

TEST REPORT



CTK Co., Ltd.

(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.:
CTK-2018-00911
Page (1) / (34) Pages

1. Client

- Name : Suntech International Ltd.
- Address : (Gasan-dong, Greatvally), B-1506, 32, Digital-ro 9-gil, Geumchon-gu, Seoul, Korea
- Date of Receipt : 2018-03-19

2. Manufacturer

- Name : Suntech International Ltd.
- Address : (Gasan-dong, Greatvally), B-1506, 32, Digital-ro 9-gil, Geumchon-gu, Seoul, Korea

3. Use of Report : For FCC Certification / ISED Certification

4. Test Sample / Model: Vehicle Information Device / ST20B

5. Date of Test : 2018-03-22 to 2018-04-03

6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247 ISED RSS-247

7. Testing Environment: Temp.: (23 ± 5) °C, Humidity: (51 ± 3) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by Ji-Hye, Kim: (Signature)	Technical Manager Won-Jae, Hwang: (Signature)
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2018-04-09

Republic of KOREA **CTK Co., Ltd.**



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REPORT REVISION HISTORY

Date	Revision	Page No
2018-04-09	Issued (CTK-2018-00911)	all

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1. General Product Description

1.1 Client Information

Company	Suntech International Ltd.
Contact Point	(Gasan-dong, Greatvally), B-1506, 32, Digital-ro 9-gil, Geumchon-gu, Seoul, Korea
Contact Person	Name : Wilson Oh E-mail : wilson@suntechint.com Tel : +82-70-7006-3138

1.2 Product Information

FCC ID	WA2-ST20B
ISED	21484-ST20B
Product Description	Vehicle Information Device
Model name	ST20B
Variant Model name	-
Operating Frequency	2 402 MHz – 2 480 MHz
RF Output Power	-0.275 dBm (0.939 mW)
Antenna Specification	Antenna type : Chip Antenna Peak Gain : 3.29 dBi
Number of channels	40
Type of Modulation	GFSK
Data Rate	1 Mbps
Power Source	DC 12 V
Hardware Rev	Rev01
Software Rev	B019

1.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	15-bs563TU	CND7253QPR
AC/DC Adapter	HP	HSTNN-LA40	-

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2. Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	
CANADA	ISED	ISED EMI (3/10m test site)	8737A-2	
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	

2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

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3. Test Specifications

3.1 Standards

FCC Part Section(s)	Requirement(s)	Status (Note 1)	Test Condition
15.247(a)	6 dB Bandwidth	C	Conducted
15.247(b)	Maximum peak conducted output power	C	
15.247(d)	Conducted Spurious emission	C	
15.247(d)	Unwanted Emission(Conducted)	C	
15.247(e)	Power Spectral Density	C	
15.209	Radiated Emissions	C	Radiated
15.207	AC Conducted Emission	NA	Line Conducted

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

Note 3: The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-2013

Note 4: The tests were performed according to the method of measurements prescribed in KDB No.558074.

ISED Part Section(s)	Requirement(s)	Status (Note 1)	Test Condition
RSS-Gen 6.6	6 dB Bandwidth	C	Conducted
RSS-247 5.4(d)	Maximum peak conducted output power	C	
RSS-Gen 6.13	Conducted Spurious emission	C	
RSS-Gen 6.13	Unwanted Emission(Conducted)	C	
RSS-247 5.2(b)	Power Spectral Density	C	
RSS-Gen 6.13	Radiated Emissions	C	Radiated
RSS-Gen 5	Receiver Spurious Emissions	C	
RSS-Gen 8.8	AC Conducted Emission	NA	Line Conducted

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

Note 3: The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-2013

Note 4: The tests were performed according to the method of measurements prescribed in KDB No.558074.



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3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments. During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests. The results are only attached worst cases.

Test Frequency

Lowest channel	Middle channel	Highest channel
2 402 MHz	2 442 MHz	2 480 MHz

Test mode

Test mode	Modulation	Data rate	Duty Cycle	Duty Cycle Factor
BLE	GFSK	1 Mbps	100 %	-

3.3 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter. Coverage factor $k = 2$, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	± 1.5 dB
Power Spectral Density	± 1.5 dB
Occupied Bandwidth	± 0.1 MHz
Unwanted Emission(conducted)	± 3.0 dB
Radiated Emissions (f ≤ 1 GHz)	± 4.0 dB
Radiated Emissions (f > 1 GHz)	± 5.0 dB

3.4 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	TOYO EMI software EP5RE Ver. 5.1.0
Line Conducted Test	ESCI7, ESCI3 : EMC32 Ver. 8.50.0 ESR7 : EMC32 Ver. 8.53.0

4. Technical Characteristic Test

4.1 6dB Bandwidth

Test Procedures

ANSI C63.10-2013 6.9.2

RSS-GEN Issue 4 6.6

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Procedures

ANSI C63.10-2013 6.9.3

RSS-GEN Issue 4 6.6

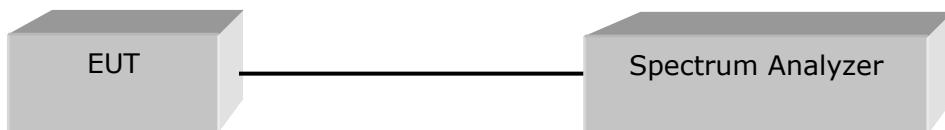
The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

a) RBW = 100 kHz	b) VBW $\geq 3 \times$ RBW
c) Detector = peak	d) Trace mode = Max hold
e) Sweep = auto couple	
f) Allow trace to fully stabilize	
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.	



Limit

6 dB Bandwidth > 500kHz



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Test Data:

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	99% Bandwidth [MHz]	Result
Low	2 402	0.683	1.079	Complies
Middle	2 442	0.685	1.074	Complies
High	2 480	0.691	1.072	Complies

See next pages for actual measured spectrum plots.



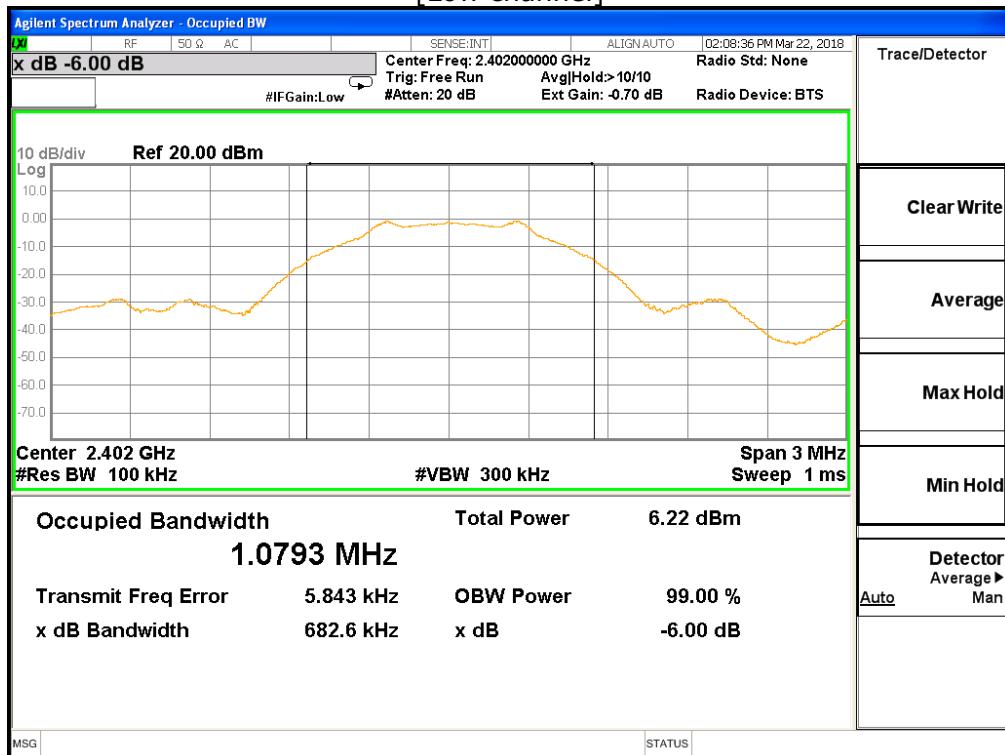
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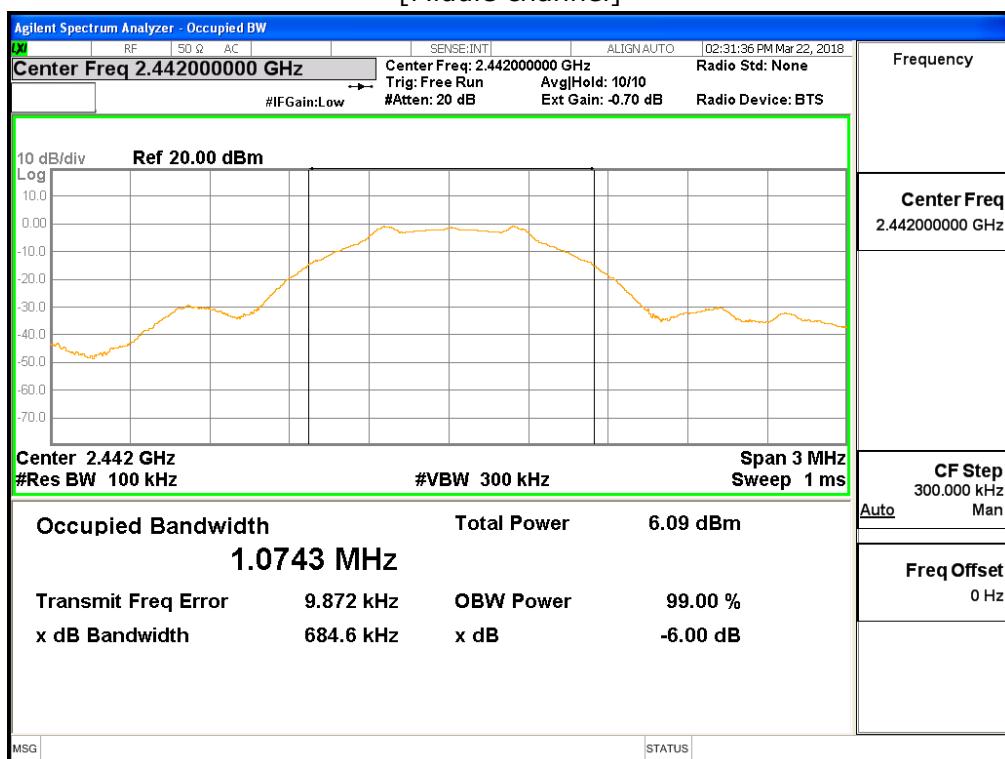
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6 dB bandwidth & 99% Bandwidth

[Low channel]



[Middle channel]



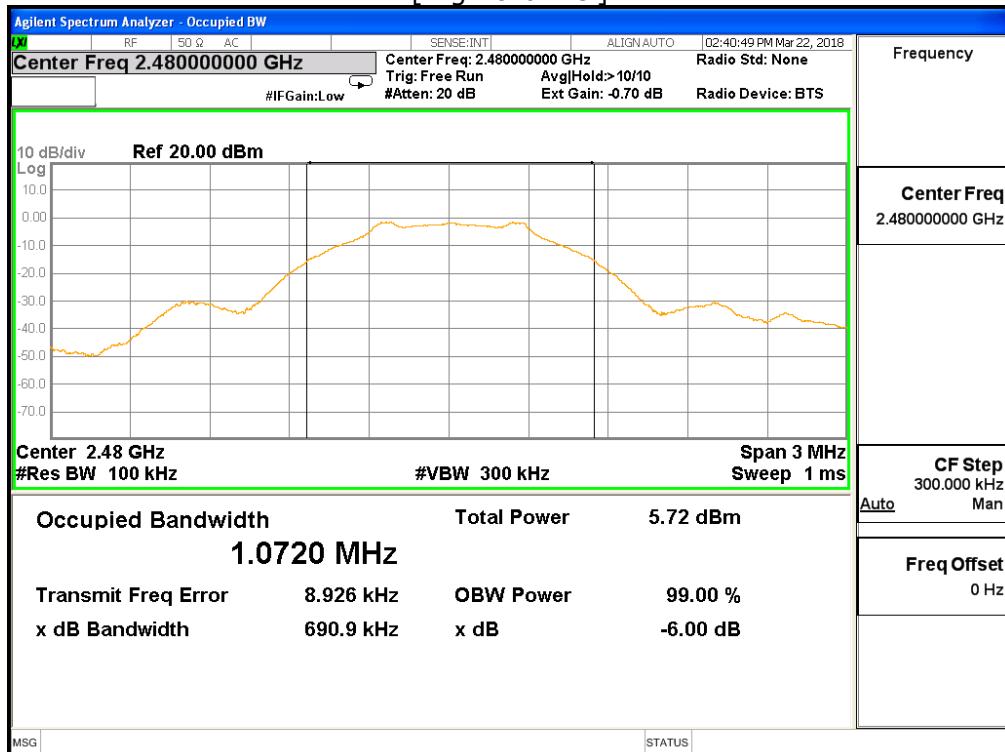


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[High channel]



4.2 Maximum peak conducted output power

Test Procedures

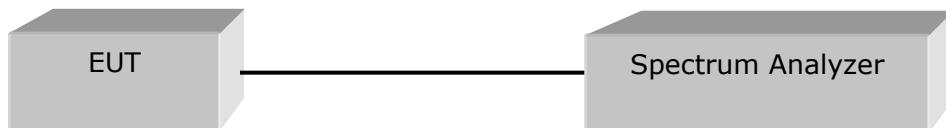
Peak Power(Procedure 9.1.1 in KDB 558074)
 RSS-GEN Issue 4 6.12

The following procedure can be used when the maximum available RBW of the instrument is less than the DTS bandwidth:

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

a) RBW \geq DTS Bandwidth	b) VBW $\geq 3 \times$ RBW
c) span $\geq 3 \times$ RBW	d) Sweep time = auto couple
e) Detector = peak	f) Trace mode= max hold
g) Allow trace to fully stabilize	
h) Use peak marker function to determine the peak amplitude level.	



Limit :

Maximum Output Power < 1 W (30 dBm)

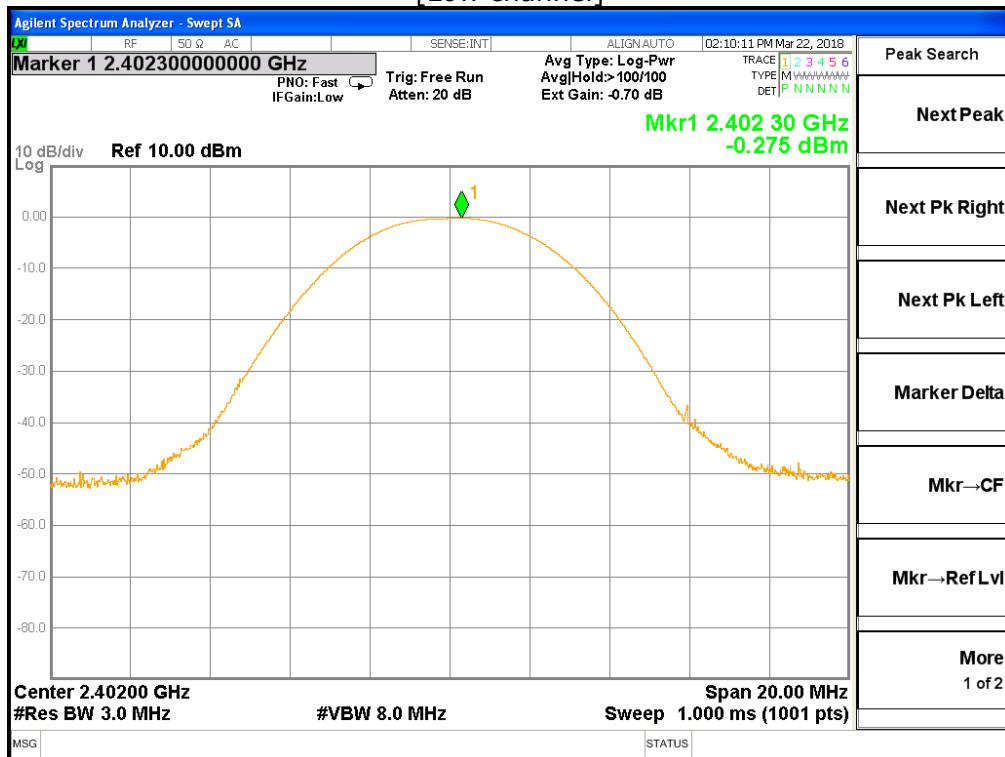
Test Data :

Channel	Frequency [MHz]	Measurement data [dBm]	Limit [dBm]	Result
Low	2 402	-0.275	30	Complies
Middle	2 442	-0.567	30	Complies
High	2 480	-0.907	30	Complies

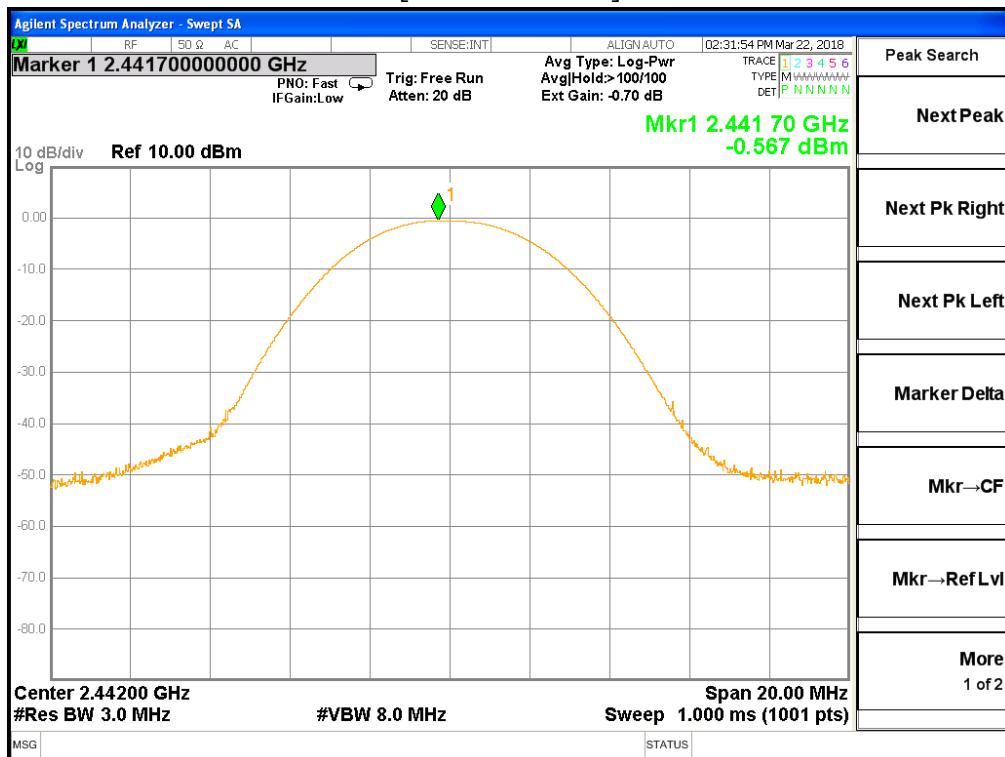
See next pages for actual measured spectrum plots.

Maximum peak conducted output power

[Low channel]



[Middle channel]



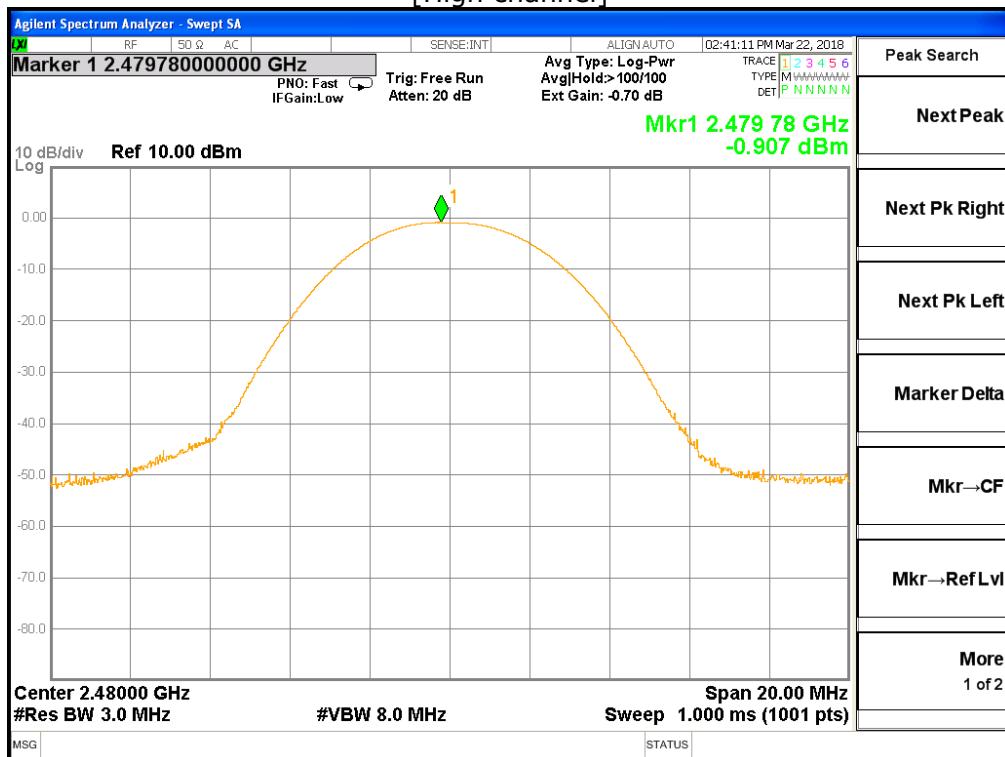


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[High channel]



4.3 Power Spectral Density

Test Procedures

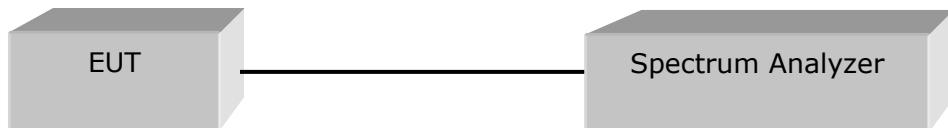
Procedure 10.2 in KDB 558074, Method Peak PSD
 RSS-247 Issue 2 5.2(b)

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

- a) RBW : $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- b) VBW $\geq 3 \times \text{RBW}$
- c) span $\geq 1.5 \times \text{DTS bandwidth}$
- d) Sweep time = auto couple
- e) Detector = peak
- f) Trace mode= max hold
- g) Allow trace to fully stabilize
- h) Use the peak marker function to determine the maximum amplitude level within the RBW.



Limit :

Power Spectral Density < 8 dBm @ 3 kHz BW

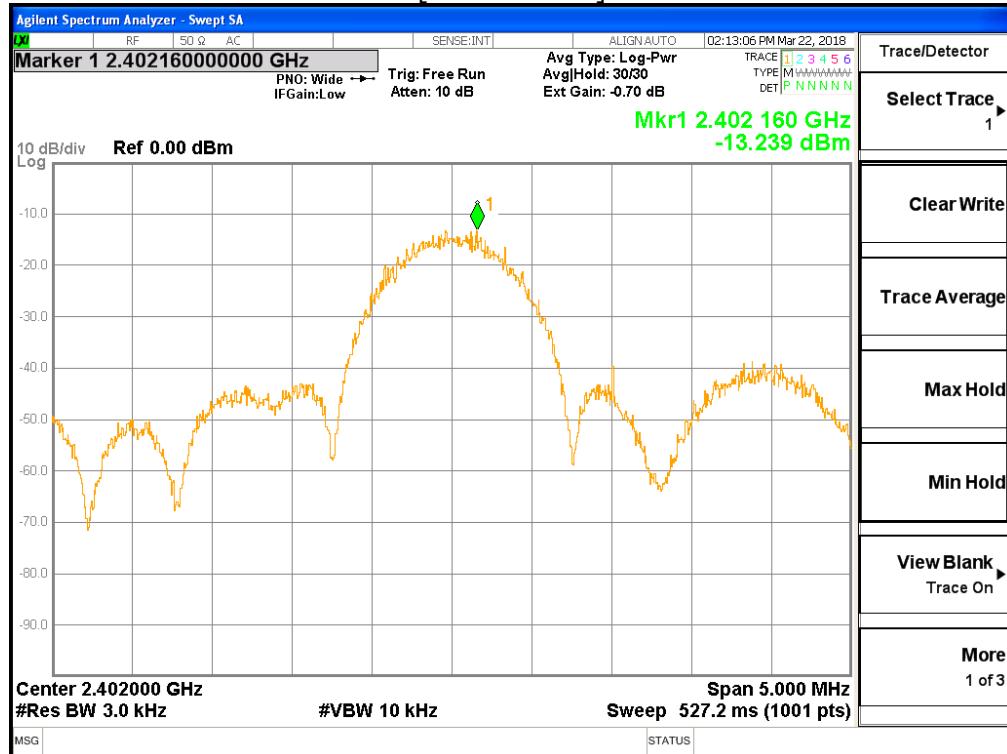
Test Data :

Channel	Frequency [MHz]	Measurement data [dBm]	Limit [dBm]	Result
Low	2 402	-13.239	8	Complies
Middle	2 442	-13.422	8	Complies
High	2 480	-13.729	8	Complies

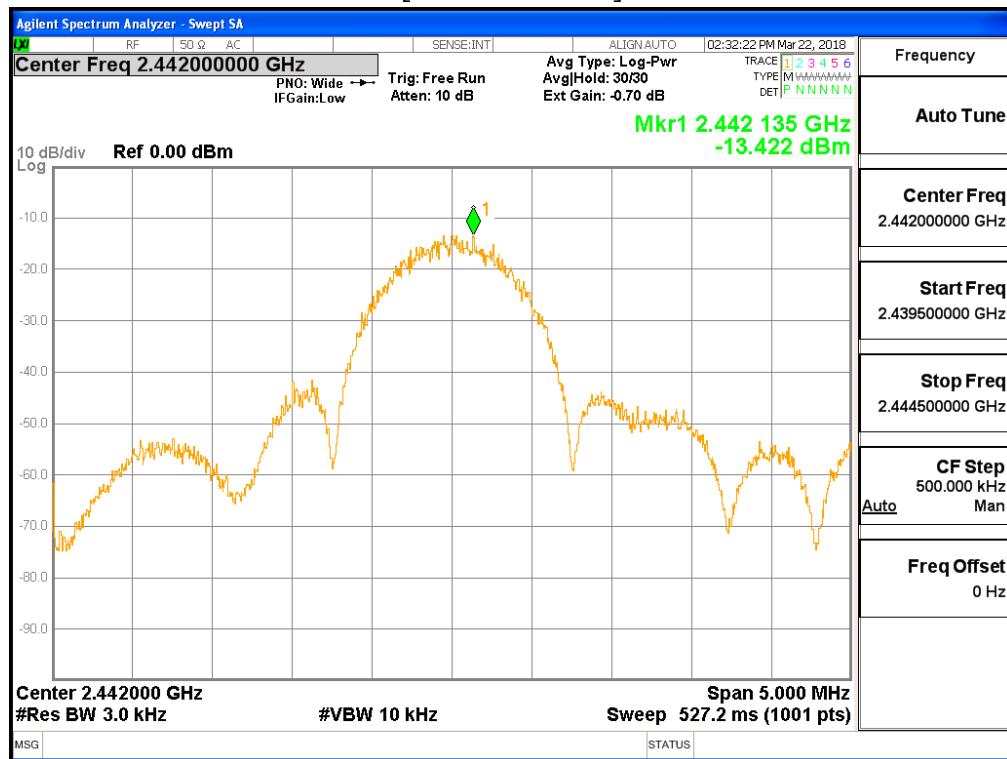
See next pages for actual measured spectrum plots.

Power Spectral Density

[Low channel]



[Middle channel]



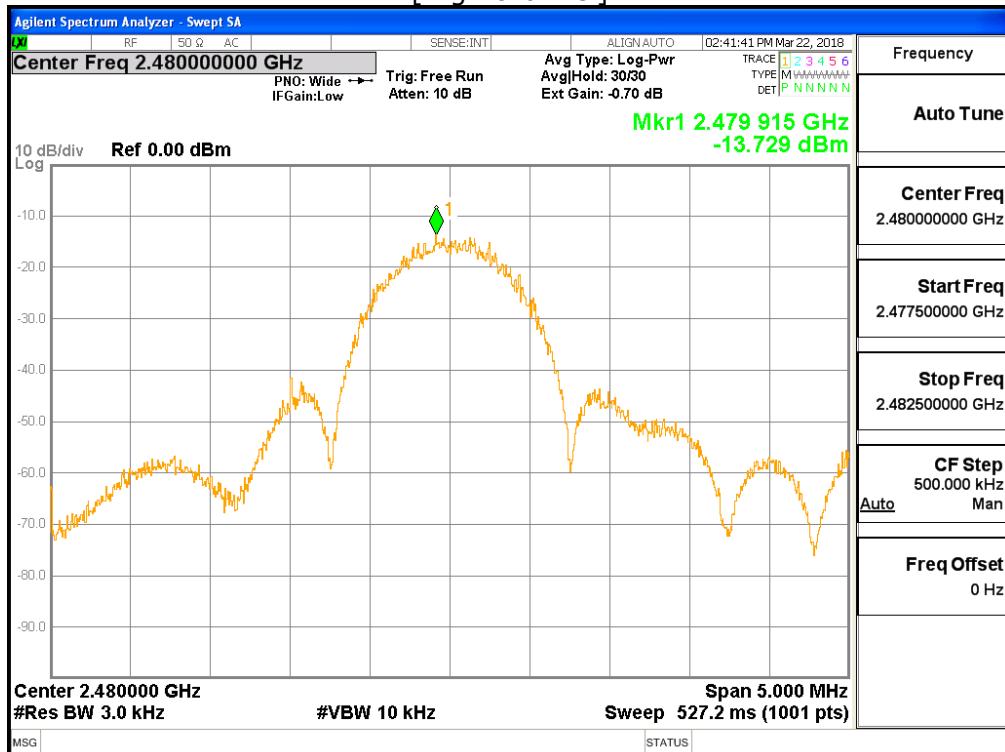


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[High channel]





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4.4 Band Edge & Conducted Spurious emission

Test Procedures

ANSI C63.10-2013 11.11.3

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB.

The bandwidth at 20 dB down from the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function disabled at the highest, middle and the lowest available channels.

Test Settings:

Center frequency = the highest, middle and the lowest channels

a) RBW = 100 kHz	b) VBW \geq 3 x RBW
c) Detector = peak	d) Sweep time = auto couple
e) Trace mode= max hold	
f) Allow trace to fully stabilize	
g) Use the peak marker function to determine the maximum amplitude level.	

Limit :

Emission level < 20 dBc

Test Results: Complies

- All conducted emission in any 100 kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.

See next pages for actual measured spectrum plots.



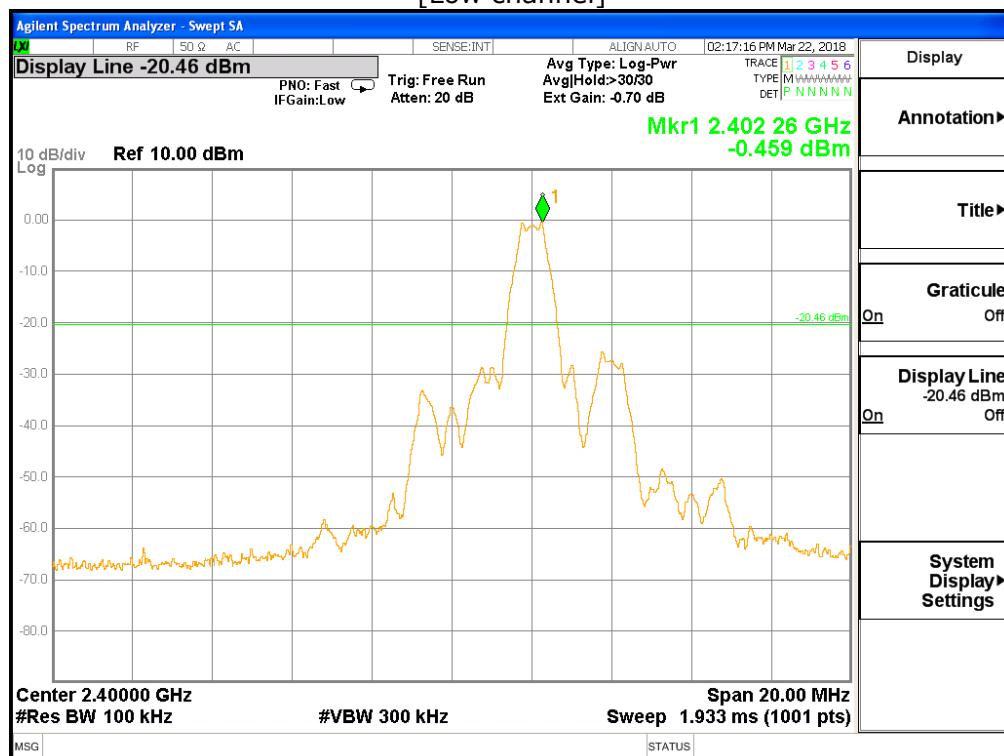
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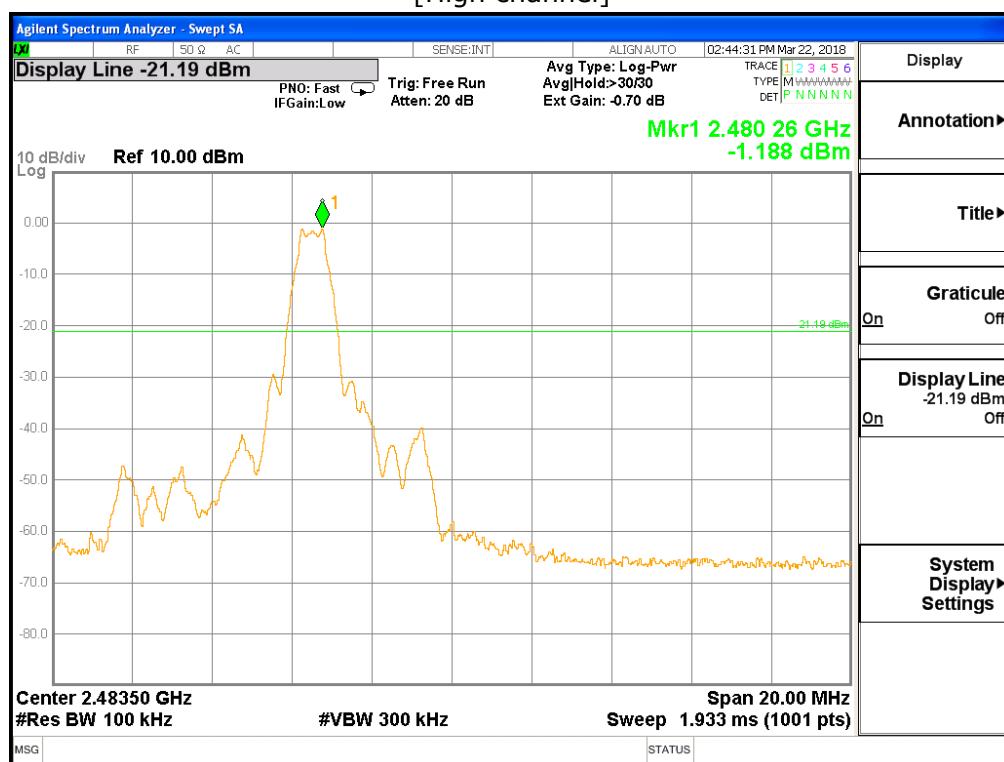
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Band Edge

[Low channel]



[High channel]





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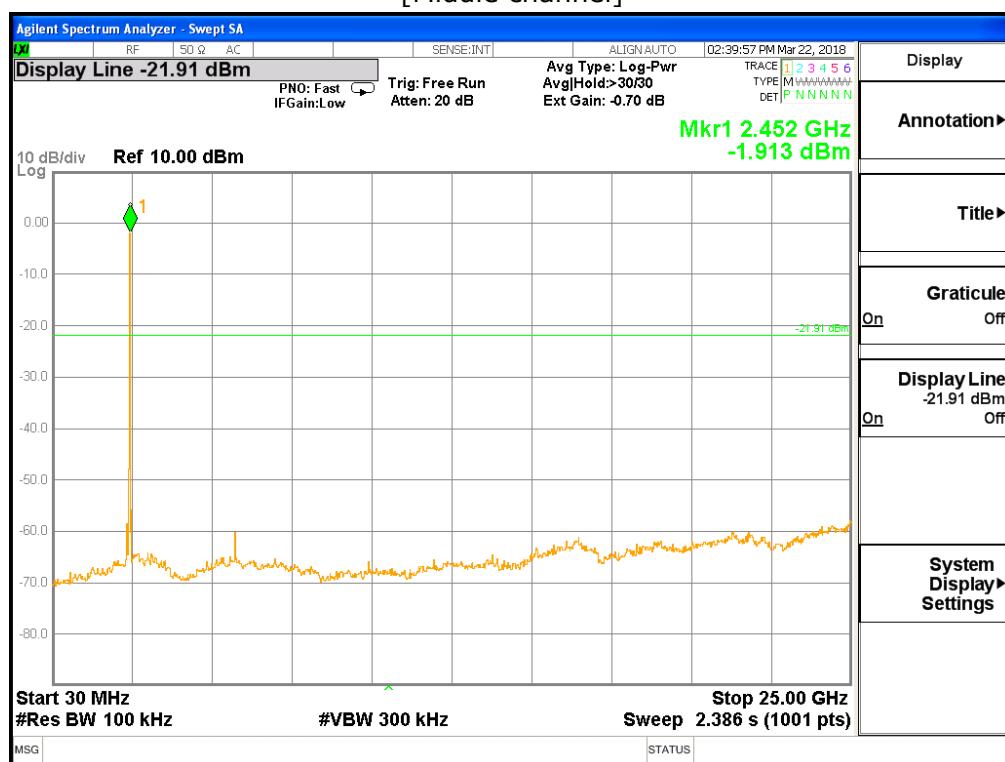
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Conducted Spurious emission

[Low channel]



[Middle channel]



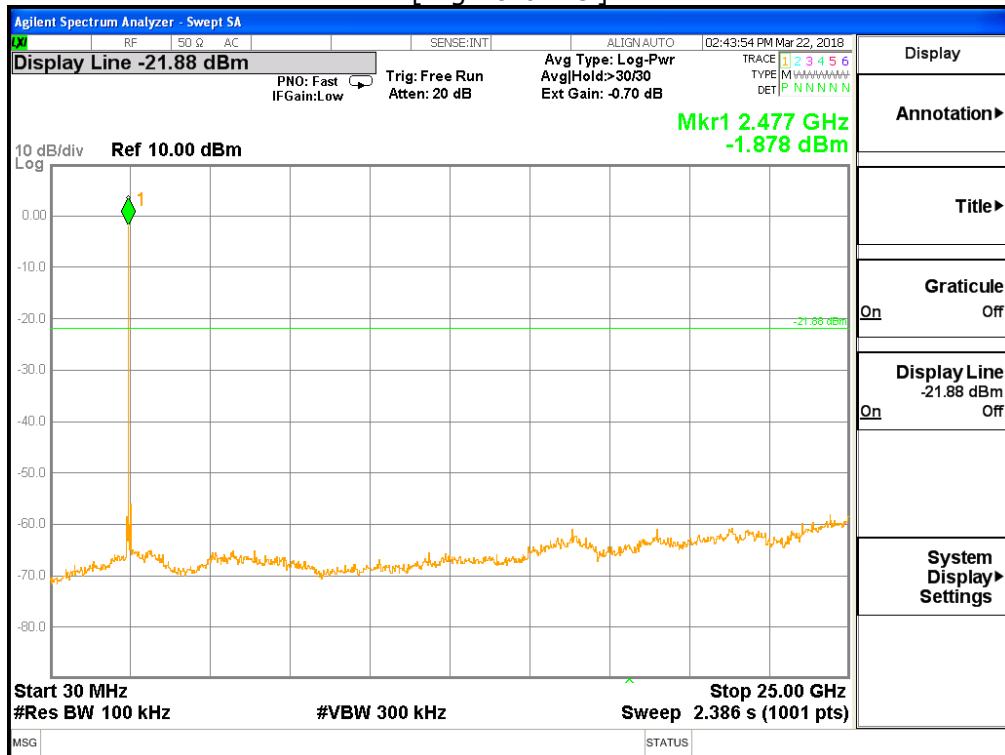


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4.5 Radiated Emission

Test Location

- 10 m SAC (test distance : 10 m, 3 m)
- 3 m SAC (test distance : 3 m)

Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

Test Settings:

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10th harmonic)

- a) RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz
- b) VBW \geq RBW
- c) Sweep time = auto couple



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Limit :

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	MHz	GHz
0.09-0.11	8.37626-8.38675	73-74.6	399.9-410	2690-2900	10.6-12.7
¹ 0.495-0.505	8.41425-8.41475	74.8-75.2	608-614	3260-3267	13.25-13.4
2.1735-2.1905	12.29-12.293	108-121.94	960-1240	3332-3339	14.47-14.5
4.125-4.128	12.51975-12.52025	123-138	1300-1427	3345.8-3358	15.35-16.2
4.17725-4.17775	12.57675-12.57725	149.9-150.05	1435-1626.5	3600-4400	17.7-21.4
4.20725-4.20775	13.36-13.41	156.52475- 156.52525	1645.5-1646.5	4500-5150	22.01-23.12
6.215-6.218	16.42-16.423	156.7-156.9	1660-1710	5350-5460	23.6-24
6.26775-6.26825	16.69475-16.69525	162.0125-167.17	1718.8-1722.2	7250-7750	31.2-31.8
6.31175-6.31225	16.80425-16.80475	167.72-173.2	2200-2300	8025-8500	36.43-36.5
8.291-8.294	25.5-25.67	240-285	2310-2390	9000-9200	² Above 38.6
8.362-8.366	37.5-38.25	322-335.4	2483.5-2500	9300-9500	

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.



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FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Deasurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

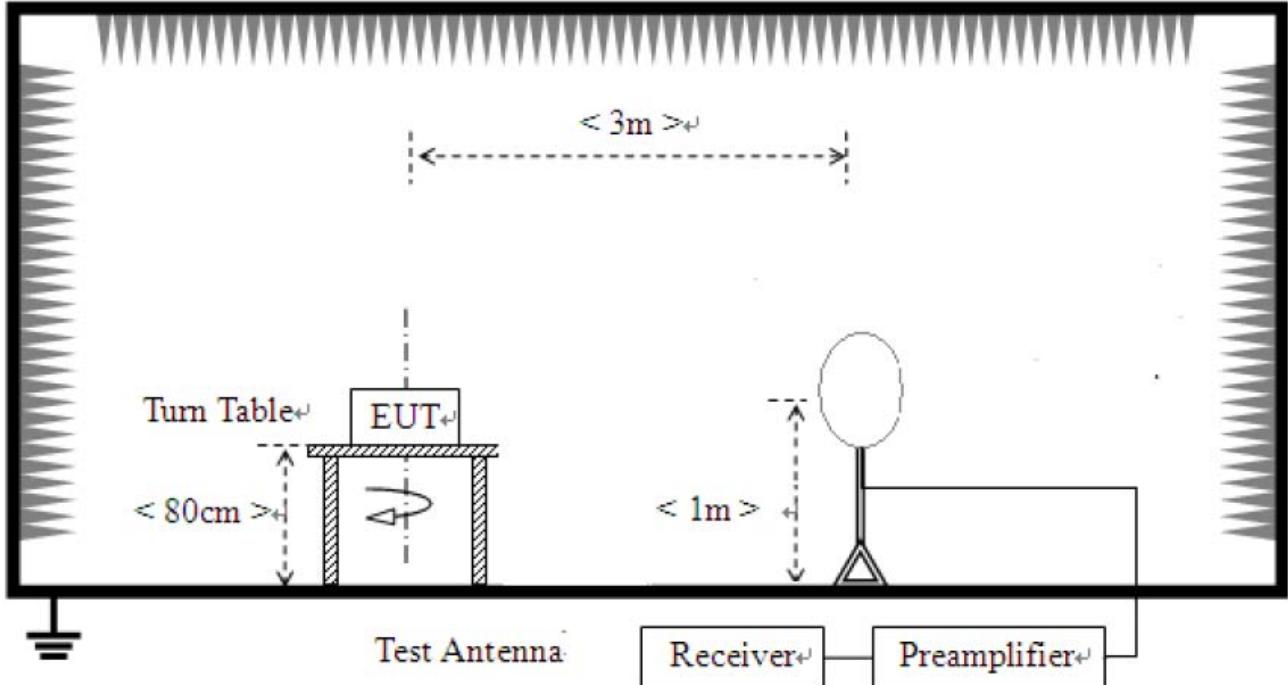
** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

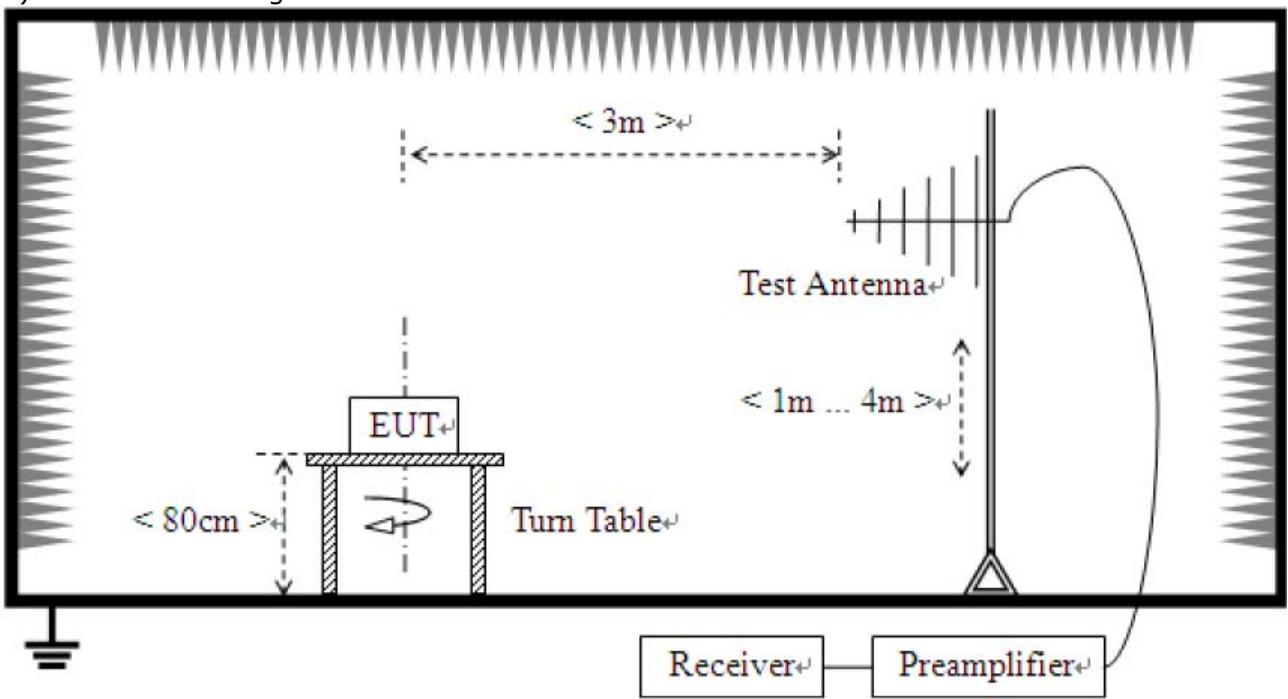
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)

Test Setup:

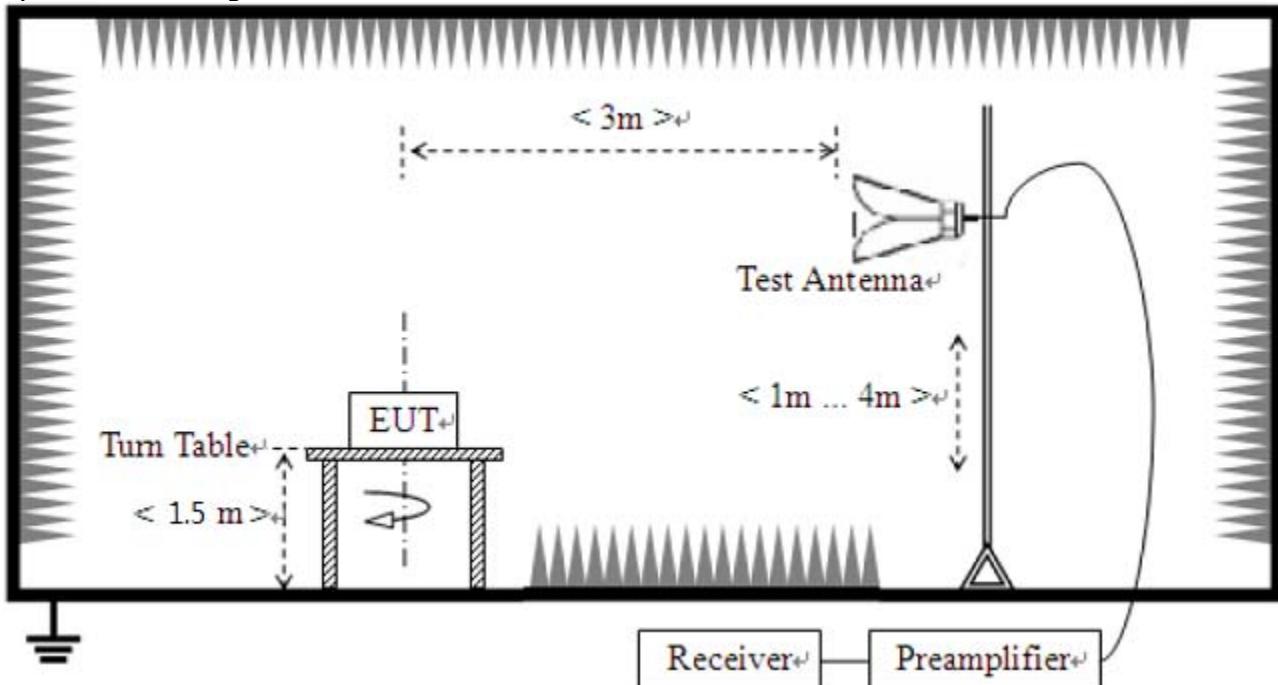
1) For field strength of emissions from 9 kHz to 30 MHz



2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



Test Results

1) 9 kHz to 30 MHz

The requirements are:

Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
-	-	-	See note

Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)



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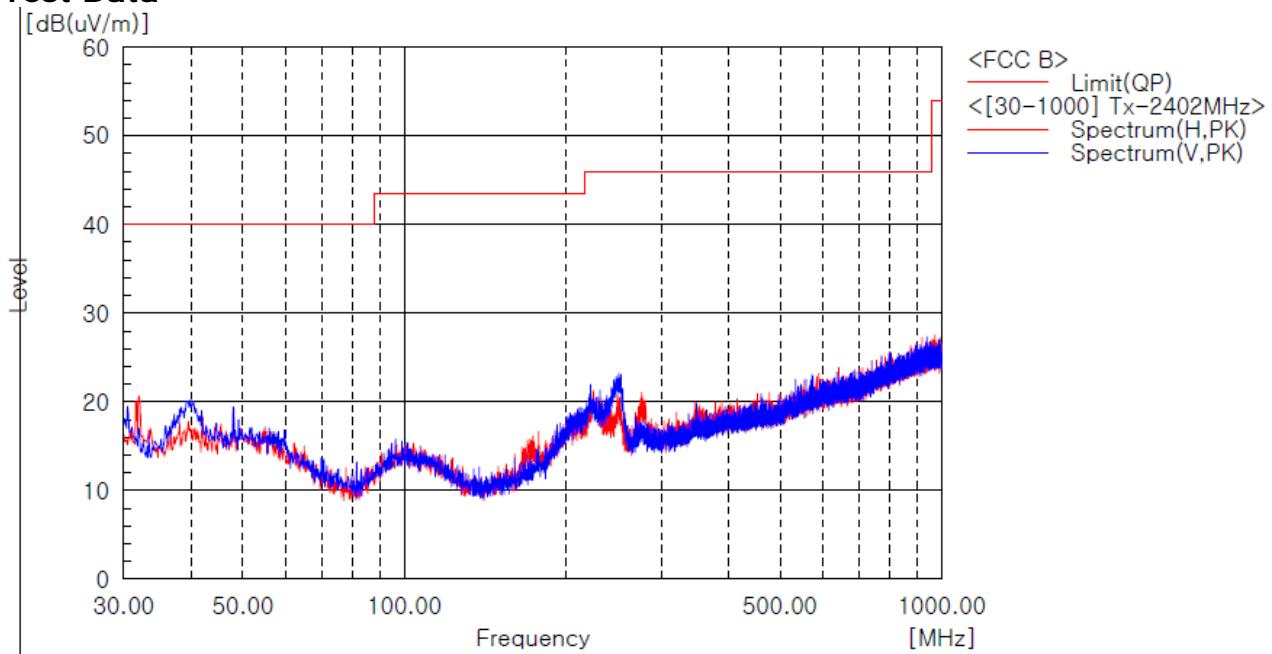
2) 30 MHz to 1 GHz

Test mode : Transmit, Lowest Channel(Worst case)

The requirements are:

Complies

Test Data



Final Result

No.	Frequency (P) [MHz]	c.f [dB(1/m)]	Angle [deg]	Remark
-----	------------------------	------------------	----------------	--------

Remark :

1. The EUT was tested in three orientations in order to determine that "Z axis" was the worst case.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain



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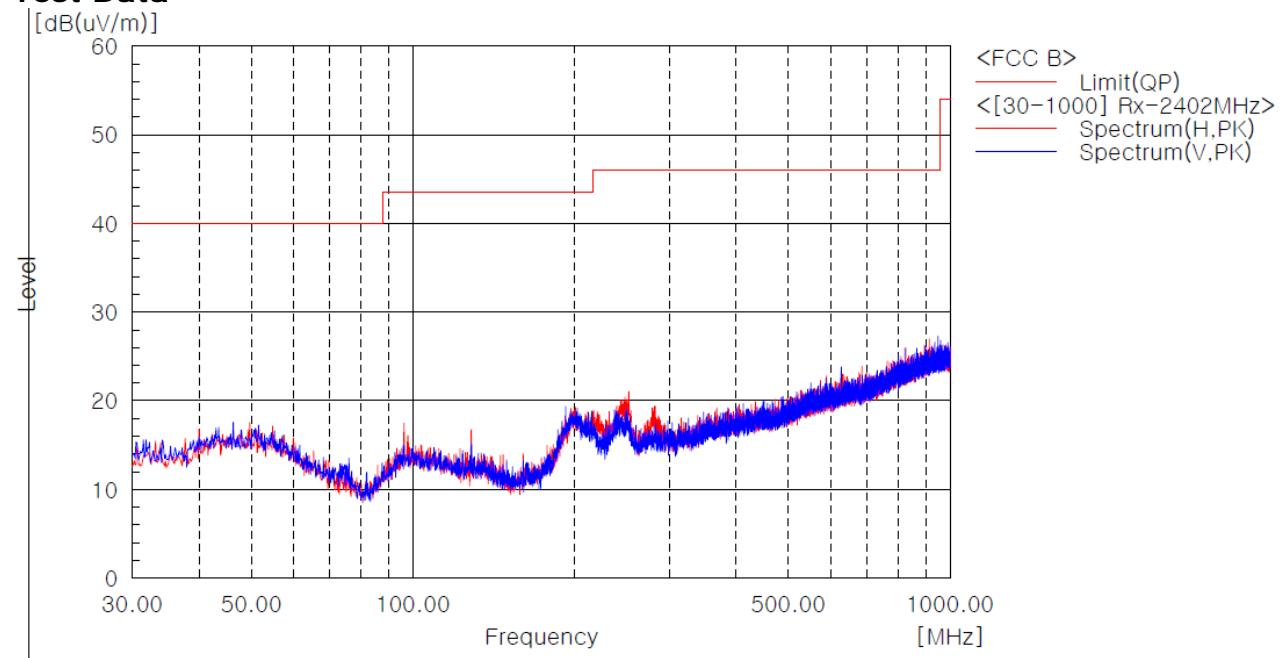
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Test mode : Receiver, Lowest Channel(Worst case)

The requirements are:

Complies

Test Data



Final Result

No.	Frequency (P) [MHz]	c.f [dB(1/m)]	Angle [deg]	Remark
-----	------------------------	------------------	----------------	--------

Remark :

1. The EUT was tested in three orientations in order to determine that "Z axis" was the worst case.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

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3) above 1 GHz

Test mode : Transmit

The requirements are:

Complies

Test Data

Low(2 402 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]
4806.00	V	54.0	74.0	36.9	43.4	17.1	30.6
4806.00	H	54.0	74.0	36.9	43.9	17.1	30.1

Mid(2 442 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]
4882.00	V	54.0	74.0	35.8	43.8	18.2	30.2
4882.00	H	54.0	74.0	37.1	43.2	16.9	30.8

High(2 480 MHz)

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]
4958.24	V	54.0	74.0	36.3	43.3	17.7	30.7
4958.24	H	54.0	74.0	38.2	44.0	15.8	30.0

Remarks

1. The EUT was tested in three orientations in order to determine that "Z axis" was the worst case.



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Test mode : Receiver

The requirements are:

- Complies

Test Data

Frequency [MHz]	(P)	Limit AV [dBuV/m]	Limit PK [dBuV/m]	Result AV [dBuV/m]	Result PK [dBuV/m]	Margin AV [dB]	Margin PK [dB]
--------------------	-----	-------------------------	-------------------------	--------------------------	--------------------------	----------------------	----------------------

The emissions above 1 GHz were 20 dB lower than the limit.



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4.6 AC Power Line Conducted Emissions

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits.

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average**
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* The level decreases linearly with the logarithm of the frequency.

** A linear average detector is required.

Test Results

The requirements are:

Not Applicable



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Test Data

[LINE]

NA



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[NEUTRAL]

NA

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APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date
1	Signal Analyzer	Agilent	N9020A	MY48011598	2017-11-01	2018-11-01
2	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2017-10-25	2018-10-25
3	Bilog Antenna	Schaffner	CBL6111C	2551	2016-05-13	2018-05-13
4	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2016-05-16	2018-05-16
5	6dB Attenuator	R&S	DNF	272.4110.50-2	2017-10-25	2018-10-25
6	AMPLIFIER	SONOMA	310	291721	2018-02-02	2019-02-02
7	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2018-02-01	2019-02-01
8	Preamplifier	Agilent	8449B	3008A02011	2017-11-30	2018-11-30
9	Horn Antenna	ETS-Lindgren	3116	00062504	2017-04-25	2019-04-25
10	Horn Antenna	ETS-Lindgren	3117	00154525	2017-09-14	2019-09-14
11	Dual-Tracking DC Power Supply	Topward Electric Instruments	6303D	711196	2018-01-30	2019-01-30