RX	1.5: 1				
	TX	1.5: 1				
Maximum Voltage		Primary Antenna – 30 Volts				
		Diversity Antenna – 25 Volts				

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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).

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6. Baseband Specification

6.1. Power Supply

The AirPrime AR series is powered via a single regulated DC power supply, 4.0V +5/-10%. The power supply requirements can be found in the following table.

Table 11: Power supply requirements

Power Supply		Min	Typ	Max	Units
Main DC Power Input Range		3.6	4.0	4.2	V
Power Supply Ripple	0 to 1kHz			200	mVpp
	>1kHz			50	mVpp
Maximum Current draw	AR8550/8552			2.5	A

AirPrime AR series does not support USB self powered operation.

Table 12: 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 varies modes of the AR series devices.

Device	Mode	Parameter	Typical	Max	Units
AR8550 / AR8552	On Call	Maximum TX Output – WCDMA	-	800	mA
		+0dBm TX Output – WCDMA	tbd	-	mA
		GSM Low Band TX – PL5	-	tbd	mA
		GSM High Band TX – PL	-	tbd	mA
	Scan	Searching for network – WCDMA	46	-	mA
		Searching for network – GSM	43	-	mA
	Sleep Mode	On-network, "listening" for page – WCDMA	-	2	mA
		On-network, "listening" for page – GSM	-	2	mA
All AR Series	Off	Power OFF Current	3.6	10	µA

6.3. USB

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

Table 13: USB pad details

Pad	Name	Direction	Function
R1	USB_VBUS	Input	USB Power Supply

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Pad	Name	Direction	Function
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 14: USB characteristics

USB		Value	Units
USB_VBUS	Voltage range	2.0 – 5.25	V
	Maximum Current draw	1	mA
	Maximum Input Capacitance (Min ESR = 50 mOhm)	10	µF

Figure 1. Recommended UIM holder implementation

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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 Ω characteristic impedance.

Basically, the characteristic impedance depends on the dielectric constant (εr) 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).

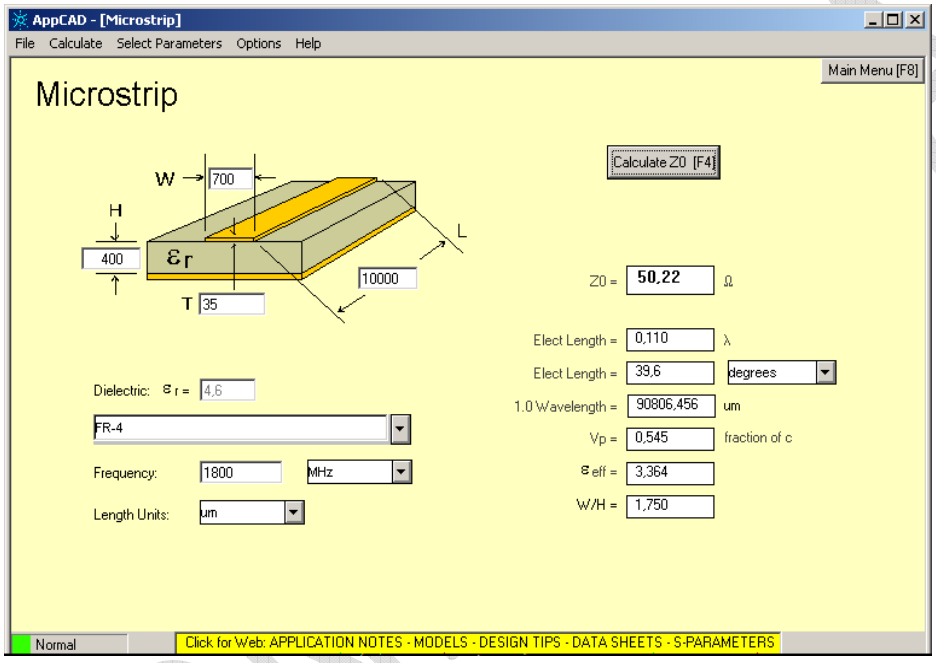


Figure 2. AppCAD screenshot for MicroStrip design power mode diagram

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.*

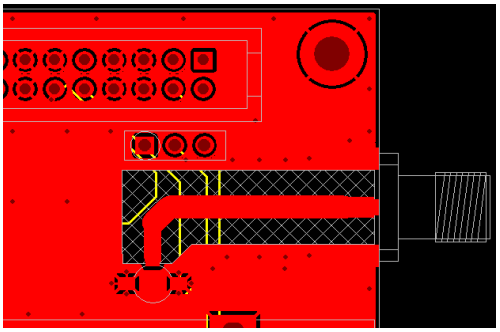
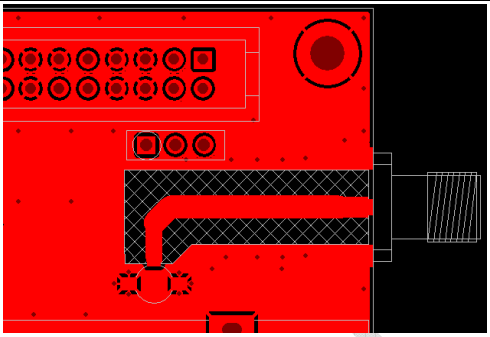
Poor routing	Correct routing
	
The yellow traces cross the RF trace.	There is no signal around the RF path.

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.

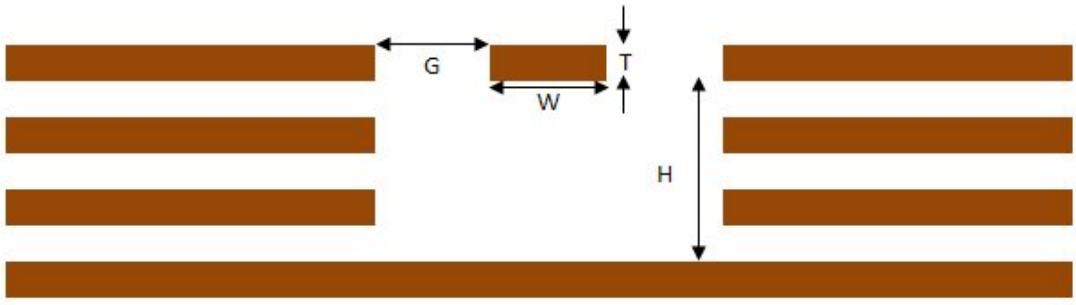


Figure 4. Coplanar clearance example

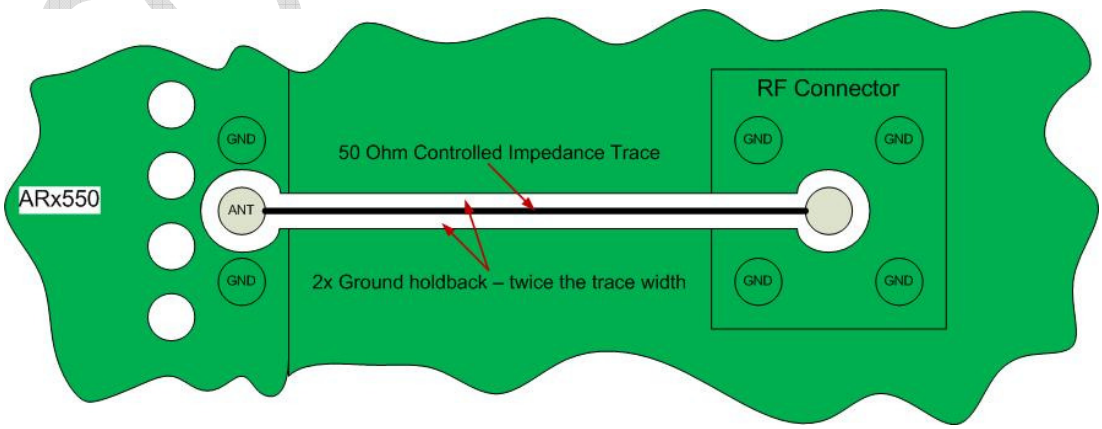


Figure 5. Antenna microstrip routing example

8. Regulatory Approval

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.

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Safety and Hazards

Do not operate you AR8550 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 AR8550 modem **MUST BE POWERED OFF**. Otherwise, the AR8550 modem can transmit signals that could interfere with this equipment
- In an aircraft, the AR8550 modem **MUST BE POWERED OFF.** Otherwise, the AR8550 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 AR8550 modem may be used normally at this time.

Important Compliance Information for USA OEM Integrators

The AR8550 modem is granted with a modular approval for mobile applications. Integrators may use the AR8550 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 5dBi for Cellular band and 3.7dBi for CDMA PCS band.
3. The AR8550 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 AR8550 modem is incorporated, with a statement similar to the following:

   This device contains FCC ID: N7NAR8550

   Contains transmitter module IC: 2417C-AR8550

   where 2417C-AR8550 is the module's certification number.

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 AR8550 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.