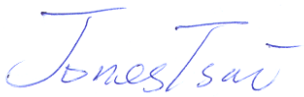
Spot Check Evaluation

Reviewed by: Joseph Lin / Supervisor



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REVISION HISTORY

VERSION	DESCRIPTION	ISSUED DATE
Rev. 01	Initial issue of report	Mar. 23, 2017

1. Introduction Section

For BT/WLAN:

The original model (FCC ID: ZNFX240H) and the variant model (FCC ID: ZNFX240DS) has identical PCB layout, antenna, SW implementation for Bluetooth/Wi-Fi/GPS. Based on their similarity, the FCC Part 15C (equipment class: DTS, DSS) test data issued for original model also apply for the variant model.

For WWAN:

The original model (FCC ID: ZNFX240YK) and the variant model (FCC ID: ZNFX240DS) has identical PCB layout, antenna, SW implementation for GSM/WCDMA/LTE. Based on their similarity, the FCC Part 22, 24, 27 (equipment class: PCS) test data issued for original model also apply for the variant model.

The applicant takes full responsibility that the test data as referenced in section 4 below represent compliance for this FCC ID (FCC ID: ZNFX240DS).

2. Difference Section

For BT/WLAN:

The original model (FCC ID: ZNFX240H) and the variant model (FCC ID: ZNFX240DS) has identical PCB layout, antenna, SW implementation for Bluetooth/Wi-Fi/GPS. The details of similarity and difference can be found in the Produce Equality Description.

For WWAN:

The original model (FCC ID: ZNFX240YK) and the variant model (FCC ID: ZNFX240DS) has identical PCB layout, antenna, SW implementation for GSM/WCDMA/LTE. The details of similarity and difference can be found in the Produce Equality Description.

The product specification is outlined in the following table:

FCC ID		ZNFX240H	ZNFX240DS
Wireless Tech	**Mode**	**Frequency (MHz)**	
Wi-Fi	11b/11g/11n(HT20)/11n(HT40)	2412-2462 MHz	
Bluetooth	BR/EDR/LE	2402-2480 MHz	

FCC ID			ZNFX240YK	ZNFX240DS
Wireless Tech	**Mode**		**Frequency (MHz)**	
GSM	GSM Voice GPRS (GMSK) EDGE (8PSK)	Multi-Slot Class 12 DTM: No	850/1900	850/1900
UMTS	AMR/RCM12.2Kbps HSDPA/HSUPA/DC-HSDPA		B5	B5
LTE (FDD)	QPSK 16QAM		B5/B7	B7

3. Spot Check Verification Data Section

Summary of the spot check:

Test Item	Mode	ZNFX240H Worst Result	ZNFX240DS Worst Result	Difference (dB)
Average Conducted Power (dBm)	802.11b	16.97	16.89	0.08
	802.11g	14.63	14.48	0.15
	11n HT20	11.43	11.29	0.14
	11n HT40	10.99	10.68	0.31
	BT (1Mbps)	7.06	6.74	0.32
	BT (2Mbps)	4.71	4.30	0.41
	BT (3Mbps)	4.67	4.31	0.36
	BT-LE	-0.93	-1.08	0.15
	Test date	Nov. 03, 2016~ Feb. 24, 2017	Feb. 09, 2017~ Feb. 27, 2017	
Peak Conducted Power (dBm)	802.11b	19.85	19.84	0.01
	802.11g	22.58	22.38	0.2
	11n HT20	20.97	20.95	0.02
	11n HT40	21.52	21.21	0.31
	BT (1Mbps)	7.25	6.89	0.36
	BT (2Mbps)	6.49	6.15	0.34
	BT (3Mbps)	6.73	6.39	0.34
	BT-LE	-0.37	-0.38	0.01
	Test date	Nov. 03, 2016~ Feb. 24, 2017	Feb. 09, 2017~ Feb. 27, 2017	
Peak Radiated Spurious Emission (Band Edge) (dBuV/m)	11n HT40	59.53	57.50	-1.99
	BT (1Mbps)	44.26	45.02	-0.02
	BT-LE	54.28	53.45	-0.26
	Test date	Nov. 12, 2016~ Feb. 24, 2017		
Average Radiated Spurious Emission (Band Edge) (dBuV/m)	11n HT40	46.76	46.32	-0.54
	BT (1Mbps)	19.44	20.20	-0.02
	BT-LE	44.71	45.05	0.04
	Test date	Nov. 12, 2016~ Feb. 24, 2017	Feb. 20, 2017~ Feb. 27, 2017	
Peak Radiated Spurious Emission (Harmonic) (dBuV/m)	11n HT40	37.88	40.06	0.36
	BT (1Mbps)	38.86	40.91	1.41
	BT-LE	37.65	39.70	0.48
	Test date	Nov. 12, 2016~ Feb. 24, 2017	Feb. 20, 2017~ Feb. 27, 2017	

Test Item	Mode	ZNFX240YK Worst Result	ZNFX240DS Worst Result	Difference (dB)
Average Conducted Power (dBm)	GSM 850 (GPRS)	33.87	33.93	-0.06
	GSM 850 (EDGE)	26.92	26.79	0.13
	GSM 1900 (GPRS)	29.92	29.84	0.08
	GSM 1900 (EDGE)	25.90	25.90	0.00
	UMTS B5 (RMC 12.2Kbps)	24.98	25.00	-0.02
	LTE B7 (FDD - QPSK)	23.24	23.18	0.06
	Test date	Feb. 06, 2017~ Feb. 07, 2017	Feb. 10, 2017	
Radiated Spurious Emission (dBm)	GSM 850 (GPRS)	-45.91	-45.76	-0.15
	GSM 1900 (GPRS)	-35.86	-36.35	0.49
	LTE B7 (FDD - QPSK) / 5MHz	-40.90	-40.77	-0.13
	Test date	Feb. 04, 2017~ Feb. 17, 2017	Feb. 17, 2017~ Feb. 22, 2017	

	System	Type of Modulation	FCC ID ZNFX240YK	FCC ID ZNFX240DS
Maximum ERP/EIRP (W)	GSM850 GPRS class 8	GMSK	0.5420	0.4753
	GSM850 EDGE class 8	8PSK	0.1866	0.1652
	WCDMA Band V RMC 12.2Kbps	BPSK	0.0977	0.1005
	GSM1900 GPRS class 8	GMSK	0.8954	0.9099
	GSM1900 EDGE class 8	8PSK	0.2891	0.2891

Remark: Effective radiated power output measurements by substitution method according to ANSI / TIA / EIA-603-D-2010, and the spectrum analyzer configuration follows KDB 971168 D01 Power Meas. License Digital Systems v02r02.

	LTE Band 7		QPSK		16QAM	
	BW (MHz)	Frequency Range (MHz)	FCC ID ZNFX240YK	FCC ID ZNFX240DS	FCC ID ZNFX240YK	FCC ID ZNFX240DS
Maximum ERP/EIRP (W)	5	2502.5 ~ 2567.5	0.1355	-	0.1102	-
	10	2505.0 ~ 2565.0	0.1343	-	0.1132	-
	15	2507.5 ~ 2562.5	0.1416	-	0.1164	-
	20	2510.0 ~ 2560.0	**0.1459**	0.1297	**0.1183**	0.1012

Remark: Effective radiated power output measurements by substitution method according to ANSI / TIA / EIA-603-D-2010, and the spectrum analyzer configuration follows KDB 971168 D01 Power Meas. License Digital Systems v02r02.

Conclusion:

Radiated spurious emission test against the variant model based on the worst-case condition from the original model was performed in this filing to demonstrate the test data from original model remains representative for the variant model.

Based on the spot check test result (power levels measured are within 0.5dB, and the worst case of RSE spot check verification based on the worst condition from the original model is within 3dB, and are compliance with the limits), the test data from the original model is representative for the variant model.

The unwanted, harmonics, radiated spurious emission is reported peak measurement only due to spurious lower than 20dB than the limit.

The detail test results can be found in this document, Appendix A, hereafter.

4. Reference detail Section

Equipment Class	Reference FCC ID	Type Grant/Permissive Change	Reference Application	Folder Test/RF Exposure	Report Title
DTS	ZNFX240H	Original Grant	FR6O1802B FR6O1802C	Part 15C	All sections applicable
			FA6O1802	RF Exposure	All sections applicable
DSS	ZNFX240H	Original Grant	FR6O1802A	Part 15C	All sections applicable
			FA6O1802	RF Exposure	All sections applicable
PCS	ZNFX240YK	Original Grant	FG6D1013A FG6D1013B	Part 22(H) Part 24(E) Part 27(M)	All sections Applicable
			FA6D1013	RF Exposure	All sections applicable

Appendix A. Spot Check Test Result

A.1 Conducted power

A.1.1 Test Procedures

DSS

1. The testing follows ANSI C63.10-2013 clause 7.8.5.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

DTS

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v03r05 section 9.1.2 PKPM1 Peak power meter method.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

PCS

1. The transmitter output port was connected to the system simulator.
2. Set EUT at maximum power through system simulator.
3. Select lowest, middle, and highest channels for each band and different modulation.
4. Measure and record the power level from the system simulator.

A.1.2 Test results

<Bluetooth>

Mode	Channel	Frequency (MHz)	FCC ID ZNFX240H Peak power (dBm)	FCC ID ZNFX240DS Peak power (dBm)
Bluetooth (1Mbps)	CH 00	2402	6.25	5.79
	CH 39	2441	7.25	6.89
	CH 78	2480	6.08	5.65
Bluetooth (2Mbps)	CH 00	2402	5.55	5.11
	CH 39	2441	6.49	6.15
	CH 78	2480	5.29	4.88
Bluetooth (3Mbps)	CH 00	2402	5.70	5.27
	CH 39	2441	6.73	6.39
	CH 78	2480	5.47	5.00
BLE (GFSK)	CH 00	2402	-1.07	-1.10
	CH 19	2440	-0.37	-0.38
	CH 39	2480	-1.53	-1.55

<Bluetooth>

Mode	Channel	Frequency (MHz)	Tune-Up Limit	FCC ID ZNFX240H Average power (dBm)	FCC ID ZNFX240DS Average power (dBm)
Bluetooth (1Mbps)	CH 00	2402	8.0	6.00	5.55
	CH 39	2441		7.06	6.74
	CH 78	2480		5.87	5.39
Bluetooth (2Mbps)	CH 00	2402	5.0	3.63	3.29
	CH 39	2441		4.71	4.30
	CH 78	2480		3.44	3.19
Bluetooth (3Mbps)	CH 00	2402	5.0	3.62	3.19
	CH 39	2441		4.67	4.31
	CH 78	2480		3.45	3.19
BLE (GFSK)	CH 00	2402	0.0	-1.70	-2.11
	CH 19	2440		-0.93	-1.08
	CH 39	2480		-2.17	-2.57

<2.4GHz WLAN>

	Mode	Channel	Frequency (MHz)	Data Rate	FCC ID ZNFX240H Peak power (dBm)	FCC ID ZNFX240DS Peak power (dBm)
2.4GHz WLAN	802.11b	CH 1	2412	1Mbps	18.77	18.70
		CH 6	2437		19.85	19.84
		CH 11	2462		18.99	18.66
	802.11g	CH 1	2412	6Mbps	21.17	20.95
		CH 6	2437		22.58	22.38
		CH 11	2462		22.02	21.65
	802.11n-HT20	CH 1	2412	MCS0	20.45	20.44
		CH 6	2437		20.95	20.67
		CH 11	2462		20.97	20.95
	802.11n-HT40	CH 3	2422	MCS0	20.45	20.40
		CH 6	2437		21.36	21.19
		CH 9	2452		21.52	21.21

<2.4GHz WLAN>

	Mode	Channel	Frequency (MHz)	Data Rate	Tune-Up Limit	FCC ID ZNFX240H Average power (dBm)	FCC ID ZNFX240DS Average power (dBm)
2.4GHz WLAN	802.11b	CH 1	2412	1Mbps	16.0	15.93	15.89
		CH 6	2437		17.0	16.97	16.89
		CH 11	2462		16.0	15.99	15.70
	802.11g	CH 1	2412	6Mbps	12.0	11.94	11.87
		CH 6	2437		15.0	14.63	14.48
		CH 11	2462		13.5	13.26	13.07
	802.11n-HT20	CH 1	2412	MCS0	11.5	11.13	10.79
		CH 6	2437			11.35	10.90
		CH 11	2462			11.43	11.29
	802.11n-HT40	CH 3	2422	MCS0	9.5	9.14	9.13
		CH 6	2437		11.0	10.94	10.55
		CH 9	2452			10.99	10.68

<WWAN>

GSM850		FCC ID ZNFX240YK Average power (dBm)			FCC ID ZNFX240DS Average power (dBm)		
TX Channel	Tune-up Limit (dBm)	128	189	251	128	189	251
Frequency (MHz)		824.2	836.4	848.8	824.2	836.4	848.8
GSM 1 Tx slot	34.00	33.73	33.80	33.81	33.91	33.92	33.85
GPRS 1 Tx slot	34.00	**33.87**	33.83	33.86	**33.93**	**33.93**	33.88
GPRS 2 Tx slots	30.50	30.32	30.13	30.10	30.06	30.09	30.12
GPRS 3 Tx slots	29.00	28.48	28.47	28.48	28.55	28.59	28.62
GPRS 4 Tx slots	28.00	27.91	27.92	27.93	27.90	27.95	28.00
EDGE 1 Tx slot	27.00	**26.92**	26.83	26.80	26.64	**26.79**	26.75
EDGE 2 Tx slots	25.00	24.79	24.81	24.77	24.56	24.70	24.63
EDGE 3 Tx slots	23.50	23.17	23.11	23.04	23.00	23.12	23.05
EDGE 4 Tx slots	22.50	21.99	21.93	21.84	21.87	21.98	21.94

GSM1900		FCC ID ZNFX240YK Average power (dBm)			FCC ID ZNFX240DS Average power (dBm)		
TX Channel	Tune-up Limit (dBm)	512	661	810	512	661	810
Frequency (MHz)		1850.2	1880	1909.8	1850.2	1880	1909.8
GSM 1 Tx slot	30.00	29.90	29.84	29.80	29.63	29.70	29.82
GPRS 1 Tx slot	30.00	29.83	29.87	**29.92**	29.65	29.72	**29.84**
GPRS 2 Tx slots	27.50	27.17	27.23	27.26	27.05	27.21	27.38
GPRS 3 Tx slots	26.00	25.37	25.47	25.56	25.40	25.67	25.85
GPRS 4 Tx slots	25.00	24.71	24.81	24.92	24.52	24.83	25.00
EDGE 1 Tx slot	26.00	25.78	25.84	**25.90**	25.57	25.84	**25.90**
EDGE 2 Tx slots	24.00	23.57	23.78	23.78	23.50	23.74	23.75
EDGE 3 Tx slots	22.00	21.83	21.98	21.95	21.71	21.97	21.98
EDGE 4 Tx slots	21.00	20.66	20.87	20.90	20.72	20.98	20.97

WCDMA V		FCC ID ZNFX240YK Average power (dBm)			FCC ID ZNFX240DS Average power (dBm)		
TX Channel	Tune-up Limit (dBm)	4132	4182	4233	4132	4182	4233
Frequency (MHz)		826.4	836.4	846.6	826.4	836.4	846.6
AMR 12.2Kbps	25.00	24.87	24.80	24.91	24.98	24.95	24.99
RMC 12.2Kbps	25.00	24.89	24.86	**24.98**	24.99	24.96	**25.00**
HSDPA Subtest-1	24.00	23.94	23.83	23.87	23.93	23.92	24.00
HSDPA Subtest-2	24.00	23.93	23.85	23.91	23.99	23.96	24.00
HSDPA Subtest-3	23.50	23.50	23.44	23.45	23.44	23.47	23.50
HSDPA Subtest-4	23.50	23.41	23.38	23.47	23.50	23.45	23.49
DC-HSDPA Subtest-1	24.00	23.76	23.71	23.74	23.91	23.90	23.95
DC-HSDPA Subtest-2	24.00	23.75	23.70	23.72	23.96	23.95	23.94
DC-HSDPA Subtest-3	23.50	23.35	23.26	23.30	23.43	23.45	23.44
DC-HSDPA Subtest-4	23.50	23.25	23.27	23.31	23.49	23.43	23.47
HSUPA Subtest-1	24.00	21.89	21.86	21.97	22.10	22.06	22.04
HSUPA Subtest-2	22.00	21.93	21.90	21.91	22.00	21.91	21.97
HSUPA Subtest-3	23.00	22.92	22.89	22.88	23.00	22.91	22.97
HSUPA Subtest-4	22.00	21.41	21.37	21.47	21.45	21.39	21.50
HSUPA Subtest-5	24.00	23.90	23.80	23.90	23.97	23.86	23.93

LTE Band 7 / 20MHz				FCC ID ZNFX240YK Average power (dBm)			FCC ID ZNFX240DS Average power (dBm)		
TX Channel			Tune-up Limit (dBm)	20850	21100	21350	20850	21100	21350
Frequency (MHz)				2510	2535	2560	2510	2535	2560
Modulation	RB Size	RB offset							
QPSK	1	0	L : 23.3	**23.24**	22.79	21.92	**23.18**	22.51	21.99
QPSK	1	49	M : 22.8	23.23	22.70	21.55	23.17	22.50	21.32
QPSK	1	99	H : 22.0	23.10	22.58	21.57	22.88	22.20	21.06
QPSK	50	0	L : 22.3	22.30	21.77	20.77	22.29	21.57	20.23
QPSK	50	24	M : 21.8	22.29	21.71	20.71	22.27	21.49	19.91
QPSK	50	50	H : 21.0	22.27	21.80	20.75	22.18	21.41	19.94
QPSK	100	0		22.26	21.78	20.70	22.21	21.46	20.06
16QAM	1	0	L : 22.3	22.29	21.76	20.97	22.23	21.76	20.93
16QAM	1	49	M : 21.8	22.27	21.73	20.75	22.26	21.70	20.10
16QAM	1	99	H : 21.0	22.26	21.77	20.79	22.10	21.47	20.08
16QAM	50	0	L : 21.3	21.25	20.79	19.71	21.25	20.53	19.20
16QAM	50	24	M : 20.8	21.23	20.75	19.56	21.24	20.44	18.86
16QAM	50	50	H : 20.0	21.22	20.75	19.60	21.11	20.36	18.90
16QAM	100	0		21.21	20.63	19.62	21.16	20.40	19.01

A.2 Radiated Spurious Emission

A.2.1 Test Procedures

DSS

6. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
7. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
8. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
9. Set to the maximum power setting and enable the EUT transmit continuously.
10. Use the following spectrum analyzer settings:
    (1) Span shall wide enough to fully capture the emission being measured;
    (2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
    (3) For average measurement: use duty cycle correction factor method per 15.35(c).
    Duty cycle = On time/100 milliseconds
    On time = $N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+N_n*L_n$
    Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
    Average Emission Level = Peak Emission Level + 20*log(Duty cycle)
11. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-24.82dB) derived from 20log (dwell time/100ms). This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

DTS

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

PCS

1. The testing follows FCC KDB 971168 D01 v02r02 Section 5.8 and ANSI / TIA-603-D-2010 Section 2.2.12.
2. The EUT was placed on a rotatable wooden table 0.8 meters for frequency below 1GHz and 1.5 meter for frequency above 1GHz above the ground.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
4. The table was rotated 360 degrees to determine the position of the highest spurious emission.
5. The height of the receiving antenna is varied between one meter and four meters to search for the maximum spurious emission for both horizontal and vertical polarizations.
6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking record of maximum spurious emission.
7. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
8. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
9. Taking the record of output power at antenna port.
10. Repeat step 7 to step 8 for another polarization.
11. EIRP (dBm) = S.G. Power – Tx Cable Loss + Tx Antenna Gain
12. ERP (dBm) = EIRP - 2.15
13. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
14. The limit line is derived from 43 + 10log(P) dB below the transmitter power P(Watts)
15. For Band 7:
    The limit line is derived from 55 + 10log(P)dB below the transmitter power P(Watts)

A.2.2 Test results

2.4GHz BT/WLAN

Mode	Ch	Freq. (MHz)	Peak /Avg.	FCC ID ZNFX240H						FCC ID ZNFX240DS					
				Band edge			Harmonic			Band edge			Harmonic		
				Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)
BT(1Mbps)	CH 78	2480	P	2484.64	44.26	74	7440	38.86	74	2483.76	45.02	74	7440	40.91	74
			A	2484.64	19.44	54				2483.76	20.2	54			
BLE	CH 39	2480	P	2491.2	54.28	74	7440	37.65	74	2498.2	53.45	74	7440	39.7	74
			A	2488.68	44.71	54				2492.36	45.05	54			
802.11n-HT40	CH 03	2422	P	2389.94	59.53	74	7266	37.88	74	2388.82	57.5	74	7266	40.06	74
			A	2389.38	46.76	54				2389.66	46.32	54			

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical
-L	**Low channel location**
-R	**High channel location**

2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BT CH 78 2480MHz	*	2480	103.93	-	-	101.08	27.45	8.98	33.58	179	208	P	H
	*	2480	79.11	-	-	-	-	-	-	-	-	A	H
		2483.76	45.02	-28.98	74	42.17	27.45	8.98	33.58	179	208	P	H
		2483.76	20.2	-33.8	54	-	-	-	-	-	-	A	H
	*	2480	100.26	-	-	97.41	27.45	8.98	33.58	389	357	P	V
	*	2480	75.44	-	-	-	-	-	-	-	-	A	V
		2492.44	44.4	-29.6	74	41.49	27.5	8.98	33.57	389	357	P	V
		2492.44	19.58	-34.42	54	-	-	-	-	-	-	A	V

BT (Harmonic @ 3m)

BT	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BT CH 78 2480MHz		4960	36.1	-37.9	74	57.67	31.94	11.12	64.63	100	0	P	H
		4960	11.28	-42.72	54	-	-	-	-	-	-	A	H
		7440	40.31	-33.69	74	54.87	37.44	12.88	64.88	100	0	P	H
		7440	15.49	-38.51	54	-	-	-	-	-	-	A	H
		4960	36.74	-37.26	74	58.31	31.94	11.12	64.63	100	0	P	V
		4960	11.92	-42.08	54	-	-	-	-	-	-	A	V
		7440	40.91	-33.09	74	55.47	37.44	12.88	64.88	100	0	P	V
		7440	16.09	-37.91	54	-	-	-	-	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 39 2480MHz	*	2480	96.73	-	-	93.88	27.45	8.98	33.58	185	353	P	H
	*	2480	96	-	-	93.15	27.45	8.98	33.58	185	353	A	H
		2498.2	53.45	-20.55	74	50.54	27.5	8.98	33.57	185	353	P	H
		2492.36	45.05	-8.95	54	42.14	27.5	8.98	33.57	185	353	A	H
	*	2480	93.11	-	-	90.26	27.45	8.98	33.58	326	280	P	V
	*	2480	92.56	-	-	89.71	27.45	8.98	33.58	326	280	A	V
		2484.12	53.95	-20.05	74	51.1	27.45	8.98	33.58	326	280	P	V
		2485.8	45.02	-8.98	54	42.17	27.45	8.98	33.58	326	280	A	V

BLE (Harmonic @ 3m)

BLE	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
BLE CH 39 2480MHz		4960	36.43	-37.57	74	58	31.94	11.12	64.63	100	0	P	H
		7440	39.56	-34.44	74	54.12	37.44	12.88	64.88	100	0	P	H
		4960	35.69	-38.31	74	57.26	31.94	11.12	64.63	100	0	P	V
		7440	39.7	-34.3	74	54.26	37.44	12.88	64.88	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11n HT40 (Band Edge @ 3m)

WIFI Ant. 1	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		2388.82	57.5	-16.5	74	55.02	27.19	8.89	33.6	214	10	P	H
		2389.66	46.32	-7.68	54	43.84	27.19	8.89	33.6	214	10	A	H
	*	2422	102.24	-	-	99.6	27.29	8.94	33.59	214	10	P	H
	*	2422	92.83	-	-	90.19	27.29	8.94	33.59	214	10	A	H
802.11n		2484.25	53.55	-20.45	74	50.7	27.45	8.98	33.58	214	10	P	H
HT40		2483.69	45.1	-8.9	54	42.25	27.45	8.98	33.58	214	10	A	H
CH 03		2389.52	56.25	-17.75	74	53.77	27.19	8.89	33.6	393	352	P	V
2422MHz		2388.26	45.21	-8.79	54	42.73	27.19	8.89	33.6	393	352	A	V
	*	2422	98.92	-	-	96.28	27.29	8.94	33.59	393	352	P	V
	*	2422	89	-	-	86.36	27.29	8.94	33.59	393	352	A	V
		2490.62	53.72	-20.28	74	50.82	27.5	8.98	33.58	393	352	P	V
		2485.93	44.96	-9.04	54	42.11	27.45	8.98	33.58	393	352	A	V

WIFI 802.11n HT40 (Harmonic @ 3m)

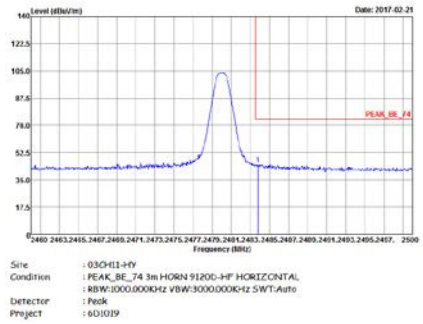
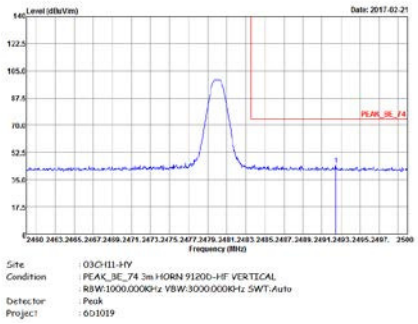
WIFI Ant. 1	Note	Frequency (MHz)	Level (dBµV/m)	Over Limit (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n		4844	34.89	-39.11	74	57.12	31.72	10.77	64.72	100	0	P	H
HT40		7266	40.06	-33.94	74	54.9	37.23	12.74	64.81	100	0	P	H
CH 03		4844	33.95	-40.05	74	56.18	31.72	10.77	64.72	100	0	P	V
2422MHz		7266	39.77	-34.23	74	54.61	37.23	12.74	64.81	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Note symbol

-L	**Low channel location**
-R	**High channel location**

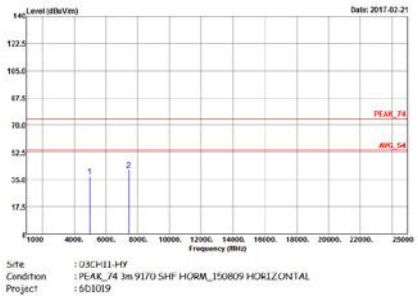
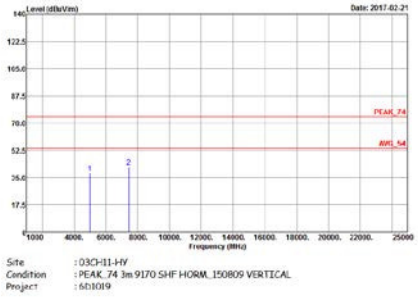
2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BT CH78 2480MHz	
1	Horizontal	Vertical
Peak		

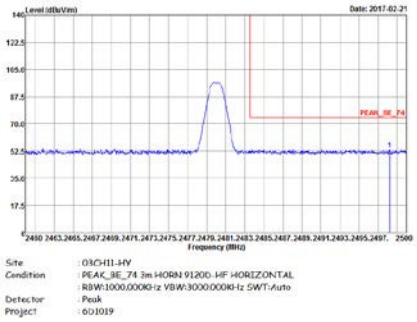
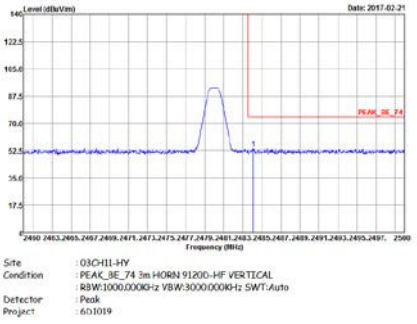
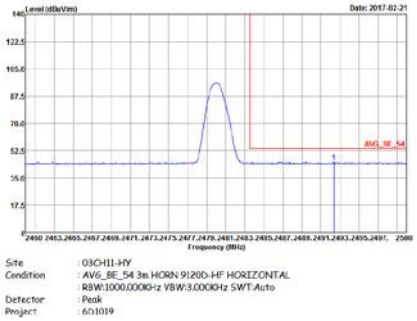
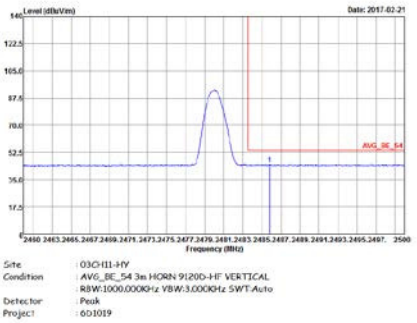
2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

BT	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BT CH78 2480MHz	
1	Horizontal	Vertical
Peak Avg.		

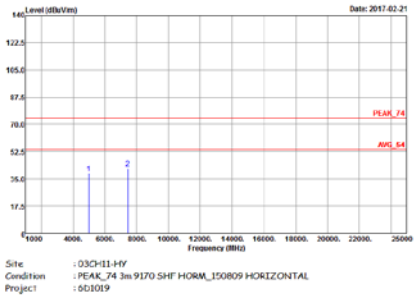
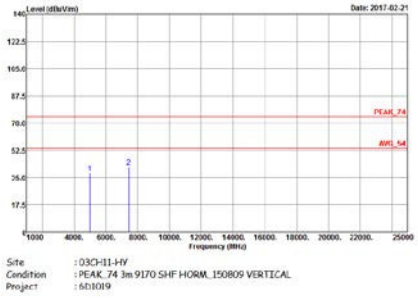
2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

BLE	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	BLE CH39 2480MHz	
1	Horizontal	Vertical
Peak		
Avg.		

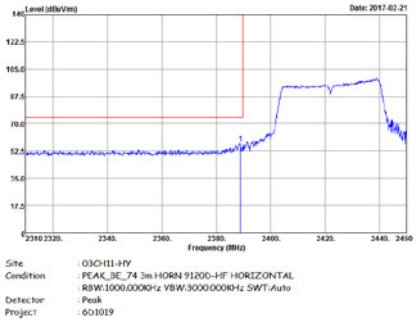
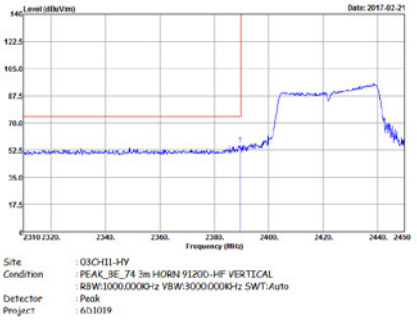
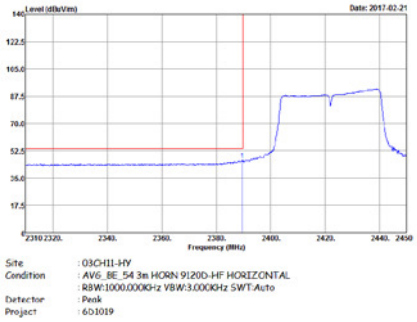
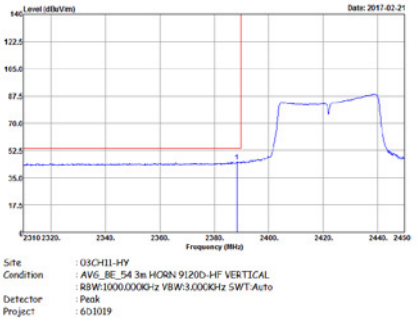
2.4GHz 2400~2483.5MHz

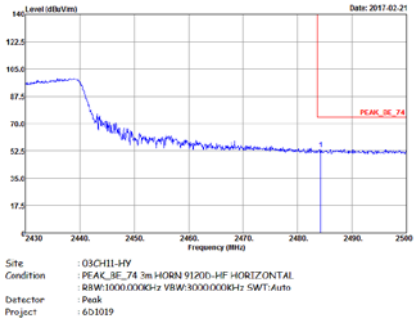
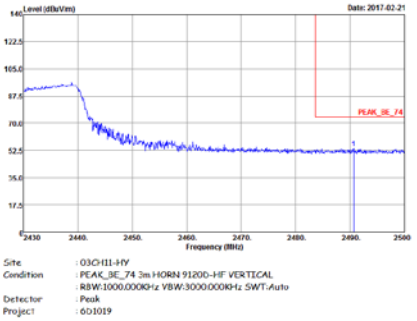
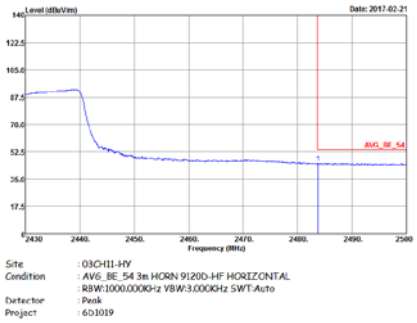
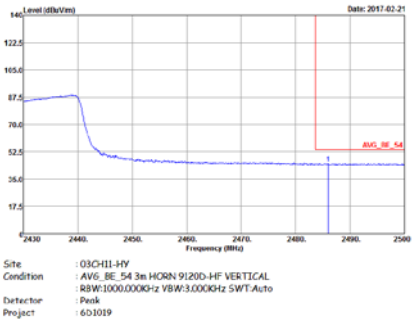
BLE (Harmonic @ 3m)

BLE	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	BLE CH39 2480MHz	
1	Horizontal	Vertical
Peak Avg.		

2.4GHz 2400~2483.5MHz

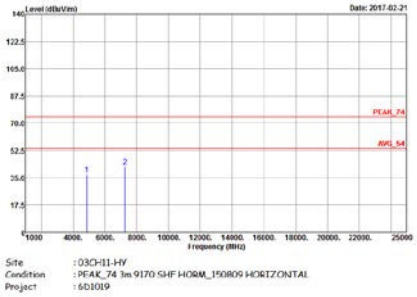
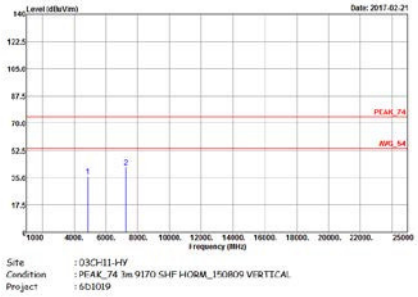
WIFI 802.11n HT40 (Band Edge @ 3m)

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH03 2422MHz - L	
1	Horizontal	Vertical
Peak		
Avg.		

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m	
ANT	802.11n HT40 CH03 2422MHz - R	
1	Horizontal	Vertical
Peak		
Avg.		

2.4GHz 2400~2483.5MHz

WIFI 802.11n HT40 (Harmonic @ 3m)

WIFI	2.4GHz 2400~2483.5MHz Harmonic @ 3m	
ANT	802.11n HT40 CH03 2422MHz	
1	Horizontal	Vertical
Peak Avg.		

WWAN

Mode	Ch	Freq. (MHz)	Modulation	FCC ID ZNFX240YK			FCC ID ZNFX240DS		
				Frequency (MHz)	Level (dBm)	Limit (dBm)	Frequency (MHz)	Level (dBm)	Limit (dBm)
GSM850	CH 128	824.2	GPRS class 8	1648	-45.91	-13	1648	-45.76	-13
GSM1900	CH 810	1909.8	GPRS class 8	7641	-35.86	-13	7641	-36.35	-13
LTE Band VII	CH 20775	2502.5	QPSK / 5MHz	10008	-40.90	-25	10008	-40.77	-25

GSM850

GSM850 (GPRS class 8)									
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	1648	-45.76	-13	-32.76	-59.27	-47.52	0.98	4.89	H
	2472	-47.16	-13	-34.16	-63.8	-49.04	1.28	5.32	H
	3296	-59.24	-13	-46.24	-79.23	-62.65	1.54	7.10	H
	4120	-57.54	-13	-44.54	-79.32	-62.18	1.83	8.62	H
	1648	-47.43	-13	-34.43	-60.94	-49.19	0.98	4.89	V
	2472	-47.85	-13	-34.85	-64.49	-49.73	1.28	5.32	V
	3296	-59.25	-13	-46.25	-79.24	-62.66	1.54	7.10	V
	4120	-53.47	-13	-40.47	-75.25	-58.11	1.83	8.62	V

GSM1900

GSM1900 (GPRS class 8)									
Channel	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Highest	3819	-49.71	-13	-36.71	-70.69	-56.39	1.70	8.38	H
	5730	-50.32	-13	-37.32	-77.8	-57.35	2.76	9.79	H
	7641	-37.70	-13	-24.70	-71.63	-47.2	2.38	11.88	H
	3819	-53.87	-13	-40.87	-74.85	-60.55	1.70	8.38	V
	5730	-52.29	-13	-39.29	-79.77	-59.32	2.76	9.79	V
	7641	-36.35	-13	-23.35	-70.27	-45.85	2.38	11.88	V

LTE Band 7

LTE Band 7 / 5MHz / QPSK									
Channel	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	5004	-51.25	-25	-26.25	-76.84	-58.61	2.34	9.70	H
	7500	-46.10	-25	-21.10	-79.8	-55.47	2.43	11.80	H
	10008	-40.77	-25	-15.77	-80.85	-50.28	2.70	12.20	H
	5004	-54.35	-25	-29.35	-79.94	-61.71	2.34	9.70	V
	7500	-45.99	-25	-20.99	-79.69	-55.36	2.43	11.80	V
	10008	-41.35	-25	-16.35	-81.43	-50.86	2.70	12.20	V

Appendix B. Measuring Instruments

List of Measuring Equipment for DSS and DTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Power Meter	Agilent	ML2495A	0932001	300MHz~40GHz	Sep. 29, 2016	Feb. 09, 2017~ Feb. 27, 2017	Sep. 28, 2017	Conducted
Power Sensor	Agilent	MA2411B	0846202	300MHz~40GHz	Sep. 29, 2016	Feb. 09, 2017~ Feb. 27, 2017	Sep. 28, 2017	Conducted
Power Meter	Agilent	E4416A	GB41292344	300MHz~40GHz	Dec. 26, 2016	Feb. 09, 2017~ Feb. 27, 2017	Dec. 25, 2017	Conducted
Power Sensor	Agilent	E9327A	US40441548	300MHz~40GHz	Dec. 26, 2016	Feb. 09, 2017~ Feb. 27, 2017	Dec. 25, 2017	Conducted
BT Base Station(Measure)	Rohde & Schwarz	CBT	101136	BT 3.0	Sep. 21, 2016	Feb. 09, 2017~ Feb. 27, 2017	Sep. 20, 2017	Conducted
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz-40GHz	Jul. 17, 2016	Feb. 09, 2017~ Feb. 27, 2017	Jul. 16, 2017	Conducted
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Nov. 10, 2016	Feb. 20, 2017~ Feb. 27, 2017	Nov. 09, 2017	Radiation
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Sep .2, 2015	Feb. 20, 2017~ Feb. 27, 2017	Sep .1, 2017	Radiation
Bilog Antenna	TESEQ	CBL 6111D	35414	30MHz~1GHz	Oct. 15, 2016	Feb. 20, 2017~ Feb. 27, 2017	OCt. 14, 2017	Radiation
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1GHz ~ 18GHz	Mar. 30, 2016	Feb. 20, 2017~ Feb. 27, 2017	Mar. 31, 2017	Radiation
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Nov. 10, 2016	Feb. 20, 2017~ Feb. 27, 2017	Nov. 09, 2017	Radiation
Spectrum Analyzer	Keysight	N9010A	MY52350276	10Hz ~ 44GHZ	Mar. 21, 2016	Feb. 20, 2017~ Feb. 27, 2017	Mar. 20, 2017	Radiation
Controller	EMEC	EM 1000	N/A	Control Turn table & Ant Mast	N/A	Feb. 20, 2017~ Feb. 27, 2017	N/A	Radiation
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1~4m	N/A	Feb. 20, 2017~ Feb. 27, 2017	N/A	Radiation
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Feb. 20, 2017~ Feb. 27, 2017	N/A	Radiation
Preamplifier	MITEQ	AMF-7D-00101800	2025787	1GHz~18GHz	Feb. 13, 2017	Feb. 20, 2017~ Feb. 27, 2017	Feb. 12, 2018	Radiation
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 08, 2016	Feb. 20, 2017~ Feb. 27, 2017	Nov. 07, 2017	Radiation

List of Measuring Equipment for PCS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Base Station(Measure)	Rohde & Schwarz	CMU200	117995	GSM / GPRS / WCDMA / CDMA	Aug. 03, 2016	Feb. 10, 2017	Aug,04, 2017	Conducted
LTE Base Station	Anritsu	MT8820C	6201432821	GSM/GPRS /WCDMA/LTE	Oct. 11, 2016	Feb. 10, 2017	Oct. 10, 2017	Conducted
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1241	1GHz ~ 18GHz	Apr. 25, 2016	Feb. 17, 2017~ Feb. 22, 2017	Apr. 24, 2017	Radiation
Amplifier	Sonoma-Instrument	310 N	187282	9KHz~1GHz	Dec. 21, 2016	Feb. 17, 2017~ Feb. 22, 2017	Dec. 20, 2017	Radiation
Bilog Antenna	TESEQ	CBL 6111D&00800N1D01N-06	40103&04	30MHz to 1GHz	Jan. 07, 2017	Feb. 17, 2017~ Feb. 22, 2017	Jan. 06, 2018	Radiation
Amplifier	Sonoma-Instrument	310 N	187282	9KHz~1GHz	Dec. 21, 2016	Feb. 17, 2017~ Feb. 22, 2017	Dec. 20, 2017	Radiation
Preamplifier	MITEQ	AMF-7D-00101800-30-10P	1590074	1GHz~18GHz	Jun. 27, 2016	Feb. 17, 2017~ Feb. 22, 2017	Jun. 26, 2017	Radiation
Preamplifier	MITEQ	JS44-18004000-33-8P	1840917	18GHz ~ 40GHz	Jun. 14, 2016	Feb. 17, 2017~ Feb. 22, 2017	Jun. 13, 2017	Radiation
Preamplifier	Keysight	83017A	MY53270147	1GHz~26.5GHz	Jan. 09, 2017	Feb. 17, 2017~ Feb. 22, 2017	Jan. 08, 2018	Radiation
Spectrum Analyzer	Keysight	N9010A	MY55370526	N/A	Mar. 14, 2016	Feb. 17, 2017~ Feb. 22, 2017	Mar. 13, 2017	Radiation
Controller	EMEC	EM1000	N/A	Control Turn table & Ant Mast	N/A	Feb. 17, 2017~ Feb. 22, 2017	N/A	Radiation
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1m~4m	N/A	Feb. 17, 2017~ Feb. 22, 2017	N/A	Radiation
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Feb. 17, 2017~ Feb. 22, 2017	N/A	Radiation
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	18GHz- 40GHz	Nov. 08, 2016	Feb. 17, 2017~ Feb. 22, 2017	Nov. 07, 2017	Radiation
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1G~18GHz	Mar. 31, 2016	Feb. 17, 2017~ Feb. 22, 2017	Mar. 30, 2017	Radiation
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 08, 2016	Feb. 17, 2017~ Feb. 22, 2017	Nov. 07, 2017	Radiation
Signal Generator	Anritsu	MG3694C	163401	0.1Hz~40GHz	Jan. 04, 2017	Feb. 17, 2017~ Feb. 22, 2017	Jan. 03, 2018	Radiation

End of this report