

SAR sensor

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1. Introduction

This device is a mobile phone with LTE function, it has embedded one proximity sensors to reduce power for the compliance with **FCC SAR**. When the body gets close to the sensor pad area, the sensor will be triggered and reduce the TX power.

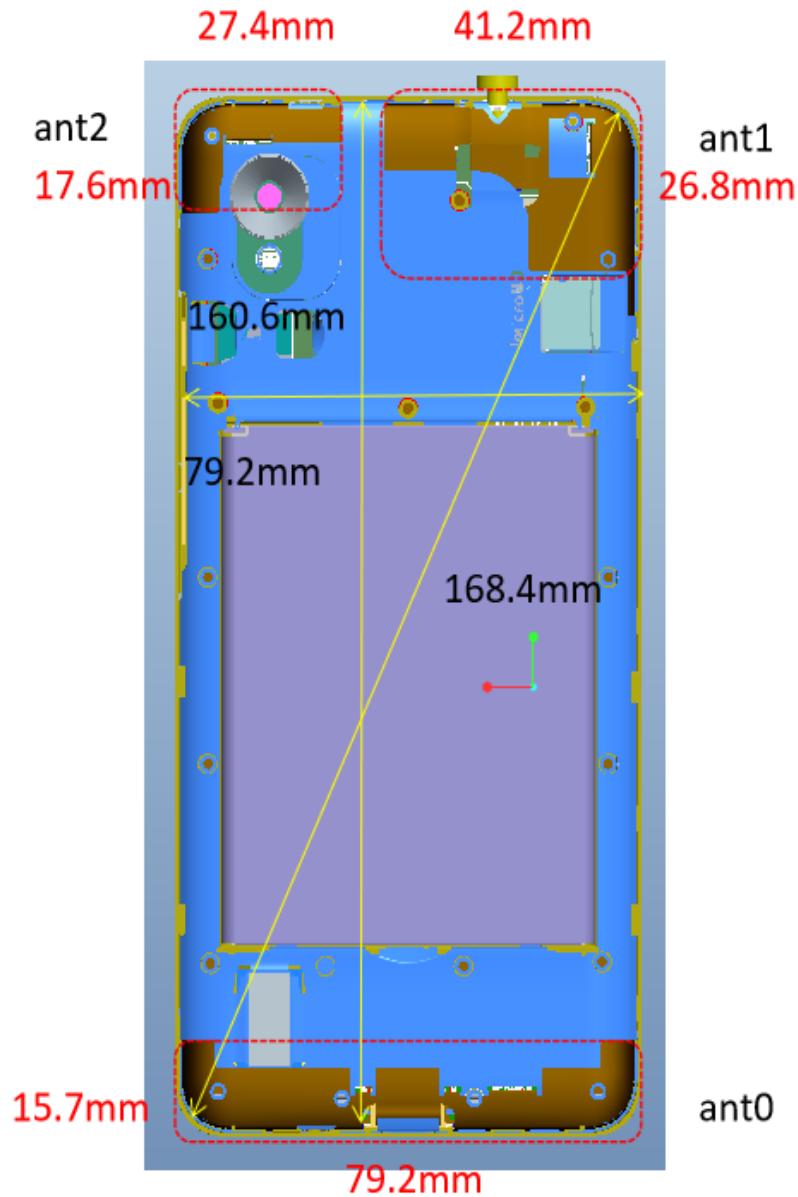
1.1 Product Spec for wireless technology and operation frequency

This device is a mobile phone, which supports GSM/WCDMA/LTE and WIFI 2.4GHz /Bluetooth.

Device Operating Configurations :			
Modulation Mode:	GSM: GMSK, 8PSK; WCDMA:UL QPSK LTE: QPSK,16QAM,64QAM WIFI: DSSS, OFDM, OFDMA; BT: GFSK, $\pi/4$ DQPSK,8DPSK		
Device Class:	B		
GPRS Multi-slots Class:	12	EGPRS Multi-slots Class:	12
HSDPA UE Category:	24	HSUPA UE Category	7
DC-HSDPA UE Category:	24		
Power Class	4, tested with power level 5(GSM850)		
	1, tested with power level 0(GSM1900)		
	3, tested with power control "all 1"(UMTS Bands)		
	3, tested with power control Max Power(LTE Bands)		
Frequency Bands:	Band	Tx (MHz)	Rx (MHz)
	GSM850	824~849	869~894
	GSM1900	1850~1910	1930~1990
	WCDMA Band II	1850~1910	1930~1990
	WCDMA Band IV	1710~1755	2110~2155
	WCDMA Band V	824~849	869~894
	LTE Band 2	1850 ~1910	1930 ~1990
	LTE Band 4	1710~1755	2110~2155
	LTE Band 5	824~849	869-894
	LTE Band 12	699~716	729~746
	LTE Band 14	788~798	758~768
	LTE Band 25	1850~1915	1930~1995
	LTE Band 26	814~849	859~894
	LTE Band 29	/	717~728
	LTE Band 30	2305~2315	2350~2360
	LTE Band 66	1710~1780	2110~2200
	LTE Band 71	663~698	617~652
Bluetooth	2400~2483.5	2400~2483.5	
Wi-Fi 2.4G	2412~2462	2412~2462	

2. The Antenna Location

The Detailed Antenna Locations are shown in the following figure.



As shown in the above figure, there are 3 antennas embedded in the phone. It has embedded capacitive proximity sensors for the power reduction of both bottom antenna (LAT) and top antenna (UAT) in order to comply with SAR requirement.

3. Power reduction for RF exposure consideration

3.1 The Methods For scenario detection

The Methods For scenario detection are shown in the following figure.

- a. Audio receiver detection
- b. Capacitive proximity sensor
- c. Hotspot Mode detection

3.2 The detect condition of each scenarios

WWAN scenarios:

DSI	Test Scenario	The Conditions
1	Head Standalone/ Combine (CE/FCC)	Receiver State: 1 Hotspot State: 0
0	Body-worn Standalone / Combine (CE/FCC)	Receiver State: 0 Hotspot State: 0 The space of SAR sensor: less than 6mm(top)or4mm(back)or3mm(r ight)
2	Hotspot	Receiver State: NA Hotspot state:1

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Remark:

a. When operating at WWAN Antenna for 4G,. There are several power tables of WWAN Antenna. The power tables selected during radiated operation are known as At-Head power table, Body-worn Power table and Hotspot power table.

b. Above table, "0" means function is inactive, "1" means function is active.

WLAN scenarios:

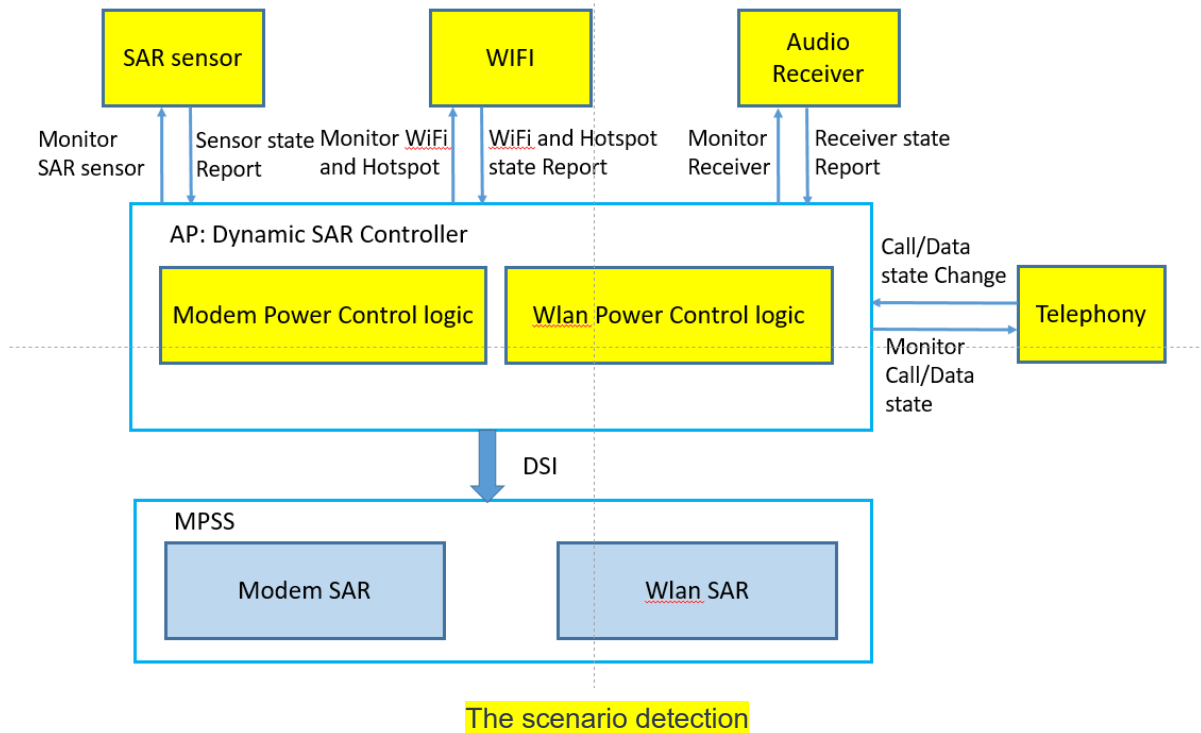
WLAN		
	Test Scenario	The Conditions
	Head Standalone (CE)	Receiver State: 1 Wi-Fi STA state:1 Hotspot State: 0 WWAN State: 0
	Head Standalone(FCC)	Receiver State: 1 Wi-Fi STA state:1 Hotspot State: 0 WWAN State: 0
	Hotspot	Hotspot State: 1

Remark:

a. When operating at WLAN Antenna, there are several power tables of WLAN Antenna. The power tables selected during radiated operation are known as At-Head for FCC power table, , and Hotspot power table.

b. Above table, "0" means function is inactive, "1" means function is active.

3.3 The scenario detection



4. Test Configuration

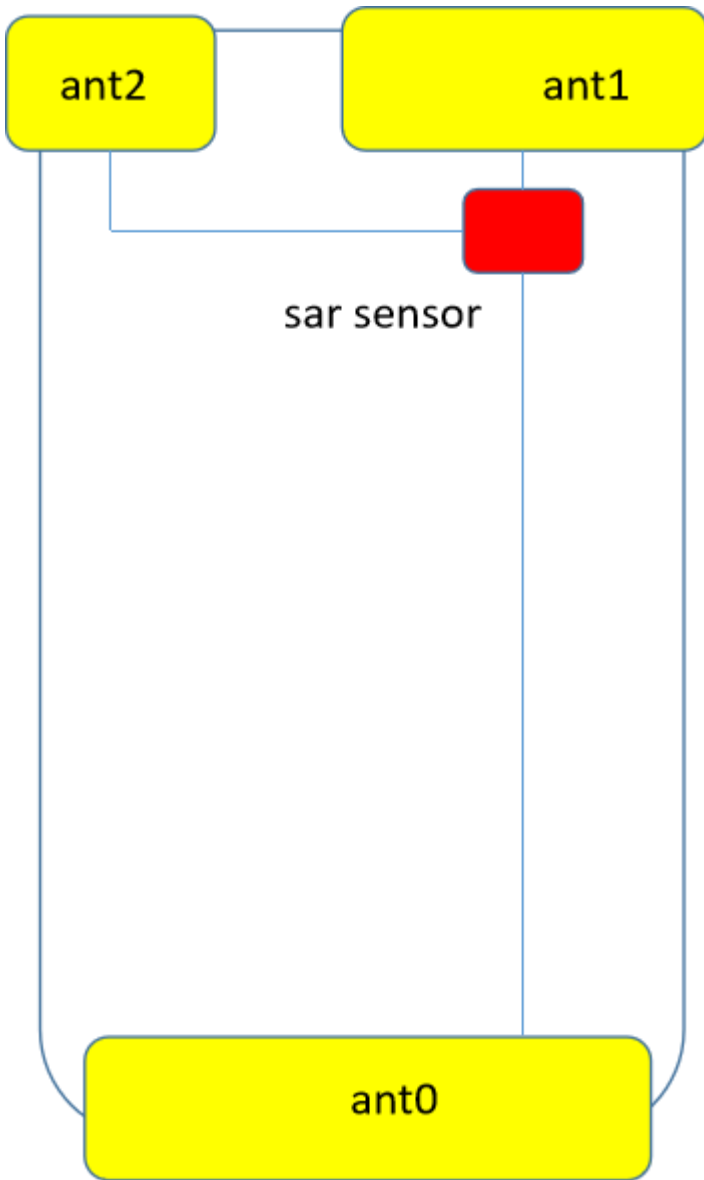
4.1 Audio receiver detection configuration

The device supports the Audio receiver detection mechanism. The audio receiver is used to determine head. When operating in a call at the head, the relevant power levels are set for WWAN and Wi-Fi antennas accordingly, in order to comply with SAR requirement.

4.2 Proximity sensor configuration

Sensor pad location

There are one sensor in this device. The sensor is connected to the transmitting antenna through different channels, and only the channel of TX ant1 is active in this device.



Proximity Sensor Introduction

GENERAL DESCRIPTION

AW96105ADNR is a 5-channel low power consumption capacitive touch and proximity controller. Each channel can be independently configured as sensor input, shield output.

Advanced self-capacitance technology is adopted, which supports parasitic capacitance compensation for each channel up to 220pF. The device has a high resolution ADC, the minimal capacitance that can be detected is as low as 1aF.

A high performance 32bit MCU is integrated by executing the firmware-program in the ROM, it implements all AFE sampling controlling and complicated data processing algorithms including signal filtering, RF noise suppression, baseline calculation, proximity status decision, etc.

With the auxiliary of DSP algorithm, the device is able to track slow environmental variations (such as temperature, humidity, etc.) and maintain high performance operation.

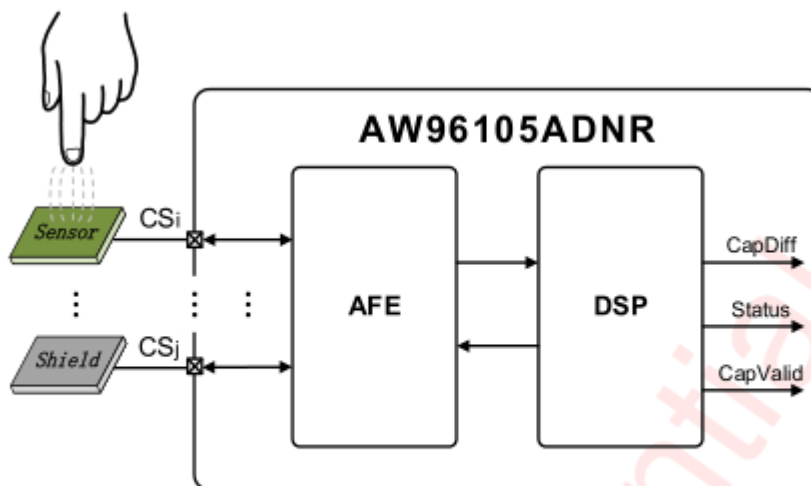


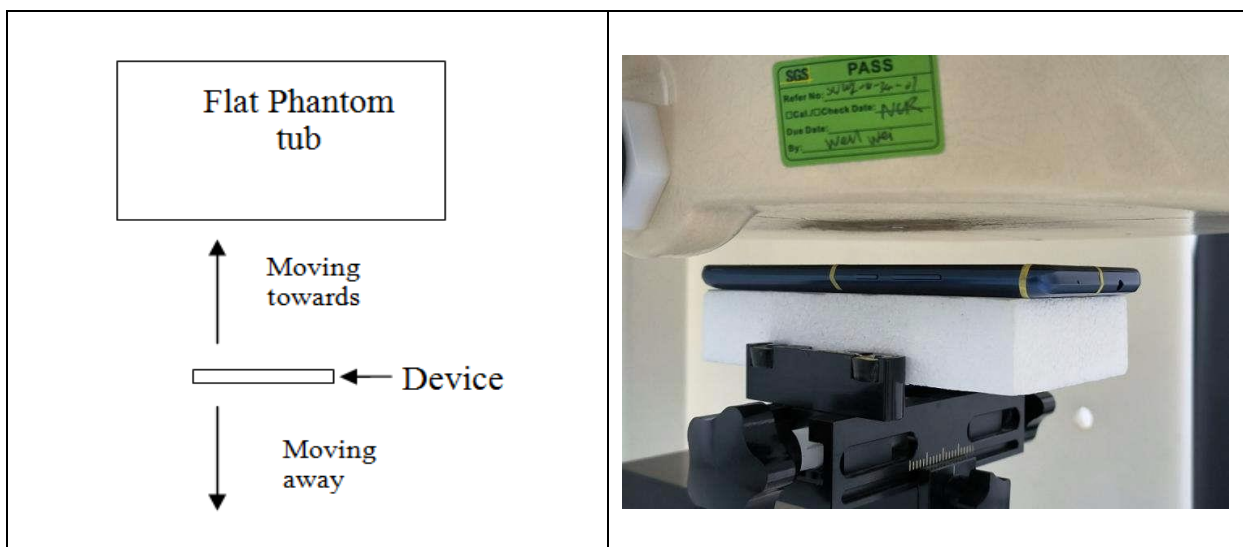
Figure 5 Proximity Sensor Operation Overview

4.3 Trigger distance of SAR sensor Sensor

Position	SAR sensor trigger	Trigger distance
Back	Y	4mm
front	Y	1mm
bottom	N	/
top	Y	6mm
right	Y	3mm
left	N	/

Sensor detection capability test

- The Front surface is moved toward the flat phantom in 1mm steps until the sensor triggers, record the distance at that moment.
- The Front surface is then moved back (further away) from the phantom until sensor off.
- Repeat Step a to b 5 time, calc the average distance
- Steps a) to c) need be repeated at related sides.



4.4 Hotspot Mode detection

The device supports the Hotspot Mode detection mechanism. The Hotspot Mode is used to determine Hotspot scenario. The relevant power levels are set for WWAN and Wi-Fi antennas accordingly.

5. Power Table

Tune-up Output Power						
		Body SAR 0mm	Head SAR	Body SAR 10mm	Body SAR 15mm	
		SAR SENSOR ON	Receiver ON	Hotspot ON	ALL OFF	
GSM850	Mode	DSI0	DSI1	DSI2	DSI3	TX Antenna
	GSM (CS)	33+/-1	33+/-1	33+/-1	33+/-1	ant0
	GPRS/EGRPS SLOT1	33+/-1	33+/-1	33+/-1	33+/-1	ant0
	GPRS/EGRPS SLOT2	32+/-1	32+/-1	32+/-1	32+/-1	ant0
	GPRS/EGRPS SLOT3	30+/-1	30+/-1	30+/-1	30+/-1	ant0
	GPRS/EGRPS SLOT4	29+/-1	29+/-1	29+/-1	29+/-1	ant0
	EDGE (8PSK) SLOT1	27+/-1	27+/-1	27+/-1	27+/-1	ant0
	EDGE (8PSK) SLOT2	26+/-1	26+/-1	26+/-1	26+/-1	ant0
	EDGE (8PSK) SLOT3	24+/-1	24+/-1	24+/-1	24+/-1	ant0
EDGE (8PSK) SLOT4	23+/-1	23+/-1	23+/-1	23+/-1	ant0	
GSM1900	Mode	DSI0	DSI1	DSI2	DSI3	TX Antenna
	GSM (CS)	24.3+/-1	23.3+/-1	24.3+/-1	29.3+/-1	ant1
	GPRS/EGRPS SLOT1	24.3+/-1	23.3+/-1	24.3+/-1	29.3+/-1	ant1
	GPRS/EGRPS SLOT2	24.3+/-1	23.3+/-1	24.3+/-1	28+/-1	ant1
	GPRS/EGRPS SLOT3	24.3+/-1	23.3+/-1	24.3+/-1	27+/-1	ant1
	GPRS/EGRPS SLOT4	24.3+/-1	23.3+/-1	24.3+/-1	25.5+/-1	ant1
	EDGE (8PSK) SLOT1	22.5+/-1	22.5+/-1	22.5+/-1	26+/-1	ant1
	EDGE (8PSK) SLOT2	20.5+/-1	20.5+/-1	19.5+/-1	25+/-1	ant1
	EDGE (8PSK) SLOT3	19+/-1	19+/-1	17.5+/-1	23+/-1	ant1
EDGE (8PSK) SLOT4	17.5+/-1	17.5+/-1	16.5+/-1	22+/-1	ant1	

UMTS II	Mode	DSI0	DSI1	DSI2	DSI3	TX Antenna
	AMR	20.5+/-1	19+/-1	21.5+/-1	23+/-1	ant1
	DC-HSDPA Subtest-1	20.5+/-1	18.5+/-1	21+/-1	22.5+/-1	ant1
	DC-HSDPA Subtest-2	20.5+/-1	18.5+/-1	21+/-1	22.5+/-1	ant1
	DC-HSDPA Subtest-3	20.5+/-1	18+/-1	20.5+/-1	22+/-1	ant1
	DC-HSDPA Subtest-4	20+/-1	18+/-1	20.5+/-1	22+/-1	ant1
	HSPA+	20+/-1	18+/-1	21+/-1	22+/-1	ant1
	HSUPA Subtest-1	20+/-1	18.5+/-1	19.5+/-1	20.5+/-1	ant1
	HSUPA Subtest-2	19.5+/-1	17.5+/-1	19.5+/-1	20.5+/-1	ant1
	HSUPA Subtest-3	19.5+/-1	17+/-1	20.5+/-1	21.5+/-1	ant1
HSUPA Subtest-4	18+/-1	17+/-1	19+/-1	20+/-1	ant1	

	HSUPA Subtest-5	19.5+/-1	17.5+/-1	20.5+/-1	21.5+/-1	ant1
UMTS IV	Mode	DSI0	DSI1	DSI2	DSI3	TX Antenna
	AMR	20.5+/-1	19+/-1	21.5+/-1	23+/-1	ant1
	DC-HSDPA Subtest-1	20.5+/-1	18.5+/-1	21+/-1	22.5+/-1	ant1
	DC-HSDPA Subtest-2	20.5+/-1	18.5+/-1	21+/-1	22.5+/-1	ant1
	DC-HSDPA Subtest-3	20.5+/-1	18+/-1	20.5+/-1	22+/-1	ant1
	DC-HSDPA Subtest-4	20+/-1	18+/-1	20.5+/-1	22+/-1	ant1
	HSPA+	20+/-1	18+/-1	21+/-1	22+/-1	ant1
	HSUPA Subtest-1	20+/-1	18.5+/-1	19.5+/-1	20.5+/-1	ant1
	HSUPA Subtest-2	19.5+/-1	17.5+/-1	19.5+/-1	20.5+/-1	ant1
	HSUPA Subtest-3	19.5+/-1	17+/-1	20.5+/-1	21+/-1	ant1
	HSUPA Subtest-4	18+/-1	17+/-1	19+/-1	20+/-1	ant1
	HSUPA Subtest-5	19.5+/-1	17.5+/-1	20.5+/-1	21.5+/-1	ant1
UMTS V	Mode	DSI0	DSI1	DSI2	DSI3	TX Antenna
	AMR	23.5+/-1	23.5+/-1	23.5+/-1	23.5+/-1	ant0
	DC-HSDPA Subtest-1	22.5+/-1	22.5+/-1	22.5+/-1	22.5+/-1	ant0
	DC-HSDPA Subtest-2	22.5+/-1	22.5+/-1	22.5+/-1	22.5+/-1	ant0
	DC-HSDPA Subtest-3	22+/-1	22+/-1	22+/-1	22+/-1	ant0
	DC-HSDPA Subtest-4	22+/-1	22+/-1	22+/-1	22+/-1	ant0
	HSPA+	22+/-1	22+/-1	22+/-1	22+/-1	ant0
	HSUPA Subtest-1	20.5+/-1	20.5+/-1	20.5+/-1	20.5+/-1	ant0
	HSUPA Subtest-2	20.5+/-1	20.5+/-1	20.5+/-1	20.5+/-1	ant0
	HSUPA Subtest-3	21+/-1	21+/-1	21+/-1	21+/-1	ant0
	HSUPA Subtest-4	20+/-1	20+/-1	20+/-1	20+/-1	ant0
HSUPA Subtest-5	21.5+/-1	21.5+/-1	21.5+/-1	21.5+/-1	ant0	

LTE STANDAL ONE	Mode/Band	DSI0	DSI1	DSI2	DSI3	TX Antenna
	FDD Band 2	20.5+/-1	19.5+/-1	21.5+/-1	23+/-1	ant1
	FDD Band 4	20.5+/-1	18.5+/-1	21.5+/-1	23+/-1	ant1
	FDD Band 5	23.5+/-1	23.5+/-1	23.5+/-1	23+/-1	ant0
	FDD Band 12	23.5+/-1	23.5+/-1	23.5+/-1	23+/-1	ant0
	FDD Band 14	23.5+/-1	23.5+/-1	23.5+/-1	23+/-1	ant0
	FDD Band 25	20.5+/-1	19.5+/-1	21.5+/-1	23+/-1	ant1
	FDD Band 26	23.5+/-1	23.5+/-1	23.5+/-1	23+/-1	ant0
	FDD Band 30	21.5+/-1	23.5+/-1	21.5+/-1	23+/-1	ant0
	FDD Band 66	20.5+/-1	18.5+/-1	21.5+/-1	23+/-1	ant1
	FDD Band 71	23.5+/-1	23.5+/-1	23.5+/-1	23+/-1	ant0

LTE STANDALONE MPR	Modulation	Channel bandwidth / Transmission bandwidth configuration [RB]						Normal Power MPR
		1.4	3	5	10	15	20	MPR (dB)
	MHz	MHz	MHz	MHz	MHz	MHz		
	QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1
	16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	1
	64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	2

Wifi TX antenna is ant2						
	Mode	Rate	receiver off	Power Setting	receiver on	Power Setting
2.4G	11b	1Mbps	18+/-1	20	16+/-1	18
	11b	2Mbps	18+/-1	20	16+/-1	18
	11b	5.5Mbps	18+/-1	20	16+/-1	18
	11b	11Mbps	18+/-1	20	16+/-1	18
	11g	6Mbps	16+/-1	18.5	16+/-1	18.5
	11g	9Mbps	16+/-1	18.5	16+/-1	18.5
	11g	12Mbps	16+/-1	18.5	16+/-1	18.5
	11g	18Mbps	16+/-1	18.5	16+/-1	18.5
	11g	24Mbps	16+/-1	18.5	16+/-1	18.5
	11g	36Mbps	16+/-1	18.5	16+/-1	18.5
	11g	48Mbps	16+/-1	18.5	16+/-1	18.5
	11g	54Mbps	16+/-1	18.5	16+/-1	18.5
	11n-HT20	MCS0	16+/-1	18	16+/-1	18
	11n-HT20	MCS1	16+/-1	18	16+/-1	18
	11n-HT20	MCS2	16+/-1	18	16+/-1	18
	11n-HT20	MCS3	16+/-1	18	16+/-1	18
	11n-HT20	MCS4	16+/-1	18	16+/-1	18
	11n-HT20	MCS5	15+/-1	17.5	15+/-1	17.5
11n-HT20	MCS6	15+/-1	17.5	15+/-1	17.5	
11n-HT20	MCS7	15+/-1	17.5	15+/-1	17.5	