Hardware Integration Guide

AirPrime AR7552

SIERRA WIRELESS

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Document History

Version	Date	Updates
1.0	May 18, 2015	Creation based on document 4116922: AirPrime - AR7558 - Hardware Integration Guide - Rev1.0.

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1. Introduction

1.1. General Features

The AirPrime AR7552 embedded modules are designed for the automotive industry. They support LTE, WCDMA air interface standards and shares hardware and firmware interfaces with the AirPrime AR5550 and AR855x. They also have Global Navigation Satellite System (GNSS) capabilities including GPS and GLONASS.

The AirPrime AR7552 embedded modules are based on the Qualcomm MDM9615 wireless chipset and support the following bands.

Table 1. AirPrime AR7552 Embedded Module

Product	Description	Band Support
AirPrime AR7552	LTE/WCDMA embedded module	LTE: B2, B4, B5, B7, B17 WCDMA: B2, B5

2. Power Interface

2.1. Power Supply

The AirPrime AR7552 embedded module is powered via a single regulated DC power supply, 3.7V nominal. The power supply requirements can be found in the following table.

Table 2. Power Supply Requirements

Power Supply		Min	Typ	Max	Units
Main DC Power Input Range		3.4	3.7	4.2	V
Power Supply Ripple	0 to 1kHz	-	-	200	mVpp
	>1kHz	-	-	50	mVpp
Maximum Current draw	AR7552	-	-	tbd	mA

AirPrime AR7552 does not support USB bus-powered operation. DC power must be supplied via the VBATT input.

Table 3. Power Supply Pads

Pad	Name	Direction	Function	If Unused
EA2	VBATT	Input	Power Supply Input	Must Be Used
EB2	VBATT	Input	Power Supply Input	Must Be Used
EC2	VBATT	Input	Power Supply Input	Must Be Used

2.2. Absolute Maximum and ESD Ratings

This section defines the Absolute Maximum and Electrostatic Discharge (ESD) Ratings of the AirPrime AR7552 embedded modules.

Warning: *If these parameters are exceeded, even momentarily, damage may occur to the device.*

Table 4. AirPrime AR7552 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	-	36	V
	RX2 Antenna	-	36	V
	GNSS Antenna	-	36	V
ESD Ratings				

Parameter		Min	Max	Units
ESD[1]	Primary, RX2 and GNSS antenna pads - Contact	-	± 8	kV
	All other signal pads - Contact	-	± 1.5	kV

1 The ESD Simulator configured with 330pF, 1000Ω.

Caution: *The AirPrime AR7552 embedded modules are sensitive to Electrostatic Discharge. ESD countermeasures and handling methods must be used when handling the AirPrime AR7552 devices.*

2.3. Power and Ground Recommendations

Power and ground routing is critical to achieving optimal performance of the AirPrime AR7552 devices when integrated into an application.

Recommendations:

- Do not use a separate GND for the Antennas
- Connections to GND from the AirPrime AR7552 should be flooded plane using thermal reliefs to ensure reliable solder joints.
- VBATT is recommended to be routed as a wide trace(s) directly from the 4V supply to the LGA pad.

3. RF Specification

This section presents the WWAN RF interface of the AirPrime AR7552 series of embedded modules. The specifications for the LTE, CDMA and WCDMA interfaces are defined.

3.1. LTE RF Interface

This section presents the LTE RF Specification for the AirPrime AR7552.

3.1.1. LTE Max TX Output Power

The Maximum Transmitter Output Power of the AirPrime AR7552 embedded modules are specified in the following table.

Table 5. Conducted TX (Transmit) Max output Power Tolerances – LTE Bands

Band	Standard (dBm) (Note 2)	Class A (dBm) (Note 3)	Notes
B2	23 ±2.7dB	23 ±2.0dB	Note 1,4
B4	23 ±2.7dB	23 ±2.0dB	Note 1
B5	23 ±2.7dB	23 ±2.0dB	Note 1
B7	23 ±2.7dB	22.5 +3.2/-1.7dB	Note 1,4
B17	23 ±2.7dB	23 ±2.0dB	Note 1

Note 1: The test configurations for all of the entries in the table above are per 3GPP specification, Connectorized (Class 3).

Note 2: Per 3GPP TS 36.521-1 6.2.2 UE Maximum Output Power (No MPR);and for B13,Per VzW's Supplementary_RF_Conformance. 2.1 Maximum Output Power – No MPR Or A-MPR

Note 3: Class A is defined in 3.3 Environmental

Note 4: For transmission bandwidths (Figure 5.4.2-1) confined within FUL_low and FUL_low + 4 MHz or FUL_high – 4 MHz and FUL_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB.

3.1.2. LTE RX Sensitivity

The Minimum Receiver Sensitivity of the AirPrime AR7552 embedded modules are specified in the following table.

Note: For the table below:

Dual receiver (SIMO) per 3GPP TS 36.521-1 Rx Sensitivity Specification.
Sensitivity values scale with bandwidth:
`x_MHz_Sensitivity = 10 MHz_Sensitivity - 10*log(10 MHz/x_MHz)`
10 MHz BW,and 50 RB DownLink and Up Link as 3GPP TS 36.521-1 Table 7.3.5-2.
All values are preliminary pending transceiver matching and testing.

Table 6. Conducted RX Sensitivity 3GPP (BW: 10MHz) – LTE Bands (Note 1, 4)

Band	Standard (dBm) (Note 2)	Room Typical (dBm)	Class A (Extreme) Typical (dBm) (Note 5)	Class A Limit (dBm) (Note 5)
B2	-94.3	-101	-100	-95.5
B4	-96.3	-101.5	-101	-97
B5	-94.3	-102.5	-102	-95.5
B7	-94.3	-100	-99	-95.5
B17	-93.3	-102	-101	-94.5

Note 1: Dual receiver (SIMO) Per 3GPP TS 36.521-1 Rx Sensitivity Specification.

Note 2: Per 3GPP Specification.

Note 3:Sensitivity values scale with bandwidth: x_MHz_Sensitivity = 10 MHz_Sensitivity - 10*log(10 MHz/x_MHz)

Note 4: 10 MHz BW,and 50 RB DownLink and Up Link as 3GPP TS 36.521-1 Table 7.3.5-2.

Note 5: Class A is defined in 3.3 Environmental

Note 6: The requirement is modified by -0.5 dB when the carrier frequency of the assigned E-UTRA channel bandwidth is within 865-894 MHz.

3.2. WCDMA RF Interface

This section presents the WCDMA RF Specification for the AirPrime AirPrime AR7552 embedded modules.

3.2.1. WCDMA Max TX Output Power

The Maximum Transmitter Output Power of the AirPrime AR7552 embedded module are specified in the following table.

Table 7. AirPrime AR7552 Maximum WCDMA Transmitter Output Power

Band	Frequency Band	Nominal Max TX Output Power	Tolerance
II (1900/PCS)	1850 MHz to 1910 MHz	+23.5 dBm	+2.2/-2.7 dB
V (850/CELL)	824 MHz to 849 MHz		

3.2.2. WCDMA RX Sensitivity

The Minimum Receiver Sensitivity of the AirPrime AR7552 embedded module are specified in the following table.

Table 8. AirPrime AR7552 Minimum WCDMA Receiver Sensitivity

Band	Frequency Band	Minimum RX Downlink	Criteria
II (1900/PCS)	1930 MHz to 1990 MHz	-106 dBm (Class A) -105 dBm (Class B)	BER < 0.001
V (850/CELL)	869 MHz to 894 MHz	-107 dBm (Class A) -106 dBm (Class B)	

3.3. WWAN Antenna Interface

The specification for the WWAN Antenna Interface of the AirPrime AR7552 embedded modules are defined in the table below.

Table 9. AirPrime AR7552 WWAN Antenna Characteristics

Characteristics		WCDMA B5 LTE B5	WCDMA B2 LTE B2	LTE B4	LTE B7	LTE B17
Frequency (MHz)	TX	824-849	1850-1910	1710 – 1755	2500-2570	704 – 716
	RX	869-894	1930-1990	2110 – 2155	2620-2690	734– 746
Impedance	RF	50 Ω				
VSWR max	RX	2:1				
	TX	2:1				
Maximum Voltage		Primary Antenna – 36 Volts				
		RX2 Antenna – 36 Volts (LTE MIMO: tbd)				

Note: RX2 Antenna port is RX only, RX parameters in the above tables are also applicable.

Table 10. WWAN Antenna Interface Pads

Pad	Name	Direction	Function
BA11	GND		Primary Antenna Ground
BA12	PRIMARY_ANT	Input/Output	Primary Antenna Interface
BA13	GND		Primary Antenna Ground
BA7	GND		Diversity Antenna Ground
BA8	DIVERSITY_ANT	Input	Diversity Antenna Interface
BA9	GND		Diversity Antenna Ground

3.3.1. WWAN Antenna Recommendations

The table below defines the key characteristics to consider for antenna selection.

Table 11. AirPrime AR7552 WWAN Antenna Recommendations

Characteristics		WCDMA B5 LTE B5	WCDMA B2 LTE B2	LTE B4	LTE B7	LTE B17
Frequency (MHz)	TX	824-849	1850-1910	1710 – 1755	2500-2570	704 – 716
	RX	869-894	1930-1990	2110 – 2155	2620-2690	734– 746
Impedance	RF	50 Ω				
	DC	10 kΩ ±1k				
VSWR max	RX	1.5: 1				
	TX	1.5: 1				
Polarization		Linear, vertical				
Typical radiated gain		0 dBi in one direction at least				

3.4. Primary Antenna Diagnostics

The primary antenna diagnostic feature allows the AirPrime AR7552 embedded module to determine if the primary antenna connected to the module is: open, shorted or normal. The antenna connected to this interface needs to have a DC resistance to ground of 10 kΩ ± 1k embedded inside.

The ARx55x FW accepts two limits which are used to evaluate the status of the antenna, representing the short and open thresholds. Refer to document [7] for the syntax of **AT+ANTLIMT**.

Table 12. Primary Antenna ADC Characteristics

	Min	Nom	Max	Units
ADC Voltage Range	0	0.9	1.8	Volts
Resolution	-		15	Bit
ADC Values	0		16383	
Voltage/ADC step		~0.0011		Volts

1 Assumes 10kΩ Nominal DC resistance in the attached antenna and internal to AirPrime AR7552 device

The following example illustrates the Antenna states and resistance values for a typical limit setting.

AT+ANTLIMT=1,839,1088

Table 13. Primary Antenna Diagnostics Ranges

Antenna State	Min ADC	Max ADC	Antenna Resistance Range
Short	0	839	~ ≤ 7 kΩ
Normal	841	1086	7 kΩ < x < 13 kΩ
Open	1088	1900	≥ 13 kΩ

Note: Highlighted numbers in the table above are programmed as shortLim and openLim using the +ANTLIMT command.

3.5. RX2 Antenna Diagnostics

The RX2 antenna diagnostic feature allows the AirPrime AR75520 to determine if the RX2 antenna connected to the module is: open, shorted or normal. The antenna connected to this interface needs to have a DC resistance to ground of 10 kΩ ± 1k embedded inside.

The AirPrime AR7552 FW accepts two limits which are used to evaluate the status of the antenna, representing the short and open thresholds. Refer to document [7] for the syntax of **AT+ANTLIMT**.

Table 14. RX2 Antenna ADC Characteristics

	Min	Nom	Max	Units
ADC Voltage Range	0	0.9	1.8	Volts
Resolution	-		15	Bit
ADC Values	0		16383	
Voltage/ADC step		~0.0011		Volts

1 Assumes 10kΩ Nominal DC resistance in the attached antenna and internal to AirPrime AR7552 device

The following example illustrates the Antenna states and resistance values for a typical limit setting.

AT+ANTLIMT=2,839,1088

Table 15. RX2 Antenna Diagnostics Ranges

Antenna State	Min ADC	Max ADC	Antenna Resistance Range
Short	0	839	~ ≤ 7 kΩ
Normal	841	1086	7 kΩ < x < 13 kΩ
Open	1088	1900	≥ 13 kΩ

Note: Highlighted numbers in the table above are programmed as shortLim and openLim using the +ANTLIMT command.

4. Audio

The AirPrime AR7552 supports both Analog and Digital audio interfaces. The following diagram illustrates the Audio subsystem and identifies where various AT commands affect the audio subsystem. Refer to document [7] for details of the AT commands.

4.1. Analog Audio

The AirPrime AR7552 provides a mono differential analog audio interface.

Table 16. Analog Audio Interface Pads

Pad	Name	Direction	Function	Interface
CD9	AUDIO1_IN_P	Input	Microphone 1 input positive	Primary
CC10	AUDIO1_IN_M		Microphone 1 input negative	
CE6	AUDIO1_OUT_P	Output	Speaker 1 output positive	
CE8	AUDIO1_OUT_M		Speaker 1 output negative	

Table 17. Analog Audio Interface Characteristics

Analog Audio		Min.	Typ.	Max.	Units
Audio IN	Input Impedance	16	20	24	kΩ
	Signal Level – Differential	-0.3	-	2.9	dBV
	Signal Level – Single-ended (the unused audio signal must be tied to GND or analog reference)	-0.3	-	2.9	dBV
Audio OUT	Signal Level – Differential	-	-		dBV
	Signal Level – Single-ended	-0.3	-	2.9	dBV
	Output Impedance	-0.3	-	2.9	Ω
	Signal Drive Strength – Application Load	-	600	1M	kΩ

4.2. Digital Audio

The AirPrime AR7552 provides a 4-wire digital audio interface. This interface can be configured as either a PCM or an I2S.

Table 18. Digital Audio Interface Pads

Pad	Name	Direction[1]	PCM Function	Direction	I2S Function	If Unused
DB3	PCM_FS	Output	PCM Frame Sync	Input/Output	I2S_WS	Leave Open
DA3	PCM_CLK	Output	PCM Clock	Input/Output	I2S_SCLK	Leave Open
DC2	PCM_DOUT	Output	PCM Data Out	Output	I2S_DOUT	Leave Open
DD2	PCM_DIN	Input	PCM Data In	Input	I2S_DIN	Leave Open

1 Direction when defined in Master mode.

5. Routing Constraints and Recommendations

Layout and routing of the AirPrime AR7552 device in the application is critical to maintaining the performance of the radio. The following sections provide guidance to the developer when designing their application to include an AirPrime AR7552 device and achieve optimal system performance.

5.1. RF Routing 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).

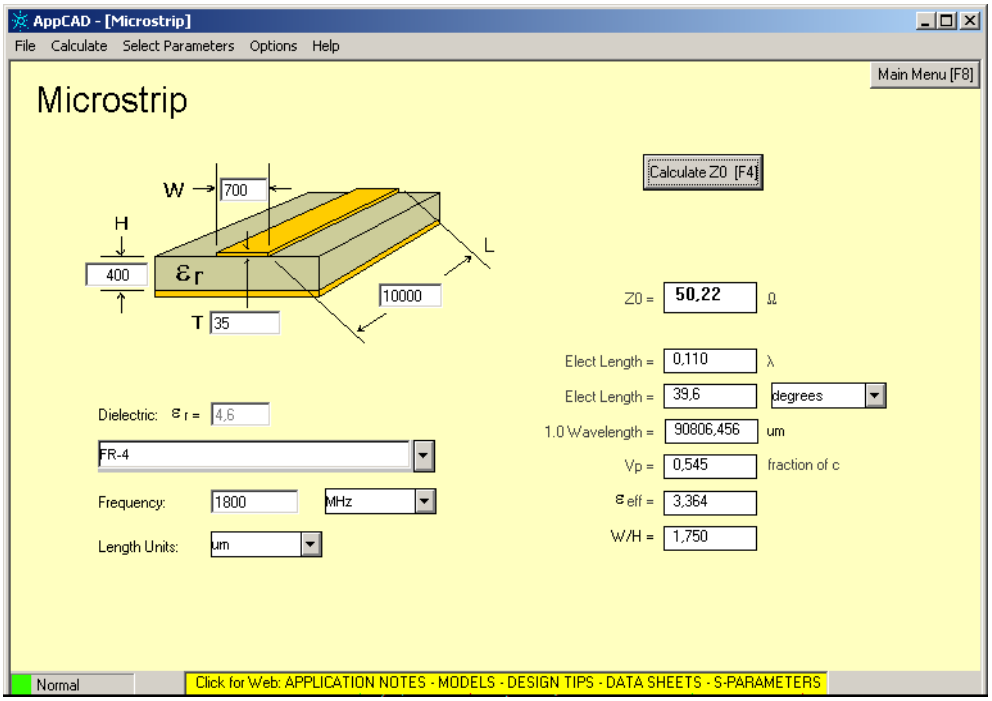


Figure 1. AppCAD Screenshot for Microstrip Design Power Mode Diagram

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.*

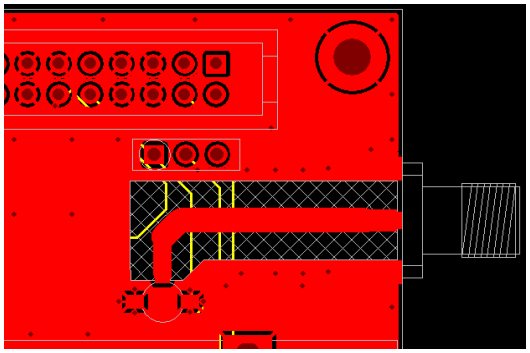
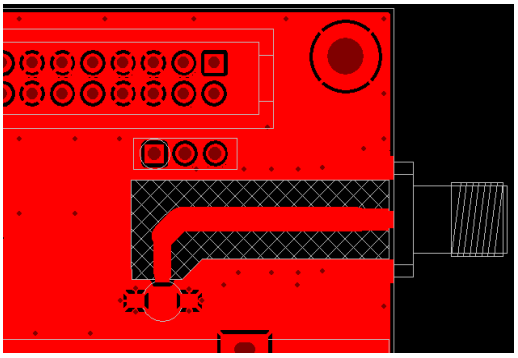
Poor routing	Correct routing
	
The yellow traces cross the RF trace.	There is no signal around the RF path.

Figure 2. 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.
  E.g. Use of 45° angles instead of 90°.
- 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.
  E.g. If W = 100 microns then G = 200 microns in an ideal setup. G = 150 microns would also be acceptable is space is limited.

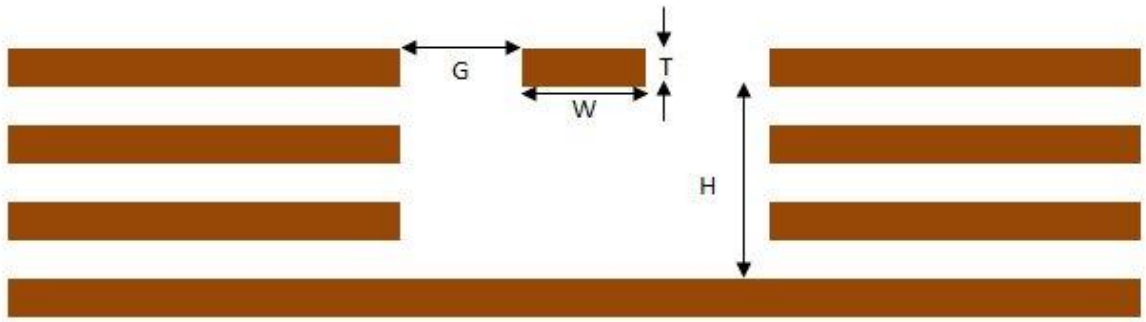


Figure 3. Coplanar Clearance Example

Note: The figure above shows several internal ground layers cut out, which may not be necessary for every application.

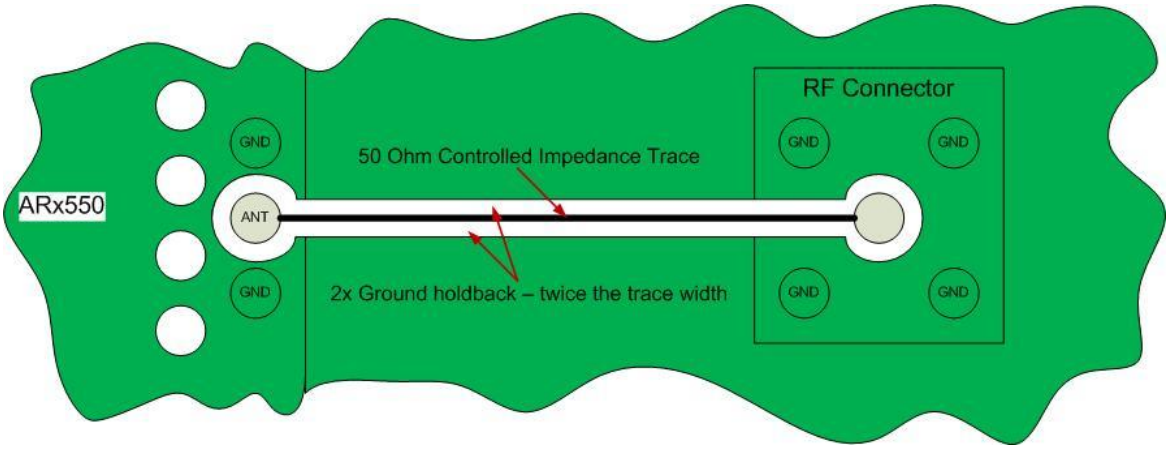


Figure 4. Antenna Microstrip Routing Example

5.2. Power and Ground Recommendations

Power and ground routing is critical to achieving optimal performance of the AirPrime AR7552 devices when integrated into an application.

Recommendations:

- Do not use a separate GND for the Antennas
- Connections to GND from the AirPrime AR7552 should be flooded plane using thermal reliefs to ensure reliable solder joints.
- VBATT is recommended to be routed as a wide trace(s) directly from the 4V supply to the LGA pad.

5.3. Antenna Recommendations

The AirPrime AR755x devices are designed to provide diagnostics status of the antennas connected to it.

- The Primary antenna interface is optimized for a multiband cellular antenna with a 10 kΩ DC impedance between the antenna element and the ground reference.
- The GNSS antenna interface is optimized for a 5V active GNSS antenna supporting the GPS L1 and GLONASS L1 FDMA bands. Refer to GNSS Antenna Diagnostics section.

Connecting the antenna ground reference to the vehicle chassis is not recommended since that has been known to cause noise from the engine to couple into the audio of the device. It is ultimately up to the integrator to evaluate this performance.

5.4. Interface Circuit Recommendations

The recommended interface implementation is to use open-drain non-inverting buffers with pull-ups to the appropriate voltage reference. This allows a host processor operating at a different voltage to communicate with the AirPrime AR7552 using the appropriate voltage levels.

The figure below is a reference circuit for a digital input signal to the AirPrime AR7552 device.

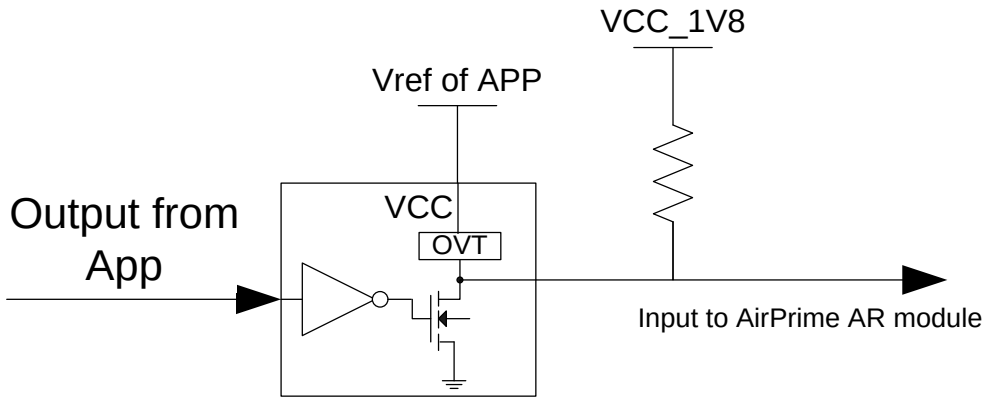


Figure 5. AirPrime AR7552 Input Reference Circuit

The figure below is a reference circuit for a digital output signal from the AirPrime AR7552 device.

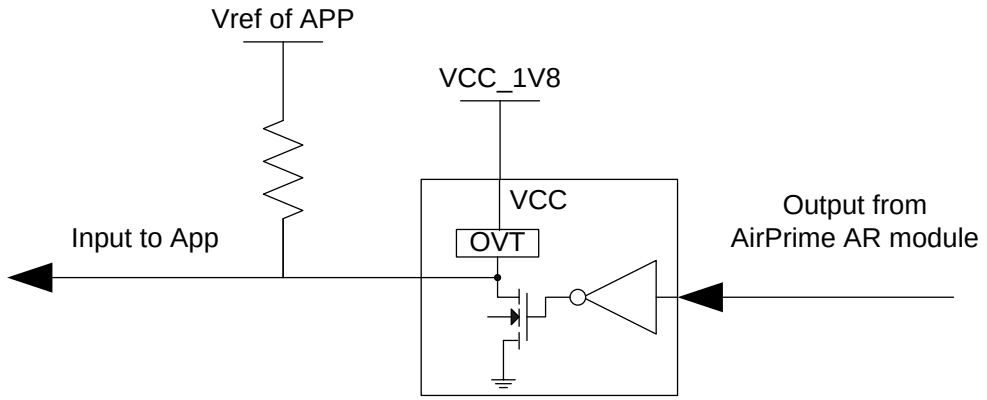


Figure 6. AirPrime AR7552 Output Reference Circuit

The open-drain non-inverting buffer used in the reference circuits above is the OnSemi NL17SZ07.

Tip: *The NL17SZ07 is over-voltage tolerant on the inputs. It may be possible to power all the buffers from the 1.8V reference voltage output. Review the digital output characteristics of the applications drivers and the Input characteristics of the buffer selected to determine if this would work in your application.*

If a Digital IO signal is used bidirectional in the application then a bidirectional buffer or bidirectional level translator is needed.

Note: The AR7552 modem is granted with a modular approval for mobile applications. During FCC/IC testing, the antenna trace of the AirPrime AR7552 embedded module which located on the CCB are defined in the table below.

Table 19. The specification of RF Trace of The CCB, Main Port

	Length-1 (mm)	Length-2 (mm)	Length-3 (mm)	Angel 1 (degree)	Angel 2 (degree)	Width (mm)
Main Port	3.9	19.79	5.86	135	135	1.58

Table 20. The specification of RF Trace of The CCB, Diversity and GPS Port

	Length (mm)	Width (mm)
Diversity Port	24.35	1.58
GPS Port	27.01	1.58

* Diversity Port is for Rx only.

The figure below is the RF trace in AR7552 CCB.

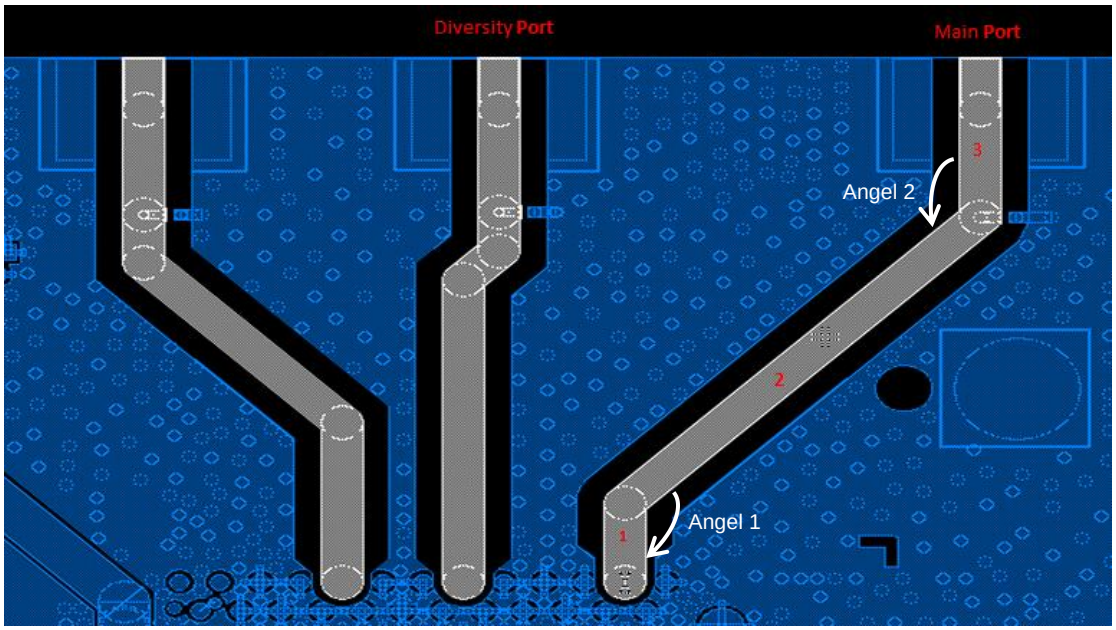


Figure 7. The definition of RF trace in the AR7552 CCB

Integrators may use the AR7552 modem in their final products without additional FCC/IC (Industry Canada) certification if they meet the above design in AR7552 CCB. Otherwise, FCC/IC Class II Permissive change need be obtained.

6. Regulatory Information

6.1. 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.

6.2. Safety and Hazards

Do not operate the AR7552 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 AR Series device **MUST BE POWERED OFF**. Otherwise, the AR Series device can transmit signals that could interfere with this equipment
- In an aircraft, the AR Series device **MUST BE POWERED OFF.** Otherwise, the AR Series device 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 AR Series device may be used normally at this time.

6.3. Important Compliance Information for USA OEM Integrators

The AR Series device is granted with a modular approval for mobile applications. Integrators may use the AR Series device 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 the gain values presented in the table below:

- 5.0 dBi in Cellular band
- 5.0 dBi in PCS band
- 5.0 dBi in LTE Band 4
- 7.0 dBi in LTE Band 7
- 5.0 dBi in LTE 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 certfied 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
AR7552 Module	LTE	2	1850-1910	25.0	5
		4	1710-1755	25.0	5
		5	824-849	25.0	5
		7	2500 – 2570	25.7	7
		17	704-716	25.0	5
	UMTS	2	1850-1910	25.7	5
		5	824-849	25.7	5
Collocated transmitters[1]	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

1. Valid collocated Transmitter combinations: WLAN+BT; WiMAX+BT. (WLAN+WiMAX+BT is not permitted.)

4. A label must be affixed to the outside of the end product into which the AirPrime AR7552 device is incorporated, with a statement similar to the following:

   This device contains FCC ID: N7NAR7552
   This equipment contains equipment certified under IC: 2417C-AR7552

5. 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 AirPrime AR7552 device 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.

7. References

7.1. Reference Documents

The table below lists the reference specifications for this product.

Table 21. Reference Specifications

Ref	Title	Issuer
[1]	Recommended Minimum Performance Standards for cdma2000 High Rate Packet Data Access Terminal – C.S0033	3GPP2
[2]	Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Mobile Stations – C.S0011 (IS-98D)	3GPP2
[3]	Universal Serial Bus Specification	USB Implementers Forum
[4]	Universal Serial Bus CDC Subclass Specification for Wireless Mobile Communication Devices	USB Implementers Forum
[5]	Universal Serial Bus Class Definitions for Communication Devices	USB Implementers Forum
[6]	AirPrime AR Series Customer Process Guidelines	Sierra Wireless
[7]	AirPrime AR7 Series AT Command Interface Specification	Sierra Wireless
[8]	AirPrime AR7 Series Firmware Download Guide	Sierra Wireless

7.2. Abbreviations

The table below lists several abbreviations used in this document.

Table 22. Abbreviations

Abbreviation	Description
CDMA	Code Division Multiple Access
DRX	Discontinuous Receive
GNSS	Global Navigation Satellite System
GSM	Global System for Mobile Communications
HSPA	High Speed Packet Access
LTE	Long Term Evolution
SCI	Slot Cycle Index
USB	Universal Serial Bus
WCDMA	Wideband Code Division Multiple Access
WWAN	Wireless Wide Area Network