TEST REPORT

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1. Client

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
- Date of Receipt : 2023-03-14

2. Use of Report : Class II Permissive change

3. Name of Product / Model : 5G sub-6 GHz M.2 Module with WCDMA and LTE / RM520N-GL

4. Manufacturer / Country of Origin : Samsung Electronics Co., Ltd. / Vietnam

5. Host Name of Product / Model : Notebook PC / NP935QNA

6. FCC ID : A3LRM520N935QNA

7. Date of Test : 2023-04-15 to 2023-05-24

8. Location of Test : ■ Permanent Testing Lab ☐ On Site Testing
(Address:65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

9. Test method used : FCC Part 2
FCC Part 22 subpart H
FCC Part 24 subpart E
FCC Part 27 subpart C
FCC Part 90 subpart S

10. Test Result : Refer to the test result in the test report

	Tested by	Technical Manager
Affirmation	Name : Sunghyun Yoon (Signature)	Name : Seungyong Kim (Signature)

2023-06-01

Eurofins KCTL Co.,Ltd.

REPORT REVISION HISTORY

Date	Revision	Page No
2023-05-26	Originally issued	-
2023-06-01	Updated	4,12,13,18,20,22

Note. The report No. KR23-SRF0169 is superseded by the report No. KR23-SRF0169-A.

General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ **Statement not required by the standard or client used for type testing**

CONTENTS

1. General information

Client	:	Samsung Electronics Co., Ltd.
Address	:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Manufacturer	:	Samsung Electronics Co., Ltd.
Address	:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Factory	:	SAMSUNG ELECTRONICS VIETNAM CO.,LTD.
Address	:	Khu Cong nghiep Ten Phong 1, Yen Trung, Yen Phong, Bac Ninh, Vietnam
Laboratory	:	Eurofins KCTL Co.,Ltd.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132
		VCCI Registration No. : R-20080, G-20078, C-20059, T-20056
		CAB Identifier: KR0040
		ISED Number: 8035A
		KOLAS No.: KT231

2. Device information

Equipment under test	:	5G sub-6 GHz M.2 Module with WCDMA and LTE		
Model	:	RM520N-GL		
Host name of Product	:	Notebook PC		
Host Model	:	NP935QNA		
Modulation technique	:	WCDMA_QPSK		
		LTE_QPSK, 16QAM, 64QAM, 256QAM		
Power source	:	DC 11.58 V		
Antenna specification	:	Antenna 0	:	PIFA Antenna (WCDMA B2/4/5, LTE B2/4/5/12/14/66)
		Antenna 2	:	PIFA Antenna (LTE B2/4/66) *Only usage for EN-DC and ULCA
Anchor band for EN-DC	:	Antenna 0	:	LTE B2/5/12/14/66
		Antenna 2	:	LTE B2/4/66
Frequency range	:	WCDMA 2, LTE B2	:	1 850 ㎒ ~ 1 910 ㎒
		WCDMA 4, LTE B4	:	1 710 ㎒ ~ 1 755 ㎒
		WCDMA 5, LTE B5	:	824 ㎒ ~ 849 ㎒
		LTE B12	:	699 ㎒ ~ 716 ㎒
		LTE B14	:	788 ㎒ ~ 798 ㎒
		LTE B66	:	1 710 ㎒ ~ 1 780 ㎒
Bandwidth	:	LTE B2	:	1.4 ㎒, 3 ㎒, 5 ㎒, 10 ㎒, 15 ㎒, 20 ㎒
		LTE B4	:	1.4 ㎒, 3 ㎒, 5 ㎒, 10 ㎒, 15 ㎒, 20 ㎒
		LTE B5	:	1.4 ㎒, 3 ㎒, 5 ㎒, 10 ㎒
		LTE B12	:	1.4 ㎒, 3 ㎒, 5 ㎒, 10 ㎒
		LTE B14	:	5 ㎒, 10 ㎒
		LTE B66	:	1.4 ㎒, 3 ㎒, 5 ㎒, 10 ㎒, 15 ㎒, 20 ㎒
Software version	:	NP930QNA.001		
Hardware version	:	REV0.1		
Test device serial No.	:	Radiated	:	KQZZ930W300232D, KQZZ930W300219W
Operation temperature	:	10 ℃ ~ 35 ℃		

Note.
In this report is based on original report FCC ID: A3LRM520N935QNA, additional simultaneous transmission measurement with the host notebook PC (FCC ID: A3LNP935QNA) was investigated in test report.

2.1. Simultaneous Transmission Configurations

No.	Scenario
1	Bluetooth (Aux) + WWAN
2	Bluetooth (Aux) + 5G WLAN MIMO + WWAN
3	2.4G WLAN SISO (Aux) + WWAN
4	2.4G WLAN MIMO + WWAN
5	5G WLAN MMO + WWAN

Note.
- For the simultaneous mode the lowest margin condition among the channels and modes of the cellular module (FCC ID: A3LRM520N935QNA) and the host notebook PC (FCC ID: A3LNP935QNA) which supports unlicensed bands was selected for the test.
- All of cases was investigated and as a representative only No.2 simultaneous transmission with the most simultaneous actions was reported.

2.2. Frequency/channel operations

This device contains the following capabilities:
WCDMA 850/1700/1900, LTE B2/4/5/12/14/66, NR n2/5/66/77

WCDMA 850

Ch.	Frequency (㎒)
4132	826.4
4183	836.6
4233	846.6

Table 2.2.1. RMC/HSDPA/HSUPA/ DC-HSDPA

WCDMA 1700

Ch.	Frequency (㎒)
1312	1 712.4
1412	1 732.4
1513	1 752.6

Table 2.2.2. RMC/HSDPA/HSUPA/ DC-HSDPA

WCDMA 1900

Ch.	Frequency (㎒)
9262	1 852.4
9400	1 880.0
9538	1 907.6

Table 2.2.3. RMC/HSDPA/HSUPA/ DC-HSDPA

LTE Band 2

Ch.	Frequency (㎒)
18607	1 850.7
18900	1 880.0
19193	1 909.3

Table 2.2.4. 1.4M BW

Ch.	Frequency (㎒)
18615	1 851.5
18900	1 880.0
19185	1 908.5

Table 2.2.5. 3M BW

Ch.	Frequency (㎒)
18625	1 852.5
18900	1 880.0
19175	1 907.5

Table 2.2.6. 5M BW

Ch.	Frequency (㎒)
18650	1 855.0
18900	1 880.0
19150	1 905.0

Table 2.2.7. 10M BW

Ch.	Frequency (㎒)
18675	1 857.5
18900	1 880.0
19125	1 902.5

Table 2.2.8. 15M BW

Ch.	Frequency (㎒)
18700	1 860.0
18900	1 880.0
19100	1 900.0

Table 2.2.9. 20M BW

LTE Band 4

Ch.	Frequency (㎒)
19957	1 710.7
20175	1 732.5
20393	1 754.3

Table 2.2.10. 1.4M BW

Ch.	Frequency (㎒)
19965	1 711.5
20175	1 732.5
20385	1 753.5

Table 2.2.11. 3M BW

Ch.	Frequency (㎒)
19975	1 712.5
20175	1 732.5
20375	1 752.5

Table 2.2.12. 5M BW

Ch.	Frequency (㎒)
20000	1 715.0
20175	1 732.5
20350	1 750.0

Table 2.2.13. 10M BW

Ch.	Frequency (㎒)
20025	1 717.5
20175	1 732.5
20325	1 747.5

Table 2.2.14. 15M BW

Ch.	Frequency (㎒)
20050	1 720.0
20175	1 732.5
20300	1 745.0

Table 2.2.15. 20M BW

LTE Band 5

Ch.	Frequency (㎒)
20407	824.7
20525	836.5
20643	848.3

Table 2.2.16. 1.4M BW

Ch.	Frequency (㎒)
20415	825.5
20525	836.5
20635	847.5

Table 2.2.17. 3M BW

Ch.	Frequency (㎒)
20425	826.5
20525	836.5
20625	846.5

Table 2.2.18. 5M BW

Ch.	Frequency (㎒)
20450	829.0
20525	836.5
20600	844.0

Table 2.2.19. 10M BW

LTE Band 12

Ch.	Frequency (㎒)
23017	699.7
23095	707.5
23173	715.3

Table 2.2.20. 1.4M BW

Ch.	Frequency (㎒)
23025	700.5
23095	707.5
23165	714.5

Table 2.2.21. 3M BW

Ch.	Frequency (㎒)
23035	701.5
23095	707.5
23155	713.5

Table 2.2.22. 5M BW

Ch.	Frequency (㎒)
23060	704.0
23095	707.5
23130	711.0

Table 2.2.23. 10M BW

LTE Band 14

Ch.	Frequency (㎒)
23305	790.5
23330	793.0
23355	795.5

Table 2.2.24 5M BW

Ch.	Frequency (㎒)
-	-
23330	793.0
-	-

Table 2.2.25. 10M BW

LTE Band 66

Ch.	Frequency (㎒)
131979	1 710.7
132322	1 745.0
132665	1 779.3

Table 2.2.26. 1.4M BW

Ch.	Frequency (㎒)
131987	1 711.5
132322	1 745.0
132657	1 778.5

Table 2.2.27. 3M BW

Ch.	Frequency (㎒)
131997	1 712.5
132322	1 745.0
132647	1 777.5

Table 2.2.28. 5M BW

Ch.	Frequency (㎒)
132022	1 715.0
132322	1 745.0
132622	1 775.0

Table 2.2.29. 10M BW

Ch.	Frequency (㎒)
132047	1 717.5
132322	1 745.0
132597	1 772.5

Table 2.2.30. 15M BW

Ch.	Frequency (㎒)
132072	1 720.0
132322	1 745.0
132572	1 770.0

Table 2.2.31. 20M BW

3. Summary of tests

FCC Part section(s)	Parameter	Test Limit	Test Condition	Test results
22.913(a)(5)	Effective Radiated Power	< 7 Watts max. ERP	Radiated	Pass
27.50(c)(10)		< 3 Watts max. ERP		Pass
90.542(a)(7)		< 3 Watts max. ERP		Pass
24.232(c)	Equivalent Isotropic Radiated Power	< 2 Watts max. EIRP		Pass
27.50(d)(4)		< 1 Watts max. EIRP		Pass
2.1053 22.917(a) 24.238(a) 27.53(g),(h) 90.543(c),(f)	Radiated Spurious Emissions	< 43 + 10Log$_{10}$(P) dB for all out of band emissions, <-70 dBW/㎒ EIRP- Wideband, <-80 dBW/㎒ EIRP- Narrowband		Pass

Notes:

1. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.26-2015
   - ANSI/TIA-603-E-2016
   - KDB 971168 D01 v03r01
2. This is the C2PC test report to add host notebook PC, NP935QNA as documented in the C2PC letter. Because the change does not affect RF characteristics, therefore, only radiated spurious emission test was done against the worst case from the highest output power.
3. All the radiated tests have been performed two modes (notebook and tablet mode) and the fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z.
   Worst case: Notebook mode, X axis
4. All the radiated tests have been performed several case. (Stand-alone, with accessories (TA))
   Worst case: stand-alone

4. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014.

All measurement uncertainty values are shown with a coverage factor of k=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

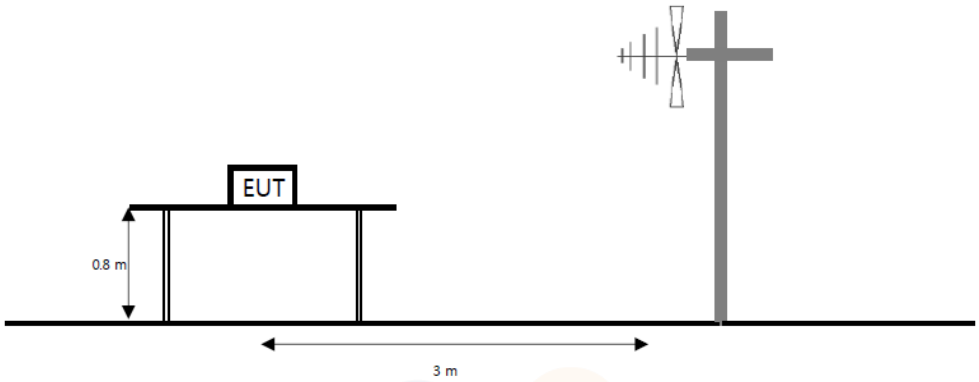
Parameter	Expanded uncertainty (±)	
Radiated spurious emissions	Below 1 000 ㎒	2.5 dB
	1 000 ㎒ ~ 18 000 ㎒	4.7 dB
	Above 18 000 ㎒	4.8 dB

5. Test results

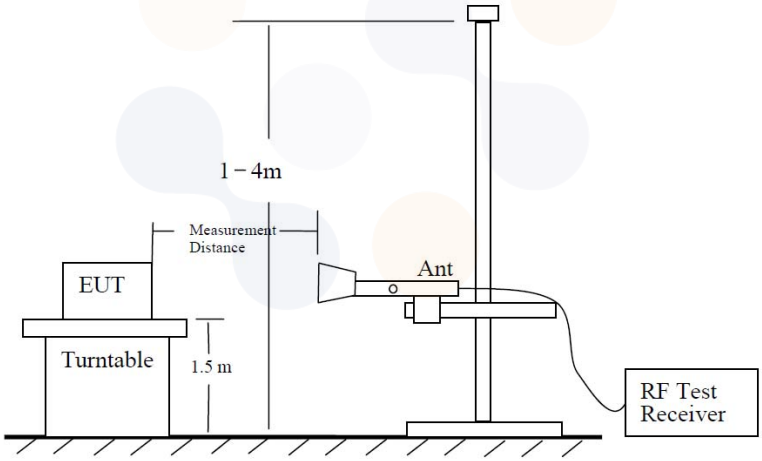
5.1. Radiated Power (ERP/EIRP)

Test setup

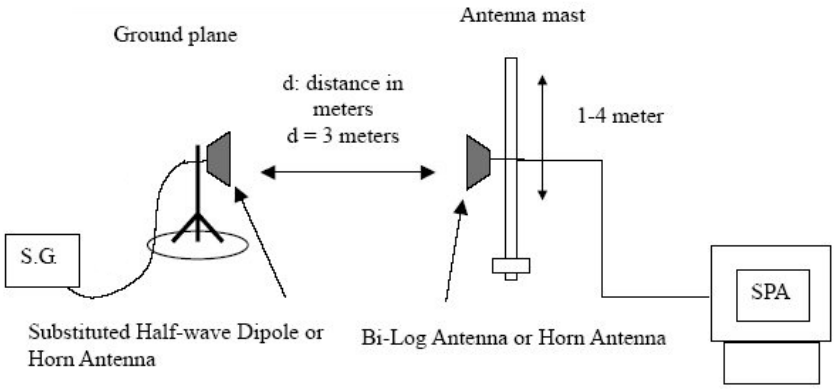
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



The diagram below shows the test setup for substituted method.



Limit

According to §22.913(a)(5), the ERP of transmitters in the cellular radiotelephone service must not exceed the limits in this section. The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

According to §24.232(c), Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

According to §27.50(c)(10), Portable stations (hand-held devices) in the 600 ㎒ uplink band and the 698-746 ㎒ band, and fixed and mobile stations in the 600 ㎒ uplink band are limited to 3 watts ERP.

According to §27.50(d)(4), portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP.

According to §90.542(a)(7), Portable stations (hand-held devices) transmitting in the 758-768 ㎒ band and 788-798 ㎒ band are limited to 3 watts ERP.

Test procedure

971168 D01 v03r01 - Section 5.2 and 5.8, 412172 D01 v01r01
ANSI 63.26-2015 – Section 5.2
ANSI/TIA-603-E-2016 - Section 2.2.17

Test settings

1) RBW = 1 % to 5 % of the OBW.
2) VBW ≥ 3 × RBW.
3) SPAN = 2 × to 3 × the OBW.
4) Number of measurement points in sweep ≥ 2 × span / RBW.
5) Sweep time :
   1) Auto couple, or
   2) ≥ [10 × (number of points in sweep) × (transmission period)] for single sweep (automation-compatible) measurement. Transmission period is the on and off time of the transmitter.
6) Detector = RMS
7) If the EUT can be configured to transmit continuously, then set the trigger to free run.
8) If the EUT cannot be configured to transmit continuously, then use a sweep trigger with the level set to enable triggering only on full power bursts and configure the EUT to transmit at full power for the entire duration of each sweep. Verify that the sweep time is less than or equal to the transmission burst duration. Time gating can also be used under similar constraints (i.e., configured such that measurement data is collected only during active full -power transmissions).
9) Trace mode = trace averaging (RMS) over 100 sweeps.
10) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power measurement function, with the band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
11) Allow trace to fully stabilize.

Notes:

1. On a test site, the EUT shall be placed at 80 cm or 1.5 m height on a turn table, and in the position close to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to Correspond to the fundamental frequency of the transmitter.
3. The turntable is rotated through 360°, and the receiving antenna scans in order to determine the Level of the maximized emission.
4. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.
5. The maximum signal level detected by the measuring receiver shall be noted.
6. The EUT was replaced by half-wave dipole (1 ㎓ below) or horn antenna (1 ㎓ above) connected to a signal generator.
   The power is calculated by the following formula;
   Pd(㏈m) = Pg(㏈m) – Cable loss (㏈) + Antenna gain (㏈)
   Note. Pd is the dipole equivalent power and Pg is the generator output power into the substitution antenna.
7. The test antenna shall be raised and lowered through the specified range of height to ensure that The maximum signal is received.
8. The input signal to the substitution antenna shall be adjusted to the level that produces a level Detected by the measuring corrected for the change of input attenuator setting of the measuring Receiver.
9. The input level to the substitution antenna shall be recorded as power level in ㏈m, corrected for Any change of input attenuator setting of the measuring receiver.
10. The measurement shall be repeated with the test antenna and the substitution antenna Orientated for horizontal polarization.

Test results

Test mode: WCDMA 850

Mode	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	ERP	
	[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[W]
RMC	846.6	H	5.47	2.49	21.82	24.80	0.302

Test mode: WCDMA 1700

Mode	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	EIRP	
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
RMC	1 752.6	H	5.79	5.26	23.60	24.13	0.259

Test mode: WCDMA 1900

Mode	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	EIRP	
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
RMC	1 880.0	H	5.54	5.19	21.11	21.46	0.140

Test mode: LTE Band 2 (Antenna 0)

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	EIRP	
		[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
20 M	QPSK	1 860.0	H	5.58	5.17	21.18	21.59	0.144

Test mode: LTE Band 2 (Antenna 2)

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	EIRP	
		[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
5 M	QPSK	1 852.5	H	5.60	5.18	17.06	17.47	0.056

Test mode: LTE Band 4 (Antenna 0)

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	EIRP	
		[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
5 M	QPSK	1 752.5	H	5.80	5.23	24.06	24.62	0.290

Test mode: LTE Band 4 (Antenna 2)

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	EIRP	
		[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
5 M	QPSK	1 712.5	H	5.88	5.16	11.37	12.08	0.016

Test mode: LTE Band 5

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	ERP	
		[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[W]
5 M	QPSK	826.5	H	5.30	2.78	21.30	23.81	0.240

Note.
1. E.R.P & E.I.R.P(㏈m) = Substitute Level(㏈) + Antenna gain(㏈d & ㏈i) - C.L(Cable loss) (㏈)

Test mode: LTE Band 12

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	ERP	
		[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[W]
5 M	QPSK	701.5	H	4.53	2.50	18.99	21.02	0.126

Test mode: LTE Band 14

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	ERP	
		[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[W]
10 M	QPSK	793.0	H	5.24	2.63	21.32	23.93	0.247

Test mode: LTE Band 66 (Antenna 0)

Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	EIRP	
		[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
15 M	QPSK	1 772.5	H	5.76	5.26	20.52	21.01	0.126

Test mode: LTE Band 66 (Antenna 2)

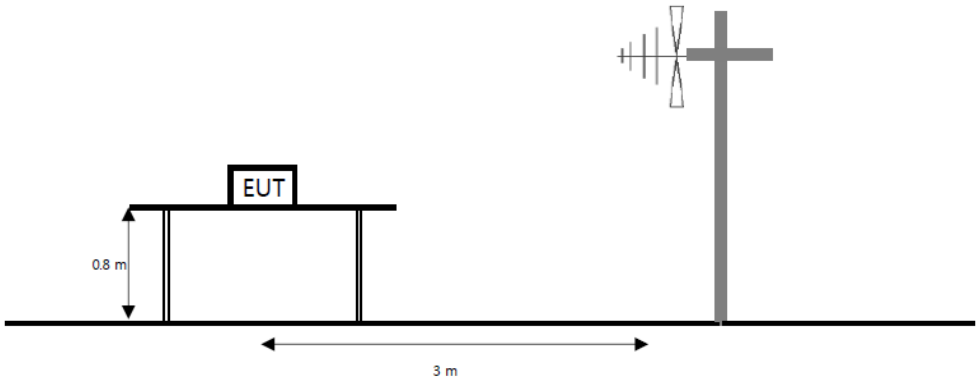
Bandwidth	Modulation	Frequency	Pol.	Antenna Gain	C.L	Substitute Level	EIRP	
		[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[W]
10 M	QPSK	1 715.0	H	5.87	5.08	15.86	16.65	0.046

Note.
1. E.R.P & E.I.R.P(㏈m) = Substitute Level(㏈) + Antenna gain(㏈d & ㏈i) - C.L(Cable loss) (㏈)

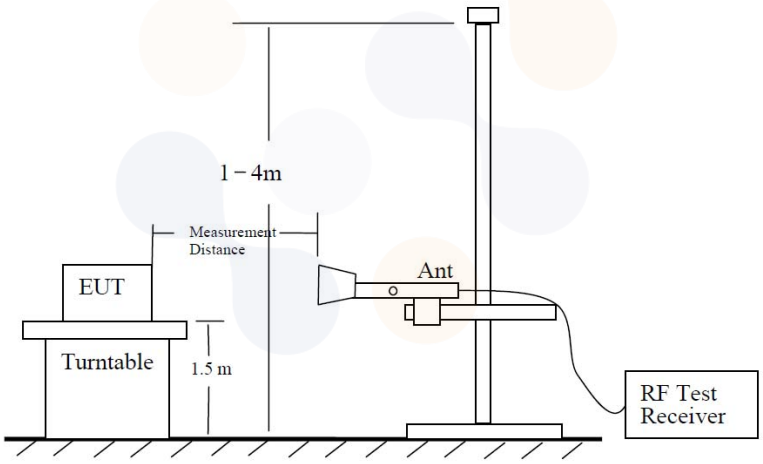
5.2. Radiated Spurious Emissions

Test setup

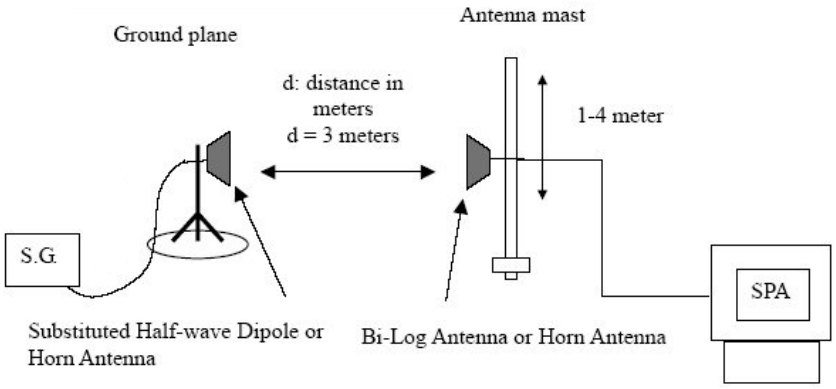
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



The diagram below shows the test setup for substituted method.



Limit

According to §22.917(a), §24.238(a), the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10log($P_{[Watts]}$) ㏈.

According to §27.53(g), for operations in the 600 ㎒ band and the 698-746 ㎒ band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10log($P_{[Watts]}$) ㏈.

According to §27.53(h), the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10log($P_{[Watts]}$) ㏈.

According to §90.543(c), the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

According to §90.543(f), for operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Test procedure

971168 D01 v03r01 - Section 6.2
ANSI 63.26-2015 – Section 5.5
ANSI/TIA-603-E-2016 - Section 2.2.12

Test settings

1) RBW = 100 ㎑ for below 1 ㎓ and 1 ㎒ for above 1 ㎓.
2) VBW ≥ 3 × RBW.
3) Detector = RMS
4) Trace mode = Max hold
5) Sweep time = Auto couple
6) Number of sweep points ≥ 2 × span / RBW
7) Allow trace to fully stabilize.

For the narrowband spurious settings:

1) RBW = 1 ㎑
2) VBW = 3 ㎑
3) Detector = RMS
4) Trace mode = Max hold
5) Sweep speed slow enough to maintain measurement calibration.

Notes:

1. On a test site, the EUT shall be placed at 80 cm or 1.5 m height on a turn table, and in the position close to normal use as declared by the applicant.
2. The test antenna shall be oriented initially for vertical polarization located 3 m from EUT to correspond to the fundamental frequency of the transmitter.
3. The turntable is rotated through 360°, and the receiving antenna scans in order to determine the level of the maximized emission.
4. The test antenna shall be raised and lowered again through the specified range of height until the maximum signal level is detected by the measuring receiver.
5. The maximum signal level detected by the measuring receiver shall be noted.
6. The EUT was replaced by half-wave dipole (1 ㎓ below) or horn antenna (1 ㎓ above) connected to a signal generator.
7. The test antenna shall be raised and lowered through the specified range of height to ensure that the maximum signal is received.
8. The input signal to the substitution antenna shall be adjusted to the level that produces a level detected by the measuring corrected for the change of input attenuator setting of the measuring receiver.
9. The input level to the substitution antenna shall be recorded as power level in ㏈m, corrected for any change of input attenuator setting of the measuring receiver.
10. The measurement shall be repeated with the test antenna and the substitution antenna orientated for horizontal polarization.

Test results

Test mode : WCDMA 850
Frequency(㎒) : 846.6
Channel : 4233

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
RMC	1 692.00	H	5.92	5.17	-60.75	-60.00	-13.00	47.00
	2 539.60	V	6.24	5.98	-57.06	-56.80	-13.00	43.80
	3 384.40	H	7.93	6.83	-56.10	-55.00	-13.00	42.00
	4 234.80	H	9.09	7.28	-56.61	-54.80	-13.00	41.80

Test mode : WCDMA 1700
Frequency(㎒) : 1 752.6
Channel : 1513

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
RMC	3 507.00	H	8.31	6.94	-56.07	-54.70	-13.00	41.70
	5 253.75	H	10.35	8.54	-55.21	-53.40	-13.00	40.40
	7 011.00	H	11.51	9.36	-51.15	-49.00	-13.00	36.00
	8 762.25	V	13.20	10.11	-51.29	-48.20	-13.00	35.20

Test mode : WCDMA 1900
Frequency(㎒) : 1 880.0
Channel : 9400

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
RMC	3 757.50	H	8.61	6.96	-51.75	-50.10	-13.00	37.10
	5 645.25	V	10.56	8.67	-53.19	-51.30	-13.00	38.30
	7 518.75	V	12.12	9.45	-52.57	-49.90	-13.00	36.90
	9 406.50	V	13.30	10.24	-50.76	-47.70	-13.00	34.70

Note.
1. E.R.P & E.I.R.P(㏈m) = Substitute Level(㏈) + Antenna gain(㏈i&㏈d) - C.L(Cable loss) (㏈)

Test mode : LTE Band 2 (Antenna 0)
Frequency(㎒) : 1 860.0
Channel : 18700
Bandwidth(㎒) : 20

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	3 720.00	H	8.56	7.12	-49.84	-48.40	-13.00	35.40
	5 580.00	H	10.53	8.66	-53.37	-51.50	-13.00	38.50
	7 440.00	V	12.03	9.32	-44.81	-42.10	-13.00	29.10
	9 303.00	V	13.30	10.11	-51.19	-48.00	-13.00	35.00

Test mode : LTE Band 2 (Antenna 2)
Frequency(㎒) : 1 852.5
Channel : 18625
Bandwidth(㎒) : 5

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	3 699.00	H	8.54	7.06	-57.08	-55.60	-13.00	42.60
	5 547.75	V	10.52	8.62	-55.30	-53.40	-13.00	40.40
	7 400.25	V	11.98	9.28	-52.90	-50.20	-13.00	37.20
	9 249.75	V	13.30	9.82	-50.18	-46.70	-13.00	33.70

Test mode : LTE Band 4 (Antenna 0)
Frequency(㎒) : 1 752.5
Channel : 20375
Bandwidth(㎒) : 5

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	3 504.75	H	8.31	6.94	-54.67	-53.30	-13.00	40.30
	5 257.50	H	10.35	8.54	-53.11	-51.30	-13.00	38.30
	7 009.50	H	11.51	9.36	-50.65	-48.50	-13.00	35.50
	8 761.50	H	13.20	10.11	-51.09	-48.00	-13.00	35.00

Note.
1. E.R.P & E.I.R.P(㏈m) = Substitute Level(㏈) + Antenna gain(㏈i&㏈d) - C.L(Cable loss) (㏈)

Test mode : LTE Band 4 (Antenna 2)
Frequency(㎒) : 1 712.5
Channel : 19975
Bandwidth(㎒) : 5

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	3 420.75	H	8.05	6.87	-58.58	-57.40	-13.00	44.40
	5 129.25	H	10.28	8.39	-54.69	-52.80	-13.00	39.80
	6 839.25	V	11.31	10.37	-49.54	-48.60	-13.00	35.60
	8 547.00	V	13.12	9.38	-51.54	-47.80	-13.00	34.80

Test mode : LTE Band 5
Frequency(㎒) : 826.5
Channel : 20425
Bandwidth(㎒) : 5

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 649.20	V	6.00	5.02	-62.58	-61.60	-13.00	48.60
	2 472.00	H	6.15	6.01	-54.94	-54.80	-13.00	41.80
	3 303.20	H	7.67	6.76	-55.31	-54.40	-13.00	41.40
	4 120.80	H	9.00	7.38	-55.02	-53.40	-13.00	40.40

Test mode : LTE Band 12
Frequency(㎒) : 701.5
Channel : 23035
Bandwidth(㎒) : 5

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 403.60	H	5.59	4.44	-63.45	-62.30	-13.00	49.30
	2 105.20	H	5.49	5.35	-55.54	-55.40	-13.00	42.40
	2 803.60	H	6.50	6.31	-56.89	-56.70	-13.00	43.70
	3 508.00	H	8.31	6.95	-55.36	-54.00	-13.00	41.00

Note.
1. E.R.P & E.I.R.P(㏈m) = Substitute Level(㏈) + Antenna gain(㏈i&㏈d) - C.L(Cable loss) (㏈)

Test mode : LTE Band 14
Frequency(㎒) : 793.0
Channel : 23330
Bandwidth(㎒) : 10

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	2 364.80	H	5.96	5.78	-56.88	-56.70	-13.00	43.70
	3 155.20	H	7.20	6.62	-54.88	-54.30	-13.00	41.30
	3 941.20	V	8.83	7.19	-54.24	-52.60	-13.00	39.60

Test mode : LTE Band 14 (1 559 ㎒ – 1 610 ㎒)
Frequency(㎒) : 793.0
Channel : 23330
Bandwidth(㎒) : 10

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBd]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	1 559.84	H	6.18	4.89	-57.89	-56.60	-40.00	16.60

Test mode : LTE Band 66 (Antenna 0)
Frequency(㎒) : 1 772.5
Channel : 132597
Bandwidth(㎒) : 15

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	3 558.00	H	8.37	7.05	-52.12	-50.80	-13.00	37.80
	5 337.00	H	10.40	8.55	-54.15	-52.30	-13.00	39.30
	7 117.50	V	11.64	9.72	-51.52	-49.60	-13.00	36.60
	8 901.00	V	13.26	9.54	-52.02	-48.30	-13.00	35.30

Note.
1. Limit Calculation(㏈m)= 43 + 10log($P_{[Watts]}$)
   Limit Calculation of wide-band (㏈m/㎒) = -70㏈W/㎒ (-40 ㏈m/㎒)
   Limit Calculation of narrow-band (㏈m) = -80㏈W (-50㏈m)
2. E.R.P & E.I.R.P(㏈ m) = Substitute Level(㏈) + Antenna gain(㏈ d&㏈ i) - C.L(Cable loss) (㏈)
3. The narrowband limit is applied because any emissions are not detected within 1 559 ㎒ ~ 1 610 ㎒.

Test mode : LTE Band 66 (Antenna 2)
Frequency(㎒) : 1 715.0
Channel : 132022
Bandwidth(㎒) : 10

Mode	Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
	[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
QPSK	3 431.25	V	8.08	6.88	-56.40	-55.20	-13.00	42.20
	5 145.00	H	10.29	8.40	-49.89	-48.00	-13.00	35.00
	6 860.25	H	11.33	10.36	-52.37	-51.40	-13.00	38.40
	8 574.00	V	13.13	9.42	-51.21	-47.50	-13.00	34.50

Note.
1. E.R.P & E.I.R.P(㏈m) = Substitute Level(㏈) + Antenna gain(㏈i&㏈d) - C.L(Cable loss) (㏈)

Spurious Emission for Simultaneous Condition

Case	WWAN	WLAN	Bluetooth
Mode	LTE Band 2 (Antenna 0)	5G WLAN MIMO (802.11ac)	EDR (3DH-3)
Channel	18700	50	78
Frequency(㎒)	1 860	5 250	2 480
Bandwidth(㎒)	20 M	160 M	-

Frequency	Pol.	Antenna Gain	Cable loss	Substitute Level	Level	Limit	Margin
[㎒]	[V/H]	[dBi]	[dB]	[dBm]	[dBm]	[dBm]	[dB]
3 719.95	V	8.56	7.12	-53.74	-52.30	-13.00	39.30
4 960.18	V	10.13	8.23	-54.50	-52.60	-13.00	39.60
7 440.13	V	12.03	9.32	-44.71	-42.00	-13.00	29.00
10 500.27	H	13.20	10.82	-51.48	-49.10	-13.00	36.10

Note.
1. E.R.P & E.I.R.P(㏈m) = Substitute Level(㏈) + Antenna gain(㏈i&㏈d) - C.L(Cable loss) (㏈)
2. For the simultaneous mode the lowest margin condition among the channels and modes were selected for the test.

6. Measurement equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	AGILENT	N9040B	MY57010132	23.10.14
Signal Generator	R&S	SMB100A	176206	24.01.19
High Pass Filter	Wainwright Instruments GmbH	WHKX10-900-1000-15000-40SS	11	23.08.10
High Pass Filter	Wainwright Instruments GmbH	WHKX12-2805-3000-18000-40SS	32	23.08.10
High Pass Filter	Wainwright Instruments GmbH	WHKX8-5655-6500-18000-40SS	5	23.08.10
Band Reject Filter	Wainwright Instruments GmbH	WRCG 1710/1785-1690/1805-60/12SS	43	24.01.19
Band Reject Filter	Wainwright Instruments GmbH	WRCTF2402/2480-2400/2483.5-35/12+9SS	43	24.01.19
Band Reject Filter	Wainwright Instruments GmbH	WTRCJV8-5100-5850-20-100-50SSK	62	23.10.14
Wideband Radio Communication Tester	R&S	CMW500	141780	24.01.19
Radio Communication Analyzer	ANRITSU	MT8000A	6262093278	24.04.26*
Bluetooth Tester	TESCOM	TC-3000B	3000B640056	24.01.19
Bi-log Antenna	Teseq GmbH	CBL 6112D	62027	24.11.17
Bi-log Antenna	ETS.LINDGREN	'3143B	228420	23.09.28
Horn Antenna	ETS-LINDGREN	3117	251528	24.02.02
Horn Antenna	ETS.LINDGREN	3117	227509	23.09.20
Horn Antenna	ETS-Lindgren	3116	00086632	24.01.25
Horn Antenna	ETS-LINDGREN	3116C	251516	24.02.02
Amplifier	SONOMA INSTRUMENT	310N	421822	23.12.14
Amplifier	C&K Technologies, Inc.	BZRT-00504000-481055-382525	26299-27735	23.09.19
Amplifier	C&K Technologies, Inc.	BZR-00504000-551028-252525	27736	23.09.19
Antenna Mast	innco systems GmbH	MA4640-XP-ET	N/A	-

* Tests related to this equipment were progressed after the calibration was completed.

End of test report