

TEST REPORT



CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
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Report No.:
CTK-2018-02206
Page (1) / (19) Pages

1. Client

- Name : Anoto Korea Corp.
- Address : Uspace2 #B-703, 670, Daewangpangyo-ro, Bundang-gu, Seongnam-si,
Gyeonggi-do, Republic of Korea
- Date of Receipt : 2018-06-27

2. Manufacturer

- Name : Anoto Korea Corp.
- Address : Uspace2 #B-703, 670, Daewangpangyo-ro, Bundang-gu, Seongnam-si,
Gyeonggi-do, Republic of Korea

3. Use of Report : For FCC Certification

4. Test Sample / Model: Digital Pen / AP-701

5. Date of Test : 2018-07-11 to 2018-07-25

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

7. Testing Environment: Temp.: (22 ± 1) °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	Technical Manager
	Kim, Bong-seok: (Signature) 	Young-taek Lee: (Signature) 

2018-07-25

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



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REPORT REVISION HISTORY

Date	Revision	Page No
2018-07-25	Issued (CTK-2018-02206)	all

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CONTENTS

1. General Product Description	4
1.1 Client Information	4
1.2 Product Information.....	4
1.3 Peripheral Devices	4
2. Facility and Accreditations.....	5
2.1 Test Facility	5
2.2 Laboratory Accreditations and Listings.....	5
2.3 Calibration Details of Equipment Used for Measurement.....	5
3. Test Specifications	6
3.1 Standards	6
3.2 Mode of operation during the test	6
3.3 Maximum Measurement Uncertainty	7
4. Technical Characteristic Test.....	8
4.1 Radiated Emission	8
4.2 AC Power Line Conducted Emissions.....	15
APPENDIX A – Test Equipment Used For Tests	18
APPENDIX B – EUT Photographs	19

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1. General Product Description

1.1 Client Information

Company	Anoto Korea Corp.
Contact Point	Uspace2 #B-703, 670, Daewangpangyo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea
Contact Person	Name : Chulmin, In E-mail : Chulmin.in@anoto.com Tel : +82-31-600-0824 Fax : +82-31-600-0801

1.2 Product Information

FCC ID	ADM-AP-701
Product Description	Digital Pen
Model name	AP-701
Operating Frequency	2 402 MHz - 2 480 MHz
RF Output Power	-1.33 dBm (0.74 mW)
Antenna Specification	Antenna type : Chip antenna Peak Gain : 1.96 dBi
Number of channels	79
Channel Spacing	1 MHz
Type of Modulation	GFSK (Bluetooth : BDR)
Power Source	DC 3.7 V (Battery)
Test SW Version	WCN _Combol_Tool : Ver. W1537
RF Power setting in Test SW	Initial value

1.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Notebook	Samsung Electronics Suzhou Computer Co., Ltd.	NT530U4E	JECJ91CDC00094R
AC Adapter	LITE-ON TECHNOLOGY(CHANGZHOU) Co., Ltd.	AD-6019P	-

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	IC 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.

3. Test Specifications

3.1 Standards

Section in FCC	Requirement(s)	Status (Note 1)	Test Condition
15.247(a)	Carrier Frequency Separation	NT(Note 4)	Conducted
15.247(a)	Number of Hopping Frequencies	NT(Note 4)	
15.247(a)	20 dB Bandwidth	NT(Note 4)	
15.247(a)	Time of occupancy (Dwell Time)	NT(Note 4)	
15.247(b)	Maximum peak conducted output power	NT(Note 4)	
15.247(d)	Unwanted emission	NT(Note 4)	
15.209	Transmitter emission	C	Radiated
15.207(a)	AC Conducted Emission	C	Line Conducted
<u>Note 1:</u> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable			
<u>Note 2:</u> The data in this test report are traceable to the national or international standards.			
<u>Note 3:</u> The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-2013			
<u>Note 4:</u> The test was performed according to the class II permissive change. This change is not related to the conducted-measurement item.			

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	2 441 MHz	2 480 MHz

Test mode

Modulation	Packet type	Data rate
GFSK	DH5	1 Mbps

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
Occupied Bandwidth	0.1 MHz
Unwanted Emission(conducted)	3.0 dB
Radiated Emissions ($f \leq 1$ GHz)	4.0 dB
Radiated Emissions ($f > 1$ GHz)	5.0 dB

4. Technical Characteristic Test

4.1 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.

Instrument 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

Limit :

Unwanted emissions that do not fall within the restricted frequency bands of Table 1 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

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:

Table 1. Restricted Frequency Bands

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 :

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 2. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 2. General Field Strength Limits for Licence-Exempt Transmitters

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Measurement 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

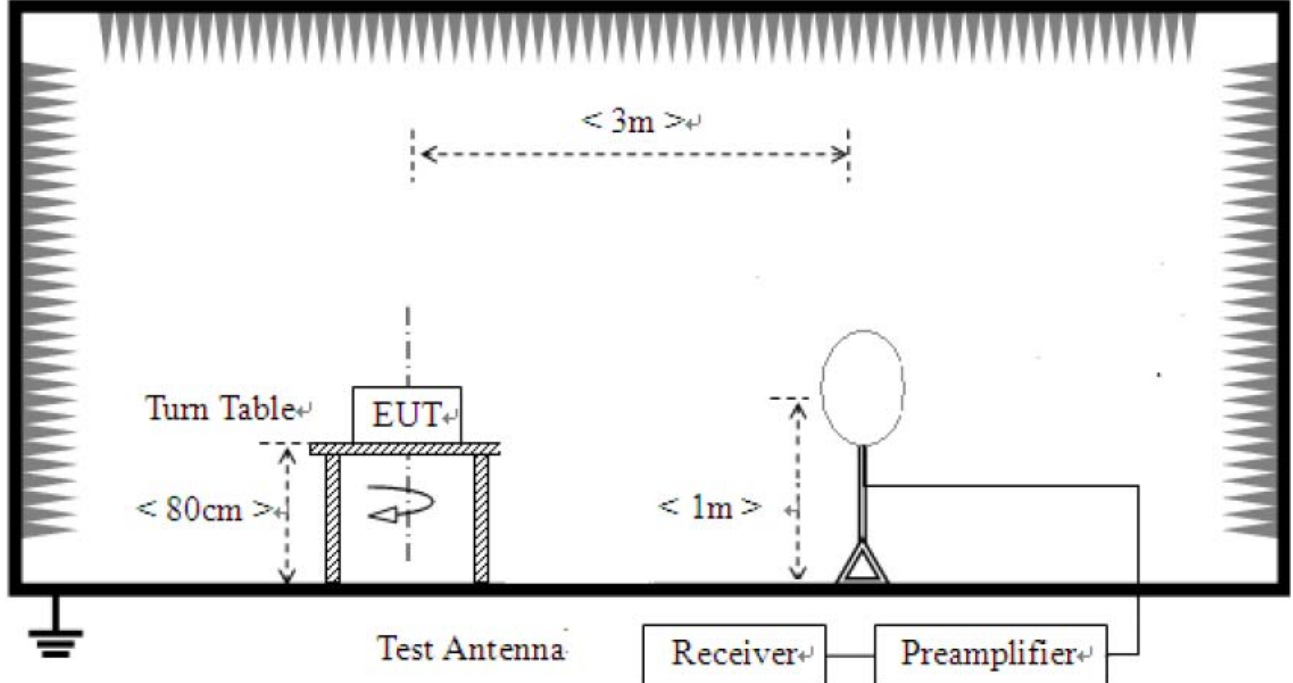
** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231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

Note :

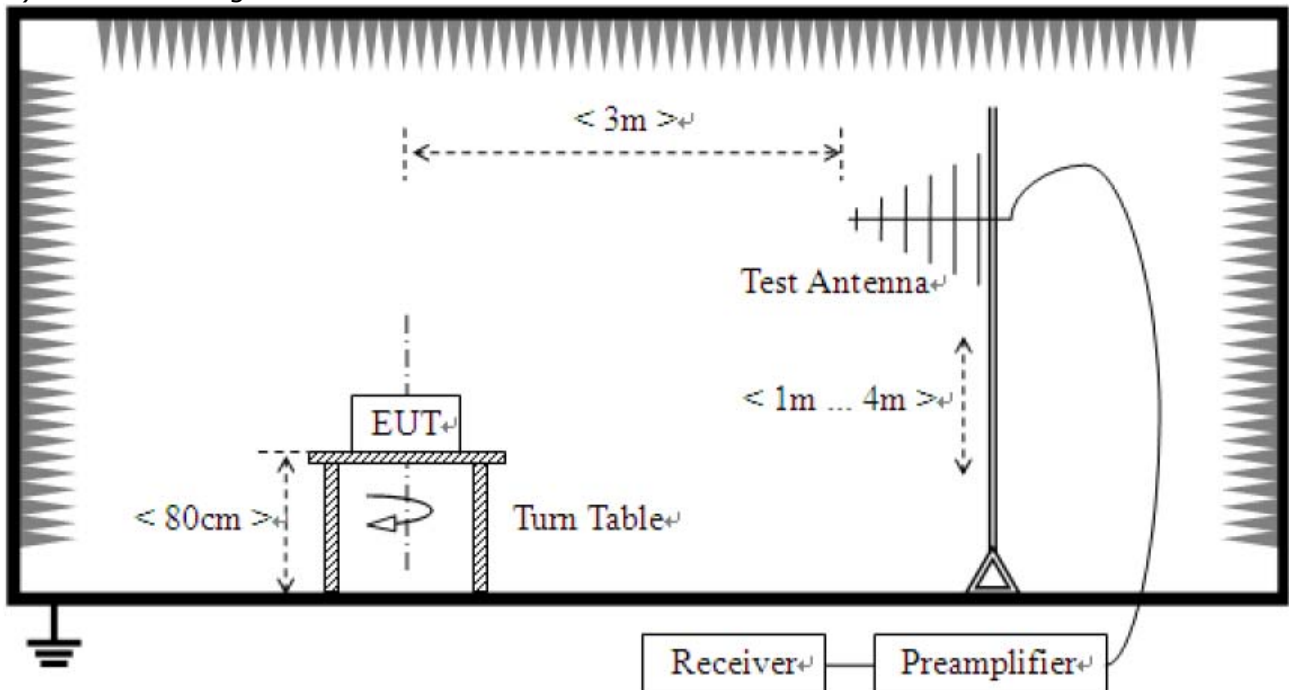
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength 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.

Test Setup:

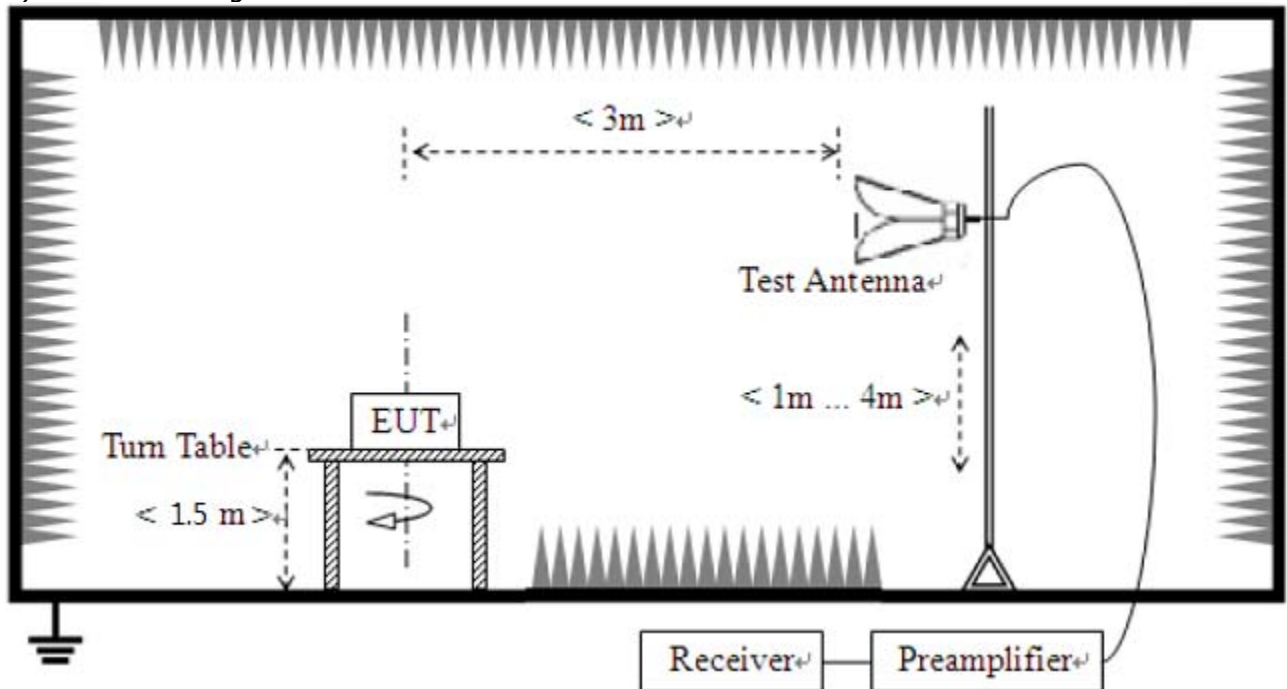
1) For field strength of emissions from 9 kHz to 30 MHz



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)

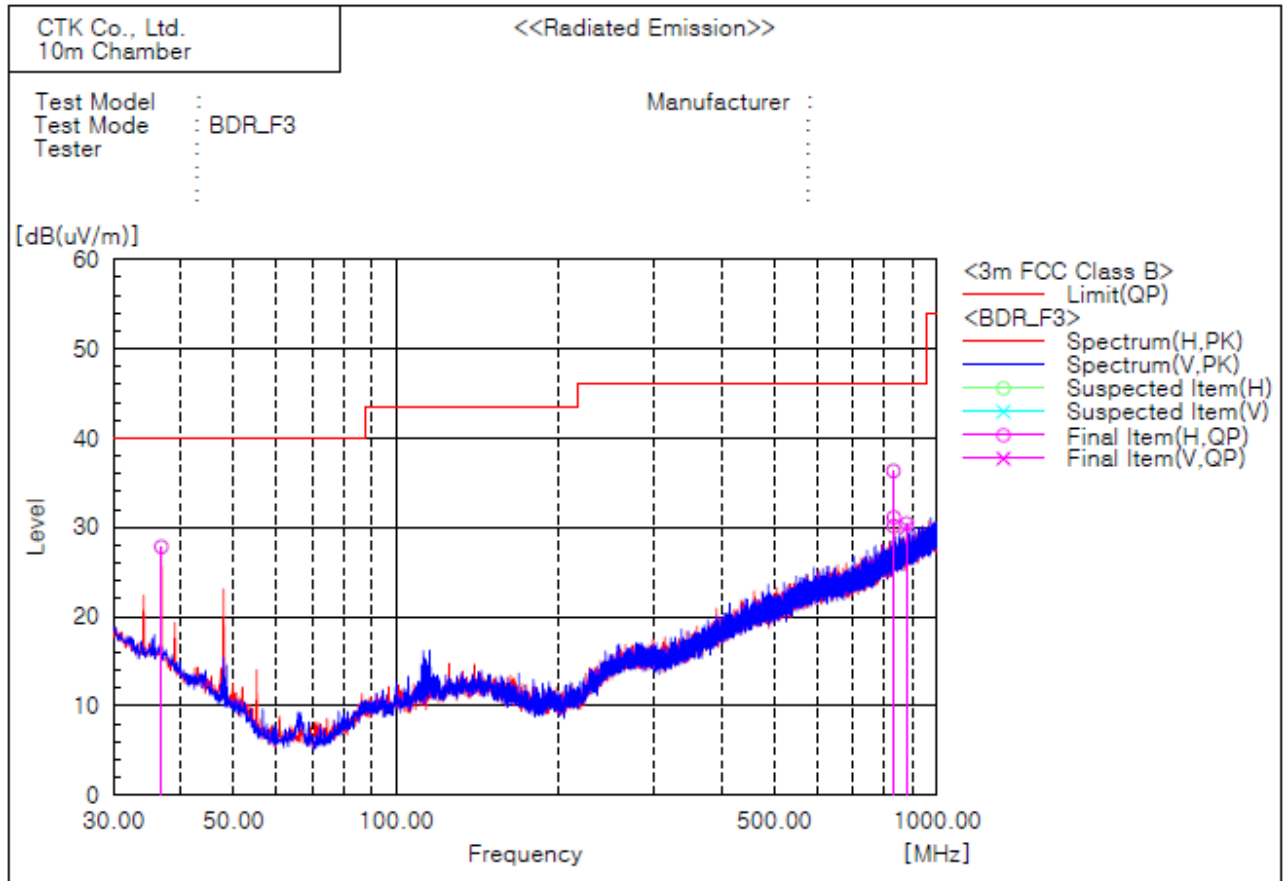
2) 30 MHz to 1 GHz

Test mode : Transmit, Highest Channel(Worst case)

The requirements are:

☒ Complies

Test Data



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	36.790	H	37.7	-9.9	27.8	40.0	12.2	400.0	322.0
2	830.614	H	32.9	3.4	36.3	46.0	9.7	101.0	328.0
3	831.948	H	26.7	3.4	30.1	46.0	15.9	101.0	328.0
4	832.433	H	27.6	3.5	31.1	46.0	14.9	101.0	328.0
5	878.507	H	25.8	4.6	30.4	46.0	15.6	300.0	358.0
6	880.326	V	25.4	4.6	30.0	46.0	16.0	300.0	322.0

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 + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

3) 1 GHz to 25 GHz

The requirements are:

☒ Complies

Test Data

Test mode : Lowest frequency(2 402 MHz)

Frequency [MHz]	Ant. Pol. (V/H)	Reading* [dBuV/m]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
2 376.08	H	48.05	-3.91	44.14	54	9.86	Peak
4 804.00	H	41.62	1.32	42.94	54	11.06	Peak

Test mode : Middle frequency(2 441 MHz)

Frequency [MHz]	Ant. Pol. (V/H)	Reading* [dBuV/m]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
4 882.00	H	42.20	1.32	43.52	54	10.48	Peak

Test mode : Highest frequency(2 480 MHz)

Frequency [MHz]	Ant. Pol. (V/H)	Reading* [dBuV/m]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
2 483.50	H	53.01	-3.74	49.27	54	4.73	Peak
4 960.00	H	41.17	1.42	42.59	54	11.41	Peak

Remarks

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 + c.f(correction factor)
 3. Correction factor = Antenna factor + Cable loss - Amp Gain
- * Reading data is the peak value.

4.2 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

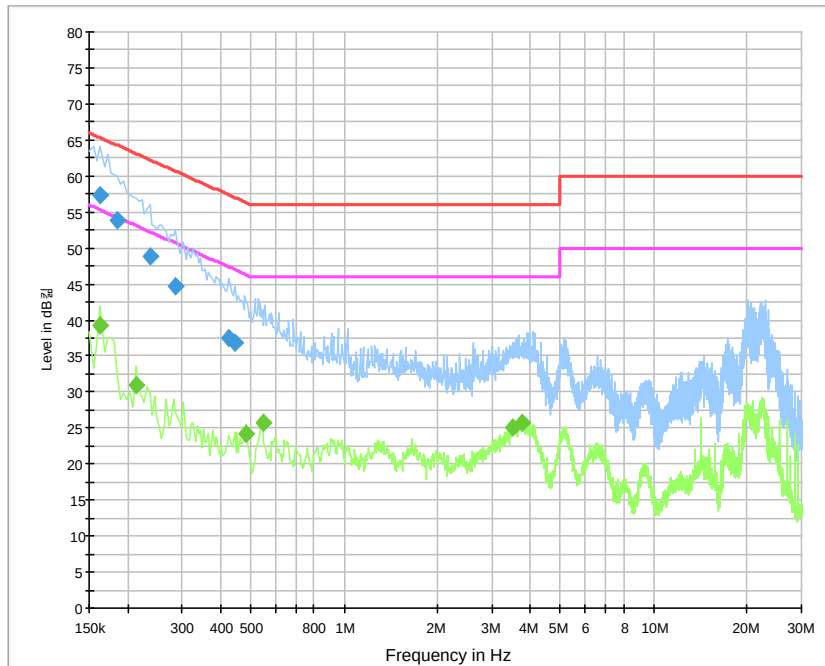
The requirements are:

☒ Complies

Test Data

Test mode : Charging Mode

Class B_L1



Final Result 1

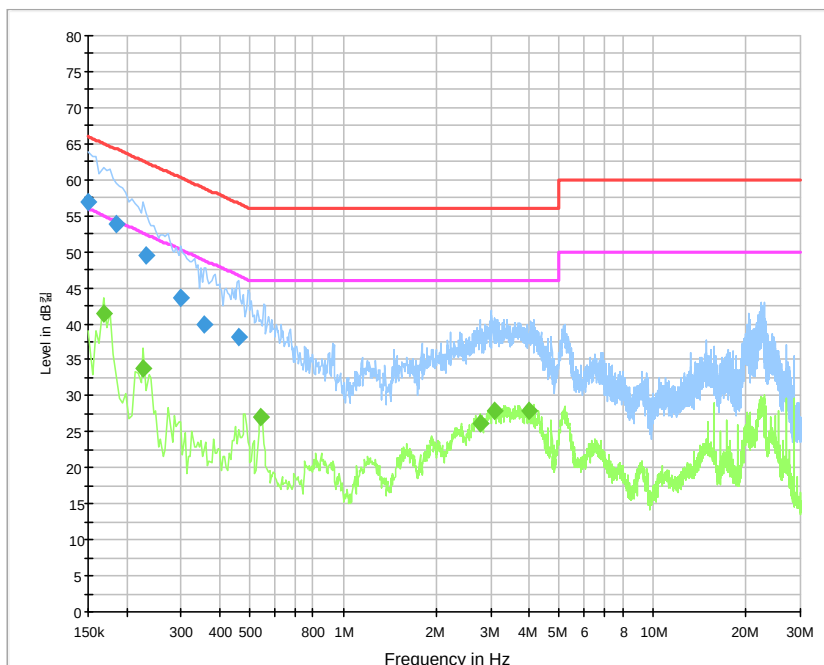
Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.163500	57.3	1000.0	9.000	On	L1	9.8	8.0	65.3
0.186000	53.8	1000.0	9.000	On	L1	9.9	10.4	64.2
0.235500	48.8	1000.0	9.000	On	L1	9.8	13.5	62.3
0.285000	44.7	1000.0	9.000	On	L1	9.8	16.0	60.7
0.424500	37.5	1000.0	9.000	On	L1	9.9	19.8	57.4
0.442500	36.8	1000.0	9.000	On	L1	9.9	20.2	57.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.163500	39.3	1000.0	9.000	On	L1	9.8	16.0	55.3
0.213000	31.0	1000.0	9.000	On	L1	9.9	22.1	53.1
0.483000	24.3	1000.0	9.000	On	L1	9.9	22.0	46.3
0.546000	25.8	1000.0	9.000	On	L1	9.9	20.2	46.0
3.484500	25.0	1000.0	9.000	On	L1	9.8	21.0	46.0
3.772500	25.8	1000.0	9.000	On	L1	9.8	20.2	46.0

[NEUTRAL]

Class B_N



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	56.9	1000.0	9.000	On	N	9.8	9.1	66.0
0.186000	53.8	1000.0	9.000	On	N	9.9	10.4	64.2
0.231000	49.4	1000.0	9.000	On	N	9.7	13.0	62.4
0.298500	43.6	1000.0	9.000	On	N	9.7	16.7	60.3
0.357000	39.8	1000.0	9.000	On	N	9.9	19.0	58.8
0.460500	38.2	1000.0	9.000	On	N	9.9	18.4	56.7

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.168000	41.5	1000.0	9.000	On	N	9.8	13.6	55.1
0.226500	33.8	1000.0	9.000	On	N	9.8	18.8	52.6
0.541500	27.0	1000.0	9.000	On	N	9.9	19.0	46.0
2.782500	26.1	1000.0	9.000	On	N	9.8	19.9	46.0
3.097500	27.9	1000.0	9.000	On	N	9.8	18.1	46.0
3.997500	27.9	1000.0	9.000	On	N	9.8	18.1	46.0

APPENDIX A – Test Equipment Used For Tests

No	Name of Equipment	Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date
1	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2017-10-25	2018-10-25
2	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2018-05-27	2020-05-27
3	Bilog Antenna	Schaffner	CBL6111C	2551	2017-04-19	2019-04-19
4	AMPLIFIER	SONOMA	310	291721	2018-02-02	2019-02-02
5	6dB Attenuator	R&S	DNF	272.4110.50-2	2017-10-25	2018-10-25
6	6dB Attenuator	R&S	DNF	272.4110.50-1	2018-03-09	2019-03-09
7	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2018-02-01	2019-02-01
8	Horn Antenna	ETS-Lindgren	3117	00154525	2017-02-17	2019-02-17
9	Horn Antenna	ETS-Lindgren	3116	0062916	2017-04-25	2019-04-25
10	Preamplifier	Agilent	8449B	3008A02011	2017-11-30	2018-11-30
11	Band Reject Filter	Micro Tronics	BRM50702	G233	2018-01-26	2019-01-26
12	LISN	Rohde & Schwarz	ENV216	101760	2018-01-31	2019-01-31
13	RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	2018-02-02	2019-02-02
14	RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 104	N/A (below 1GHz)	2018-02-02	2019-02-02
15	RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 104	MY27573/4	2017-11-30	2018-11-30
16	RF Cable (Radiated)	HUBER+SUHNER	SUCOFLEX 106	N/A (above 1GHz)	2017-11-30	2018-11-30

APPENDIX B – EUT Photographs

