SIM8200G_LGA Antenna Port Mapping and Deign Guide

5G Module

SIMCom Wireless Solutions Co. Ltd.
Building B, SIM Technology Building, No.633, Jinzhong Road
Changning District, Shanghai P.R.China
Tel: 86-21-31575100
support@simcom.com
www.simcom.com

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SIMCom Wireless Solutions Limited
Building B, SIM Technology Building, No.633 Jinzhong Road, Changning District, Shanghai P.R.China
Tel: +86 21 31575100
Email: simcom@simcom.com

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Version History

Date	Version	Description of change	Author
2020-04-03	1.00	Original	Yu.Liu
2020-04-03	1.01	Add antenna reduction chapter	Yu.Liu
2021-01-08	1.02	Update table 2, 4 and 5	Yibo.Zhong

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1 Introduction

This document describes the SIM8200G 5G module antenna port mapping and Antenna design guide to customer to refer.

2 Definitions, symbols and abbreviations

Abbreviations	Description
LB	Low Frequency Band [1]
MHB	Middle and High Frequency Band[2]
UHB	Ultra High Frequency Band[3]
LAA	Limited Access Authorization
TRX	Transmit and Receive signal
DRX	The Diversity Receive signal
UL-MIMO	Uplink- Multiple Input Multiple Output
DL-MIMO	Downlink- Multiple Input Multiple Output
GNSS	Global Navigation Satellite System

※ NOTE

1. Frequency is from 600MHz to 960MHz, such as LTE B5/B8/B12/B20/B28 and so on;
2. Frequency is from 1710MHz to 2690MHz, such as LTE B1/B2/B3/B7/B25/ B38/B40/B41 and so on;
3. Frequency is from 3300MHz to 4200MHz, such as LTE B48.

3 Antenna Design Guide

3.1 Port mapping

SIM8200G_LGA is designed with 6 antennas, module and antenna connector is shown in figure1. the Bands and the Antenna port mapping is shown in table1.

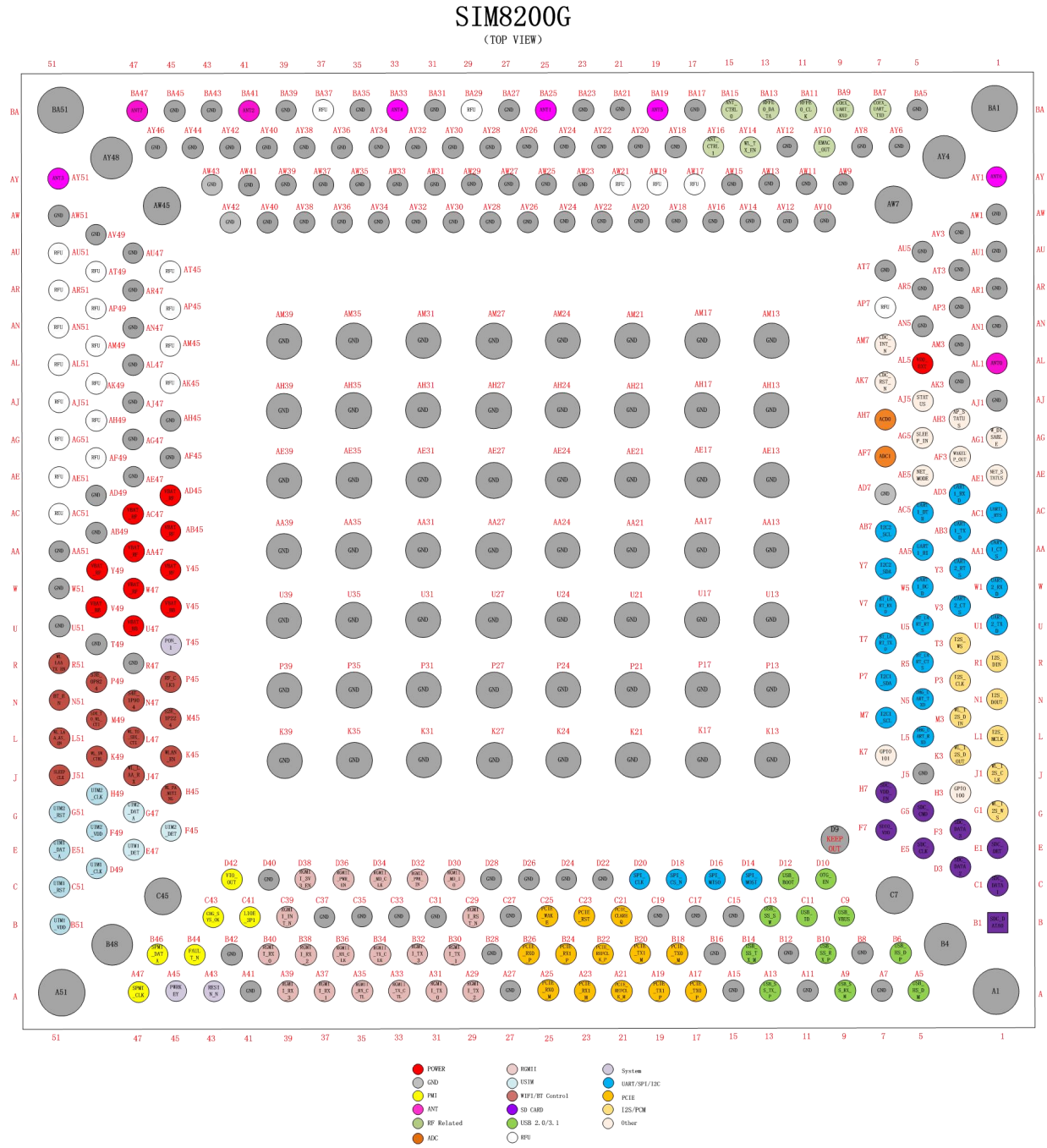

Figure1 SIM8200-LGA Module

Table1: Antenna Pin Definition

ANT number	LGA footprint number
ANT0	AL1
ANT1	BA25
ANT2	BA41
ANT3	AY51
ANT4	BA33
ANT5	BA19
ANT6	AY1
ANT7	BA47

Table2: Module frequency bands and antenna ports mapping

BANDS / ANTENNAS / FUNCTIONS			ANT0	ANT1	ANT2	ANT3	ANT4	ANT5	ANT6	ANT7
3G/4G/5G	LB/MHB	TRX								
5G	n41	UL/DL-MIMO1	✓							
5G	n79	DL-MIMO2								
4G	MHB	DL-MIMO2								
4G	UHB	DIV		✓						
5G	n41/n77/n78	DIV								
3G/4G/5G	LB/MHB	DIV								
5G	n41	DL-MIMO2			✓					
5G	n79	UL/DL-MIMO1								
3G/4G/5G	MHB	DL-MIMO1								
4G	UHB	DI-MIMO2				✓				
5G	n77/n78	DL-MIMO2								
4G	UHB	DL-MIMO1								
5G	n41	TRX					✓			
5G	n77/n78	UL/DL-MIMO1								
5G	n77/n78	TRX								
4G	UHB	TRX						✓		
5G	n79	DIV								
GNSS									✓	
5G	n79	TRX								✓

※ NOTE

1. For base function test, only the antennas responding to TRX is needed.

3.2 Reference Design

The space isolation of each antenna should be larger than 20dB. And the isolation between LTE antennas and 5GNR antennas is at least 15dB, and the GNSS antenna between 4G/5G antennas should be larger than 15dB.

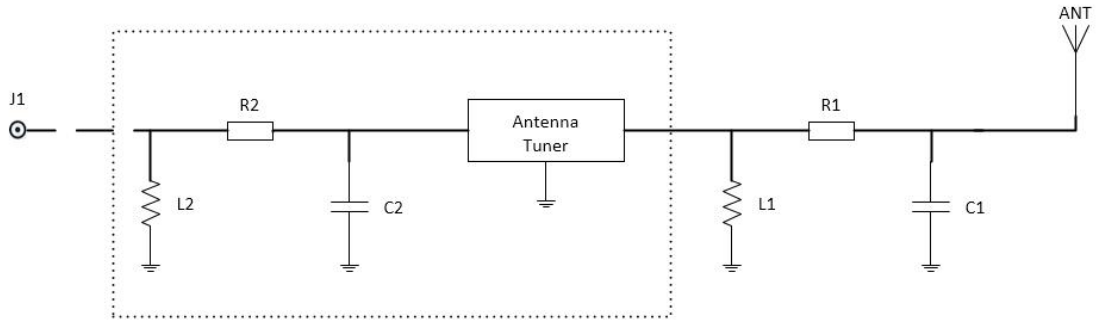

Figure2 Antenna refence design

J1 is the LGA pad of RF signal. For most of customers, above match-components (R1/R2,L1/L2,C1/C2 and Tuner) are not needed to meet the requirements. But for the high-level requirements or some bad antenna design conditions, it is recommended. What's more, antenna tuner design in the dotted line may be considered for some customers to enhance the low frequency band performance.

※ NOTE

Customer should submit request to SIMcom for tuner support if needed.

3.3 PCB layout recommendation

To avoid interference, minimalize the insertion loss of the RF trace, the PCB should follow below rules:

(1) The coaxial cable PCB pads, RF antenna connector and other connectors which used to test contact performance of module should place as close as to the module antenna pads.

(2) The antenna matching network should place to antenna feed port.

(3) The RF trace should be as short and straight as possible, and do not routing as perpendicular line, we recommend do it as 45° corner trace.

(4) And the RF trace ground should be complete;
(5) RF device should place ground to the nearest ground plane;
(6) Between RF trace and below should avoid other signal trace or parallel trace to the RF signal.
(7) Recommend to more ground vias near the RF traces.

4 Antenna Requirements

Table 3: Antenna requirements

Antenna Class	Antenna Requirements
GNSS	frequency：1166.22MHz~1228.62MHz/1559MHz~1609MHz Polarization：RHCP or Linear VSWR：<2 Passive antenna Gain: >0dBi Active antenna noise: <1.5dBi Active antenna gain: >0dBi Active antenna LNA gain: <17dB
WCDMA/LTE/NR Sub-6	VSWR：<2 Efficiency：>50% Input/output impedance：50Ω Cable Loss：<1dB

5 Antenna Reduction

5.1 Two antennas design

If there is a requirement for minimum two antennas, it is recommended to combine ANT4. ANT5 and ANT7 with a triplexer, and another antenna is ANT0. The triplexer should contain MHB, n77 and n79 bands. In the market, there is no such triplexer now, need customer to find it by themselves. But if use n78 not n77, the below triplexer can be used. The P/N is: FI 252M2059CV-T, which designed by Taiyo Yuden

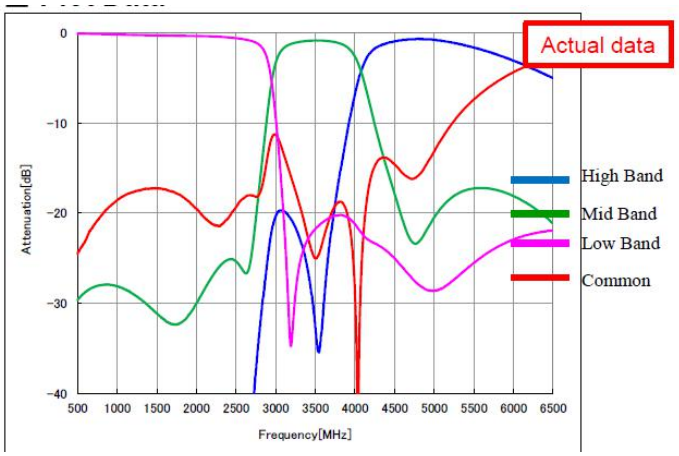

Figure3 Triplexer characteristic

In this program, the max downlink throughput for n79/n41 changes to half, and quarter for n77/n78. the max uplink throughput for n79/n77/n78 changes to half, n41 is not affected.

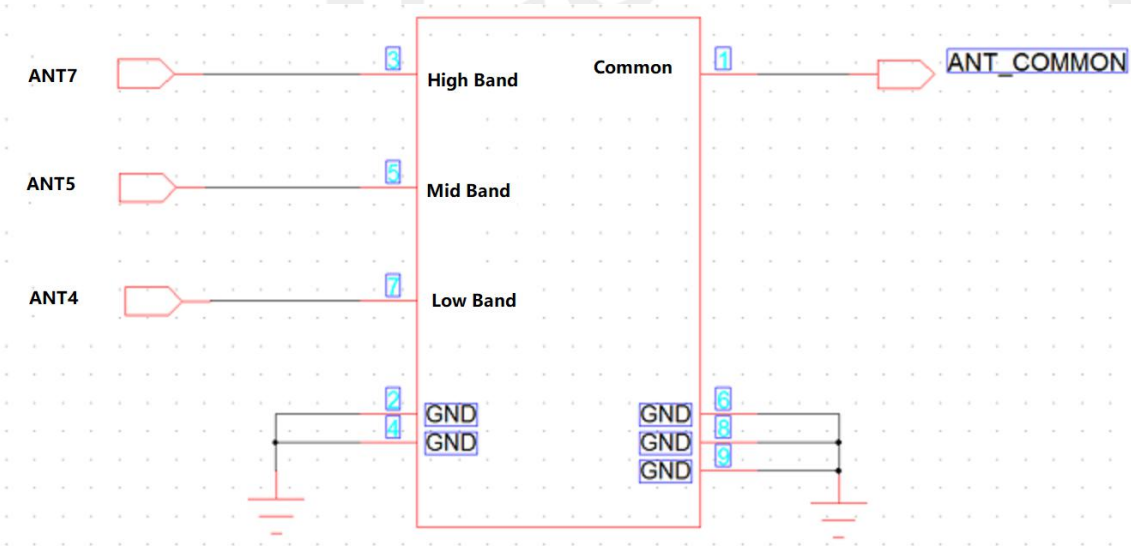

Figure4 Triplexer and Antenna connection

5.2 Four antennas design

For **China Mobile (CMCC)** only, the NR band need n41 and n79, if customer want to use less antennas, at least 4 Antennas should be used, they are ANT0, ANT1, ANT4, ANT7.

Table 4: Antenna selection

ANTENNAS	ANT0	ANT1	ANT4	ANT7

BANDS / FUNCTIONS						
3G/4G/5G LB/MHB		TRX				
5G	n41	UL/DL-MIMO1	✓			
5G	n79	DL-MIMO2				
4G	MHB	DL-MIMO2				
4G	UHB	DIV		✓		
5G	n41/n77/n78	DIV				
4G	UHB	DL-MIMO1				
5G	n41	TRX			✓	
5G	n77/n78	UL/DL-MIMO1				
5G	n79	TRX				✓

In this case, 3G/4G UL/DL , 5G n79 UL/DL and n41 UL throughput is half of the 8 antennas situation; 5G n41 DL throughput is 3/4 of the 8 antennas situation.

For **China Unicom (CU) and China Telecom (CT)** , the NR band need n1 (it's the same to LTE B1) and n78, if customer want to use less antennas, 4 Antennas should be used, they are ANT0, ANT1, ANT4, ANT5

Table 5: Antenna selection

ANTENNAS / BANDS / FUNCTIONS			ANT0	ANT1	ANT4	ANT5
3G/4G/5G LB/MHB		TRX				
5G	n41	UL/DL-MIMO1	✓			
5G	n79	DL-MIMO2				
4G	MHB	DL-MIMO2				
4G	UHB	DIV		✓		
5G	n41/n77/n78	DIV				
4G	UHB	DL-MIMO1				
5G	n41	TRX			✓	
5G	n77/n78	UL/DL-MIMO1				
5G	n77/n78	TRX				
4G	UHB	TRX				✓

In this case, 3G/4G UL/DL , 5G n1 throughput is half of the 8 antennas situation; 5G n78 DL throughput is 3/4 of the 8 antennas situation. UL speed is not affected.

5.3 Six antennas design

If customers want to use all the China NR bands, and want to use less Antennas than the original design which use 8 Antennas. The six antennas configuration is recommended. Like the 2 Ants design, ANT4, ANT5 and ANT7 should be combine to with a triplexer, the triplexer detail please refer to 2 antennas design.

In this case, only n77/78 DL/UL throughput is change to half.