

TEST REPORT

According to : FCC 47CFR part 15 subpart C

Test Report No. : CTK-2017-00868
Date of Issue : 2017-05-11
FCC ID : 2AALG-NWP-F121
Model/Type No. : NWP-F121
Kind of Product : Neo smartpen N2
Applicant : NeoLAB Convergence
Applicant Address : #1501, Mario Tower, 28, Digital-ro 30-gil, Guro-gu, Seoul, Korea 08389
Manufacturer : NeoLAB Convergence
Manufacturer Address : #1501, Mario Tower, 28, Digital-ro 30-gil, Guro-gu, Seoul, Korea 08389
Contact Person : Bongki Park
Telephone : +82-70-4377-0740
Received Date : 2017-04-19
Test period : Start : 2017-05-01 End : 2017-05-11
Test Results : ☒ In Compliance ☐ Not in Compliance

The test results presented in this report relate only to the object tested.

Tested by

Y. T. Lee

Young-taek Lee
Test Engineer
Date: 2017-05-11

Reviewed by

Y. J. Park

Young-Joon, Park
Technical Manager
Date: 2017-05-11



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REPORT REVISION HISTORY

Date	Revision	Page No
2017-05-11	Issued (CTK-2017-00868)	All

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1.0 General Product Description

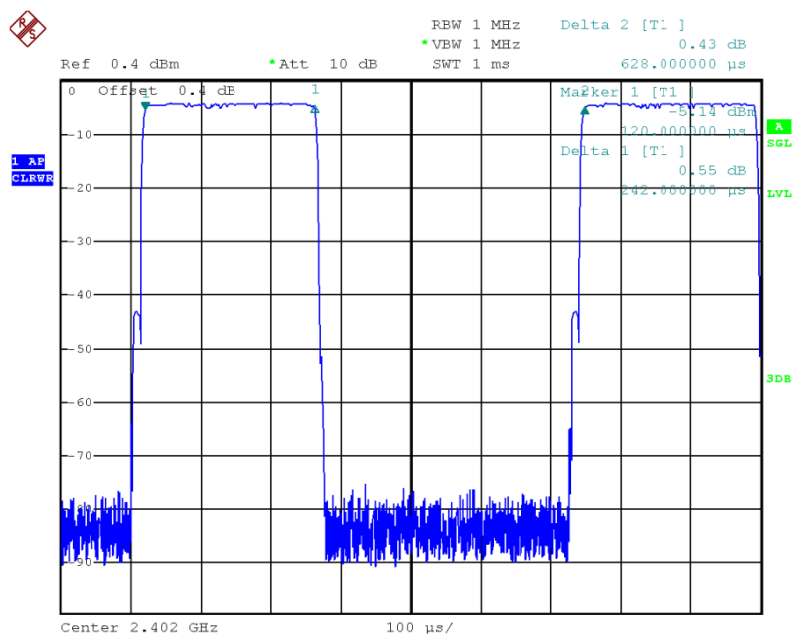
Kind of product	Neo smartpen N2
FCC ID	2AALG-NWP-F121
Equipment model name	NWP-F121
Variant Model	-
RF Power setting in Test SW	Initial value
Antenna type	PCB antenna
Antenna Gain	Peak 2.28 dBi
Frequency Range	2 402 MHz – 2 480 MHz
RF output power	-3.61 dBm (Peak Conducted)
Number of channels	40
Rated Channel spacing	2 MHz
Type of Modulation	GFSK
Power supply	DC 3.7 V
Test Site Registration Number	8737A-2

1.1 Tested Frequency

	Low	Middle	High
Frequency (MHz)	2 402	2 440	2 480

1.2 Duty Cycle

Duty Cycle	39 %
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Date: 10.MAY.2017 15:18:53

1.3 Device Modifications

None

1.4 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Notebook Computer	HP	HP ProBook 650 G1	5CG5114K13

1.5 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.

1.6 Test Facility

The measurement facility is located at 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

1.7 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	
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	



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2.0 Summary of tests

FCC Part Section(s)	Parameter	Result (note)
15.247(a)	6 dB Bandwidth	C
15.247(e)	Transmitter Power Spectral Density	C
15.247(b)	Maximum peak conducted output power	C
15.247(d)	Unwanted Emission (Conducted)	C
15.209	Unwanted Emission (Radiated)	C
NA	Receiver Emission	C
2.1091	RF exposure evaluation	C
15.207(a)	AC Power line Conducted Emission	C

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

The sample was tested according to the following specification:

-FCC Part 15.247, ANSI C63.10-2013

-RSS-247 Issue 1

The tests were performed according to the method of measurements prescribed in 558074 D01 DTS Meas Guidance v04.



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2.1 Technical Characteristic Test

2.1.1 6dB Bandwidth & 99 % Bandwidth

Procedure:

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.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Trace = Max hold

Sweep = auto

Detector function = peak

Measurement Data:

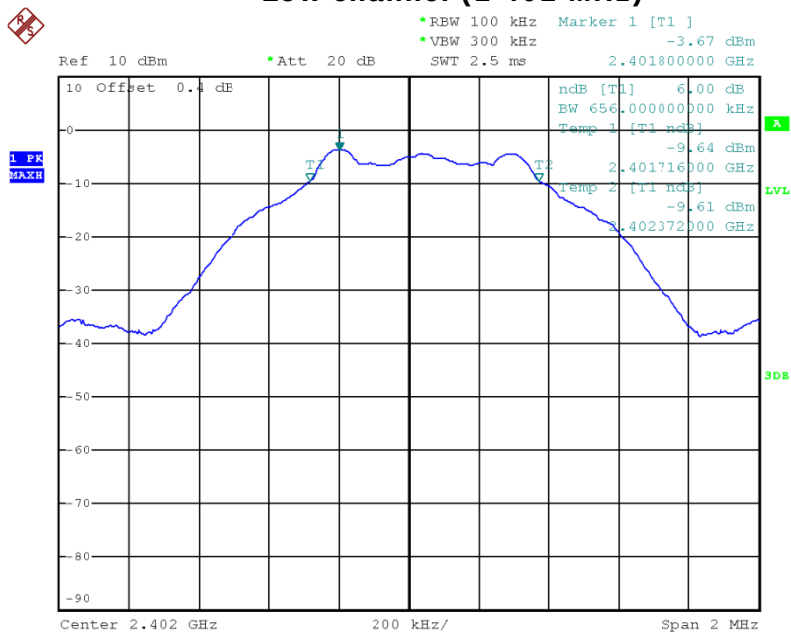
Frequency (MHz)	6dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result
2 402	0.656	1.056	Complies
2 440	0.656	1.056	Complies
2 480	0.660	1.052	Complies

Minimum Standard:

6 dB Bandwidth > 500kHz

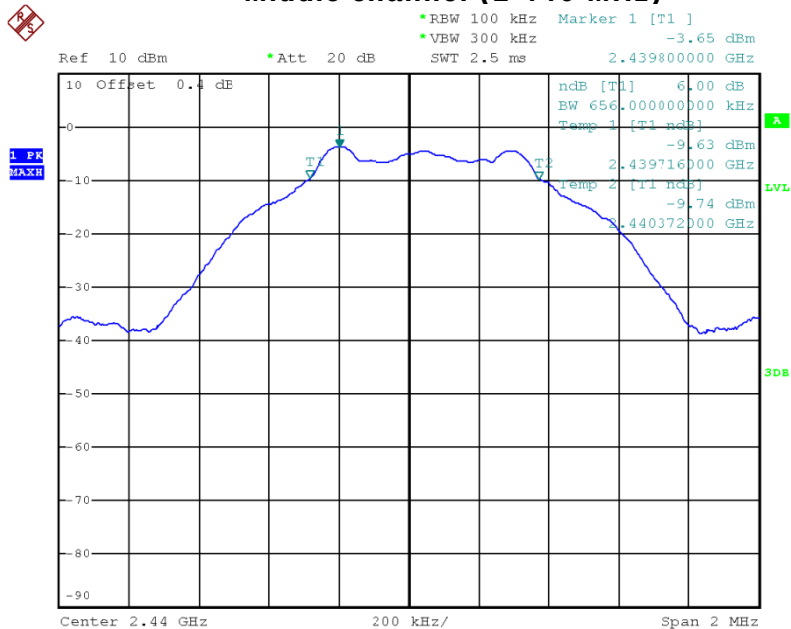
See next pages for actual measured spectrum plots.

6dB Bandwidth Low channel (2 402 MHz)



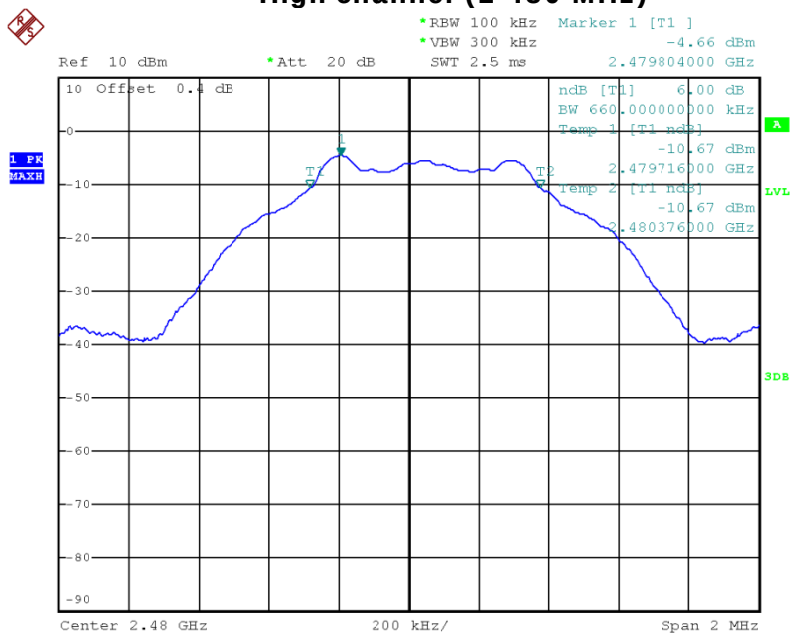
Date: 10.MAY.2017 15:21:19

Middle channel (2 440 MHz)



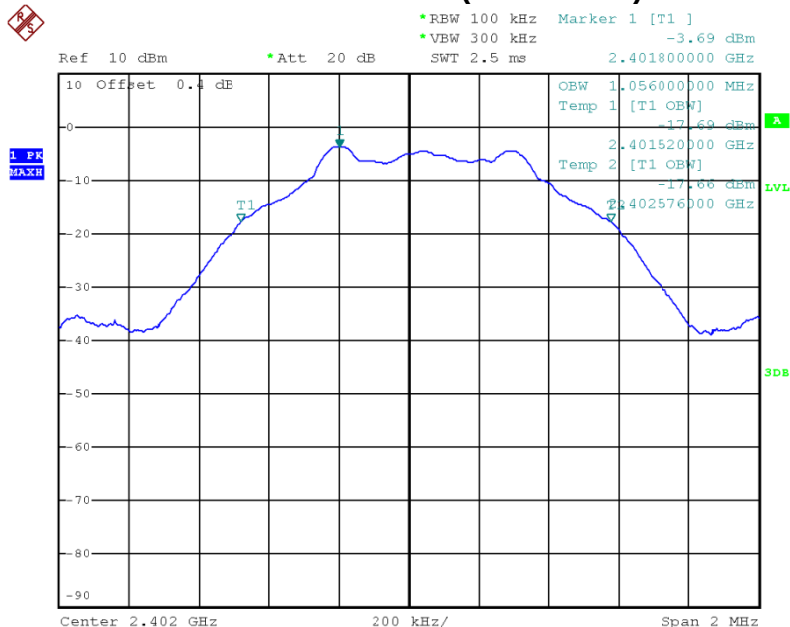
Date: 10.MAY.2017 15:22:07

High channel (2 480 MHz)



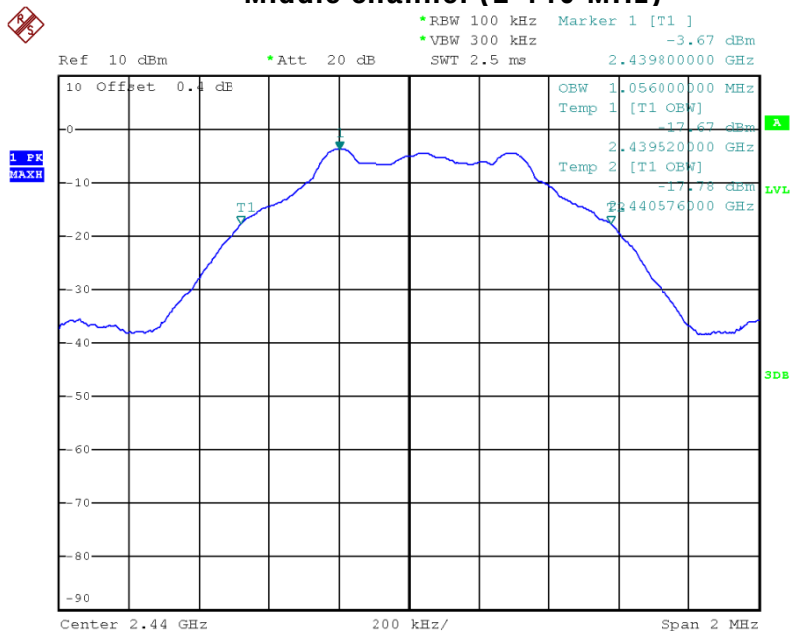
Date: 10.MAY.2017 15:22:39

99% Bandwidth Low channel (2 402 MHz)



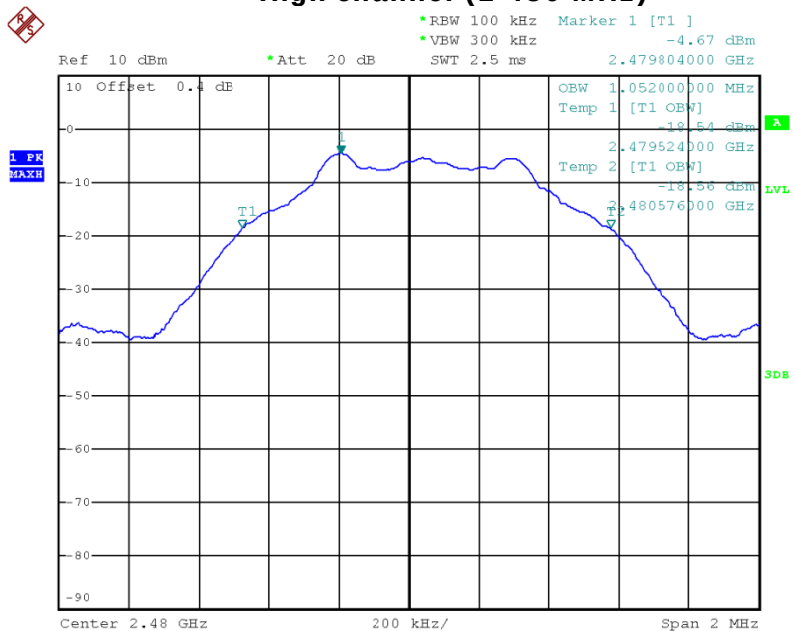
Date: 10.MAY.2017 15:24:29

Middle channel (2 440 MHz)



Date: 10.MAY.2017 15:23:53

High channel (2 480 MHz)



Date: 10.MAY.2017 15:23:11

2.1.2 Maximum peak Conducted Output Power

Test Procedures

Maximum Peak Output Power from the EUT were measured according to the dictates power measurement procedure in section 11.9.1.1 of ANSI C63.10-2013.

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

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

Limit

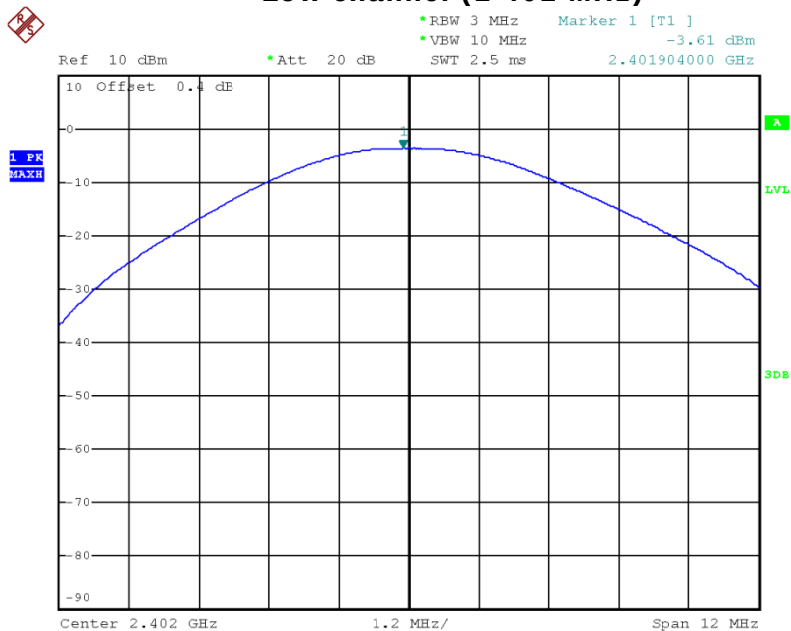
< 1 W (30 dBm)

Test Results

Frequency (MHz)	Maximum peak Conducted Output Power		
	Output power (dBm)	Output power (mW)	Result
2 402	-3.61	0.44	Complies
2 440	-3.61	0.44	Complies
2 480	-4.62	0.35	Complies

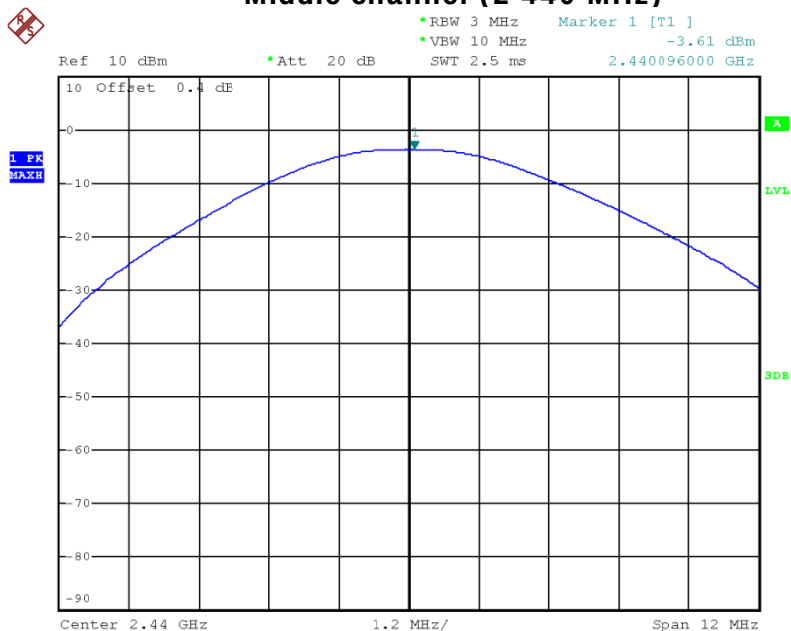
See next pages for actual measured spectrum plots.

Low channel (2 402 MHz)



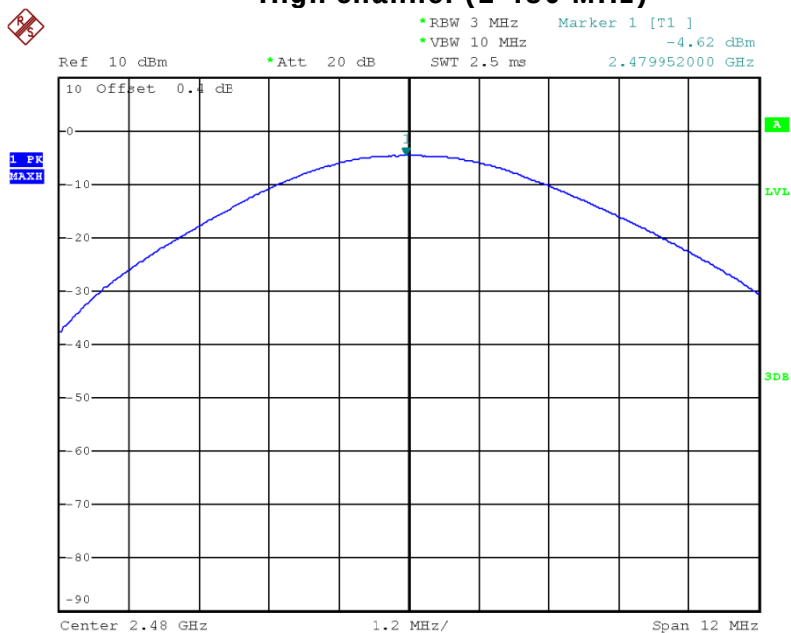
Date: 10.MAY.2017 15:26:16

Middle channel (2 440 MHz)



Date: 10.MAY.2017 15:26:51

High channel (2 480 MHz)



Date: 10.MAY.2017 15:27:16

2.1.3 Power Spectral Density

Procedure:

Power Spectral Density from the EUT were measured according to the dictates PKPSD measurement procedure in section 11.10.2 of ANSI C63.10-2013.

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance.

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to : $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- d) Set the VBW $\geq 3 \times \text{RBW}$
- e) Detector = peak
- f) Sweep time = auto couple
- g) Trace mode = max hold
- h) Allow trace to fully stabilize
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceed limit, reduce RBW(no less than 3 kHz) and repeat.

Test results:

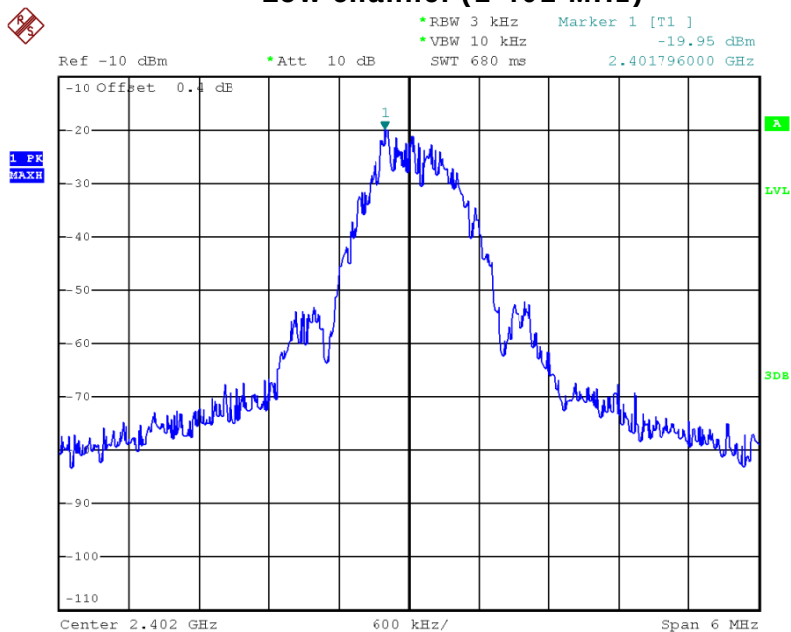
Frequency (MHz)	Power Spectral Density	
	dBm	Result
2 402	-19.95	Complies
2 440	-19.51	Complies
2 480	-20.84	Complies

Minimum Standard:

Power Spectral Density	< 8dBm @ 3 kHz BW
------------------------	-------------------

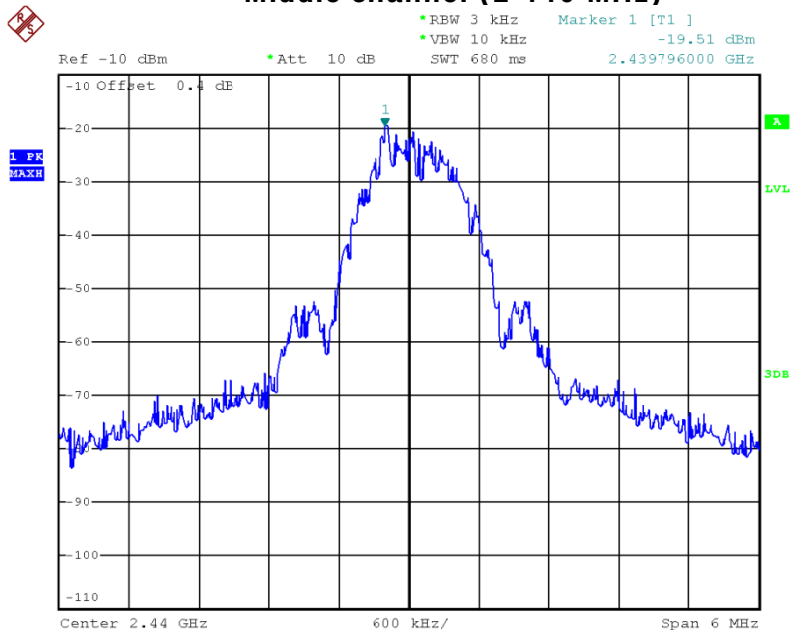
See next pages for actual measured spectrum plots.

Low channel (2 402 MHz)



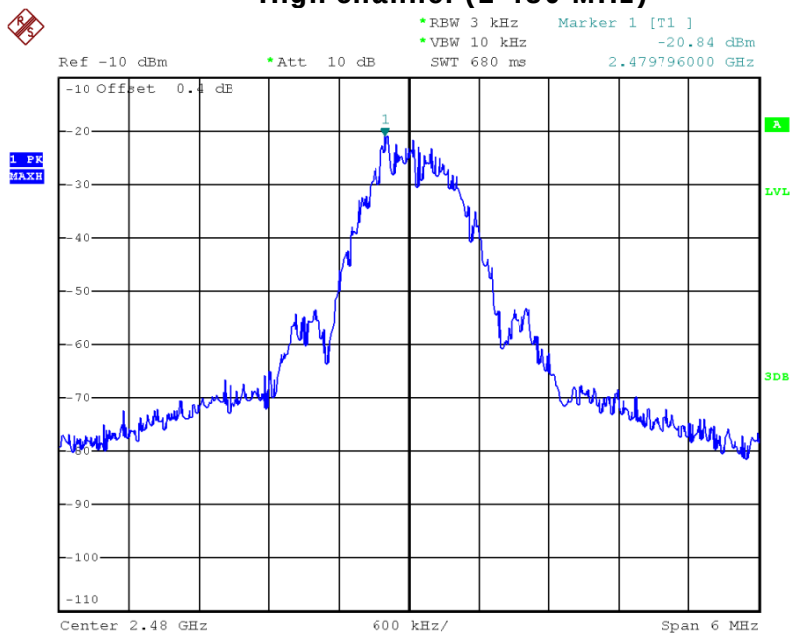
Date: 10.MAY.2017 15:33:07

Middle channel (2 440 MHz)



Date: 10.MAY.2017 15:32:38

High channel (2 480 MHz)



Date: 10.MAY.2017 15:31:34

2.1.4 Unwanted emission (Conducted)

Procedure:

The Unwanted emission from the EUT were measured according to the dictates PKPSD measurement procedure in section 11.11 of ANSI C63.10-2013.

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. Attenuation below the general field strength limits specified in RSS-Gen is not required.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Trace = Max hold

Detector function = peak

Sweep = auto

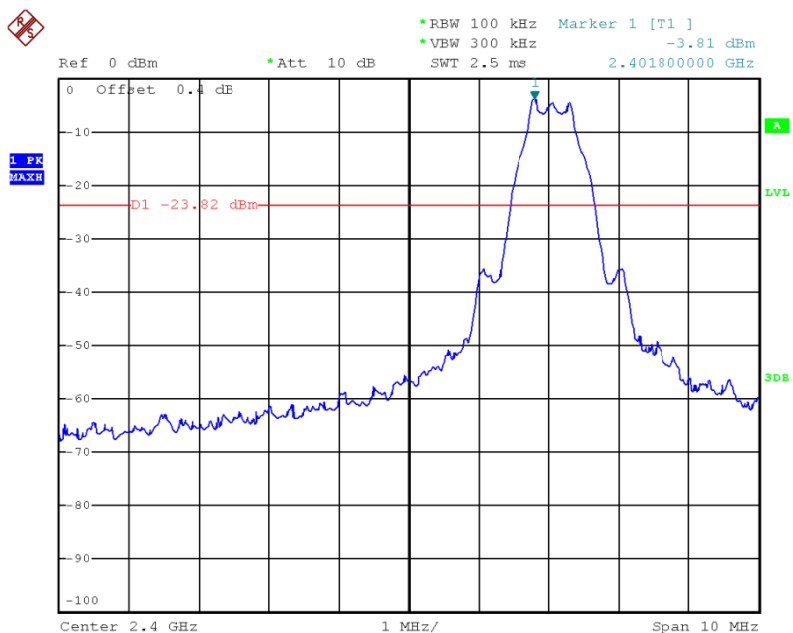
Test results: Complies

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

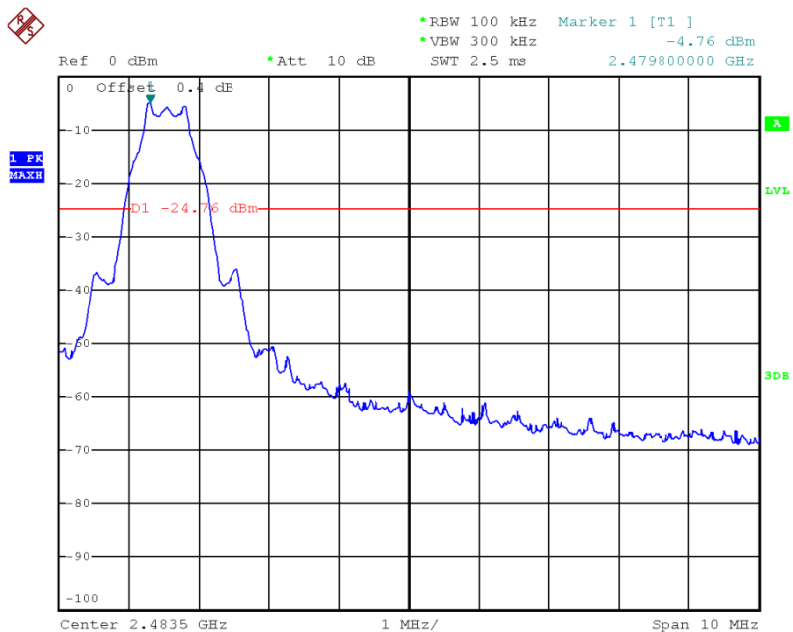
Minimum Standard:	> 20 dBc
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See next pages for actual measured spectrum plots.

Band-edge

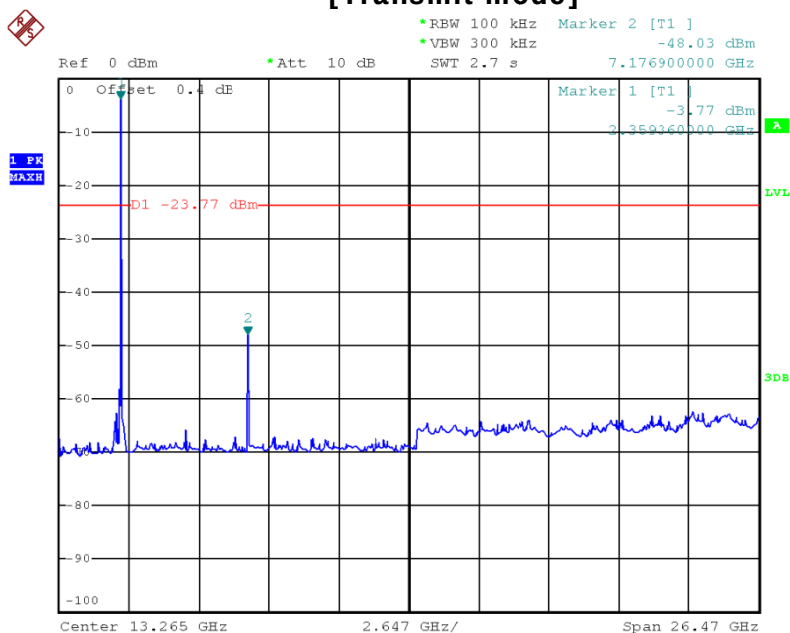


Date: 10.MAY.2017 15:41:45



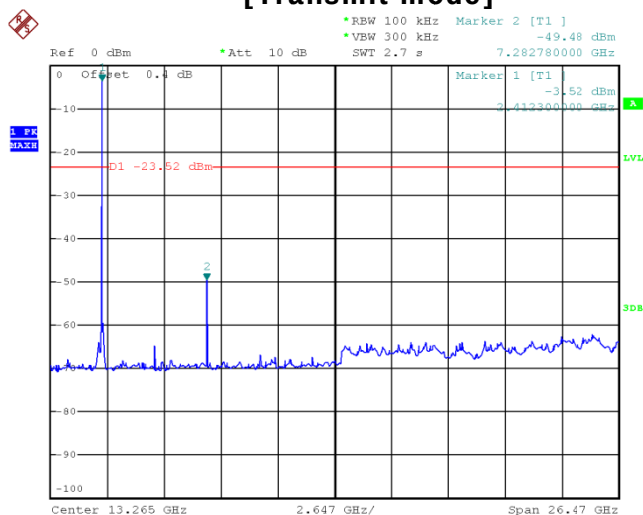
Date: 10.MAY.2017 15:43:09

Low channel (2 402 MHz)
[Transmit mode]



Date: 10.MAY.2017 15:48:30

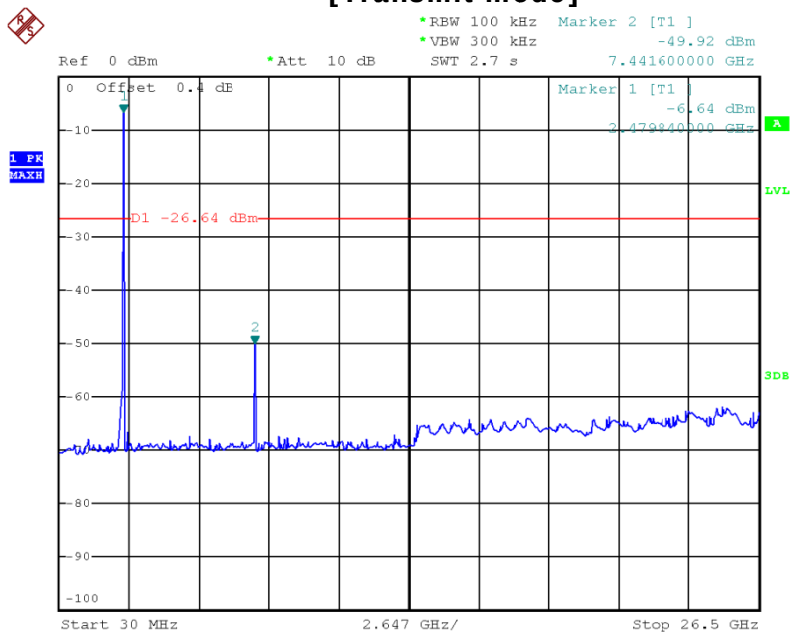
Middle channel (2 440 MHz)
[Transmit mode]



Date: 10.MAY.2017 15:45:50

High channel (2 480 MHz)

[Transmit mode]



Date: 10.MAY.2017 15:47:15



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2.1.5 Unwanted emission (Radiated)

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 Test Antenna is positioned with its plane vertical at 1m distance from the EUT. 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.

The spectrum analyzer is set to:

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

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz

VBW $\geq$ RBW

Sweep = auto

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.

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

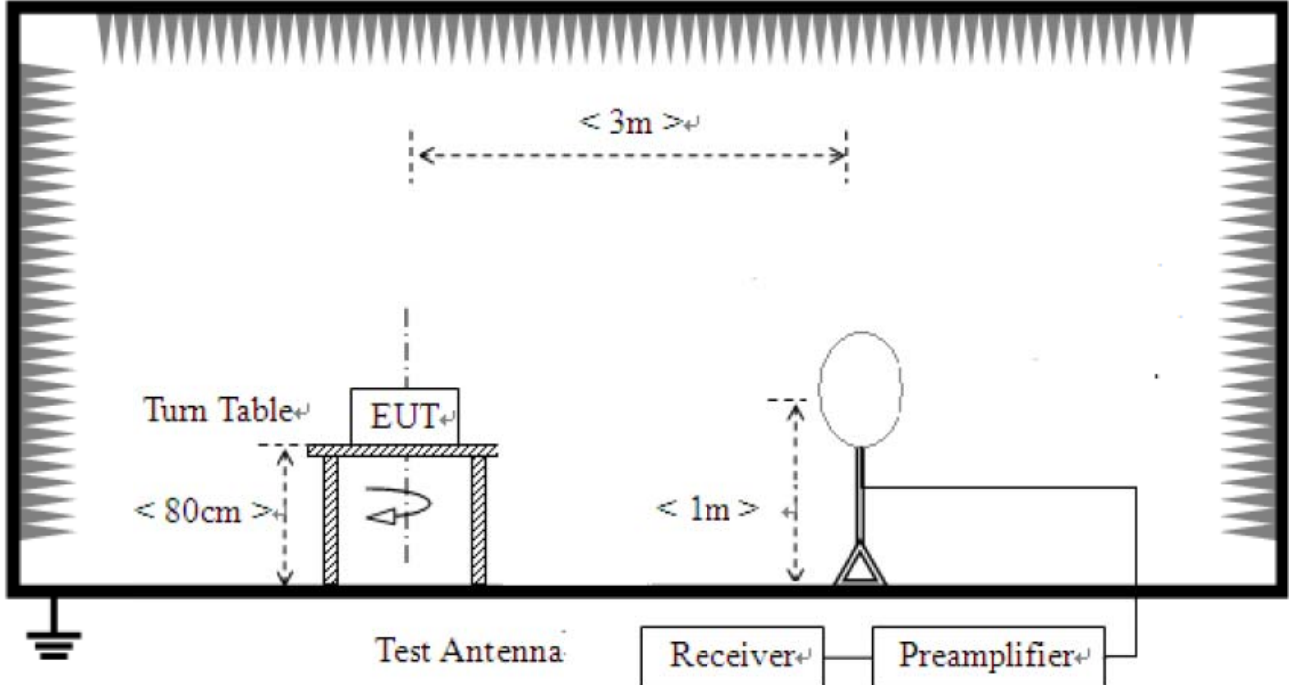
** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231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

Note :

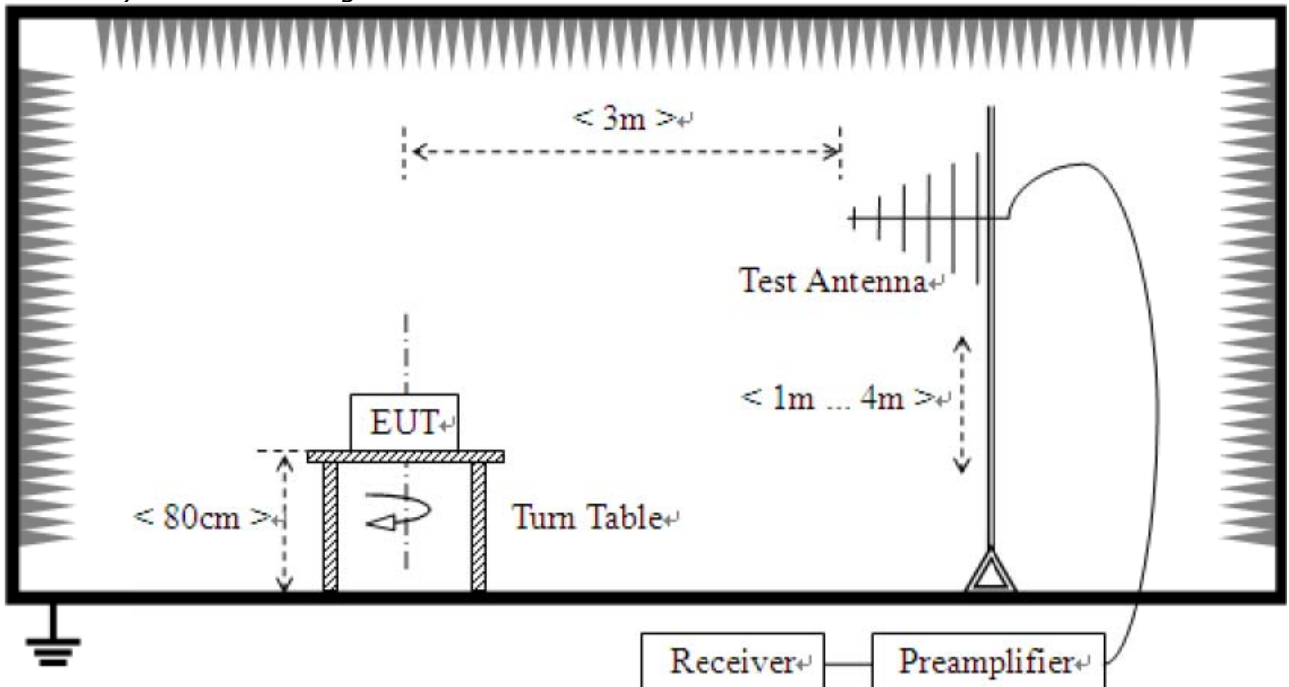
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)
- 3) For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 1 MHz for peak measurement and 10 Hz for average measurement.(Duty Cycle is > 98%,)
- 4) Duty Cycle is < 98%, VBW setting will need to > 1/T.
(**VBW : 3 kHz**) (T : minimum transmitter on time)

Test Setup:

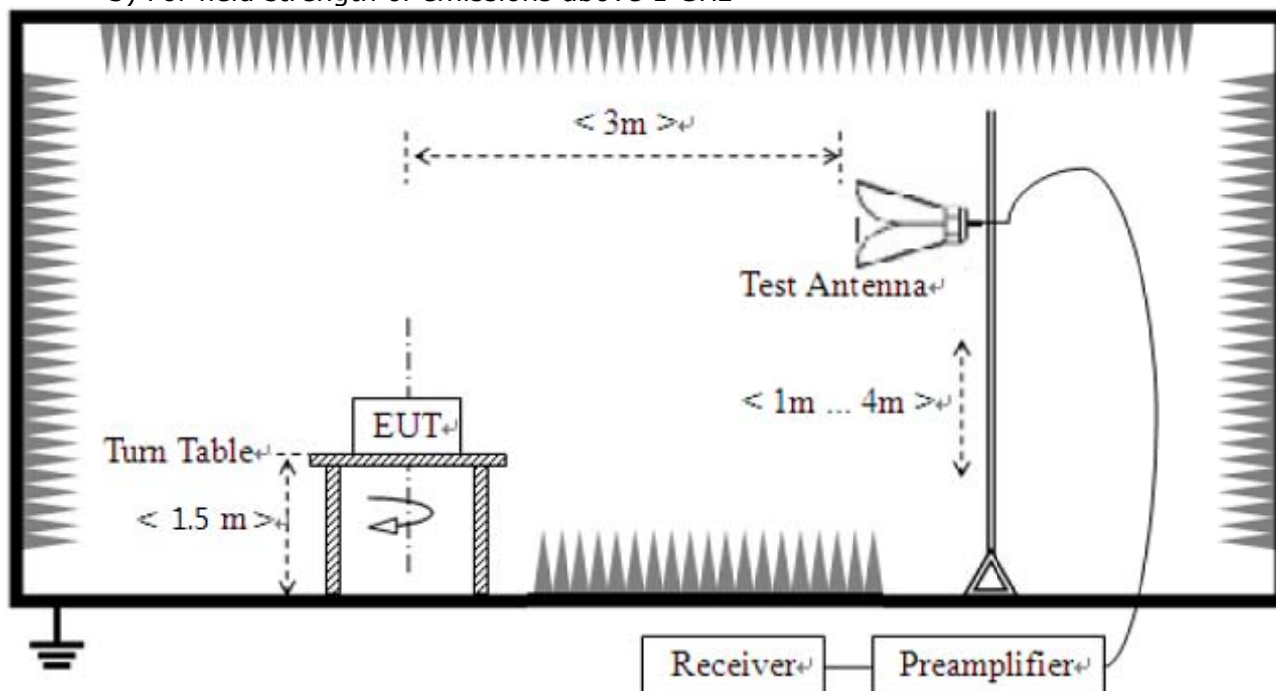
- 1) For field strength of emissions from 9 kHz to 30 MHz



- 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

EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F121	Frequency Range	9 kHz – 30 MHz
Test mode	Continuous modulated carrier	Detector function	Quasi-Peak

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)

2) 30 MHz to 1 GHz

Test mode : Transmit, High Channel(Worst case)

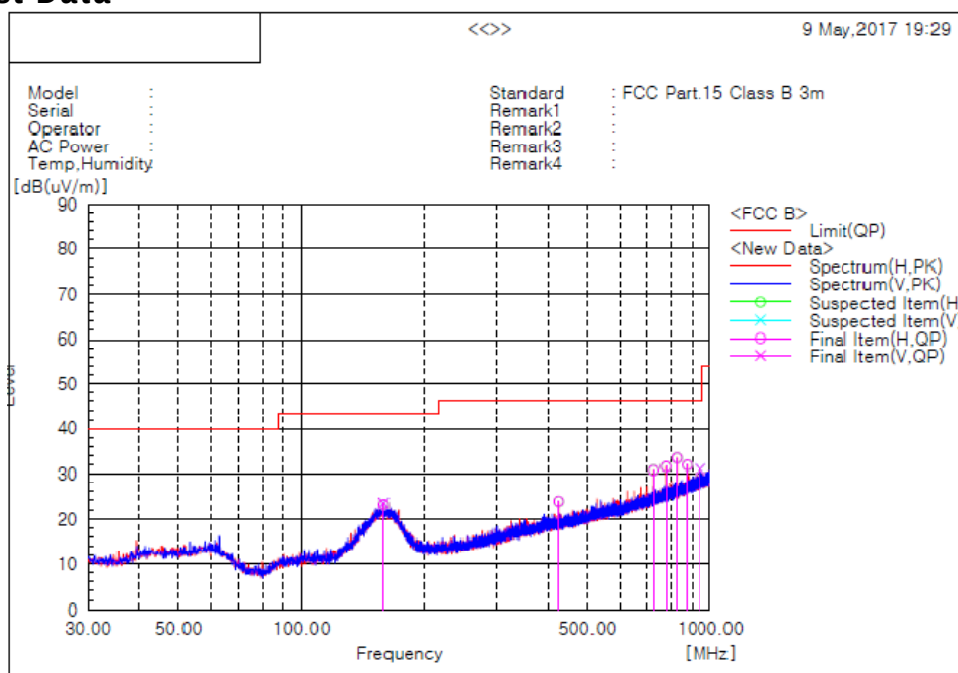
EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F121	Frequency Range	Below 1 000MHz
Mode	Transmit, High Channel	Detector function	Quasi-Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
825.01	33.5	12.5	-

Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Angle [deg]
1	158.299	V	30.0	-6.6	23.4	43.5	20.1	13.9
2	158.420	H	29.7	-6.6	23.1	43.5	20.4	357.0
3	424.961	H	33.4	-9.6	23.8	46.0	22.2	63.0
4	724.971	H	35.2	-4.4	30.8	46.0	15.2	48.4
5	775.053	H	35.2	-3.6	31.6	46.0	14.4	77.7
6	825.014	H	36.4	-2.9	33.5	46.0	12.5	48.4
7	875.097	H	33.8	-1.9	31.9	46.0	14.1	48.4
8	943.612	V	31.6	-0.6	31.0	46.0	15.0	195.6

Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + Correction factor
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

3) above 1 GHz

EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F121	Frequency Range	1-25GHz
Channel	Low (2 402 MHz)	Detector function	Average / Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

☒ Complies

Test Data

[Transmit mode]

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Height [m]	Correction Factor	Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
					Antenna + Amp. Gain + Cable						
7 206.34	39.51	45.31	H	1.5	5.9	54.0	74.0	45.4	51.2	8.6	22.8

Restricted band edge test data

Measured frequency range : 2 310 - 2 390 MHz

[Transmit mode]

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Height [m]	Correction Factor	Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
					Antenna + Amp. Gain + Cable						
2 375.92	30.58	51.71	H	1.5	-4.3	54.0	74.0	26.3	47.4	27.7	26.6

EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F121	Frequency Range	1-25GHz
Channel	Middle (2 440 MHz)	Detector function	Average / Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

☒ Complies

Test Data

[Transmit mode]

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Height [m]	Correction Factor	Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
					Antenna + Amp. Gain + Cable						
7 320.065	37.95	44.14	H	1.5	5.6	54.0	74.0	43.6	49.7	10.4	24.3

Restricted band edge test data

Measured frequency range : 2 310 - 2 390 MHz

[Transmit mode]

Frequency [MHz]	Reading [dBuV / m] AV / Peak	Pol.	Height [m]	Correction Factor	Limits [dBuV / m] AV / Peak	Result [dBuV / m] AV / Peak	Margin [dB] AV / Peak
				Antenna + Amp. Gain + Cable			
No other emissions were detected at a level greater than 20dB below limit.							

EUT	Neo smartpen N2	Measurement Detail	
Model	NWP-F121	Frequency Range	1-25GHz
Channel	High (2 480 MHz)	Detector function	Average / Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

☒ Complies

Test Data

[Transmit mode]

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Height [m]	Correction Factor	Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
					Antenna + Amp. Gain + Cable						
7 440.18	34.69	42.59	H	1.5	6.1	54.0	74.0	40.8	48.7	13.2	25.3

Restricted band edge test data

Measured frequency range : 2 483.5 - 2 500 MHz

[Transmit mode]

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Height [m]	Correction Factor	Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
					Antenna + Amp. Gain + Cable						
2 483.729	32.93	44.15	H	1.5	-4.1	54.0	74.0	28.8	40.0	25.2	34.0



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2.1.6 AC Power Line Conducted Emissions

Frequency Range of Measurement

150 kHz to 30 MHz

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

- 15.207(a)

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

* Decreases with the logarithm of the frequency.

Test Results

The requirements are:

☒ Complies

Test mode : Charging mode

Frequency (MHz)	Measured Data (dBuV)	Margin (dB)	Remark
0.483	33.1	13.2	CAverage



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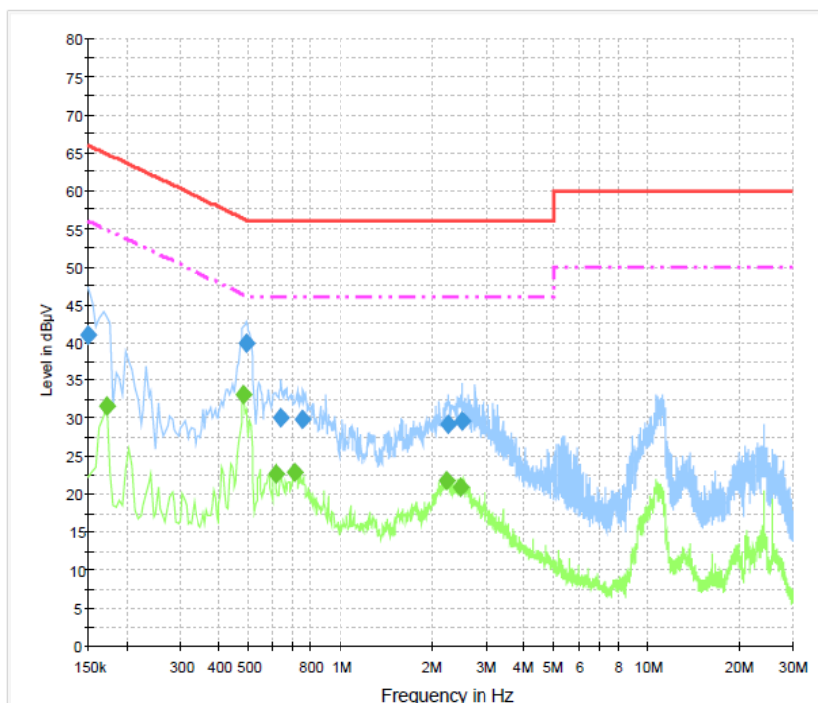
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Test Data

[L1]
Class B_L1



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	40.9	1000.0	9.000	On	L1	9.7	25.1	66.0
0.492000	39.9	1000.0	9.000	On	L1	9.9	16.2	56.1
0.640500	30.0	1000.0	9.000	On	L1	9.9	26.0	56.0
0.753000	29.8	1000.0	9.000	On	L1	9.8	26.2	56.0
2.247000	29.3	1000.0	9.000	On	L1	9.8	26.7	56.0
2.494500	29.5	1000.0	9.000	On	L1	9.8	26.5	56.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.172500	31.5	1000.0	9.000	On	L1	9.8	23.3	54.8
0.483000	33.1	1000.0	9.000	On	L1	9.9	13.2	46.3
0.613500	22.6	1000.0	9.000	On	L1	9.9	23.4	46.0
0.708000	22.9	1000.0	9.000	On	L1	9.8	23.1	46.0
2.215500	21.8	1000.0	9.000	On	L1	9.8	24.2	46.0
2.476500	20.8	1000.0	9.000	On	L1	9.8	25.2	46.0



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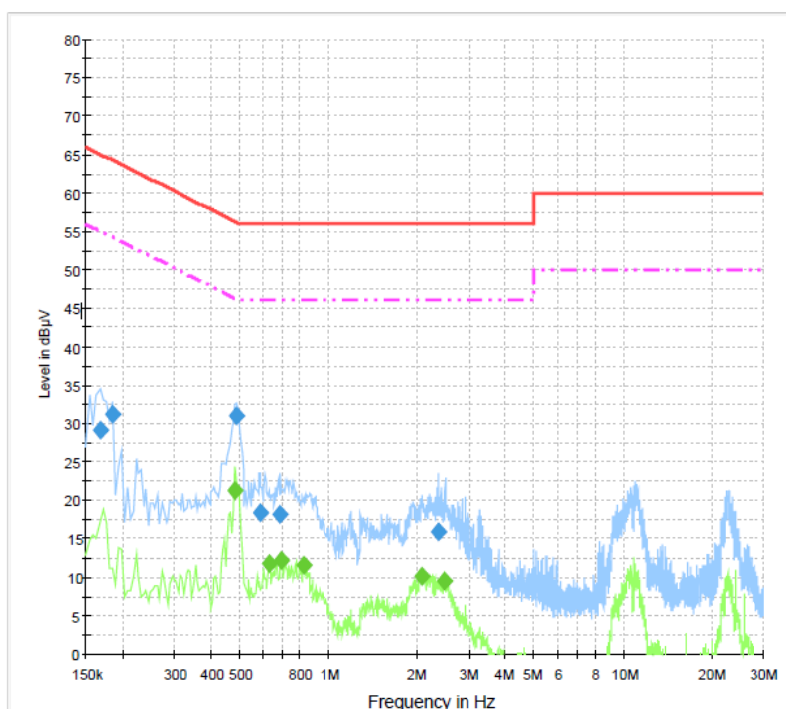
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[NEUTRAL]

Class B_N



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.168000	29.2	1000.0	9.000	GND	N	0.0	35.9	65.1
0.186000	31.2	1000.0	9.000	GND	N	0.0	33.1	64.2
0.487500	31.0	1000.0	9.000	GND	N	0.0	25.2	56.2
0.586500	18.4	1000.0	9.000	GND	N	0.0	37.6	56.0
0.685500	18.2	1000.0	9.000	GND	N	0.0	37.8	56.0
2.355000	15.9	1000.0	9.000	GND	N	0.1	40.1	56.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.483000	21.2	1000.0	9.000	GND	N	0.0	25.1	46.3
0.627000	11.7	1000.0	9.000	GND	N	0.0	34.3	46.0
0.690000	12.2	1000.0	9.000	GND	N	0.0	33.8	46.0
0.820500	11.6	1000.0	9.000	GND	N	0.0	34.4	46.0
2.067000	10.2	1000.0	9.000	GND	N	0.1	35.8	46.0
2.481000	9.4	1000.0	9.000	GND	N	0.1	36.6	46.0

2.1.7 RF Exposure evaluation

Requirement

This device belongs to Mobile device. The definition of the category as following:

Mobile Derives:

CFR Title 47 §2.1091(b)

(b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

FCC Limits

According to FCC Part 1.1307, systems operating under the provisions of this section shall be operated in a manner the ensures that the public is not exposed to radio frequency energy level in excess of the commission's guidelines.

Limits for General Population / Uncontrolled Exposure			
Frequency range (MHz)	Electric field strength (V / m)	Magnetic field strength (A / m)	Power density (mW / cm ²)
0.3-1.34	614	1.63	*100
1.34-30	824/f	2.19/f	*180/f ²
30-300	27.5	0.073	0.2
300-1,500			f/1500
1,500-100,000			1.0

f = frequency in MHz, * = Plane-wave equivalent power density



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c MPE Calculation formula

$$S = PG / 4\pi R^2$$

S = Power density

P = Output Power(W)

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Separation distance between radiator and human body(m)

Result

Maximum peak output power at antenna input terminal(dBm): -3.61

Maximum peak output power at antenna input terminal(mW): 0.44

Prediction distance(cm): 20

Prediction frequency(MHz): 2440

Antenna Gain (typical) (dBi): 2.28

Power density at prediction frequency at 20 cm(mW/cm²): **0.0001**

FCC MPE limit for RF exposure at prediction frequency(mW/cm²): 1

So the SAR report is not required.



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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	SPECTRUM ANALYZER	Rohde & Schwarz	FSP-30	100994	2016-11-01	2017-11-01
2	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2016-11-02	2017-11-07
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100816	2016-11-02	2017-10-31
4	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2016-05-14	2017-05-14
5	Bilog Antenna	Schaffner	CBL6111C	2551	2017-04-19	2019-04-19
6	Double Ridged Guide Antenna	ETS-Lindgren	3117	00154525	2015-09-02	2017-09-02
7	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2017-05-25	2018-05-25
8	Attenuator	Rohde & Schwarz	DNF	272.4110.50-2	2016-11-01	2017-11-01
9	PREAMPLIFIER	Agilent	8449B	3008A02011	2016-12-01	2017-12-01
10	AMPLIFIER	Sonoma Instrument Co.	310	291721	2017-02-02	2018-02-02
11	Signal Generator	Rohde & Schwarz	SMB100A	175528	2016-11-01	2017-11-01
12	DC POWER SUPPLY	HP	E3632A	MY40011638	2016-11-01	2017-11-01
13	LISN	Rohde & Schwarz	ENV216	101760	2017-02-03	2018-02-03
14	Band Reject Filter	Micro Tronics	BRM50702	G233	2017-02-03	2018-02-03