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Sony Mobile Communications, Inc.
4-12-3 Higashi-shinagawa, Shinagawa-ku, Tokyo, 140-0002, Japan

Date: November 03, 2017

PY7-67442A Technical description for FCC

1. Introduction

The scope of this document is to provide an overview and understanding of project PY7-67442A hardware.

2. Simultaneous transmission

PY7-67442A supports the following simultaneous transmissions.

Case	cellular	WLAN/BT Main	Note
1	GSM/GPRS/EDGE	BT/BLE	Support
2		WLAN 2.4G	Support
3		WLAN 5G	Support
4	UMTS/HSPA	BT/BLE	Support
5		WLAN 2.4G	Support
6		WLAN 5G	Support
7	LTE	BT/BLE	Support
8		WLAN 2.4G	Support
9		WLAN 5G	Support

Note: WLAN 2.4/5G and BT/BLE time share the same antenna and cannot transmit simultaneously.

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3. HW configuration

3.1 platform information

PY7-67442A uses Qualcomm SDM630 and configuration is as below list

Feature	
process	14 nm FinFET
package	Non-PoP – small, thermally efficient package 692 NSP: 12 × 12 × 0.9 mm; 0.4 mm pitch
processor	Octa core ARM v8-compliant 64-bit One quad high-performance cores targeting 2.2 GHz One quad low-power cores targeting 1.843 GHz
MODEM	GSM/GPRS/EDGE Rel9 DC-HSPA+ (DC-HSDPA only, not support DC-HSUPA) LTE Rel. 11 Cat. 11 DL and Cat.5 UL FDD
Modem Enhancements	N/A
RF & PMC chipset	RF:SDR660 PMIC:PM660 and PM660L
LCD Support	5.2” FHD 1080x1920 60fps, IPS display, supper narrow border, Brightness 450 min
Bluetooth	WCN3980
WLAN	WCN3980
NFC	PN553 E2EV/C210
Video Decode	4096 × 2160 at 24 fps / 3840 × 2160 at 30 fps / 1920 × 1080 at 60 fps HEVC / H.264 / H.263 / VC-1 / MPEG-4 / DivX / MPEG-2 / VP8 / VP9
Video Encode	3840 × 2160 at 30 fps, 100 Mbps / 1920 × 1080 at 30 fps, 40 Mbps / 864 × 480 at 30 fps, 2 Mbps HEVC / H.264 / H.263 / MPEG-4
Qcamera	23M ExmorRS w/ Flash LED + 8MP (IMX219) Wide FOV 16MP OIS (IMX234) AF w/ Flash LED
Audio	AAC/HE-AAC v1/HE-AAC v2/AMR/AWB/MIDI/MP3/OGG VORBIS/WAV/FLAC
Graphics	N/A
GPS	SDR660
Security and DRM	Widevine DRM Level1

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3.2 Variant information and major chipset

Number		**1**	2	3	4
FCC ID		PY7-82574V	PY7-78553D	PY7-67442A	PY7-48140L (Leading SKU)
BB Asic		Qualcomm SDM630 (64GB eMMC / 4GB RAM LPDDR3)			
RF Asic		Qualcomm SDR660			
Wifi /BT Asic		Qualcomm WCN3980			
Felica/ NFC Asic		NXP PN553 E2EV/C210			
WLAN		802.11 a/b/g/n/ac			
Bluetooth		BT5.0 + BLE			
Category	GSM	850/900:Class4 1800/1900:Class1			
	DTM	Y			
	HSUPA HSDPA	DL:Cat24 UL:Cat6			
	LTE	Cat11	Cat11	Cat11	Cat11
ANT	Main	PIFA			
	Sub	PIFA			
	HoRxD	N/A			
	4x4 MIMO	N/A			
	Wifi/BT	Monopole			
	NFC	Single loop			
	GPS	Monopole			
Dual SIM		SS	DS	SS	DS
Digital TV		NA	NA	NA	NA

3.2.1 Band capability of each variants

LTE Australia/NZ China

Variant	1	2	3	4	5	7	7	8	12	13	17	20	25	28*	29	38	39	40	41	66
PY7-78553D	x	x	x		x	x	x	x				x				X				
PY7-82574V	x	x	x		x	x	x	x				x				X				
PY7-48140L	x	x	x		x	x	x	x						X		X	X	X	X	
PY7-67442A	X	X		X	X	X	X	X	X	X	X		X	X	X					X

UMTS Telestra (Australia)

Variant	1	2	4	5	5*	8
PY7-78553D	x	x		X		x
PY7-82574V	x	x		X	x	x
PY7-48140L	x	x		X	x	x
PY7-67442A	x	x	X	X		x

GSM

850	900	1800	1900
x	x	x	x
x	x	x	x
x	x	x	x
x	x	x	x

CE Marking: Test
FCC: Test & Certificate

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Number	**1**	2	3	4
FCC ID	PY7-82574V	PY7-78553D	PY7-67442A	PY7-48140L (Leading SKU)
GSM	Quad-Band 850/900/1800/1900			
UMTS	1, 2, 5, 8	1, 2, 5, 8	1, 2, 4, 5, 8	1, 2, 5, 8
LTE	1, 2, 3, 5, 7, 8, 20, 38	1, 2, 3, 5, 7, 8, 20, 38	1,2,4,5,7,8,12,13,17,25, 28,29,66	1,2,3,5,7,8,28,38,39, 40,41M
LTE CA band(DL)	CA_1A-3A\CA_1A-3A-7A\CA_1A-3A-8A\CA_1A-3A-20A\CA_1A-7A\CA_1A-7A-20A\CA_1A-8A\CA_1A-20A\CA_1A-38A\CA_3A-3A\CA_3C\CA_3A-5A\CA_3A-3A-20A\CA_3A-7A\CA_3A-7C\CA_3A-7B\CA_3C-7A\CA_3A-7A-7A\CA_3A-7A-8A\CA_3A-7A-20A\CA_3A-7A-38A\CA_3A-8A\CA_3C-8A\CA_3A-20A\CA_3C-20A\CA_3A-38A\CA_7C\CA_7B\CA_7A-7A\CA_7A-8A\CA_7A-20A\CA_7A-20A-38A\CA_7C-20A\CA_20A-38A\CA_38C	CA_1A-3A\CA_1A-3A-7A\CA_1A-3A-8A\CA_1A-3A-20A\CA_1A-7A\CA_1A-7A-20A\CA_1A-8A\CA_1A-20A\CA_1A-38A\CA_3A-3A\CA_3C\CA_3A-5A\CA_3A-3A-20A\CA_3A-7A\CA_3A-7C\CA_3A-7B\CA_3C-7A\CA_3A-7A-7A\CA_3A-7A-8A\CA_3A-7A-20A\CA_3A-7A-38A\CA_3A-8A\CA_3C-8A\CA_3A-20A\CA_3C-20A\CA_3A-38A\CA_7C\CA_7B\CA_7A-7A\CA_7A-8A\CA_7A-20A\CA_7A-20A-38A\CA_7C-20A\CA_20A-38A\CA_38C	CA_2A-2A\CA_2A-4A\CA_2A-4A-5A\CA_2A-4A-7A\CA_2A-4A-12A\CA_2A-4A-29A\CA_2A-66A\CA_2A-5A\CA_2A-7A\CA_2A-7A-7A\CA_2A-7A-12A\CA_2A-12A\CA_2A-12B\CA_2A-13A\CA_2A-17A\CA_2A-28A\CA_2A-29A\CA_4A-4A\CA_4A-4A-12A\CA_4A-4A-29A\CA_4A-5A\CA_4A-7A\CA_4A-7A-7A\CA_4A-7A-12A\CA_4A-12A\CA_4A-12B\CA_4A-13A\CA_4A-17A\CA_4A-28A\CA_4A-29A\CA_5A-7A\CA_5A-25A\CA_7C\CA_7B\CA_7A-7A\CA_7A-12A\CA_7A-28A\CA_7C-28A\CA_7B-28A\CA_12B\CA_12A-66A\CA_12A-66A-66A\CA_12A-66C\CA_12A-25A\CA_25A-25A\CA_66C\CA_66B\CA_66A-66A	CA_1A-3A\CA_1A-3C\CA_1A-3A-5A\CA_1A-3A-7A\CA_1A-3A-8A\CA_1A-3A-28A\CA_1A-5A\CA_1A-7A\CA_1A-7C\CA_1A-7A-8A\CA_1A-7A-28A\CA_1A-8A\CA_1A-28A\CA_1A-41A\CA_3A-3A\CA_3A-3A-7A\CA_3C\CA_3A-5A\CA_3C-5A\CA_3A-7A\CA_3A-7C\CA_3A-7B\CA_3C-7A\CA_3A-7A-7A\CA_3A-7A-8A\CA_3A-7A-28A\CA_3A-8A\CA_3A-28A\CA_3C-28A\CA_3A-40A\CA_3A-40C\CA_3A-41A\CA_5A-7A\CA_5A-40A\CA_5A-40A-40A\CA_5A-40C\CA_7C\CA_7B\CA_7A-7A\CA_7A-8A\CA_7A-28A\CA_7C-28A\CA_7B-28A\CA_28A-40A\CA_28A-40C\CA_38C\CA_39C\CA_40A-40A\CA_40C\CA_40D\CA_41C

Non-CA LTE Bandwidth information

Band	Support Bandwidth					
	1.4MHz	3MHz	5MHz	10MHz	15MHz	20MHz
1			Yes	Yes	Yes	Yes
2	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes		
7			Yes	Yes	Yes	Yes
8	Yes	Yes	Yes	Yes		
12	Yes	Yes	Yes	Yes		
13			Yes	Yes		
17			Yes	Yes		
25	Yes	Yes	Yes	Yes	Yes	Yes
28		Yes	Yes	Yes	Yes	Yes
29		Yes	Yes	Yes		
66	Yes	Yes	Yes	Yes	Yes	Yes

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3.2.2 Carrier aggregation support bands

E-UTRA CA configuration/ Bandwidth combination set for inter-band CA

E-UTRA CA configuration / Bandwidth combination set for inter-band CA										
E-UTRA CA Configuration	Uplink CA configurations	E-UTRA Bands	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz	Maximum aggregated bandwidth [MHz]	Bandwidth combination set
CA_2A-4A		2	Yes	Yes	Yes	Yes	Yes	Yes	40	0
		4			Yes	Yes	Yes	Yes		
		2			Yes	Yes			20	1
		4			Yes	Yes				
		2			Yes	Yes	Yes	Yes	40	2
		4			Yes	Yes	Yes	Yes		
CA_2A-4A-5A		2			Yes	Yes	Yes	Yes	50	0
		4			Yes	Yes	Yes	Yes		
		5			Yes	Yes				
CA_2A-4A-7A		2			Yes	Yes	Yes	Yes	60	0
		4			Yes	Yes	Yes	Yes		
		7			Yes	Yes	Yes	Yes		
CA_2A-4A-12A		2			Yes	Yes	Yes	Yes	50	0
		4			Yes	Yes	Yes	Yes		
		12			Yes	Yes				
CA_2A-4A-29A		2			Yes	Yes	Yes	Yes	50	0
		4			Yes	Yes	Yes	Yes		
		29			Yes	Yes				
CA_2A-66A		2	Yes	Yes	Yes	Yes	Yes	Yes	40	0
		66			Yes	Yes	Yes	Yes	40	0
		2			Yes	Yes			20	1
		66			Yes	Yes			20	1
		2			Yes	Yes	Yes	Yes	40	2
		66			Yes	Yes	Yes	Yes	40	2
CA_2A-5A		2			Yes	Yes	Yes	Yes	30	0
		5			Yes	Yes				

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		2			Yes	Yes			20	1
		5			Yes	Yes				
CA_2A-7A		2			Yes	Yes	Yes	Yes	40	0
		7			Yes	Yes	Yes	Yes		
CA_2A-7A-7A	-	2			Yes	Yes	Yes	Yes	60	0
		7	See the CA_7A-7A Bandwidth combination set 1 in Table 5.4.2A.1-3							
CA_2A-7A-12A	-	2			Yes	Yes	Yes	Yes	50	0
		7			Yes	Yes	Yes	Yes		
		12			Yes	Yes				
CA_2A-12A		2			Yes	Yes	Yes	Yes	30	0
		12			Yes	Yes				
		2			Yes	Yes	Yes	Yes	30	1
		12		Yes	Yes	Yes				
		2			Yes	Yes			20	2
		12			Yes	Yes				
CA_2A-12B		2			Yes	Yes	Yes	Yes	35	0
		12	See CA_12B Bandwidth Combination Set 0 in Table 5.4.2A.1-1							
CA_2A-13A		2			Yes	Yes	Yes	Yes	30	0
		13				Yes				
		2			Yes	Yes			20	1
		13				Yes				
CA_2A-17A	-	2			Yes	Yes			20	0
		17			Yes	Yes				
CA_2A-29A	-	2			Yes	Yes			20	0
		29		Yes	Yes	Yes				
		2			Yes	Yes			20	1
		29			Yes	Yes				
		2			Yes	Yes	Yes	Yes	30	2
		29			Yes	Yes				
CA_4A-4A-12A	-	4	See CA_4A-4A Bandwidth Combination Set 0 in Table 5.4.2A.1-3						50	0
		12			Yes	Yes				
CA_4A-4A-29A	-	4	See CA_4A-4A Bandwidth combination set 0 in Table 5.4.2A.1-3						50	0

		29			Yes	Yes				
CA_4A-5A		4			Yes	Yes			20	0
		5			Yes	Yes				
		4			Yes	Yes	Yes	Yes	30	1
		5			Yes	Yes				
CA_4A-7A		4			Yes	Yes			30	0
		7			Yes	Yes	Yes	Yes		
		4			Yes	Yes	Yes	Yes	40	1
		7			Yes	Yes	Yes	Yes		
CA_4A-7A-7A	-	4			Yes	Yes	Yes	Yes	60	0
		7	See the CA_7A-7A Bandwidth combination set 1 in Table 5.4.2A.1-3							
CA_4A-7A-12A	-	4			Yes	Yes			40	0
		7			Yes	Yes	Yes	Yes		
		12			Yes	Yes				
		4			Yes	Yes	Yes	Yes	50	1
		7			Yes	Yes	Yes	Yes		
		12			Yes	Yes				
CA_4A-12A		4	Yes	Yes	Yes	Yes			20	0
		12			Yes	Yes				
		4	Yes	Yes	Yes	Yes	Yes	Yes	30	1
		12			Yes	Yes				
		4			Yes	Yes	Yes	Yes	30	2
		12		Yes	Yes	Yes				
		4			Yes	Yes			20	3
		12			Yes	Yes				
		4			Yes	Yes	Yes	Yes	30	4
		12			Yes	Yes				
		4			Yes	Yes	Yes		20	5
		12			Yes					
CA_4A-12B		4			Yes	Yes	Yes	Yes	35	0
		12	See CA_12B Bandwidth Combination Set 0 in Table 5.4.2A.1-1							
CA_4A-13A		4			Yes	Yes	Yes	Yes	30	0
		13				Yes				

		4			Yes	Yes			20	1
		13				Yes				
CA_4A-17A		4			Yes	Yes			20	0
		17			Yes	Yes				
CA_4A-29A	-	4			Yes	Yes			20	0
		29		Yes	Yes	Yes				
		4			Yes	Yes			20	1
		29			Yes	Yes				
		4			Yes	Yes	Yes	Yes	30	2
		29			Yes	Yes				
CA_5A-7A		5	Yes	Yes	Yes	Yes			30	0
		7				Yes	Yes	Yes		
		5			Yes	Yes			30	1
		7				Yes	Yes	Yes		
CA_5A-25A	-	5			Yes	Yes			30	0
		25			Yes	Yes	Yes	Yes		
CA_7A-12A	-	7			Yes	Yes	Yes	Yes	30	0
		12			Yes	Yes				
CA_12A-66A		12			Yes	Yes			20	0
		66	Yes	Yes	Yes	Yes				
		12			Yes	Yes			30	1
		66	Yes	Yes	Yes	Yes	Yes	Yes		
		12		Yes	Yes	Yes			30	2
		66			Yes	Yes	Yes	Yes		
		12			Yes	Yes			20	3
		66			Yes	Yes				
		12			Yes	Yes			30	4
		66			Yes	Yes	Yes	Yes		
		12			Yes				20	5
		66			Yes	Yes	Yes			
CA_12A-66A-66A	-	12			Yes	Yes			50	0
		66	See CA_66A-66A Bandwidth combination set 0 in Table 5.4.2A.1-3							
CA_12A-66C	-	12			Yes	Yes			50	0

		66	See CA_66C Bandwidth combination set 0 in Table 5.4.2A.1-1							
CA_12A-25A	-	12			Yes	Yes			30	0
		25			Yes	Yes	Yes	Yes		

E-UTRA CA configuration / Bandwidth combination set for NON-contiguous intra-band CA

		E-UTRA CA configuration / Bandwidth combination set for NON-contiguous intra-band CA						
E-UTRACA configuration	**Uplink CA configurations**	**Component carriers in order of increasing carrier frequency**					**Maximum aggregated**	**Bandwidth combination set**
		Channel bandwidths for carrier [MHz]	**Channel bandwidths for carrier [MHz]**	**Channel bandwidths for carrier [MHz]**	**Channel bandwidths for carrier [MHz]**	**Channel bandwidths for carrier [MHz]**	**bandwidth [MHz]**	
CA_2A-2A	-	5, 10, 15, 20	5, 10, 15, 20				40	0
CA_4A-4A		5, 10, 15, 20	5, 10, 15, 20				40	0
		5, 10	5, 10				20	1
CA_7A-7A	-	5	15				40	0
		10	10, 15					
		15	15, 20					
		20	20					
		5, 10, 15, 20	5, 10, 15, 20				40	1
		5, 10, 15,	5, 10				30	2

		20						
		10, 15, 20	10, 15, 20				40	3
CA_25A-25A	-	5, 10	5, 10				20	0
		5, 10, 15, 20	5, 10, 15, 20				40	1
CA_66A-66A	-	5, 10, 15, 20	5, 10, 15, 20				40	0

E-UTRA CA configuration / Bandwidth combination set for contiguous intra-band

		E-UTRA CA configuration / Bandwidth combination set for contiguous intra-band						
E-UTRA CA configuration	**Uplink CA configurations**	**Component carriers in order of increasing carrier frequency**					**Maximum aggregated**	**Bandwidth combination set**
		Channel bandwidths for carrier [MHz]	**Channel bandwidths for carrier [MHz]**	**Channel bandwidths for carrier [MHz]**	**Channel bandwidths for carrier [MHz]**	**Channel bandwidths for carrier [MHz]**	**bandwidth [MHz]**	
CA_7B		15	5				20	0
CA_7C		15	15				40	0
		20	20					
		10	20				40	1
		15	15, 20					
		20	10, 15, 20					
		15	10, 15				40	2
		20	15, 20					

CA_12B	-	5	5, 10				15	0
CA_66B	-	5	5, 10, 15				20	0
		10	5, 10					
		15	5					
CA_66C	-	5	20				40	0
		10	15, 20					
		15	10, 15, 20					
		20	5, 10, 15, 20					

RF

4.1 RF configuration

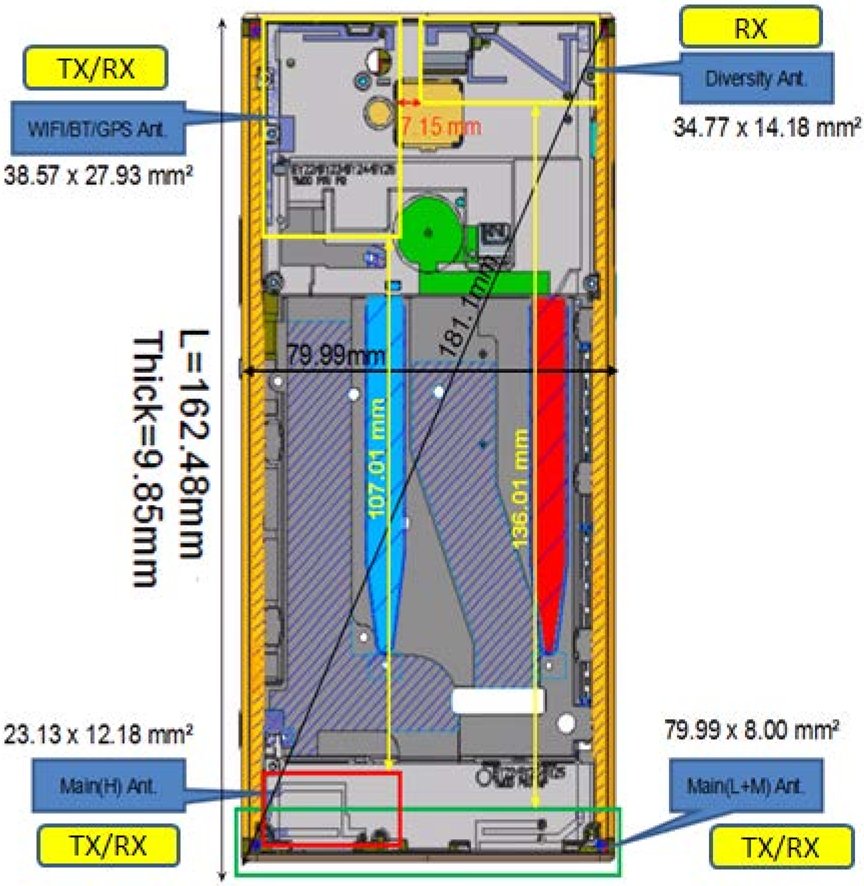
There are two main antennas at bottom of lower half. One is used for high band and the other is used for low-middle band. The two antennas are used for main transmission and reception, a diversity antenna is used for RX, located at the upper left corner.

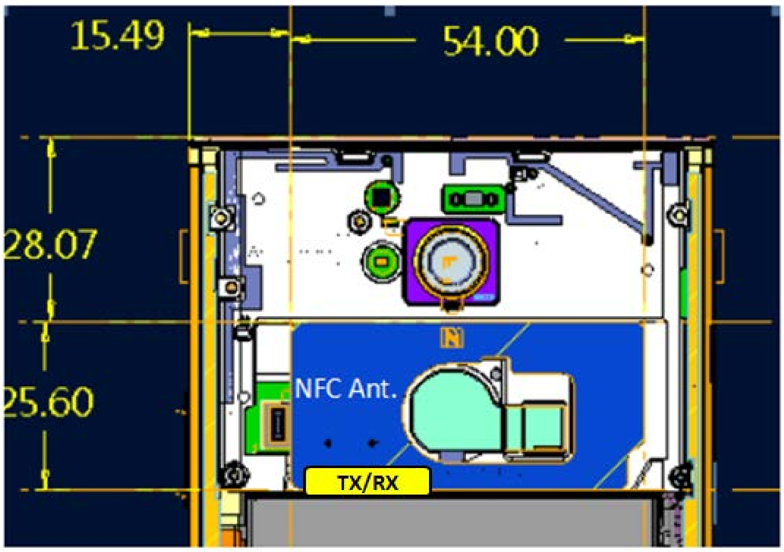
The Front End block connects the proper block in the radio system to the antenna. The Front End has two inputs for EDGE/GSM/GPRS, one for low band (850/900 MHz) and one for high band (1800/1900 MHz). The EDGE/GSM/GPRS power amplifier output is filtered by a low pass filter in the Front End and then connected to the antenna through a switch. In receive mode, the EDGE/GSM/GPRS signal from the antenna passes through the switch to one of the four receive SAW filters. The SAW filter provide receive band selectivity.

In GSM/GRPS/EDGE systems, transmit and receive operations are divided in time and the switch connects the proper block in accordance with the mode of operation (that is, transmit or receive; one at a time).

In WCDMA/LTE the transmit outputs from the WCDMA transceiver are filtered by a SAW filter that cleans up the spectrum. The SAW filter output is connected to the power amplifier, one for each band. This signal is used to control the transmitter output power. The transmit signal passes through a duplexer. The duplexer output is selected by the switch in the Front End for connection to the antenna. In WCDMA receive mode the signal from the antenna is switched by the Front End to the correct duplexer. The output from the duplexer is connected to the LNA input in the WCDMA receiver.

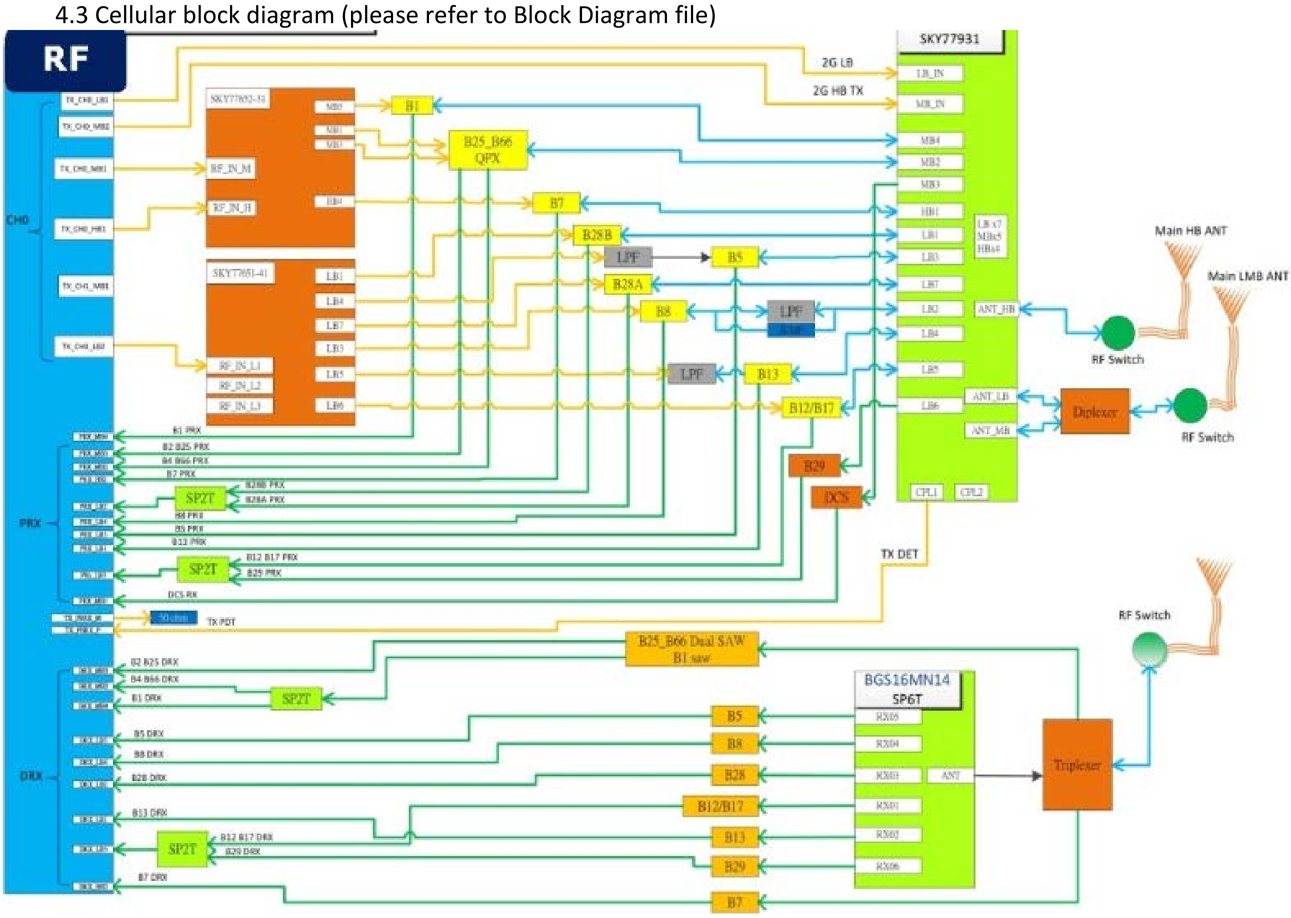
4.2 Antenna combination





Block	Antenna	Support Bands
LTE	Main (L+M)	LTE Band 2,4,5,12,13,17,25,29,66
	Diversity (Rx)	LTE Band 2,4,5,7,12,13,17,25,29,66
	Main (H)	LTE Band 7
UMTS	Main (L+M)	HSDPA/ WCDMA Band 2,4,5
	Diversity (Rx)	HSDPA/ WCDMA Band 2,4,5
GSM	Main (L+M)	GSM/GPRS/EGPRS 850/1900
GPS	GPS	GPS, GALILEO, GLONASS and BEIDOU
WLAN/BT	WIFI/BT	BT5.0, 802.11 a/b/g/n/ac
NFC	NFC (TX+RX)	NFC

4.3 Cellular block diagram (please refer to Block Diagram file)



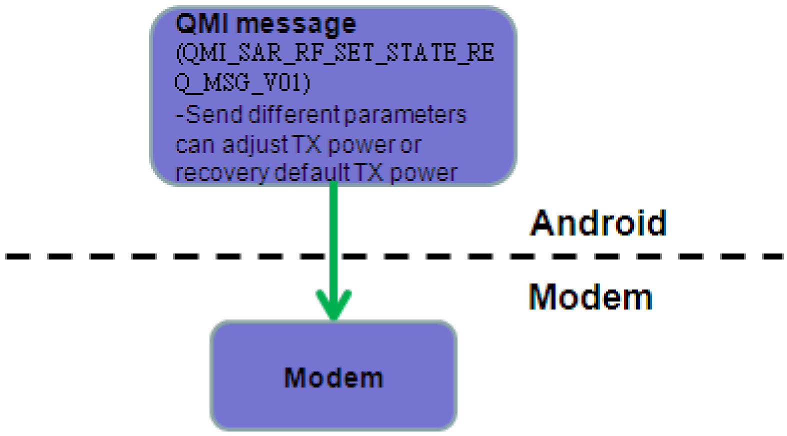
4.4 Dual transfer mode

Dual Transfer Mode (DTM) is supported by Qualcomm default setting. Dual Transfer Mode (DTM) is a protocol based on the GSM standard that makes simultaneous transfer of Circuit switched (CS) voice and Packet switched (PS) data over the same radio channel (ARFCN) simpler

4.5 Devices using mobile country code

Control by SW, device will detect register network's mobile country code. Device can get current register network's mobile country code and compare CE mobile country code list (It come from customer). If this mobile country code is include CE mobile country code list, device will enable power back off mechanism.

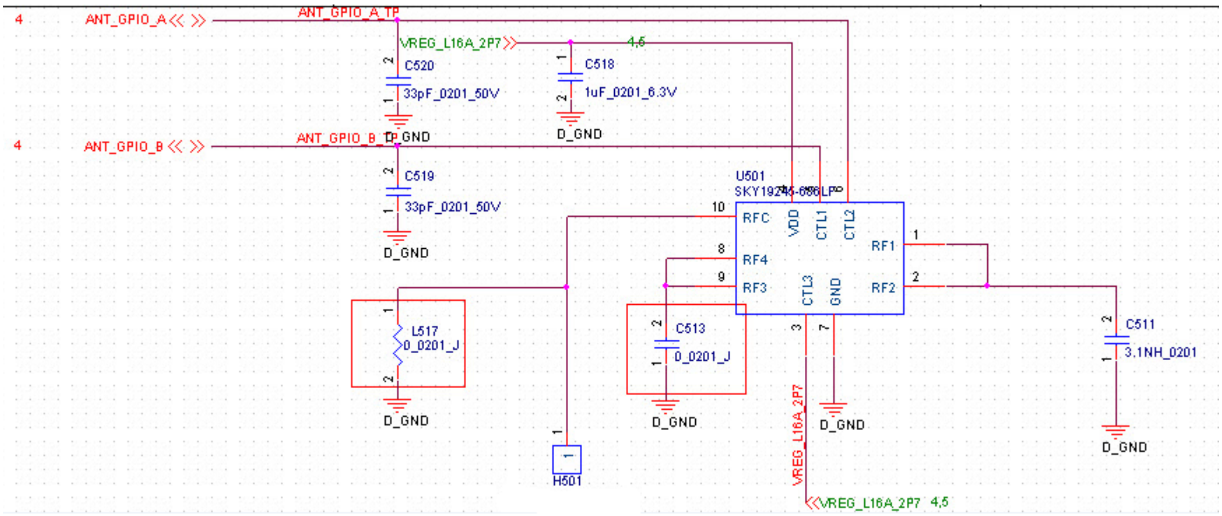
For QCT platform, we sync Sony reference project's design. Device adjust the TX power by QMI message (QMI_SAR_RF_SET_STATE_REQ_MSG_V01). And power table is defined at modem(NV item).You can see it at below.



4.6 Antenna matching switch circuit

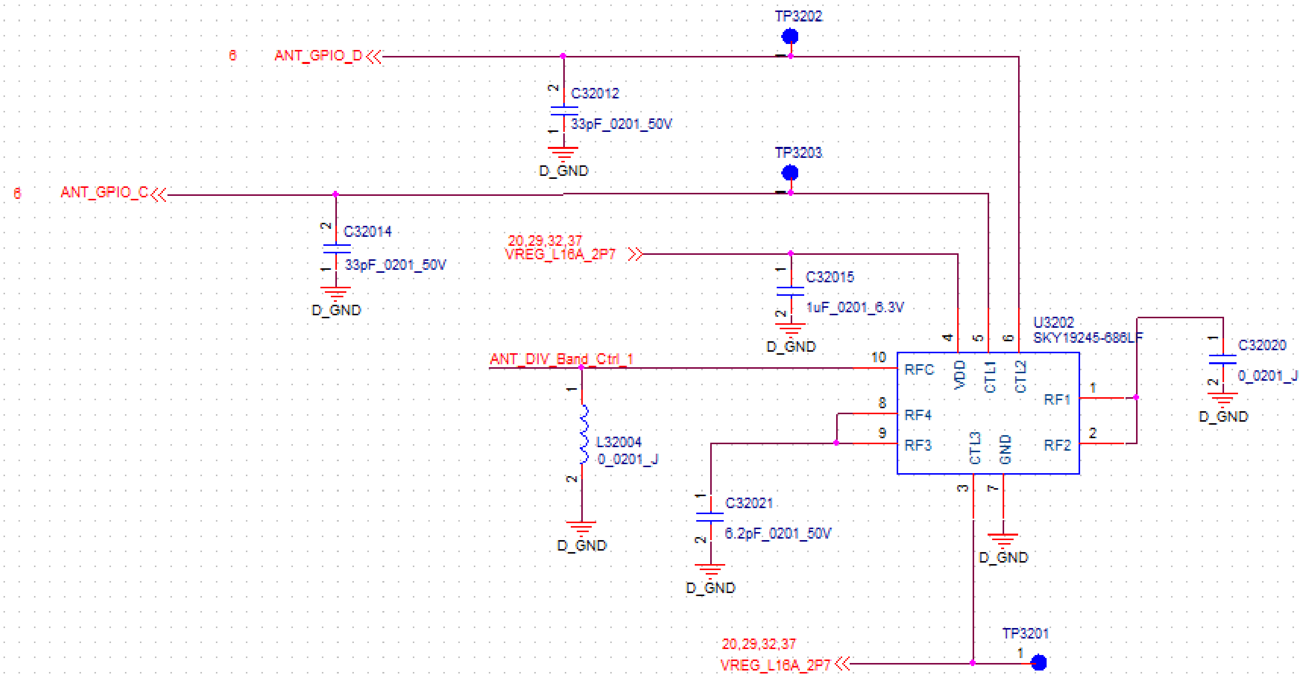
Device have antenna SPDT switch for better impedance matching of Main & Diversity antenna to increase antenna efficiency.

Main Antenna SPDT switch:



Note : L517 : None mount, C513 : Mount

Diversity Antenna SPDT switch:



Note : C32020: 2nH

5 Wi-Fi/BT

5.1 Configuration

The information of WLAN operation and Block diagram for WCN3980 as follows. Regarding the power, please refer to each manufacturing tolerance. This device 2.4G WLAN support Hotspot operation and Bluetooth support tethering application.

Band [MHz]	BW [MHz]	DFS/TPC	Channel set
2412.000 - 2462.000	20	n/a	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
5180.000 - 5240.000	20	n/a	36, 40, 44, 48,
	40		38, 46
	80		42
5260.000 - 5320.000	20	DFS	52, 56, 60, 64,
	40		54, 62
	80		58
5500.000 - 5640.000	20	DFS	100, 104, 108, 112, 116, 120, 124, 128
	40		102, 110, 118, 126
	80		106, 122
5660.000 - 5720.000	20	DFS	132, 136, 140, 144
	40		134, 142
	80		138
5745.000 - 5825.000	20	n/a	149, 153, 157, 161, 165
	40		151, 159
	80		155

For Industry Canada(IC), 120, 122, 124, 128 / 118, 126 channels are not supported

[Wi-Fi Channel]

2.4GHz Operation

Channel	Freq. (MHz)	DFS/TPC	Scanning	802.11 Mode
1	2412	-	Active	b/g/n/ac
2	2417	-	Active	b/g/n/ac
3	2422	-	Active	b/g/n/ac
4	2427	-	Active	b/g/n/ac
5	2432	-	Active	b/g/n/ac
6	2437	-	Active	b/g/n/ac
7	2442	-	Active	b/g/n/ac
8	2447	-	Active	b/g/n/ac
9	2452	-	Active	b/g/n/ac
10	2457	-	Active	b/g/n/ac
11	2462	-	Active	b/g/n/ac

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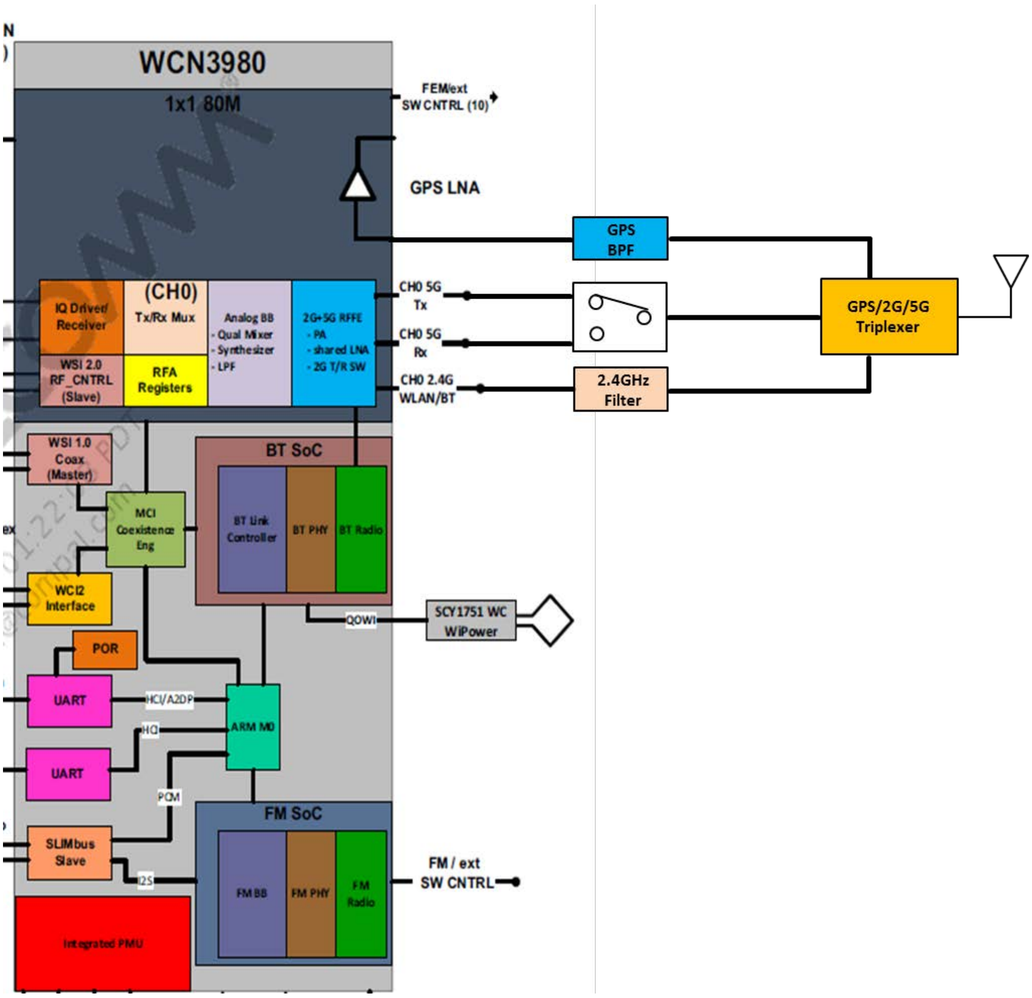
5GHz Operation in U-NII Bands - 802.11 Channel Plan (KDB 905462 D06)

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	DFS/TPC	Scanning	802.11 Mode
UNII 1								
20MHz BW		40MHz BW		80MHz BW				
36	5180	38	5190	42	5210	-	Active	a/n/ac
40	5200					-	Active	
44	5220	46	5230			-	Active	
48	5240					-	Active	
UNII 2-A								
20MHz BW		40MHz BW		80MHz BW				
52	5260	54	5270	58	5290	DFS/TPC	Passive	a/n/ac
56	5280					DFS/TPC	Passive	
60	5300	62	5310			DFS/TPC	Passive	
64	5320					DFS/TPC	Passive	
UNII 2-C								
20MHz BW		40MHz BW		80MHz BW				
100	5500	102	5510	106	5530	DFS/TPC	Passive	a/n/ac
104	5520					DFS/TPC	Passive	
108	5540	110	5550			DFS/TPC	Passive	
112	5560					DFS/TPC	Passive	
116	5580	118(*1)	5590	122(*1)	5610	DFS/TPC	Passive	
120(*1)	5600					DFS/TPC	Passive	
124(*1)	5620	126(*1)	5630			DFS/TPC	Passive	
128(*1)	5640					DFS/TPC	Passive	
132	5660	134	5670	138	5690	DFS/TPC	Passive	
136	5680					DFS/TPC	Passive	
140	5700	142	5710			DFS/TPC	Passive	
144	5720					DFS/TPC	Passive	
UNII 3								
20MHz BW		40MHz BW		80MHz BW				
149	5745	151	5755	155	5775	-	Active	a/n/ac
153	5765					-	Active	
157	5785	159	5795			-	Active	
161	5805					-	Active	
165	5825					-	Active	

(*1) For Industry Canada(IC), 120, 122, 124, 128 / 118, 126 channels are not supported.



Figure_WCN3980

5.2 Power control by mobile country code

WLAN power in 2.4GHz will be controlled by Mobile Country Code, hereafter referred to as MCC, for our products. We use MCC alone. US MCC includes US territories, such as Guam, or Puerto Rico, etc., and the default operation mode is for compliant operation in the US and its territories.

The mechanism meets the requirement from KDB 594280 D01 Software Configuration Control v02r01 to check MCC because the phone is constantly receiving MCC and whenever the network changes, such as handover to a new cell, loss of signal, etc., the phone will revert to the default mode and follow the decision process once MCC has been decoded.

If a valid code is not received, the device may not be reconfigured, and will search another base station with a valid code. Until a valid code is received, the device may not transmit any control signals or data. All these behaviors comply with 3GPP/3GPP2 specification.

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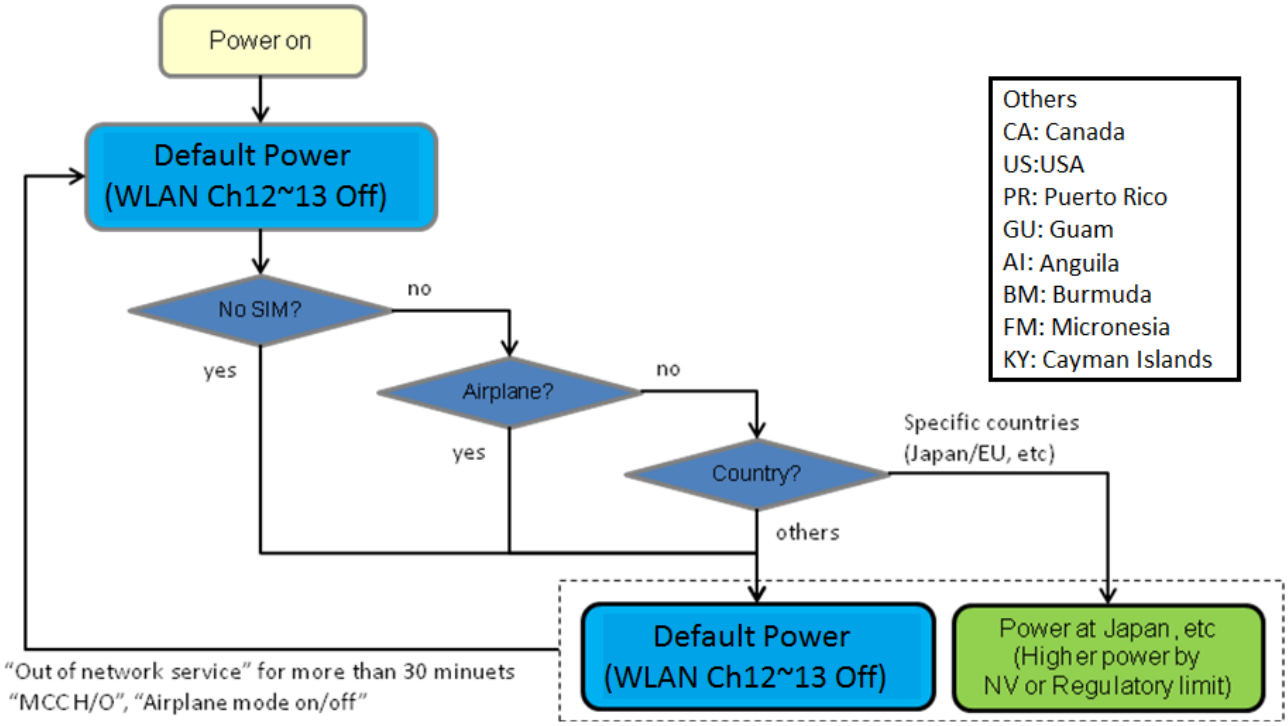
WLAN Power controlled by Mobile Country Code flow

The mobile phone, by default, operates in a mode that is compliant with the U.S. requirements, and regularly rechecks the geo-location information at least once every hour when the phone is switched on and connections are established or changed.



If receiving MCC does not match with JP or EU or others MCC which stores in the phone firmware, then the power will be set to the default mode which is comply with FCC regulation. If MCC received is other countries, Wi-Fi channel and power settings follows its mapping regulatory domain

5.3 For geolocation mechanism test validation

Set up phone with Wi-Fi link in channel 12 and 13 and way to measure power (coupler or antenna).

Step1: Start with no cellular connection and check power.
Step2: Set cellular connection with EU country code.
Measure power (should be high)
Step3: Set country code to US
Measure power (should be off – no power)
Step4: Set country code to Japan
Measure power (should be high)
Step5: Set country code to other.(Ex: PR - Puerto Rico)
Measure power (should be off – no power)

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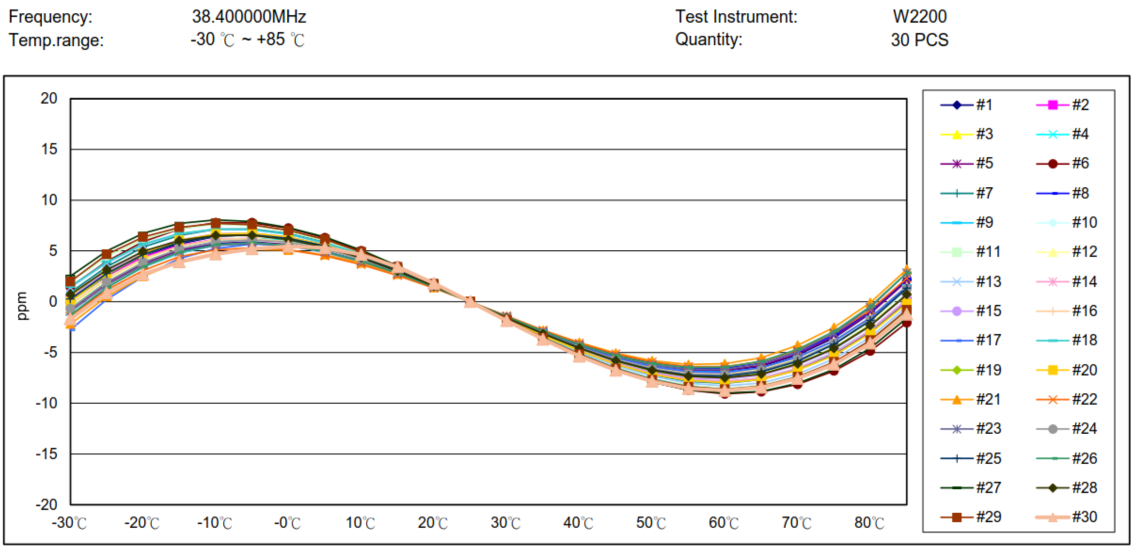
Ch12 and 13 are measured respectively and all compliant with FCC regulation as below table.

Channel	Modulation	C-code	No Sim	UK	US	JP	other(PR)
		MCC	-	234	310	440	330
12	11b_1M	target [dBm]	N/A	14	N/A	14	N/A
		actual [dBm]	N/A	13.38	N/A	13.45	N/A
	11g_6M	target [dBm]	N/A	13.5	N/A	13.5	N/A
		actual [dBm]	N/A	12.92	N/A	13.15	N/A
13	11b_1M	target [dBm]	N/A	14	N/A	14	N/A
		actual [dBm]	N/A	13.45	N/A	13.51	N/A
	11g_6M	target [dBm]	N/A	13.5	N/A	13.5	N/A
		actual [dBm]	N/A	12.97	N/A	12.95	N/A

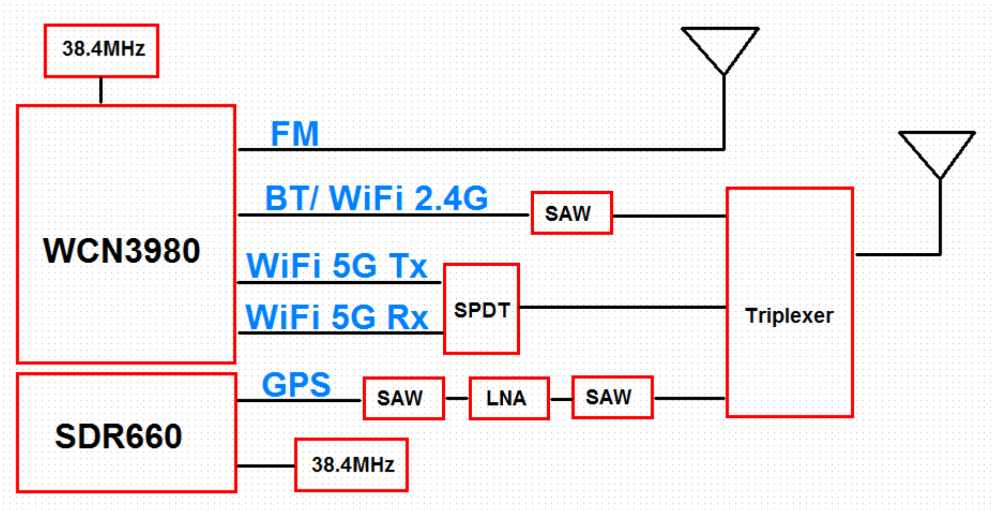
N/A: Ch12, 13 are off, and no power measured.

5.4 WLAN frequency tolerance/stability

Frequency tolerance/ stability: Max +/- 10 ppm



5.5 WLAN BT block diagram



5.6 Bluetooth

WCN3980 supports BT5.0 + BLE. Block diagram for Bluetooth is included

"WLAN/BT/BLE Block Diagram: refer to 5.5.

BT: 2402-2480MHZ, 1MHZ step 79ch(0-78ch)

BLE: 2402-2480MHZ, 2MHZ step 40ch(0-39ch)

Regarding the power, please refer to each manufacturing tolerance.

Bluetooth Declaration Per FCC 15.247 Requirements

(1) Output power and channel separation of a Bluetooth device in the different operating modes:
The different operating modes (data-mode, acquisition-mode) of a Bluetooth device don't influence the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters. Only a different hopping sequence will be used. For this reason the check of these RF parameters in one op-mode is sufficient.

(2) Frequency range of a Bluetooth device:
Hereby we declare that the maximum frequency of this device is: 2402 - 2480 MHz.
This is according the Bluetooth Core Specification V 5.0 for devices which will be operated in the USA.
This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04-E).
Other frequency ranges (e.g. for Spain, France, Japan) which are allowed according the Core Specification are not supported by this device.

(3) Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:
Bluetooth units which want to communicate with other units must be organized in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from it's BD address which is unique for every Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

(4) Example of a hopping sequence in data mode:
Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67,
56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59,
72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75,
09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06,
01, 51, 03, 55, 05, 04

(5) Equally average use of frequencies in data mode and behavior for short transmissions:
The generation of the hopping sequence in connection mode depends essentially on two input values:

1. LAP/UAP of the master of the connection

2. Internal master clock The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS.

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronization with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used.

With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behaviors:
The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended.
The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always differ from the first one.

(6) Receiver input bandwidth and behaviors for repeated single or multiple packets:
The input bandwidth of the receiver is 1 MHz.
In every connection one Bluetooth device is the master and the other one is the slave.
The master determines the hopping sequence (see chapter 5). The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master.

Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.

Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

(7) Dwell time in data mode

Test Mode:	DH5	**Temperature:**	24~26ºC
Test Engineer	Luffy Lin and Derek Hsu	**Relative Humidity**	48~53%

Mode	**Hopping Channel Number**	**Hops Over Occupancy Time(hops)**	**Package Transfer Time (msec)**	**Dwell Time (sec)**	**Limits (sec)**	**Pass/Fall**
Normal	79	106.67	2.90	0.31	0.4	Pass
AFH	20	53.34	2.90	0.15	0.4	Pass

Remark:

1. In normal mode, hopping rate is 1600 hops/s with 6 slots in 79 hooping channels.

With channel hopping rate (1600/6/79) in Occupancy Time Limit (0.4x79)(s).

Hops Over Occupancy Time comes to (1600 / 6 / 79)x(0.4x79){s}.

2. In AFH mode, hopping rate is 800 hops/s with 6slots in 20 hopping channels.

With channel hopping rate (800 / 6 / 20) in Occupancy Time Limit (0.4 x 20) (s).

Hops Over Occupancy Time comes to (800 / 6/ 20) x (0.4 x 20) = 53.33 hops.

3. Dwell Time(s)= Hops Over Occupancy Time(hops) x Pacge Transfer Time

(8) Channel Separation in hybrid mode
The nominal channel spacing of the Bluetooth system is 1MHz independent of the operating mode.
The maximum “initial carrier frequency tolerance” which is allowed for Bluetooth is fcenter = 75 kHz.
This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/07-E) for three frequencies (2402, 2441, 2480 MHz).
Additionally an example for the channel separation is given in the test report.

(9) Derivation and examples for a hopping sequence in hybrid mode
For the generation of the inquiry and page hop sequences the same procedures as described for the data mode are used (see chapter 5), but this time with different input vectors:

For the inquiry hop sequence, a predefined fixed address is always used. This results in the same 32 frequencies used by all devices doing an inquiry but every time with a different start frequency and phase in this sequence.

For the page hop sequence, the device address of the paged unit is used as input vector. This results in the use of a subset of 32 frequencies which is specific for that initial state of the connection establishment between the two units. A page to different devices would result in a different subset of 32 frequencies.

So it is ensured that also in hybrid mode the frequency use equally averaged.

Example of a hopping sequence in inquiry mode:
48, 50, 09, 13, 52, 54, 41, 45, 56, 58, 11, 15, 60, 62, 43, 47, 00, 02, 64, 68, 04, 06,
17, 21, 08, 10, 66, 70, 12, 14, 19, 23

Example of a hopping sequence in paging mode:
08, 57, 68, 70, 51, 02, 42, 40, 04, 61, 44, 46, 63, 14, 50, 48, 16, 65, 52, 54, 67, 18, 58, 56, 20,
53, 60, 62, 55, 06, 66, 64

(10) Receiver input bandwidth and synchronization in hybrid mode:
The receiver input bandwidth is the same as in the data mode (1 MHz). When two Bluetooth devices establish contact for the first time, one device sends an inquiry access code, the other device is scanning for this inquiry access code. If two devices have been connected previously and want to start a new transmission, a similar procedure takes place. The only difference is, instead of the inquiry access code, an special access code, derived from the BD_ADDRESS of the paged device will be, will be sent by the master of this connection.
Due to the fact that both units have been connected before (in the inquiry procedure) the paging unit has timing and frequency information about the page scan of the paged unit. For this reason the time to establish the connection is reduced considerable.

(11) Spread rate / data rate of the direct sequence signal
The Spread rate / Data rate in inquiry and paging mode can be defined via the access code. The access code is the only criterion for the system to check if there is a valid transmission or not. If you regard the presence of a valid access code as one bit of information, and compare it with the length of the access code of 68 bits, the Spread rate / Data rate will be 68/1.

(12) Spurious emission in hybrid mode
The Dwell in hybrid mode is shorter than in data mode. For this reason the spurious emissions average level in data mode is worst case. The spurious emissions peak level is the same for both modes.

6 GNSS

The SDR660 is Integrated GNSS RF receiver.

6.1 GNSS features

(1) RF supports GPS, GALILEO, GLONASS and BEIDOU.

(2) Support Simultaneous-GNSS (WAN + GNSS at the same time).

(3) Support Standalone-GNSS (without WAN)

7 NFC

PN553 is an NFC controller designed for integration in mobile devices and devices compliant with NFC standards (NFC Forum, NCI, EMVCo, ETSI/SCP).

PN553 is designed based on learnings from previous NXP NFC device generation to ease the integration of NFC technology in mobile devices by providing:

(1)A low PCB footprint and a reduced external Bill of Material by enabling as unique feature the capability to achieve RF standards (NFC Forum, EMVCo card) with small form factor antenna

(2)An optimized architecture for low-power consumption in different modes (Standby, low-power polling loop)

(3)A highly efficient integrated power management unit allowing direct supply from a mobile battery while a constant power (operating distance in Reader/Writer mode) for extended battery supply range (2.8 V to 5.5 V) can be achieved. Moreover, this power management provides full flexibility to support the different configurations in the mobile devices (screen ON, screen OFF, phone OFF)

PN553 embeds a new generation RF contactless front-end supporting various transmission modes according to NFCIP-1 and NFCIP-2, ISO/IEC14443, ISO/IEC 15693, MIFARE and FeliCa specifications. This new contactless front-end design brings a major performance step-up with on one hand a higher sensitivity and on the other hand the capability to work in active load modulation communication enabling the support of small antenna form factor.

Supported transmission modes are listed in below Figure. For contactless card functionality, the PN553 can act autonomously if previously configured by the host in such a manner. PICC functionality can be supported without phone being turned on.

PN553 can be connected on a host controller through I2C-bus.

PN553 can be connected to a UICC through a SWP interface.

The SWP physical interfaces are compliant with ETSI/SCP SWP and HCI. Moreover, PN553 provides flexible and integrated power management unit in order to preserve energy supporting powered-down mode. It also allows various power schemes for the UICC.

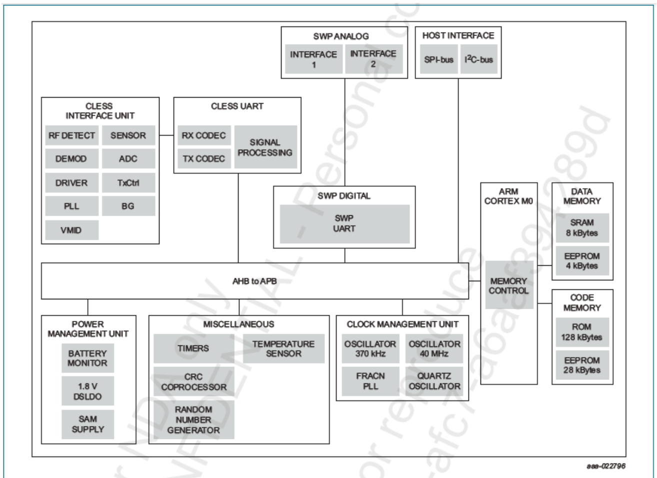
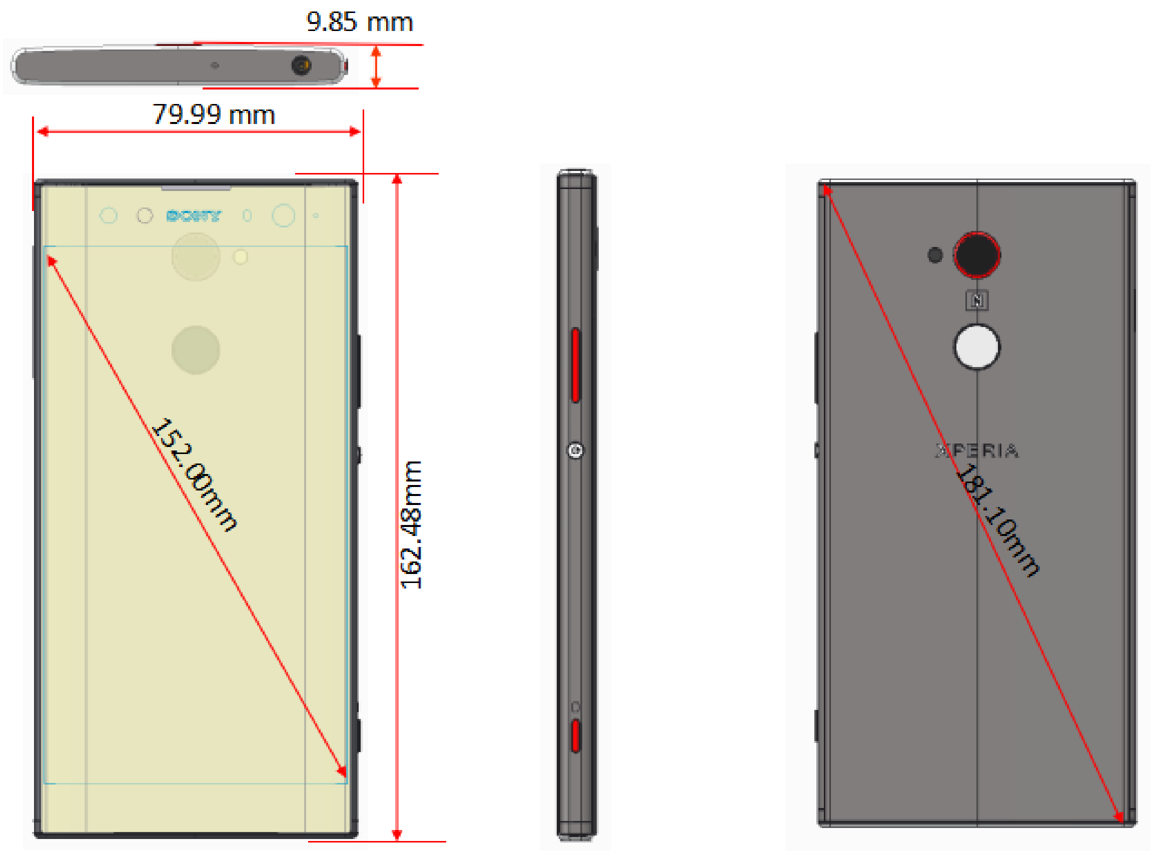


Fig 3. PN553 block diagram

8 Size of the Phone



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9 Technical description for WLAN Security

The information within this section of the /12Description is to show compliance against the Software Security Requirements laid out within KDB 594280 D02 U-NII Security.

The information below describes how we maintain the overall security measures and systems so that only:

1. Authenticated software is loaded and operating on the device
2. The device is not easily modified to operate with RF parameters outside of the authorization

General Description	
1. Describe how any software/firmware updates for elements than can affect the device's RF parameters will be obtained, downloaded, validated and installed. For software that is accessed through manufacturer's website or device's management system, describe the different levels of security as appropriate.	Software/Firmware is pushed from the Sony's authorized servers by means of encryption by OTA or PC tool via USB. But update packages are encrypted and digitally signed by proprietary key. Therefore, user cannot obtain unauthorized software/firmware.
2. Describe the RF parameters that are modified by any software/firmware without any hardware changes. Are these parameters in some way limited, such that any other software/firmware changes will not allow the device to exceed the authorized RF characteristics?	RF parameters are embedded at the time of production in the factory per FCC approved. These parameters are therefore fixed at the factory such that they will not exceed the authorized values.
3. Describe in detail the authentication protocols that are in place to ensure that the source of the RF-related software/firmware is valid. Describe in detail how the RF-related software is protected against modification	Yes, software/firmware are digitally signed and encrypted using proprietary handshaking, authorization and provisioning protocols. Secure Sockets Layer is used as a protocol for encrypting information over the internet. Therefore, Sony ensures that the source of the software/firmware is legitimate.
4. Describe in detail any encryption methods used to support the used of legitimate RF-related software/firmware.	Yes, by means of proprietary public key encryption.
5. For a device that can be configured as a master and client (with active or passive scanning), explain how the device ensures compliance for each mode? In particular if the device acts as master in some band of operation and client in another; how is compliance ensured in each band of operation?	The device will be able as master only ISM band and UNII 1 and 3 bands. For DFS bands, device cannot be master device with DFS detection. For compliance, device will transmit under approved power. And user can't access to change Master/client feature per band.

3rd Party Access Control	
1. Explain if any third parties have the capability to operate a U.S.-sold device on any other regulatory domain, frequencies, or in any manner that may allow the device to operate in violation of the device's authorization if activated in the U.S.	No, third parties don't have capability to access and change radio parameters.
2. Describe, if the device permits third-party software or firmware installation, what mechanisms are provided by the manufacturer to permit integration of such functions while ensuring that the RF parameters of the device cannot be operated outside its authorization for operation in the U.S. In the description include what control and/or agreements are in place with providers of third-party functionality to ensure the devices' underlying RF parameters are unchanged and how the manufacturer verifies the functionality.	No. As mentioned above, RF parameters or other parameters which impact device compliance are fixed at time of production in the factory.
3. For Certified Transmitter modular devices, describe how the module grantee ensures that hosts manufactures fully comply with these software security requirements for U-NII devices. If the module is controlled through driver software loaded in the host, describe how the drivers are controlled and managed such that the modular transmitter RF parameters are not modified outside the grant of authorization.	Not a modular device

SOFTWARE CONFIGURATION DESCRIPTION GUIDE – USER CONFIGURATION GUIDE[1]	
1. Describe the user configurations permitted through the UI. If different levels of access are permitted for professional installers, system integrators or end-users, describe the differences.	The UI is accessible to anyone using the device. But the UI never gives access for specific operation parameters which are frequency of operation, power settings, antenna types, DFS settings, receiver thresholds, or country code settings.
a) What parameters are viewable and configurable by different parties?	Nothing to control the radio operation parameter for professional installer/end-user
b) What parameters are accessible or modifiable by the professional installer or system integrators?	This device is not subject to professional installation

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SOFTWARE CONFIGURATION DESCRIPTION GUIDE – USER CONFIGURATION GUIDE[1]	
1) Are the parameters in some way limited, so that the installers will not enter parameters that exceed those authorized?	
2) What controls exist that the user cannot operate the device outside its authorization in the U.S.?	
c) What parameters are accessible or modifiable to by the end-user?	The end user has no access to configuration settings that could change the radio operation parameters.
1) Are the parameters in some way limited, so that the user or installers will not enter parameters that exceed those authorized?	
2) What controls exist so that the user cannot operate the device outside its authorization in the U.S.?	
d) Is the country code factory set? Can it be changed in the UI?	The country code is factory set and it is never changed by UI.
1) If it can be changed, what controls exist to ensure that the device can only operate within its authorization in the U.S.?	
e) What are the default parameters when the device is restarted?	The specific operation parameters which are frequency of operation, power settings, antenna types, DFS settings, receiver thresholds, or country code settings are never changed after even being restarted.
2. Can the radio be configured in bridge or mesh mode? If yes, an attestation may be required. Further information is available in KDB Publication 905462 D02.	This device cannot be configured in a bridge or mesh mode
3. For a device that can be configured as a master and client (with active or passive scanning), if this is user configurable, describe what controls exist, within the UI, to ensure compliance for each mode. If the device acts as a master in some bands and client in others, how is this configured to ensure compliance?	The device will be able as master only ISM band and UNII 1 and 3 bands. For DFS bands, device cannot be master device with DFS detection. For compliance, device will transmit under approved power. And user can't access to change Master/client feature per band
4. For a device that can be configured as different types of access points, such as point-to-point or point-to-multipoint, and use different types of antennas, describe what controls exist to ensure compliance with applicable limits and the proper antenna is used for each mode of operation. (See Section 15.407(a))	The device will be able as master only ISM band and UNII 1 and 3 bands. For DFS bands, device cannot be master device with DFS detection. For compliance, device will transmit under approved power. And user can't access to change Master/client feature per band. The device only contains integrated antennas that are not user selectable or interchangeable.

Appendix A

PY7-67442A_ Referencing Test Data

FCC ID: PY7-48140L (lead) and FCC ID: PY7-67442A

The Purpose of this document is to provide information for FCC ID: PY7-67442A application to reuse test data according to "484596 D01 R eferencing Test Data DR01-42712".

FCC ID: PY7-48140L and FCC ID: PY7-67442A are electronically identical for WLAN/BT/GPS/NFC technology from comparison of the internal photos.

1. Introduction of different models:

The document describes details of the difference among PY7-48140L and PY7-67442A, and as a supporting document to justify data reuse across the 2 models.

<table>
<tr><td colspan="2">FCC ID</td><td>PY7-67442A</td><td>PY7-48140L (Leading)</td></tr>
<tr><td colspan="2">IC ID</td><td>4170B-21831Z</td><td>N/A</td></tr>
<tr><td rowspan="6">Supported US Frequency Band</td><td>GSM</td><td>850/1900</td><td>850/1900</td></tr>
<tr><td>UMTS</td><td>B2/4/5
(DL/UL: Cat 24/Cat 6)</td><td>B2/5
(DL/UL: Cat 24/Cat 6)</td></tr>
<tr><td>LTE</td><td>B2/4/5/7/12/13/17/25/29(Rx)/66
Rel.11</td><td>B2/5/7/41* (2555MHz~2655MHz)
Rel.11</td></tr>
<tr><td>WLAN</td><td>802.11 a/b/g/n(HT40)/ac (VHT80)
(ch1-ch11, B1-B4, Straddle mode)</td><td>802.11 a/b/g/n(HT40)/ac (VHT80)
(ch1-ch11, B1-B4, Straddle mode)</td></tr>
<tr><td>BT</td><td>BT5.0+BT/EDR</td><td>BT5.0+BT/EDR</td></tr>
<tr><td>NFC</td><td>YES</td><td>YES</td></tr>
</table>

2. Proposed Test Plan:

FCC ID	PY7-67442A	PY7-48140L (Leading)
EMC (Part 15B)	Full (certification)	Full (certification)
WWAN SAR	Full	Full
BT/WLAN SAR	Full	Full
WWAN RF (Part 22/24/27)	Full	Full
BT/WLAN/NFC RF (Part 15C, 15E)	Spot check conducted power and radiated spurious emission from PY7-48140L	Full
HAC	Yes	N/A

3. Comparison of transmitters across different models

FCC ID		PY7-67442A	PY7-48140L (Leading)
Platform		●	●
WWAN	Chip	SDR660	SDR660
	Component on PCB	▲	●
	Antenna (L + M band)	●	●
	Antenna (H band)	▲	●
	Antenna performance	▲	●
	Output power level	▲	●
Wi-Fi/BT	Chip	WCN3980	WCN3980
	Component on PCB	●	●
	Antenna (same part#)	●	●
	Antenna performance	●	●
	Output power level	●	●
NFC	Chip	PN553	PN553
	Component on PCB	●	●
	Antenna (same part#)	●	●
	Antenna performance	●	●
	Output power level	●	●

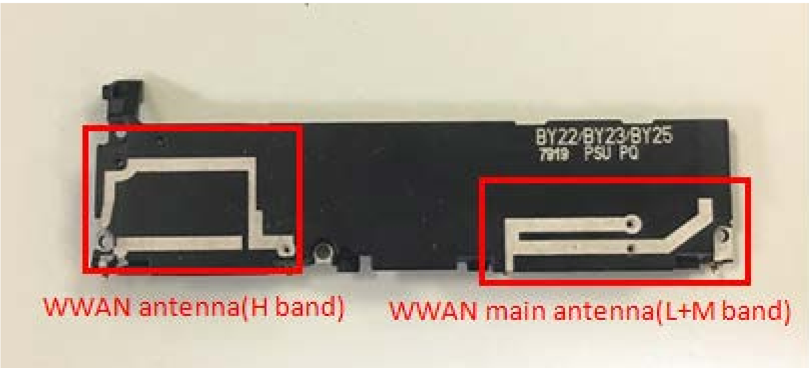
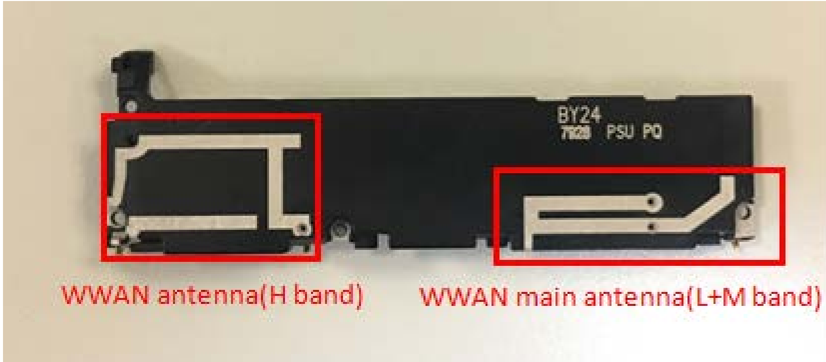
Remark:

●: Identical

▲: Different

4. Comparison of antennas across different models

Only WWAN (H band) antennas are different. Wi-Fi/BT/NFC antenna, WWAN (L+M band) antenna and WWAN Diversity are the same.

<table>
<tr><th>PY7-67442A</th><th>PY7-48140L</th></tr>
<tr><td>
</td><td>
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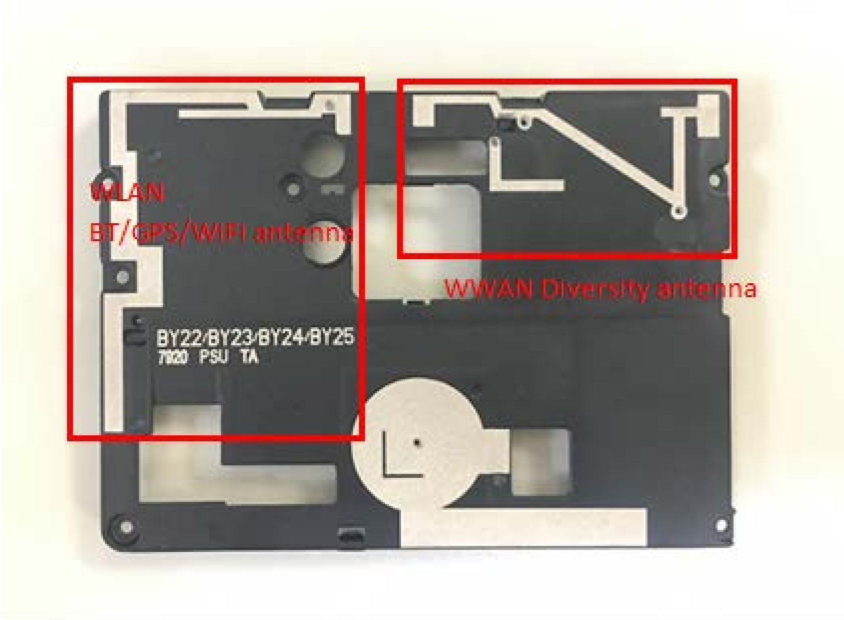
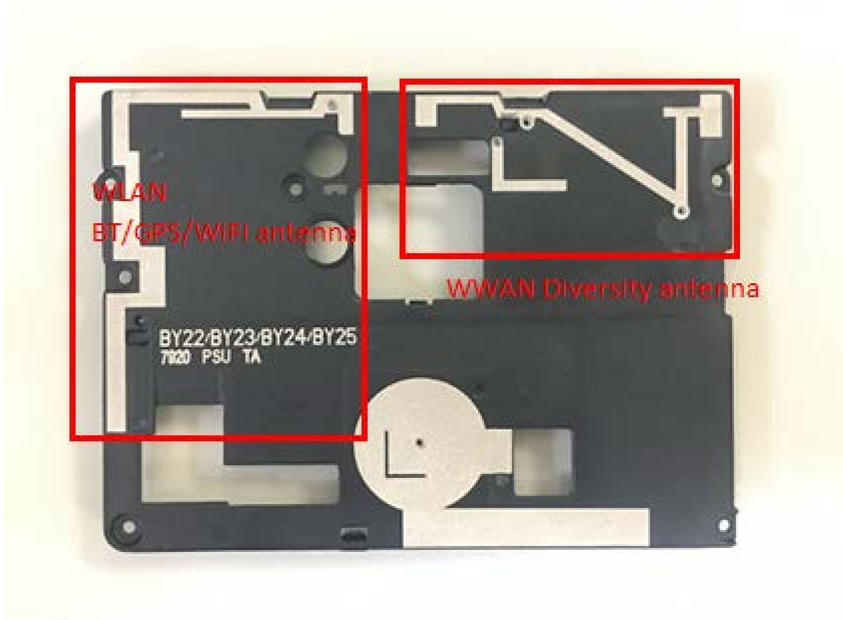
<tr><td>
</td><td>
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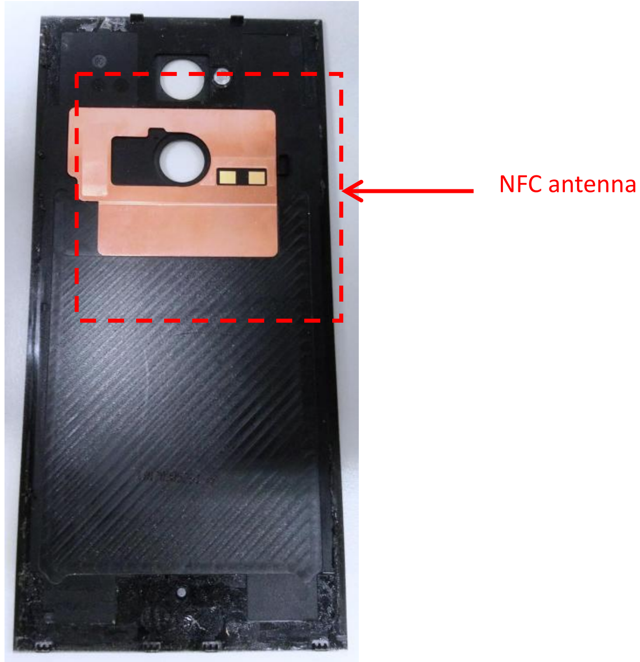
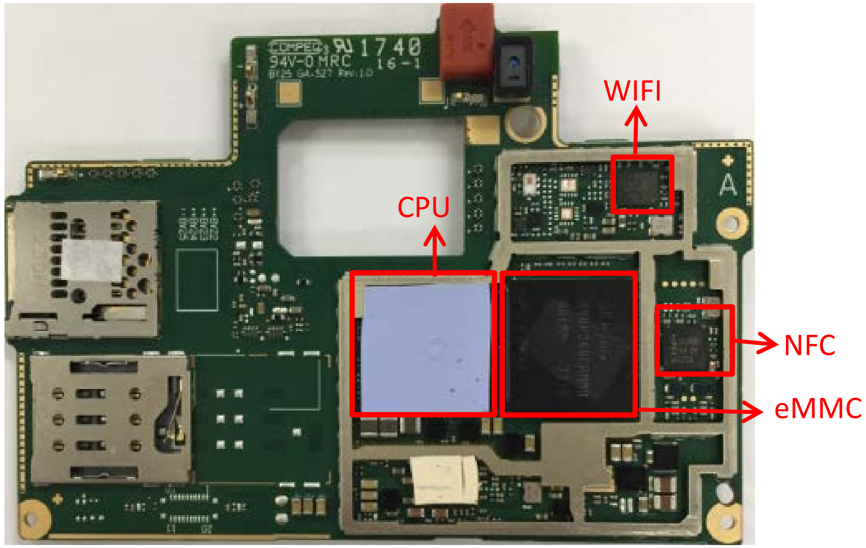
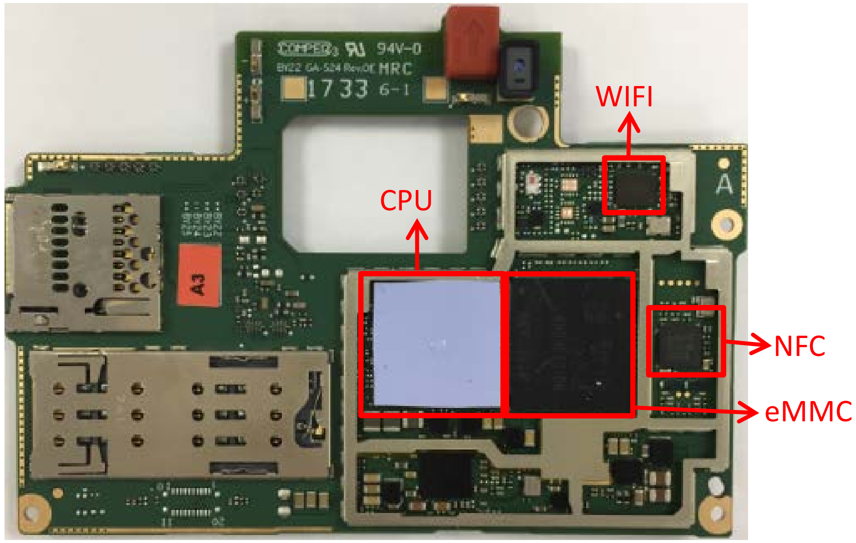
</table>

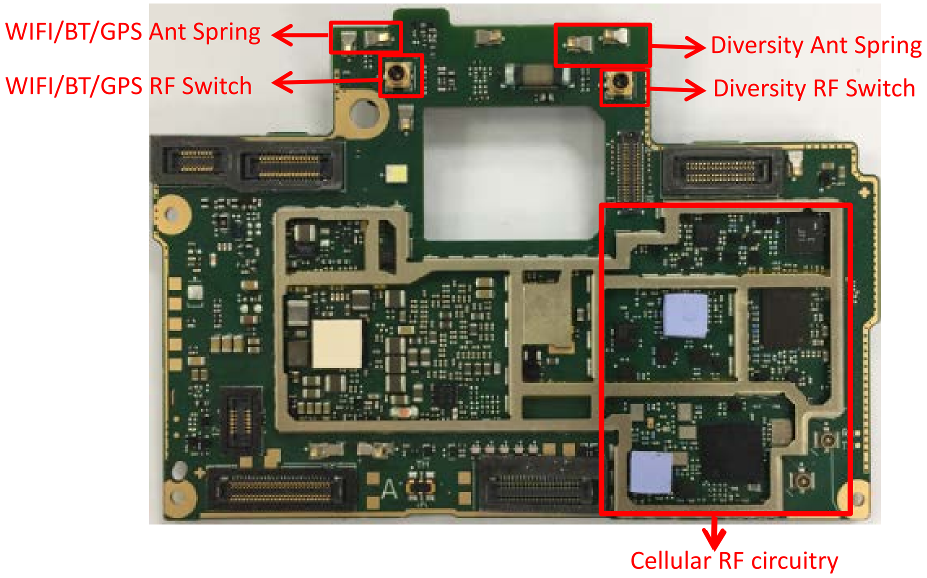
PY7-67442A / PY7-48140L [NFC antenna on the back cover] Only one NFC Antenna	
	

5. Comparison of PCB across different models

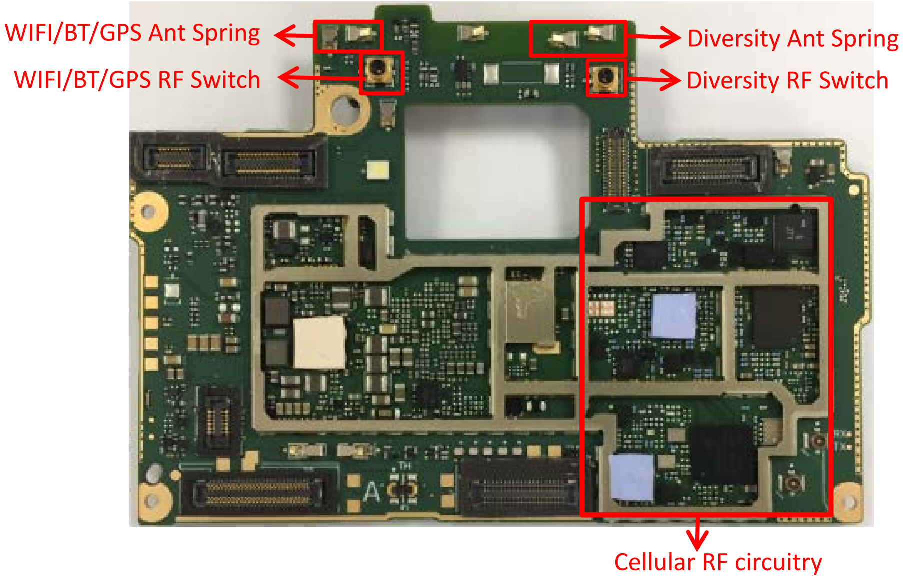
Each models uses identical PCB layout and components of Wi-Fi/BT/NFC.

PY7-67442A and PY7-48140L uses the identical PCB layout and components of WWAN.

PY7-67442A	PY7-48140L
 **Top view**	 **Top view**



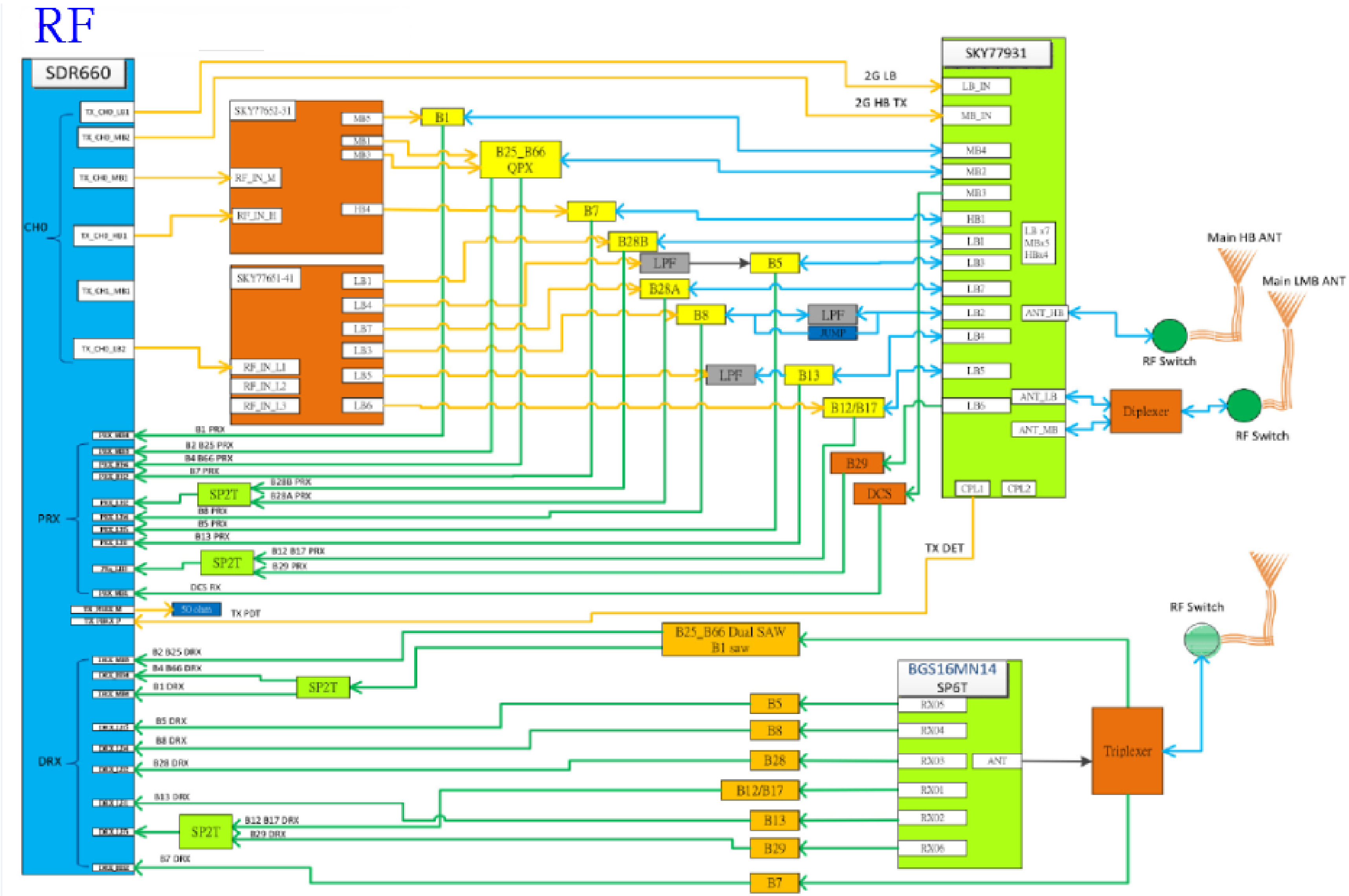
Bottom view



Bottom view

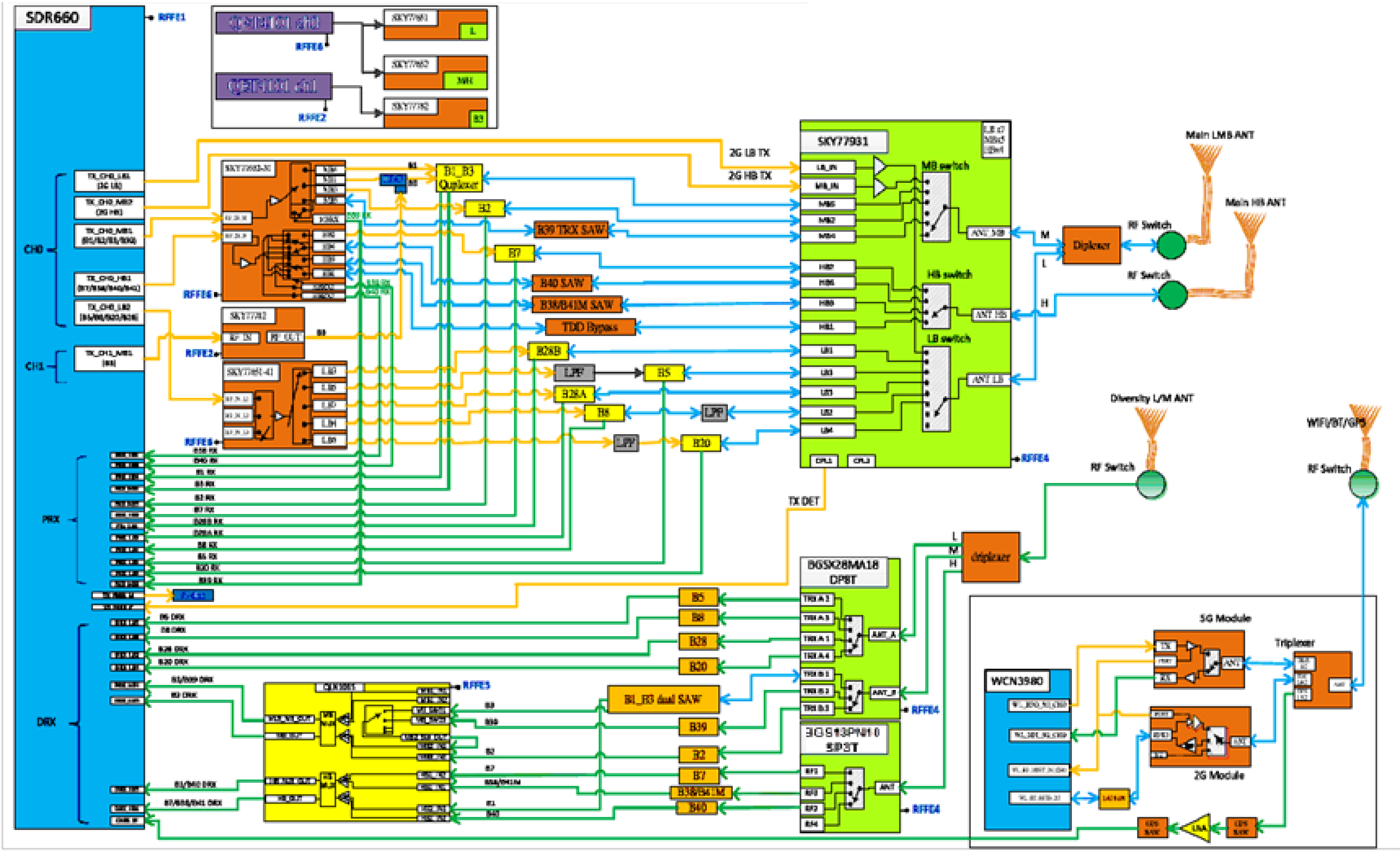
6. Comparison of Schematics (TX/RX Portion)

PY7-67442A



PY7-48140L

RF



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7. RF power

Wi-Fi, Bluetooth, NFC: RF maximum output power level (including tolerance) is the same