

FCC RADIO TEST REPORT

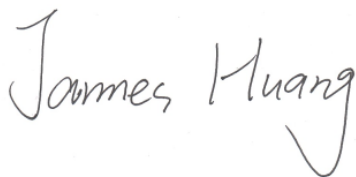
FCC ID : 2AJN7-TP00110AUC
Equipment : Notebook Computer
Brand Name : Lenovo
Model Name : TP00110A
Applicant : LC Future Center Limited Taiwan Branch
7F., No. 780, Bei'an Rd., Zhongshan Dist.,
Taipei City 104, Taiwan (R.O.C.)
Manufacturer : LC Future Center Limited Taiwan Branch
7F., No. 780, Bei'an Rd., Zhongshan Dist.,
Taipei City 104, Taiwan (R.O.C.)
Standard : 47 CFR Part 2, 22(H), 24(E), 27(L)

Equipment: Fibocom L860-GL and Intel 9560D2W tested inside of Lenovo Notebook Computer.

The product was received on Mar. 13, 2019 and testing was started from Apr. 05, 2019 and completed on Apr. 05, 2019. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI / TIA-603-E and has been in compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP or any agency of government.

The test results in this partial report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.



Approved by: James Huang / Manager

Sporton International (Kunshan) Inc.

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone,
Jiangsu Province 215335, China**

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History of this test report

Report No.	Version	Description	Issued Date
FG931313A	01	Initial issue of report	May 03, 2019

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046	Conducted Output Power	Pass	-
	§22.913 (a)(2)	Effective Radiated Power		
	§24.232 (c)	Equivalent Isotropic Radiated Power		
	§27.50 (d)(4)	Equivalent Isotropic Radiated Power		
4.4	§2.1053 §22.917 (a) §24.238 (a) §27.53 (h)	Field Strength of Spurious Radiation	Pass	Under limit 32.19 dB at 5198.000 MHz

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Jason Jia

Report Producer: Echo Wu

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Notebook Computer
Brand Name	Lenovo
Model Name	TP00110A
FCC ID	2AJN7-TP00110AUC
Sample 1	EUT with Amphenol Antenna
Sample 2	EUT with SPEEDWIRE Antenna
EUT supports Radios application	WCDMA/HSPA/LTE/GNSS WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80/VHT160 Bluetooth BR/EDR/LE
EUT Stage	Production Unit

Remark:

1. The above EUT's information was declared by manufacturer.
2. Equipment: Fibocom L860-GL and Intel 9560D2W tested inside of Lenovo Notebook Computer.
3. All test items were performed with Sample 1.

Antenna Information				
WWAN				3G<E (dBi)
Antenna 1	Manufacturer	Amphenol	Peak gain	2.30
	Part number	LX9865-16-000-C	Type	PIFA
Antenna 2	Manufacturer	SPEEDWIRE	Peak gain	2.07
	Part number	F.0G.ZV-0008-001-00	Type	PIFA

1.2 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx Frequency	WCDMA: Band V: 826.4 MHz ~ 846.6 MHz Band II: 1852.4 MHz ~ 1907.6 MHz Band IV: 1712.4 MHz ~ 1752.6 MHz
Rx Frequency	WCDMA: Band V: 871.4 MHz ~ 891.6 MHz Band II: 1932.4 MHz ~ 1987.6 MHz Band IV: 2112.4 MHz ~ 2152.6 MHz
Maximum Output Power to Antenna	WCDMA: Band V: 23.48 dBm Band II: 23.57 dBm Band IV: 23.57 dBm
Type of Modulation	WCDMA: BPSK (Uplink) HSDPA: 64QAM (Downlink) HSUPA: QPSK (Uplink)

1.3 Modification of EUT

No modifications are made to the EUT during all test items.

1.4 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0).

Test Site	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone, Jiangsu Province 215335, China		
Test Site No.	Sporton Site No.	FCC designation No.	FCC Test Firm Registration No.
	03CH06-KS	CN5013	630927
Test Engineer	Level Zhao		
Temperature	23~24 °C		
Relative Humidity	63~66 %		

Note: The test site complies with ANSI C63.4 2014 requirement.

1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ ANSI C63.26-2015
- ♦ ANSI / TIA-603-E
- ♦ 47 CFR Part 2, 22(H), 24(E), 27(L)
- ♦ FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- ♦ FCC KDB 412172 D01 Determining ERP and EIRP v01r01

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

2 Test Configuration of Equipment Under Test

2.1 Test Mode

Antenna port conducted and radiated test items were performed according to KDB 971168 D01 Power Meas. License Digital Systems v03r01 with maximum output power.

For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z for table mode and notebook mode. The worst cases (Notebook mode for WCDMA Band II and Band IV, Y plane for WCDMA Band V) were recorded in this report.

Radiated emissions were investigated as following frequency range:

1. 30 MHz to 9000 MHz for WCDMA Band V.
2. 30 MHz to 18000 MHz for WCDMA Band IV.
3. 30 MHz to 19100 MHz for WCDMA Band II.

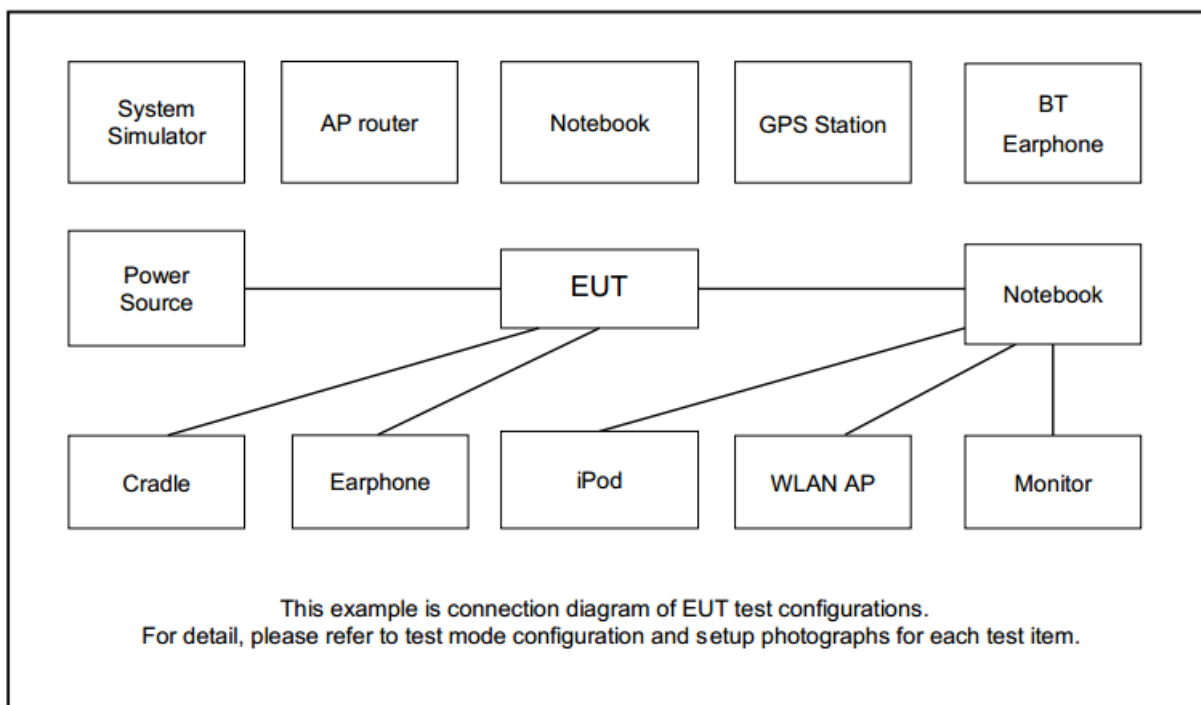
All modes and data rates and positions were investigated.

Test modes are chosen to be reported as the worst case configuration below:

Test Modes		
Band	Radiated TCs	Conducted TCs
WCDMA Band V	■ RMC 12.2Kbps Link	■ RMC 12.2Kbps Link
WCDMA Band II	■ RMC 12.2Kbps Link	■ RMC 12.2Kbps Link
WCDMA Band IV	■ RMC 12.2Kbps Link	■ RMC 12.2Kbps Link

Remark: All the radiated test cases were performed with Adapter 1.

2.2 Connection Diagram of Test System



2.3 Support Unit used in test configuration

Item	Equipment	Trade Name	Model No.	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	8820C	N/A	N/A	Unshielded, 1.8 m
2.	Earphone	zyia	N/A	N/A	Unshielded, 1.2 m	N/A

2.4 Frequency List of Low/Middle/High Channels

Frequency List				
Band	Channel/Frequency(MHz)	Lowest	Middle	Highest
WCDMA Band V	Channel	4132	4182	4233
	Frequency	826.4	836.4	846.6
WCDMA Band II	Channel	9262	9400	9538
	Frequency	1852.4	1880.0	1907.6
WCDMA Band IV	Channel	1312	1413	1513
	Frequency	1712.4	1732.6	1752.6

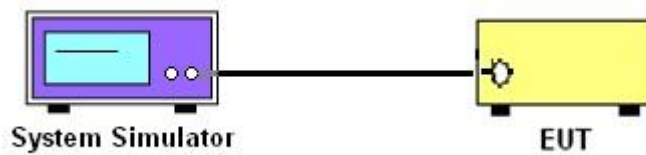
3 Conducted Test Result

3.1 Measuring Instruments

See list of measuring instruments of this test report.

3.1.1 Test Setup

3.1.2 Conducted Output Power



3.1.3 Test Result of Conducted Test

Please refer to Appendix A.

3.2 Conducted Output Power and ERP/EIRP

3.2.1 Description of the Conducted Output Power and ERP/EIRP

A system simulator was used to establish communication with the EUT. Its parameters were set to enforce EUT transmitting at the maximum power. The measured power in the radio frequency on the transmitter output terminals shall be reported.

The ERP of mobile transmitters must not exceed 7 Watts for GSM850 and WCDMA Band V.

The EIRP of mobile transmitters must not exceed 2 Watts for GSM1900 and WCDMA Band II.

The EIRP of mobile transmitters must not exceed 1 Watts for WCDMA Band IV.

According to KDB 412172 D01 Power Approach,

$EIRP = P_T + G_T - L_C$, $ERP = EIRP - 2.15$, where

P_T = transmitter output power in dBm

G_T = gain of the transmitting antenna in dBi

L_C = signal attenuation in the connecting cable between the transmitter and antenna in dB

3.2.2 Test Procedures

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 the maximum burst average power for GSM and maximum average power for other modulation signal.

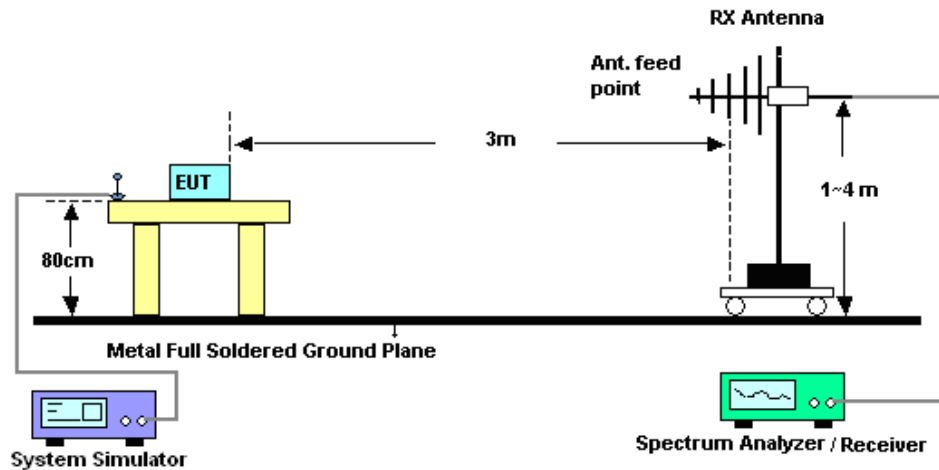
4 Radiated Test Items

4.1 Measuring Instruments

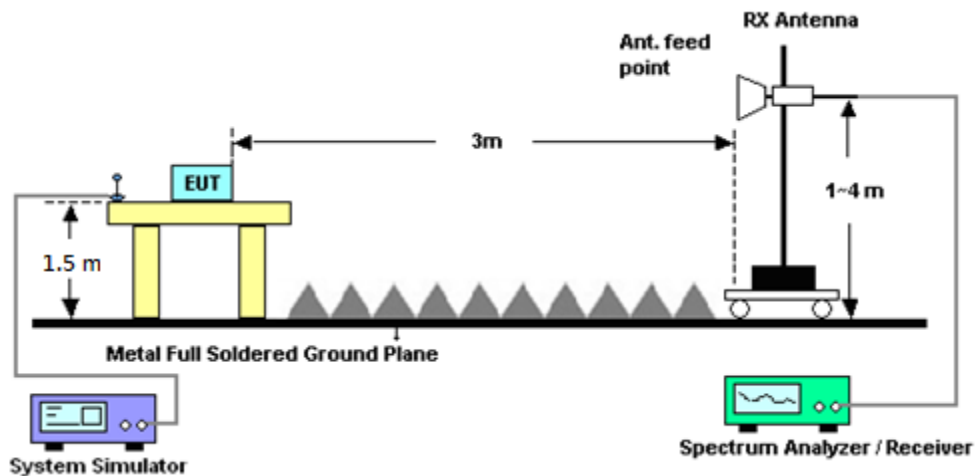
See list of measuring instruments of this test report.

4.2 Test Setup

For radiated test from 30MHz to 1GHz



For radiated test above 1GHz



4.3 Test Result of Radiated Test

Please refer to Appendix B.

4.4 Field Strength of Spurious Radiation Measurement

4.4.1 Description of Field Strength of Spurious Radiated Measurement

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

4.4.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 5.8 and ANSI / TIA-603-E Section 2.2.12.

1. 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.
2. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest spurious emission.
4. 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.
5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking record of maximum spurious emission.
6. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
7. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
8. Taking the record of output power at antenna port.
9. Repeat step 7 to step 8 for another polarization.
10. $EIRP \text{ (dBm)} = S.G. \text{ Power} - Tx \text{ Cable Loss} + Tx \text{ Antenna Gain}$
11. $ERP \text{ (dBm)} = EIRP - 2.15$
12. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
13. The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power P(Watts)

5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
LTE Base Station	Anritsu	MT8820C	KS141204JCG S01	6201432836	Jan. 14, 2019	Apr. 05, 2019	Jan. 13, 2020	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55370528	10Hz-44GHz	Oct. 10, 2018	Apr. 05, 2019	Oct. 09, 2019	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6112D	35406	30MHz-1GHz	Apr. 19, 2018	Apr. 05, 2019	Apr. 18, 2019	Radiation (03CH06-KS)
Broad-Band Horn Antenna	Schwarzbeck MESS-ELEKT RONIK	BBHA9120D	01648	1GHz~18GHz	Jan. 27, 2019	Apr. 05, 2019	Jan. 26, 2020	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	380827	9KHz-1GHz Gain 32dB	Aug. 03, 2018	Apr. 05, 2019	Aug. 02, 2019	Radiation (03CH06-KS)
Amplifier	MITEQ	AMF-7D-0010 1800-30-10P	2025788	100MHz-18GHz Gain 55dB	Apr. 17, 2018	Apr. 05, 2019	Apr. 16, 2019	Radiation (03CH06-KS)
Preamplifier	Keysight	83017A	MY53270319	0.5G-26.5GHz	Oct. 12, 2018	Apr. 05, 2019	Oct. 11, 2019	Radiation (03CH06-KS)
SHF-EHF Horn	Schwarzbeck	BBHA 9170	BBHA170249	15-40GHz	Feb. 07, 2019	Apr. 05, 2019	Feb. 06, 2020	Radiation (03CH06-KS)
Amplifier	MITEQ	TTA1840-35-H G	1887435	18~40GHz, 45dB Min	Feb. 08, 2019	Apr. 05, 2019	Feb. 07, 2020	Radiation (03CH06-KS)
Radio communication analyzer	Anritsu	MT8820C	KS141204JCG S01	6201432836	Jan. 14, 2019	Apr. 05, 2019	Jan. 13, 2020	Radiation (03CH06-KS)

6 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	2.50
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Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	2.10
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Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	2.10
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Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power)

Conducted Power (*Unit: dBm)						
Band	WCDMA Band V			WCDMA Band II		
Channel	4132	4182	4233	9262	9400	9538
Frequency	826.4	836.4	846.6	1852.4	1880	1907.6
RMC 12.2K	23.37	23.46	23.48	23.52	23.57	23.52
HSDPA Subtest-1	23.28	23.40	23.41	23.48	23.51	23.51
HSDPA Subtest-2	22.67	23.07	22.77	22.69	22.76	22.68
HSDPA Subtest-3	22.05	22.59	22.19	22.02	22.15	22.17
HSDPA Subtest-4	22.07	22.54	22.26	22.03	22.10	22.25
HSUPA Subtest-1	22.60	22.82	22.74	22.60	22.76	22.82
HSUPA Subtest-2	20.66	20.96	20.86	20.56	20.61	20.81
HSUPA Subtest-3	21.52	21.51	22.05	21.73	21.76	21.86
HSUPA Subtest-4	20.58	20.79	20.59	20.50	20.74	20.87
HSUPA Subtest-5	22.54	22.83	22.63	22.57	22.70	22.74

Conducted Power (*Unit: dBm)			
Band	WCDMA Band IV		
Channel	1312	1413	1513
Frequency	1712.4	1732.6	1752.6
RMC 12.2K	23.28	23.50	23.57
HSDPA Subtest-1	23.22	23.45	23.27
HSDPA Subtest-2	22.52	23.01	22.91
HSDPA Subtest-3	22.05	22.21	22.12
HSDPA Subtest-4	22.02	22.20	22.08
HSUPA Subtest-1	22.55	22.89	22.71
HSUPA Subtest-2	20.56	20.73	20.53
HSUPA Subtest-3	21.55	21.72	21.61
HSUPA Subtest-4	20.54	20.64	20.58
HSUPA Subtest-5	22.58	22.77	22.65



Appendix B. Test Results of ERP/EIRP and Radiated Test

ERP/EIRP

Channel	Mode	Conducted		ERP	
		Power (dBm)	Power (Watts)	ERP(dBm)	ERP(W)
Lowest	WCDMA Band V	23.37	0.2173	22.39	0.1734
Middle	RMC 12.2Kbps	23.46	0.2218	22.48	0.1770
Highest	(GT - LC = 1.17 dB)	23.48	0.2228	22.50	0.1778
Limit	ERP < 7W	Result		PASS	

Channel	Mode	Conducted		EIRP	
		Power (dBm)	Power (Watts)	EIRP(dBm)	EIRP(W)
Lowest	WCDMA Band II	23.52	0.2249	24.96	0.3133
Middle	RMC 12.2Kbps	23.57	0.2275	25.01	0.3170
Highest	(GT - LC = 1.44 dB)	23.52	0.2249	24.96	0.3133
Limit	EIRP < 2W	Result		PASS	

Channel	Mode	Conducted		EIRP	
		Power (dBm)	Power (Watts)	EIRP(dBm)	EIRP(W)
Lowest	WCDMA Band IV	23.28	0.2128	24.38	0.2742
Middle	RMC 12.2Kbps	23.50	0.2239	24.60	0.2884
Highest	(GT - LC = 1.1 dB)	23.57	0.2275	24.67	0.2931
Limit	EIRP < 1W	Result		PASS	

**Radiated Spurious Emission****WCDMA 850**

WCDMA 850								
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	1652	-55.03	-13	-42.03	-58.27	1.11	6.50	H
	2476	-51.50	-13	-38.50	-54.12	1.43	6.20	H
	3306	-55.99	-13	-42.99	-60.43	1.71	8.30	H
								H
	1652	-58.05	-13	-45.05	-61.29	1.11	6.50	V
	2476	-52.89	-13	-39.89	-55.51	1.43	6.20	V
	3306	-59.51	-13	-46.51	-63.95	1.71	8.30	V
								V
Middle	1672	-57.88	-13	-44.88	-61.12	1.11	6.50	H
	2510	-52.96	-13	-39.96	-55.58	1.43	6.20	H
	3348	-55.27	-13	-42.27	-59.71	1.71	8.30	H
								H
	1672	-57.92	-13	-44.92	-61.16	1.11	6.50	V
	2510	-55.32	-13	-42.32	-57.94	1.43	6.20	V
	3348	-59.30	-13	-46.30	-63.74	1.71	8.30	V
								V
Highest	1694	-59.98	-13	-46.98	-63.22	1.11	6.50	H
	2540	-54.45	-13	-41.45	-57.07	1.43	6.20	H
	3384	-58.01	-13	-45.01	-62.45	1.71	8.30	H
								H
	1694	-55.79	-13	-42.79	-59.03	1.11	6.50	V
	2540	-55.89	-13	-42.89	-58.51	1.43	6.20	V
	3384	-59.64	-13	-46.64	-64.08	1.71	8.30	V
								V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.



WCDMA 1700

WCDMA 1700								
Channel	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	3420	-52.98	-13	-39.98	-59.30	1.81	8.13	H
	5136	-53.80	-13	-40.80	-61.78	2.22	10.20	H
	6852	-53.03	-13	-40.03	-61.85	2.54	11.36	H
								H
	3420	-54.01	-13	-41.01	-60.33	1.81	8.13	V
	5136	-52.52	-13	-39.52	-60.50	2.22	10.20	V
	6852	-53.21	-13	-40.21	-62.03	2.54	11.36	V
								V
Middle	3465	-48.36	-13	-35.36	-54.68	1.81	8.13	H
	5198	-45.19	-13	-32.19	-53.17	2.22	10.20	H
	6930	-51.24	-13	-38.24	-60.06	2.54	11.36	H
								H
	3465	-54.31	-13	-41.31	-60.63	1.81	8.13	V
	5198	-51.62	-13	-38.62	-59.60	2.22	10.20	V
	6930	-52.49	-13	-39.49	-61.31	2.54	11.36	V
								V
Highest	3505	-46.94	-13	-33.94	-53.26	1.81	8.13	H
	5258	-51.88	-13	-38.88	-59.86	2.22	10.20	H
	7010	-51.80	-13	-38.80	-60.62	2.54	11.36	H
								H
	3505	-53.90	-13	-40.90	-60.22	1.81	8.13	V
	5258	-52.61	-13	-39.61	-60.59	2.22	10.20	V
	7010	-52.09	-13	-39.09	-60.91	2.54	11.36	V
								V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.

WCDMA 1900

WCDMA 1900								
Channel	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	3702	-55.95	-13	-42.95	-62.52	1.85	8.42	H
	5556	-54.14	-13	-41.14	-62.50	2.32	10.68	H
	7410	-53.00	-13	-40.00	-62.33	2.61	11.94	H
								H
	3702	-54.49	-13	-41.49	-61.06	1.85	8.42	V
	5556	-53.04	-13	-40.04	-61.40	2.32	10.68	V
	7410	-52.06	-13	-39.06	-61.39	2.61	11.94	V
								V
Middle	3762	-54.22	-13	-41.22	-60.79	1.85	8.42	H
	5640	-52.21	-13	-39.21	-60.57	2.32	10.68	H
	7518	-51.92	-13	-38.92	-61.25	2.61	11.94	H
								H
	3762	-54.03	-13	-41.03	-60.60	1.85	8.42	V
	5640	-52.68	-13	-39.68	-61.04	2.32	10.68	V
	7518	-51.98	-13	-38.98	-61.31	2.61	11.94	V
								V
Highest	3816	-54.88	-13	-41.88	-61.45	1.85	8.42	H
	5724	-54.07	-13	-41.07	-62.43	2.32	10.68	H
	7632	-53.20	-13	-40.20	-62.53	2.61	11.94	H
	3816	-54.96	-13	-41.96	-61.53	1.85	8.42	V
	5724	-54.18	-13	-41.18	-62.54	2.32	10.68	V
	7632	-53.49	-13	-40.49	-62.82	2.61	11.94	V
								V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.