RF TEST REPORT

Test Equipment	:	Stationary Transmitter 2.4GHz
Model Name	:	Xepton Stationary Transmitter
Variant model name	:	Xepton Stationary Transmitter 2.4GHz Stationary Transmitter 2.4GHz, XST-24 ST-24, MST-24, MRT-24
FCC ID	:	YJHMCSTATIONARY
Date of receipt	:	2018-12-10
Test duration	:	2018-12-28 ~ 2019-01-04
Date of issue	:	2019-01-18

Applicant : Maytel Co., Ltd

#417 Doosan Venture Digm 126-1, Pyeongchon-dong,Dongan-gu
Anyang-si, Gyeonggi-do, Republic of Korea

Test Laboratory : Lab-T, Inc.

2182-42 Baegok-daero, Mohyeon-myeon, Cheoin-gu, Yongin-si
Gyeonggi-do, 17036, Korea

Test specification	:	FCC Part 15 Subpart C 15.247
RF Output Power	:	13.65 dBm
Test result	:	Pass

The above equipment was tested by Lab-T Testing Laboratory for compliance
with the requirements of FCC Rules and Regulations.
The test results presented in this test report are limited only to the sample supplied by applicant
and the use of this test report is inhibited other than its purpose.
This test report shall not be reproduced except in full, without the written approval of Lab-T, Inc

Tested by:

Engineer
SungSin Kim

Reviewed by:

Technical Manager
SangHoon Yu

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1. Applicant Information

Applicant	:	Maytel Co., Ltd
Address	:	#417 Doosan Venture Digm 126-1, Pyeongchon-dong,Dongan-gu, Anyang-si Gyeonggi-do, Republic of Korea
Telephone No.	:	+82-31-487-5508
Person in charge	:	Steven W, Bae / swmaytel@naver.com

Manufacturer	:	Maytel Co., Ltd
Address	:	#417 Doosan Venture Digm 126-1, Pyeongchon-dong,Dongan-gu, Anyang-si Gyeonggi-do, Republic of Korea

2. Laboratory Information

Test Laboratory	:	Lab-T, Inc.
Address	:	2182-42 Baegok-daero, Mohyeon-myeon, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea
Telephone No.	:	+82 31-322-6767
Facsimile No.	:	+82 31-322-6768

Certificate

FCC Designation No.	:	KR0159
FCC Registration No.	:	133186
IC Site Registration No.	:	22000-1

3. Information About Test Equipment

3.1 Equipment Information

Equipment type	Stationary Transmitter 2.4GHz
Model name	Xepton Stationary Transmitter
Variant model name[Note2]	Xepton Stationary Transmitter 2.4GHz, Stationary Transmitter 2.4GHz XST-24, ST-24, MST-24, MRT-24
Frequency range	2 405 ~ 2 477 MHz (0.5 MHz Separation 145 Channels)
Modulation type	GFSK
Modulation technology	FHSS
Power supply	DC 5.00 V
H/W version	V1.0
S/W version	V1.0

Note1 : The above EUT information was declared by the manufacturer.
Note2 : Variant model name by buyer request

3.2 Antenna Information

Antenna	Type	Dipole Antenna
	Gain	3.137 dBi

3.3 Test Frequency

Test mode	Test frequency (MHz)		
	Lowest frequency	Middle frequency	Highest frequency
GFSK	2 405	2 440	2 477

3.4 Tested Companion Device Information

Type	Manufacturer	Model	Note
Adaptor	MEPOS	GPE052B-V050100-Z (S/N : PTWA-053USB-050100V-Z)	Used Conducted Emission Input : AC 100 ~ 240 V Output : DC5V,1.0 A USB version : 3.0 micro usb
-	-	-	-

3.5 Equipment Channel List

Chnnel	Freq,(MHz)	Chnnel	Freq,(MHz)	Chnnel	Freq,(MHz)	Chnnel	Freq,(MHz)
0	2405	37	2423.5	74	2442	111	2460.5
1	2405.5	38	2424	75	2442.5	112	2461
2	2406	39	2424.5	76	2443	113	2461.5
3	2406.5	40	2425	77	2443.5	114	2462
4	2407	41	2425.5	78	2444	115	2462.5
5	2407.5	42	2426	79	2444.5	116	2463
6	2408	43	2426.5	80	2445	117	2463.5
7	2408.5	44	2427	81	2445.5	118	2464
8	2409	45	2427.5	82	2446	119	2464.5
9	2409.5	46	2428	83	2446.5	120	2465
10	2410	47	2428.5	84	2447	121	2465.5
11	2410.5	48	2429	85	2447.5	122	2466
12	2411	49	2429.5	86	2448	123	2466.5
13	2411.5	50	2430	87	2448.5	124	2467
14	2412	51	2430.5	88	2449	125	2467.5
15	2412.5	52	2431	89	2449.5	126	2468
16	2413	53	2431.5	90	2450	127	2468.5
17	2413.5	54	2432	91	2450.5	128	2469
18	2414	55	2432.5	92	2451	129	2469.5
19	2414.5	56	2433	93	2451.5	130	2470
20	2415	57	2433.5	94	2452	131	2470.5
21	2415.5	58	2434	95	2452.5	132	2471
22	2416	59	2434.5	96	2453	133	2471.5
23	2416.5	60	2435	97	2453.5	134	2472
24	2417	61	2435.5	98	2454	135	2472.5
25	2417.5	62	2436	99	2454.5	136	2473
26	2418	63	2436.5	100	2455	137	2473.5
27	2418.5	64	2437	101	2455.5	138	2474
28	2419	65	2437.5	102	2456	139	2474.5
29	2419.5	66	2438	103	2456.5	140	2475
30	2420	67	2438.5	104	2457	141	2475.5
31	2420.5	68	2439	105	2457.5	142	2476
32	2421	69	2439.5	106	2458	143	2476.5
33	2421.5	70	2440	107	2458.5	144	2477
34	2422	71	2440.5	108	2459		
35	2422.5	72	2441	109	2459.5		
36	2423	73	2441.5	110	2460		

Note1 : Test frequencies are the lowest channel: 0 channel(2 405 MHz), middle channel: 70 channel(2 440 MHz) and highest channel: 144 channel(2 477 MHz)

Note2 : This device uses 16 random hopping channels among total 145 channels

4. Test Report

4.1 Summary

FCC Rule	Parameter	Clause	Status
Transmitter Requirements			
15.203 15.247(b)(4)	Antenna Requirement	4.4.1	C
15.247(a)(1)	20 dB Channel Bandwidth	4.4.2	C
-	Occupied Bandwidth	4.4.2	-
15.247(a)(1)(iii)	Number of Hopping Frequencies	4.4.3	C
15.247(a)(1)(iii)	Time of occupancy (Dwell Time)	4.4.4	C
15.247(a)(1)	Carrier Frequencies Separation	4.4.5	C
15.247(b)(1)	Peak Output Power	4.4.6	C
15.247(d) 15.205(a) 15.209(a)	Spurious Emission, Band Edge and Restricted bands	4.4.7	C
15.207(a)	Conducted Emissions	4.4.8	C
NOTE 1 : C = Comply N/C = Not Comply N/T = Not Tested N/A = Not Applicable			

* The general test methods used to test this device is ANSI C63.10:2013

4.2 Measurement Uncertainty

Mesurement items	Expanded Uncertainty	
RF Output Power	0.75 dB	(The confidence level is about 95 %, *k*=2)
Power Spectral Density	0.94 dB	(The confidence level is about 95 %, *k*=2)
Occupied Channel Bandwidth	10.22 kHz	(The confidence level is about 95 %, *k*=2)
Conducted Spurious Emissions	0.44 dB	(The confidence level is about 95 %, *k*=2)
Radiated Spurious Emissions (1 GHz under)	4.56 dB	(The confidence level is about 95 %, *k*=2)
Radiated Spurious Emissions (Above 1 GHz)	4.46 dB	(The confidence level is about 95 %, *k*=2)
Conducted emission	4.08 dB	(The confidence level is about 95 %, *k*=2)

4.3 Test Report Version

Test Report No.	Date	Description
TRRFCC19-0001	19-01-18	Initial issue

4.4 Transmitter Requirements

4.4.1 Antenna Requirement

4.4.1.1 Regulation

Accoding to §15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Accoding to §15.247(b)(4) e conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.4.1.2 Result

Comply
(The transmitter has a connector type dipole Antenna(reverse connector). The directional peak gain of the antenna is 3.137
dBi.)

4.4.2 20 dB Bandwidth and Occupied Bandwidth

4.4.2.1 Regulation

Not Applicable

4.4.2.2 Measurement Procedure

The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
ANSI C63.10 § 6.9.2 Occupied bandwidth 20dB Relative procedure
ANSI C63.10 § 6.9.3 Occupied bandwidth 99% procedure

4.4.2.3 Result

Comply (measurement data : refer to the next page)

4.4.2.4 Measurement data

Test mode : GFSK

Frequency (MHz)	20 dB Bandwidth (MHz)	Min. Limit (MHz)	Occupied Bandwidth (99 % Bandwith)(MHz)
2 405	0.60	0.25	0.84
2 440	0.59	0.25	0.82
2 477	0.59	0.25	0.83

4.4.2.5 Test Plot

GFSK_2 405 MHz(20 dB Bandwidth)

GFSK_2 440 MHz(20 dB Bandwidth)

GFSK_2 477 MHz(20 dB Bandwidth)

GFSK_2 405 MHz(Occupied Bandwidth)

GFSK_2 440 MHz(Occupied Bandwidth)

GFSK_2 477 MHz(Occupied Bandwidth)

4.4.3 Number of Hopping Frequencies

4.4.4.2 Regulation

According to §15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

4.4.3.2 Measurement Procedure

The testing follows FCC Public Notice DA 00-705 Measurement Guidelines
ANSI C63.10 § 7.8.3 Number of hopping frequencies

4.4.3.3 Result

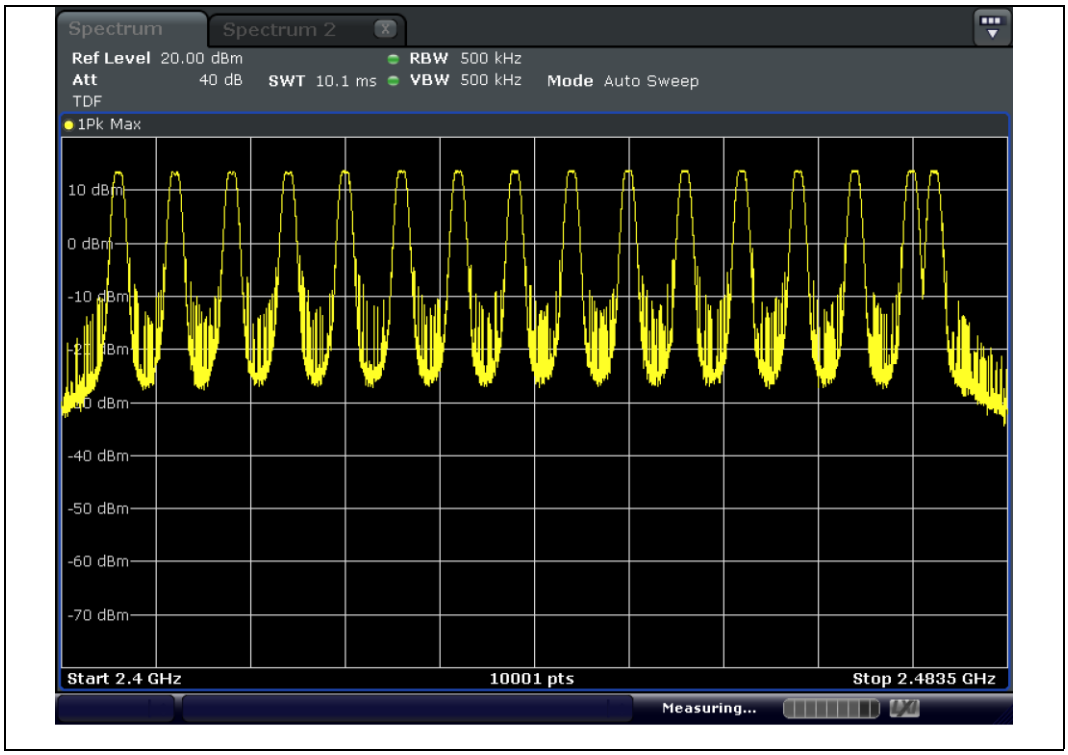
Comply (measurement data : refer to the next page)

4.4.3.4 Measurement data

Total number of Hopping Channels is 16

4.4.3.5 Test Plot

GFSK



4.4.4 Time of occupancy (Dwell Time)

4.4.4.2 Regulation

According to §15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

4.4.4.2 Measurement Procedure

The testing follows FCC Public Notice DA 00-705 Measurement Guidelines
ANSI C63.10 § 7.8.3 Time of Occupancy

4.4.4.3 Result

Comply (measurement data : refer to the next page)

4.4.4.4 Measurement data

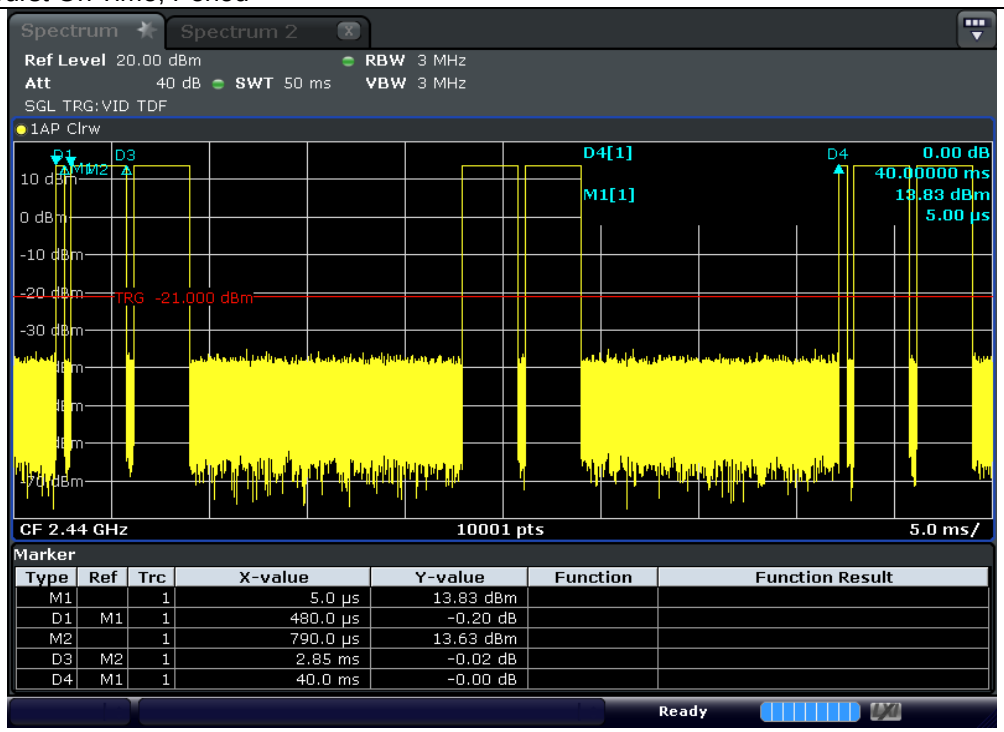
Test mode : Hopping

Time of occupancy				
Number of hopping Channels	Burst On Time (ms)	Period (ms)	Result (sec)	Limit (sec)
16	11.88	40.00	0.12	0.400

NOTE1 : Result = (0.4 * Number of hopping channels) * Burst On Time / (Period * Number of hopping channels)

4.4.4.5 Test Plot

Burst On Time, Period



NOTE1 : Burst On Time(ms) = 0.48+(2.85*4) = 11.88 ms
Period(ms) = 40.00 ms

4.4.5 Carrier Frequencies Separation

4.4.5.2 Regulation

According to §15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

4.4.5.2 Measurement Procedure

The testing follows FCC Public Notice DA 00-705 Measurement Guidelines
ANSI C63.10 § 7.8.2 Carrier frequency separation

4.4.5.3 Result

Comply (measurement data : refer to the next page)

4.4.5.4 Measurement data

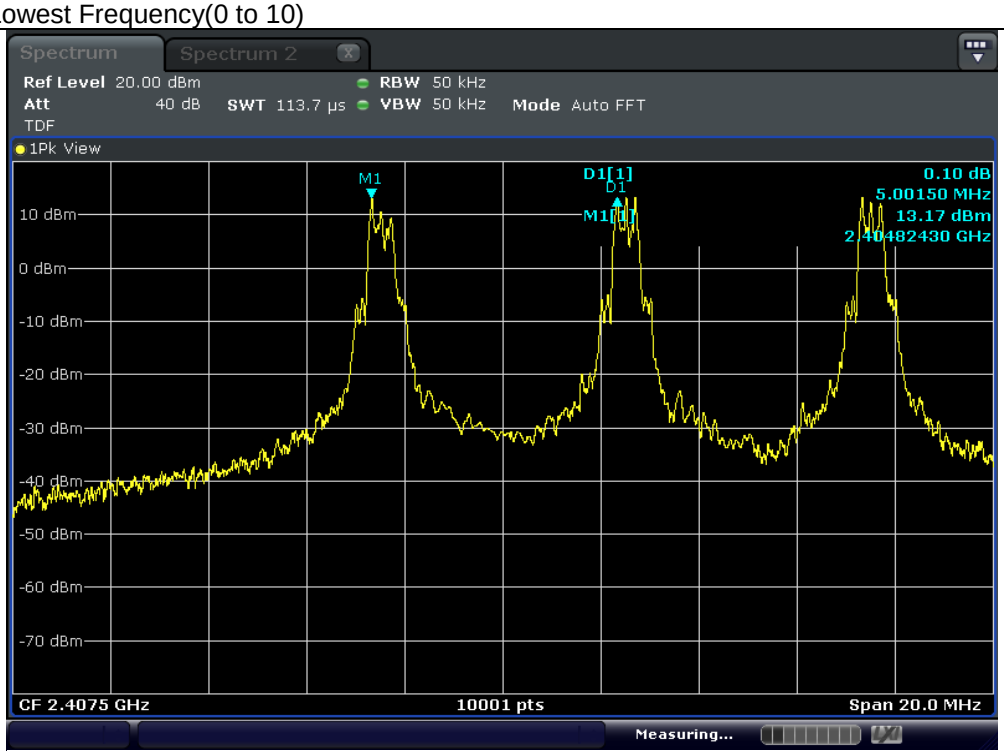
Test mode : MASTER_GFSK

Carrier Frequency Separation		
Test hopping channel No.	Result (MHz)	Min. Limit (MHz)
Lowest Frequency(0 to 10)	5.002	0.40
Middle Frequency(70 to 80)	5.000	0.40
Highest Frequency(140 to 144)	2.000	0.40

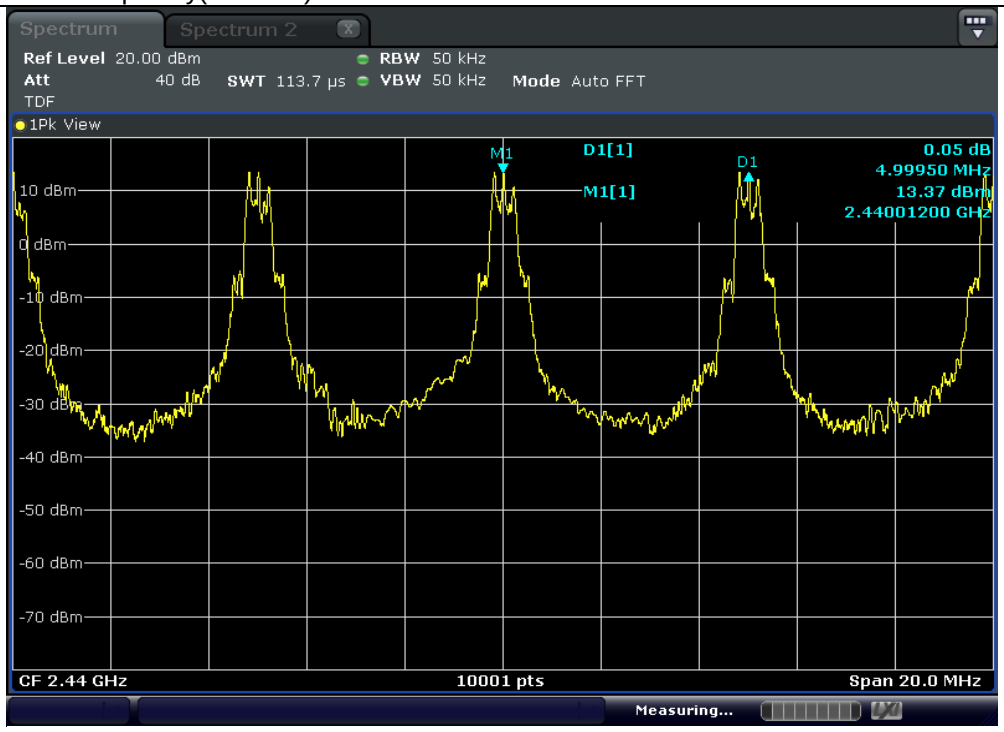
NOTE1 : Limit(kHz) : Result of 20 dB Bandwidth*2/3

4.4.5.5 Test Plot

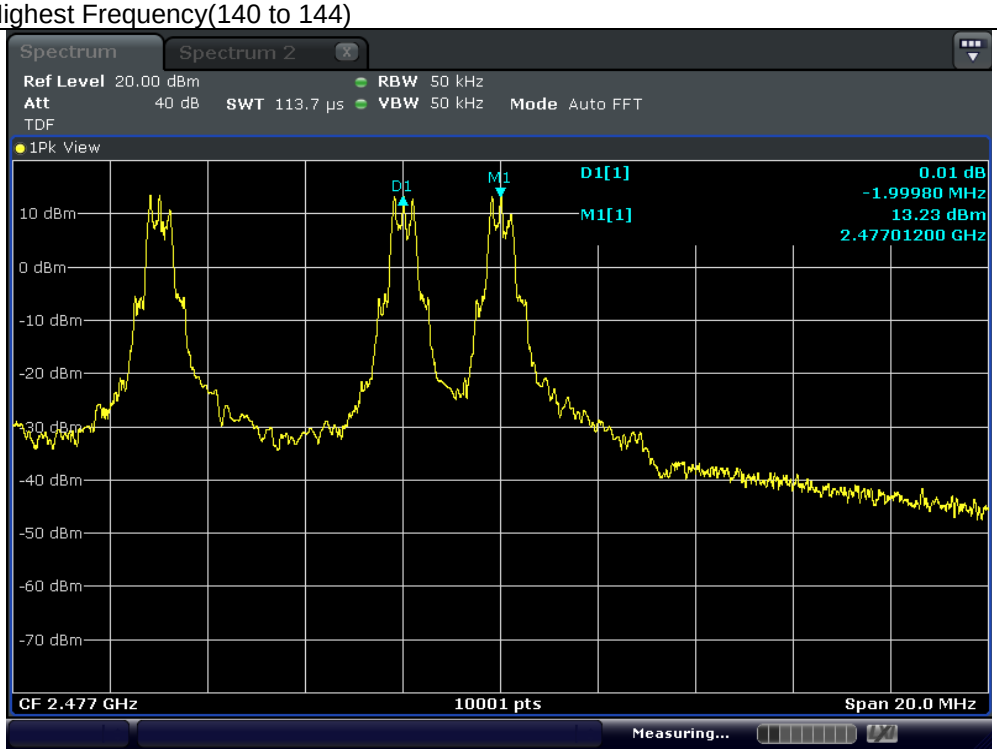
Lowest Frequency(0 to 10)



Middle Frequency(70 to 80)



Highest Frequency(140 to 144)



4.4.6 Peak Output Power

4.4.6.1 Regulation

According to §15.247(b)(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 nonoverlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

4.4.6.2 Measurement Procedure

The testing follows FCC Public Notice DA 00-705 Measurement Guidelines
ANSI C63.10 § 7.8.5 Output Power test procedure for FHSS

4.4.6.3 Result

Comply (measurement data : refer to the next page)

4.4.6.4 Measurement data

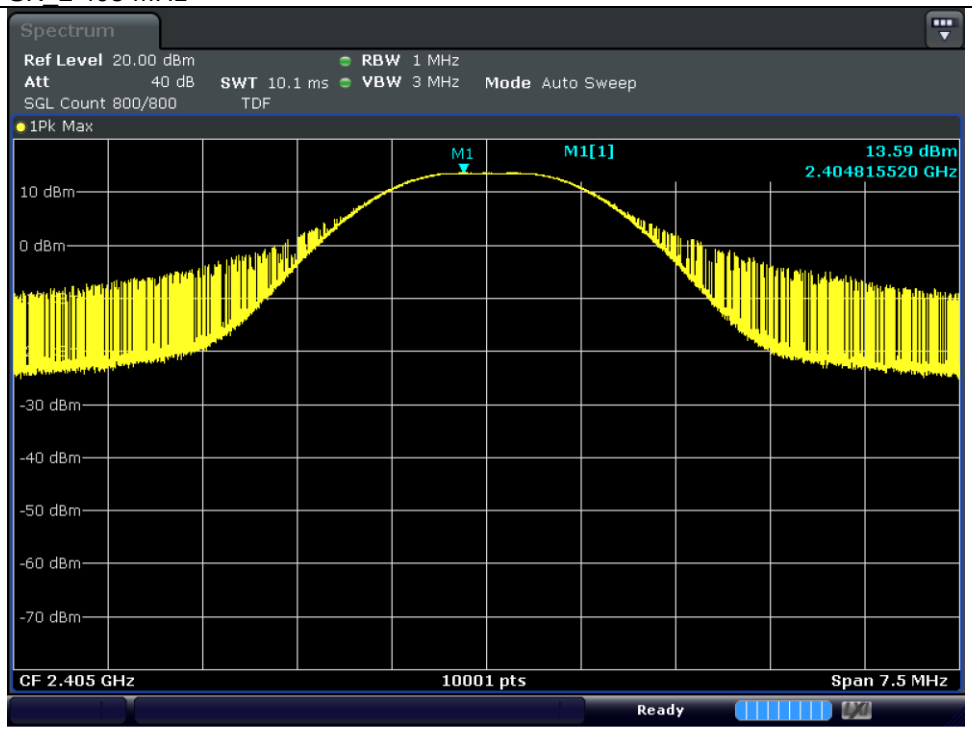
Test mode : GFSK

Frequency (MHz)	Peak Output Power Result (dBm)	Peak Output Power Result (mW)	Avg Output Power Result (dBm)
2 405	13.59	22.83	7.13
2 440	13.64	23.14	7.33
2 477	13.65	23.16	7.31

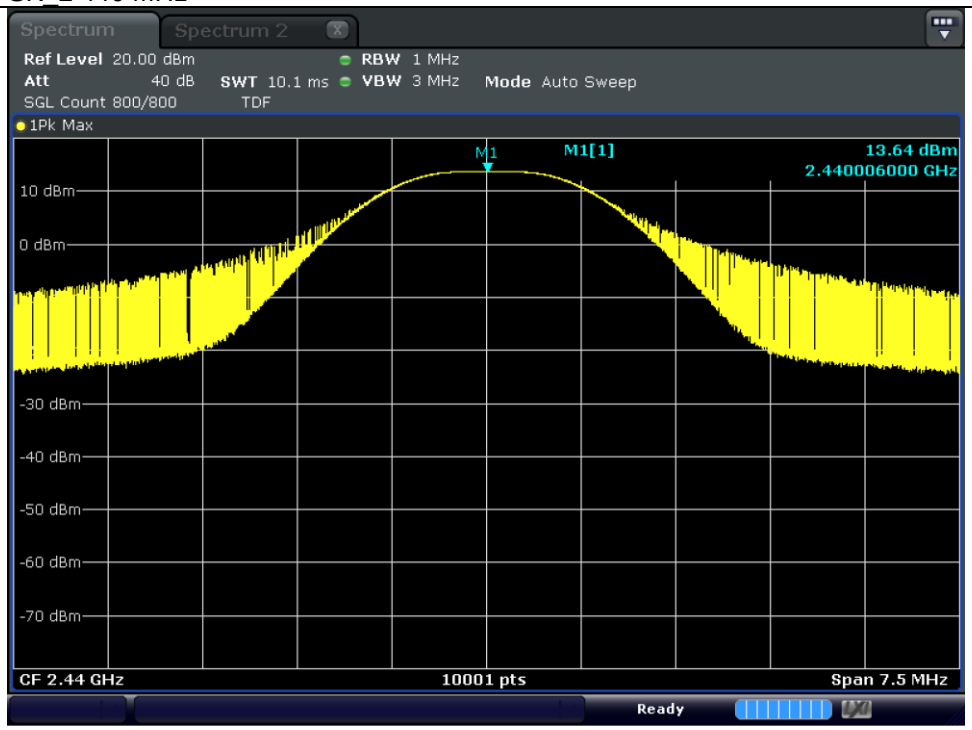
NOTE1 : Since the directional gain of the PCB Antenna declared by the manufacturer (GANT =3.00 dBi), does not exceed 6.0 dBi ,there was no need to reduce the output power.
NOTE2 : We took the insertion loss of the cable loss into consideration within the measuring instrument.
NOTE3 : Peak Output Power Result(W) = (10^(Peak Output Power Result(dBm)/10))

4.4.6.5 Test Plot

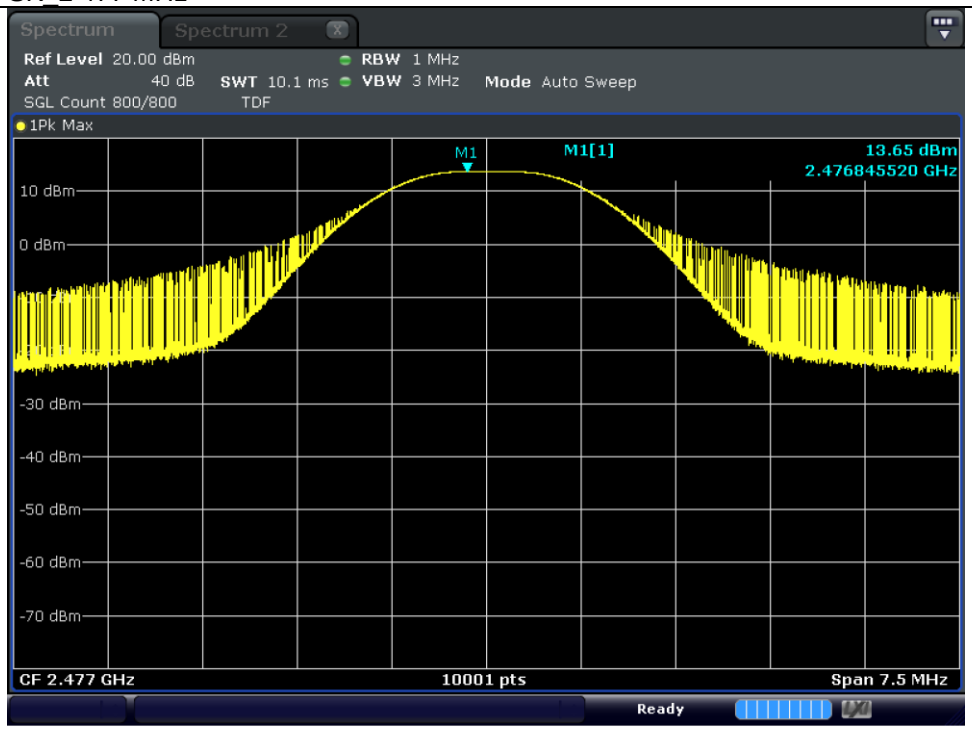
GFSK_2 405 MHz



GFSK_2 440 MHz



GFSK_2 477 MHz



4.4.7 Spurious Emission, Band Edge, and Restricted bands

4.4.7.1 Regulation

According to §15.247(d) in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §15.209(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall notexceed the field strength levels specified in the following table:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009 - 0.490	2 400/F(kHz)	300
0.490 - 1.705	24 000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shallnot be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permItted under other sections of this part, e.g., §§15.231 and 15.241.

According to §15.205(a),(b) only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 – 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 – 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 – 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 – 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 – 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 – 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 – 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 – 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 – 2 500	17.7 - 21.4
8.376 25 - 8.386 75	156.7 - 156.9	2 690 – 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 – 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 – 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 – 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 – 4 400	Above 38.6
13.36 - 13.41			

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

4.4.7.2 Measurement Procedure

The testing follows FCC Public Notice DA 00-705 Measurement Guidelines
ANSI C63.10 § 6.10.4 Authorized band-edge relative method (lower bandedge)
ANSI C63.10 § 6.10.6 Marker Delta Method (upper restricted bandedge)
ANSI C63.10 § 11.11.1 General Information
ANSI C63.10 § 11.11.3 Emission level measurement

4.4.7.2.1 Band-edge Compliance of RF Conducted Emissions

Span : wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation
RBW : ≥ 1% of the span
VBW : ≥ RBW
Sweep : Auto
Detector : Peak
Trace : Max hold

Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot.

Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit. Submit this plot.

4.4.7.2.2 Conducted Spurious Emissions

Span : wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation
RBW : ≥ 1% of the span
VBW : ≥ RBW
Sweep : Auto
Detector : Peak
Trace : Max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section. Submit these plots.

4.4.7.2.3 Radiated Spurious Emissions

1) The preliminary and final rdiated measurements were performed to determine the frequency producing the maximum emissions in at a 10m anechoic chamber. The EUT was tested at a distance 3 m(Below 1 GHz) and 1 m(Above 1 GHz).
2) The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3) The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, and from 30 to 1 000 MHz using the BILOG broadband antenna, and from 1 000 MHz to 10 000 MHz using the horn antenna.
4) Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

Span : wide enough to fully capture the emission being measured
RBW : ≥ 1 MHz for f ≥1 GHz, 100 kHz for f < 1 GHz
VBW : ≥ RBW
Sweep : Auto
Detector : Peak
Trace : Max hold

Follow the guidelines in ANSI C63.4 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

NOTE1 : The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.
NOTE2 : The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
NOTE3 : The 0.8 m height is for below 1 GHz testing, and 1.5 m is for above 1 GHz testing

4.4.7.3 Result

Comply (measurement data : refer to the next page)

4.4.7.4 Measurement data_Radiated Spurious Emissions

Test mode : Below 1 GHz (Worst case : GFSK_2 477 MHz)

Frequency (MHz)	Detector	Pol. (V/H)	Reading (dBµV)	Ant Factor (dB)	Loss (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
98.26	QP	H	54.30	9.10	-22.80	40.60	43.50	2.90
	QP	V	53.80	9.10	-22.80	40.10	43.50	3.40
196.59	QP	H	48.50	9.60	-21.80	36.30	43.50	7.20
	QP	V	48.70	9.60	-21.80	36.50	43.50	7.00
294.92	QP	H	44.20	13.30	-21.10	36.40	46.00	9.60
	QP	V	40.80	13.30	-21.10	33.00	46.00	13.00

Note 1 : Loss : Cable loss - Amp gain
Note 2 : Result : Reading + Ant Factor + Loss

Test mode : Above 1 GHz_GFSK_2 405

Frequency (MHz)	Detector	Pol. (V/H)	Reading (dBµV)	Factor (dB)	Dutycycle Factor (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2366.40	PK	H	62.80	6.60	-	69.40	83.54	14.14
	AV	H	37.40	6.60	-	44.00	63.54	19.54
2370.63	PK	V	59.20	6.60	-	65.80	83.54	17.74
	AV	V	35.50	6.60	-	42.10	63.54	21.44
2381.32	PK	H	65.50	6.60	-	72.10	83.54	11.44
	AV	H	37.80	6.60	-	44.40	63.54	19.14
2489.63	PK	H	56.40	6.90	-	63.30	83.54	20.24
	AV	H	38.90	6.90	-	45.80	63.54	17.74
4810.26	PK	H	62.90	11.30	-	74.20	83.54	9.34
	AV	H	40.10	11.30	-	51.40	63.54	12.14
4810.26	PK	V	51.80	11.30	-	63.10	83.54	20.44
	AV	V	33.90	11.30	-	45.20	63.54	18.34
7213.65	PK	H	60.70	15.30	-	76.00	83.54	7.54
	AV	H	38.80	15.30	-	54.10	63.54	9.44
9618.95	PK	H	45.80	18.70	-	64.50	83.54	19.04
	AV	H	35.40	18.70	-	54.10	63.54	9.44
Above 10 GHz	Not Detected	-	-	-		-	-	-

Note 1 : Factor : Ant Factor + Cable loss - Amp gain + site factor
Note 2 : Peak Result : Reading + Factor
Note 3 : DCCF(Duty Cyle Correction Factor) : 20 x Log(worst case dwell time / 100 ms) dB, refer to 4.4.7.7
Average Reasult : Result + DCCF
Note 4 : Below 1 GHz Measured distance : 3 m, Above 1 GHz Measured distance : 1 m
Above 1 GHz Distance Factor = 20log(1 / 3) = -9.54
Above 1 GHz Limit Peak = 74 - (-9.54) = 83.54
Above 1 GHz Limit Average = 54 - (-9.54) = 63.54
Note 5 : Average measurement did not take place because the peak data did not exceed Average Limit.
Note 6 : Not Detected means that peak data does not exceed the average limit.

Test mode : Above 1 GHz_GFSK_2 440

Frequency (MHz)	Detector	Pol. (V/H)	Reading (dBµV)	Factor (dB)	Dutycycle Factor (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2334.49	PK	H	51.80	6.40	-	58.20	83.54	25.34
	AV	H	25.70	6.40	-	32.10	63.54	31.44
2353.62	PK	V	50.50	6.60	-	57.10	83.54	26.44
	AV	V	25.80	6.60	-	32.40	63.54	31.14
2485.40	PK	H	60.60	6.90	-	67.50	83.54	16.04
	AV	H	25.50	6.90	-	32.40	63.54	31.14
2498.13	PK	H	57.30	6.90	-	64.20	83.54	19.34
	AV	H	27.90	6.90	-	34.80	63.54	28.74
4879.76	PK	H	60.00	11.50	-	71.50	83.54	12.04
	AV	H	25.30	11.50	-	36.80	63.54	26.74
4879.76	PK	V	63.90	11.50	-	75.40	83.54	8.14
	AV	V	26.20	11.50	-	37.70	63.54	25.84
7319.65	PK	H	46.80	15.40	-	62.20	83.54	21.34
	AV	H	24.90	15.40	-	40.30	63.54	23.24
7319.65	PK	V	42.50	15.40	-	57.90	83.54	25.64
	AV	V	25.10	15.40	-	40.50	63.54	23.04
12198.56	PK	H	39.70	23.00	-	62.70	83.54	20.84
	AV	H	28.70	23.00	-	51.70	63.54	11.84
Above 13 GHz	Not Detected	-	-	-		-	-	-

Note 1 : Factor : Ant Factor + Cable loss - Amp gain + site factor
Note 2 : Peak Result : Reading + Factor
Note 3 : DCCF(Duty Cyle Correction Factor) : 20 x Log(worst case dwell time / 100 ms) dB, refer to 4.4.7.7
Average Reasult : Result + DCCF
Note 4 : Below 1 GHz Measured distance : 3 m, Above 1 GHz Measured distance : 1 m
Above 1 GHz Distance Factor = 20log(1 / 3) = -9.54
Above 1 GHz Limit Peak = 74 - (-9.54) = 83.54
Above 1 GHz Limit Average = 54 - (-9.54) = 63.54
Note 5 : Average measurement did not take place because the peak data did not exceed Average Limit.
Note 6 : Not Detected means that peak data does not exceed the average limit.

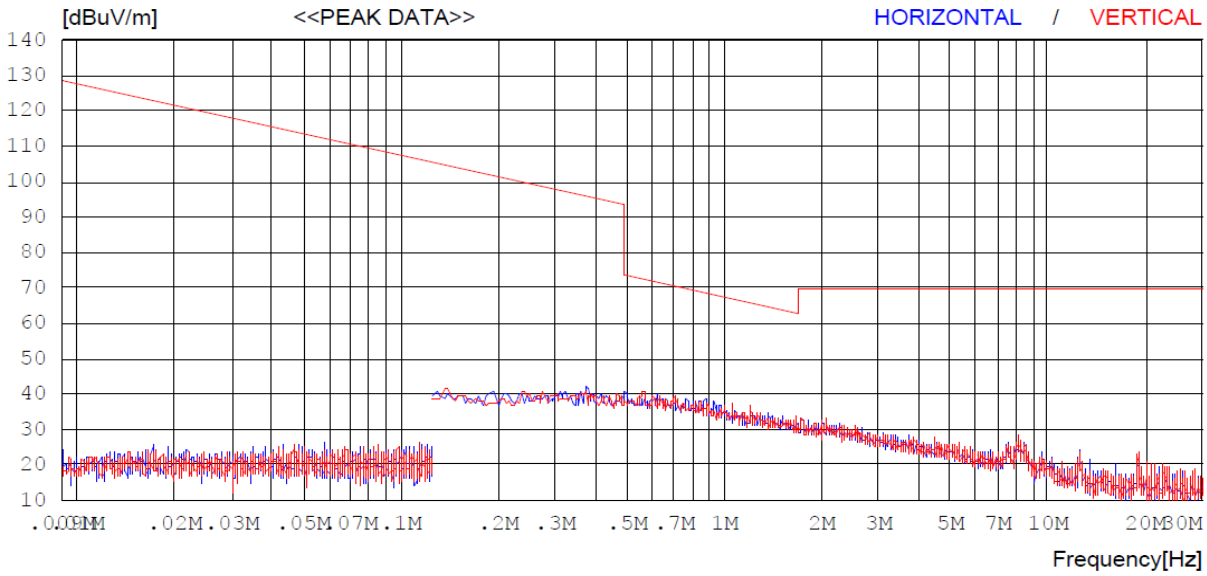
Test mode : Above 1 GHz_GFSK_2 477

Frequency (MHz)	Detector	Pol. (V/H)	Reading (dBµV)	Factor (dB)	Dutycycle Factor (dB)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2315.37	PK	H	53.90	6.40	-	60.30	83.54	23.24
	AV	H	25.30	6.40	-	31.70	63.54	31.84
2343.00	PK	H	47.90	6.40	-	54.30	83.54	29.24
	AV	H	25.90	6.40	-	32.30	63.54	31.24
2347.24	PK	H	48.70	6.50	-	55.20	83.54	28.34
	AV	H	26.40	6.50	-	32.90	63.54	30.64
2379.15	PK	H	52.00	6.60	-	58.60	83.54	24.94
	AV	H	25.80	6.60	-	32.40	63.54	31.14
2485.77	PK	H	59.50	6.90	-	66.40	83.54	17.14
	AV	H	25.70	6.90	-	32.60	63.54	30.94
2485.77	PK	V	54.00	6.90	-	60.90	83.54	22.64
	AV	V	25.60	6.90	-	32.50	63.54	31.04
4952.48	PK	H	69.00	11.50	-	80.50	83.54	3.04
	AV	H	25.50	11.50	-	37.00	63.54	26.54
7430.10	PK	H	43.30	15.60	-	58.90	83.54	24.64
	AV	H	25.90	15.60	-	41.50	63.54	22.04
9907.77	PK	H	38.90	19.30	-	58.20	83.54	25.34
	AV	H	25.80	19.30	-	45.10	63.54	18.44
Above 10 GHz	Not Detected	-	-	-		-	-	-

Note 1 : Factor : Ant Factor + Cable loss - Amp gain + site factor
Note 2 : Peak Result : Reading + Factor
Note 3 : DCCF(Duty Cyle Correction Factor) : 20 x Log(worst case dwell time / 100 ms) dB, refer to 4.4.7.7
Average Reasult : Result + DCCF
Note 4 : Below 1 GHz Measured distance : 3 m, Above 1 GHz Measured distance : 1 m
Above 1 GHz Distance Factor = 20log(1 / 3) = -9.54
Above 1 GHz Limit Peak = 74 - (-9.54) = 83.54
Above 1 GHz Limit Average = 54 - (-9.54) = 63.54
Note 5 : Average measurement did not take place because the peak data did not exceed Average Limit.
Note 6 : Not Detected means that peak data does not exceed the average limit.

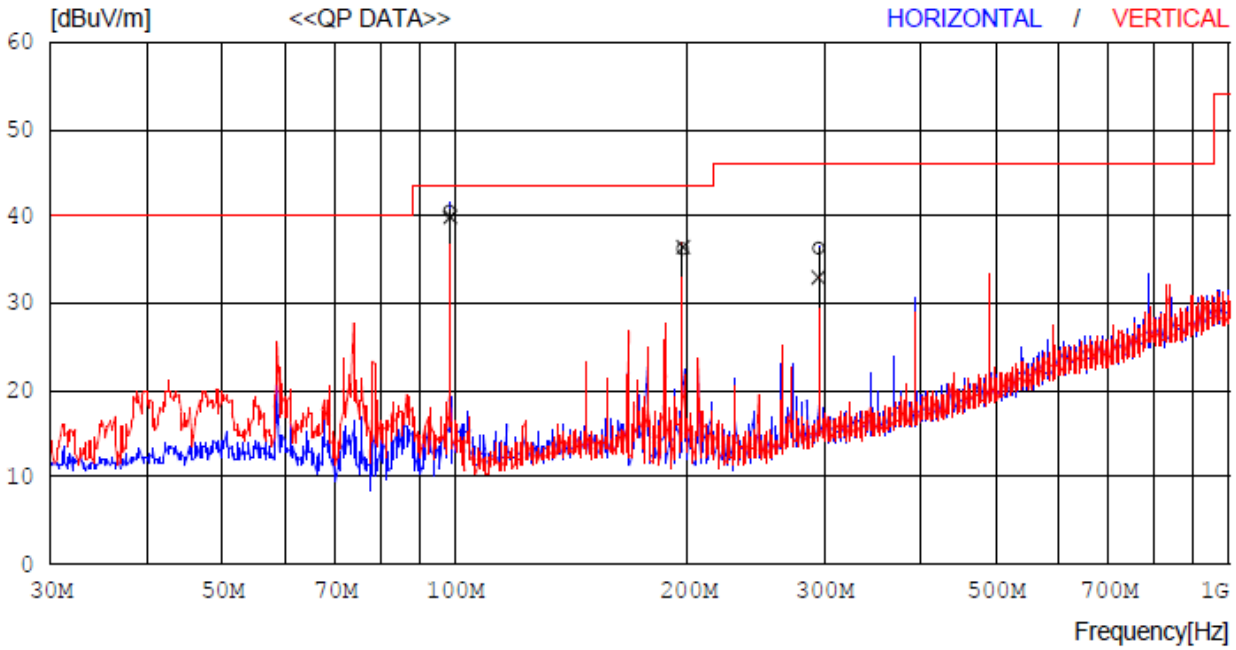
4.4.7.5 Measurement Plot_Radiated Spurious Emissions

Test mode : 9 kHz ~ 30 MHz Worst Case(GFSK_2 477 MHz)



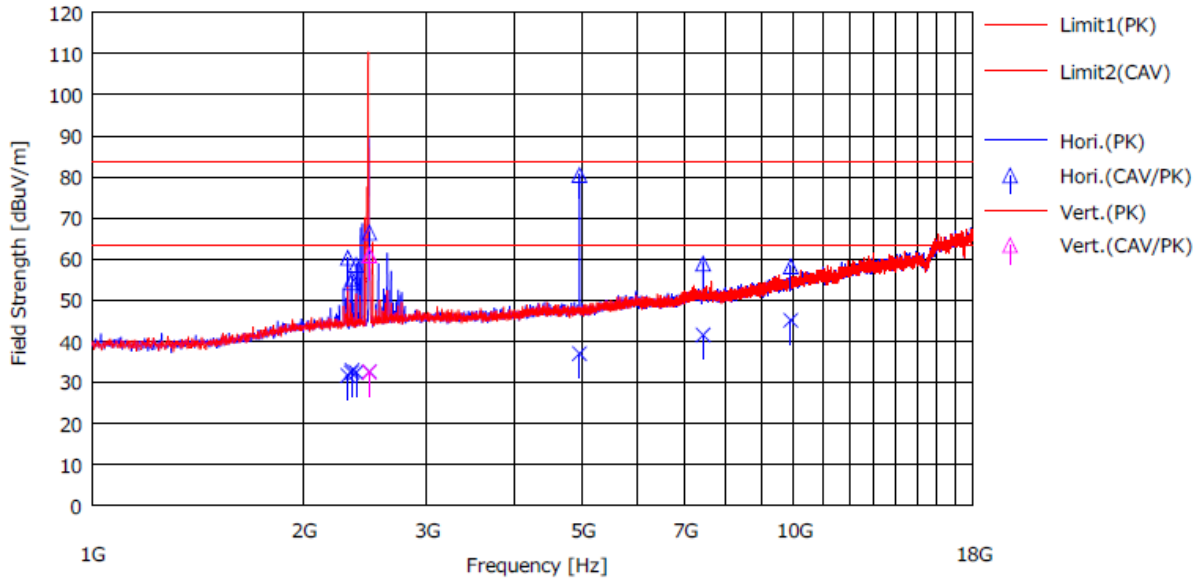
No.	FREQ	READING PEAK	ANT FACTOR	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]

Test mode : 30 MHz ~ 1 GHz Worst Case(GFSK_2 477 MHz)



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	98.263	54.3	9.1	-22.8	0.0	40.6	43.5	2.9	200	0
2	196.594	48.5	9.6	-21.8	0.0	36.3	43.5	7.2	200	111
3	294.924	44.2	13.3	-21.1	0.0	36.4	46.0	9.6	100	359
----- Vertical ------										
4	98.263	53.8	9.1	-22.8	0.0	40.1	43.5	3.4	100	6
5	196.594	48.7	9.6	-21.8	0.0	36.5	43.5	7.0	100	0
6	294.924	40.8	13.3	-21.1	0.0	33.0	46.0	13.0	200	359

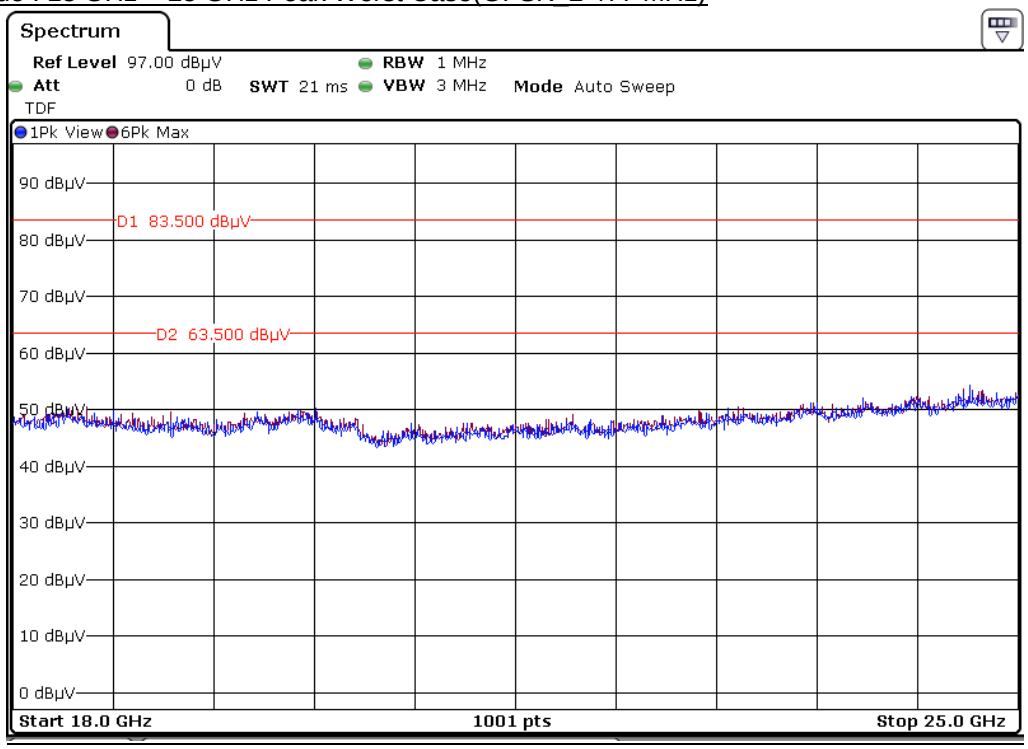
Test mode : 1 GHz ~ 18 GHz Peak Worst Case(GFSK_2 477 MHz)



No.	Freq.	Reading		Ant.Fac	Loss	Gain	S.Fac	Result		Limit		Margin		Pola.	Height	Angle	Ant. Type	Comment
		<CAV>	<PK>					<CAV>	<PK>	<PK>	<CAV>	<PK>	<CAV>					
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	[H/V]	[cm]	[deg]		
1	2315.373	25.3	53.9	32.0	6.9	34.4	1.9	31.7	60.3	83.5	63.5	23.2	31.8	Hori.	150	213	8719K	
2	2343.003	25.9	47.9	32.0	6.9	34.4	1.9	32.3	54.3	83.5	63.5	29.2	31.2	Hori.	150	107	8719K	
3	2347.241	26.4	48.7	32.0	7.0	34.4	1.9	32.9	55.2	83.5	63.5	28.3	30.6	Hori.	150	255	8719K	
4	2379.145	25.8	52.0	32.1	7.0	34.4	1.9	32.4	58.6	83.5	63.5	24.9	31.1	Hori.	150	213	8719K	
5	2485.767	25.7	59.5	32.2	7.2	34.4	1.9	32.6	66.4	83.5	63.5	17.1	30.9	Hori.	150	35	8719K	
6	4952.483	25.5	69.0	34.0	10.1	34.5	1.9	37.0	80.5	83.5	63.5	3.0	26.5	Hori.	150	107	8719K	
7	7430.103	25.9	43.3	35.6	12.9	34.8	1.9	41.5	58.9	83.5	63.5	24.6	22.0	Hori.	150	347	8719K	
8	9907.766	25.8	38.9	37.0	15.5	35.1	1.9	45.1	58.2	83.5	63.5	25.3	18.4	Hori.	150	143	8719K	
9	2485.767	25.6	54.0	32.2	7.2	34.4	1.9	32.5	60.9	83.5	63.5	22.6	31.0	Vert.	150	77	8719K	

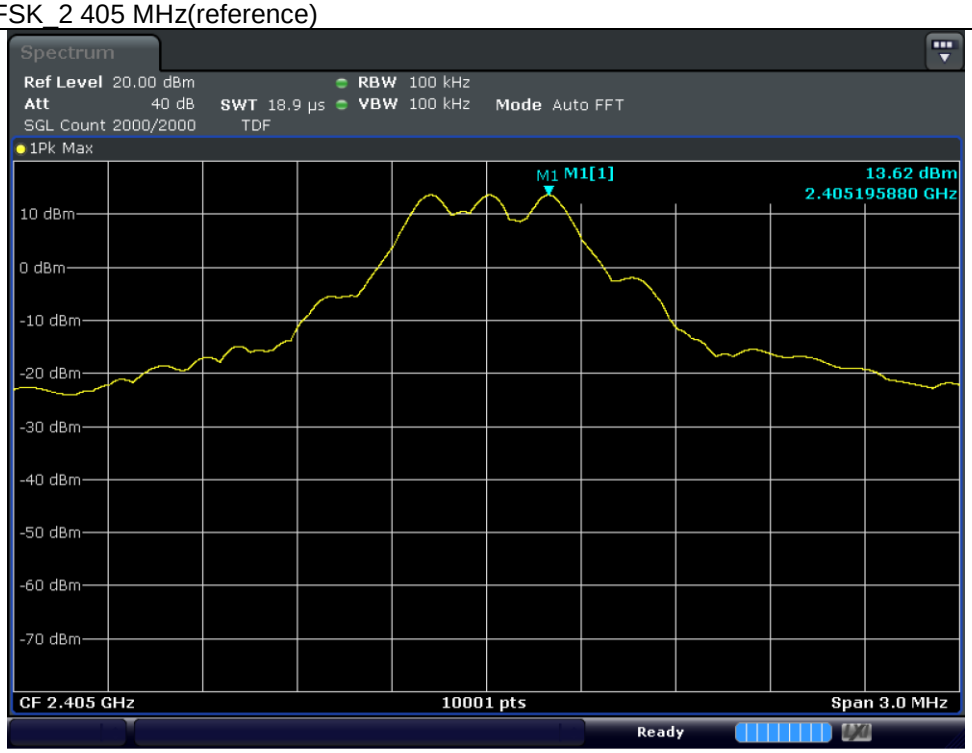
Note 1 : Measured distance : 1 m
Note 2 : Limit : Peak : 83.5 dBµV/m
Average : 63.5 dBµV/m

Test mode : 18 GHz ~ 25 GHz Peak Worst Case(GFSK_2 477 MHz)

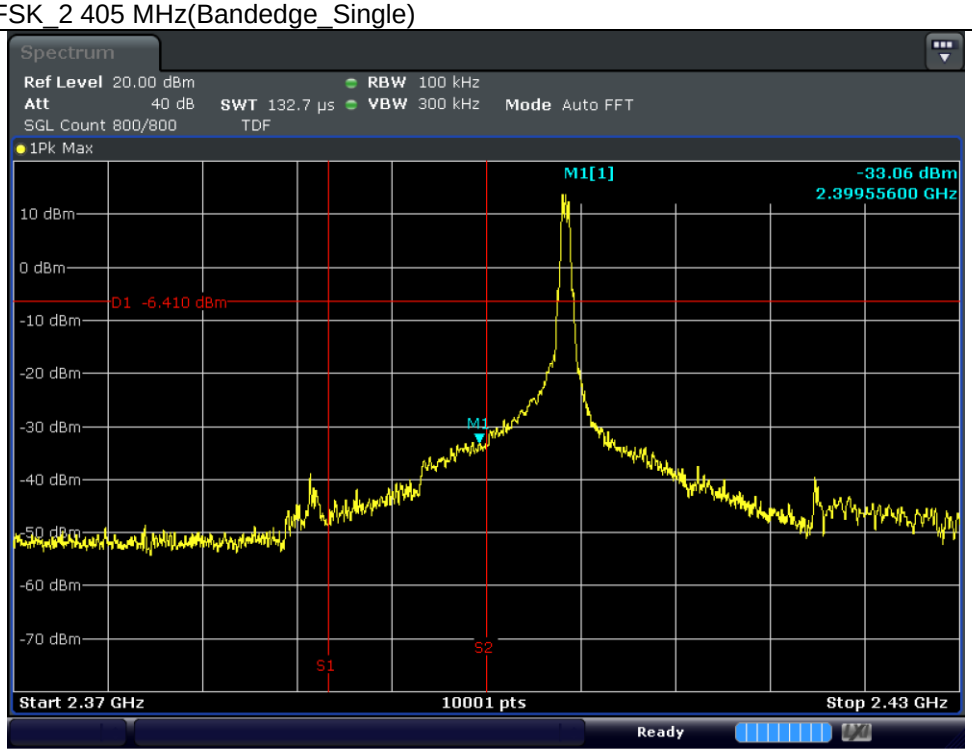


4.4.7.6 Measurement data_Conducted Spurious Emissions

GFSK_2 405 MHz(reference)

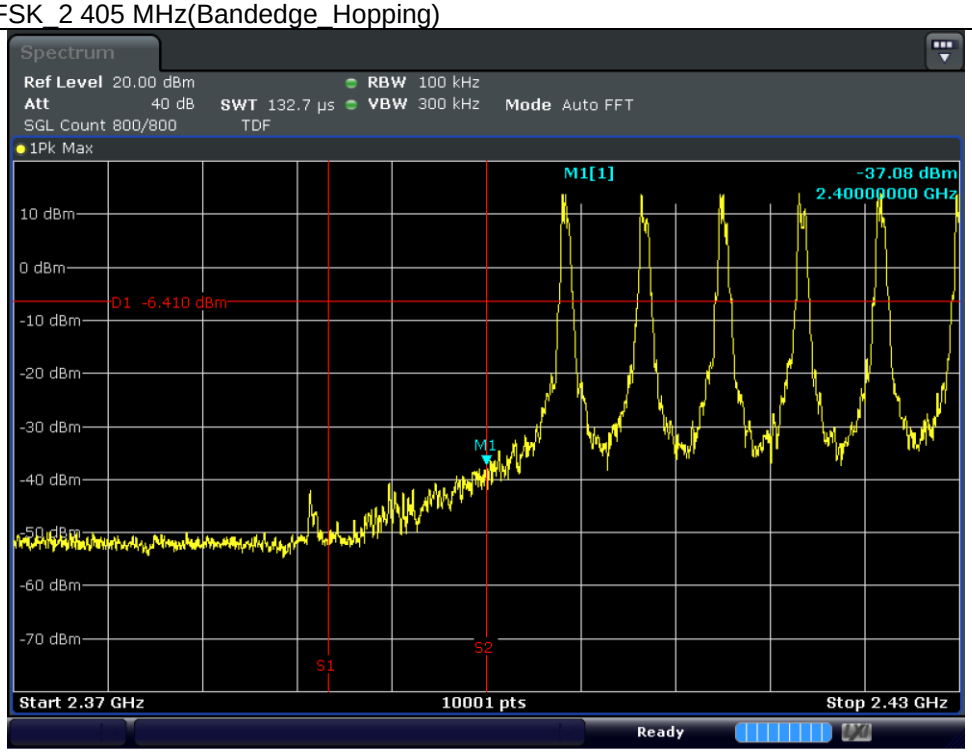


GFSK_2 405 MHz(Bandedge_Single)



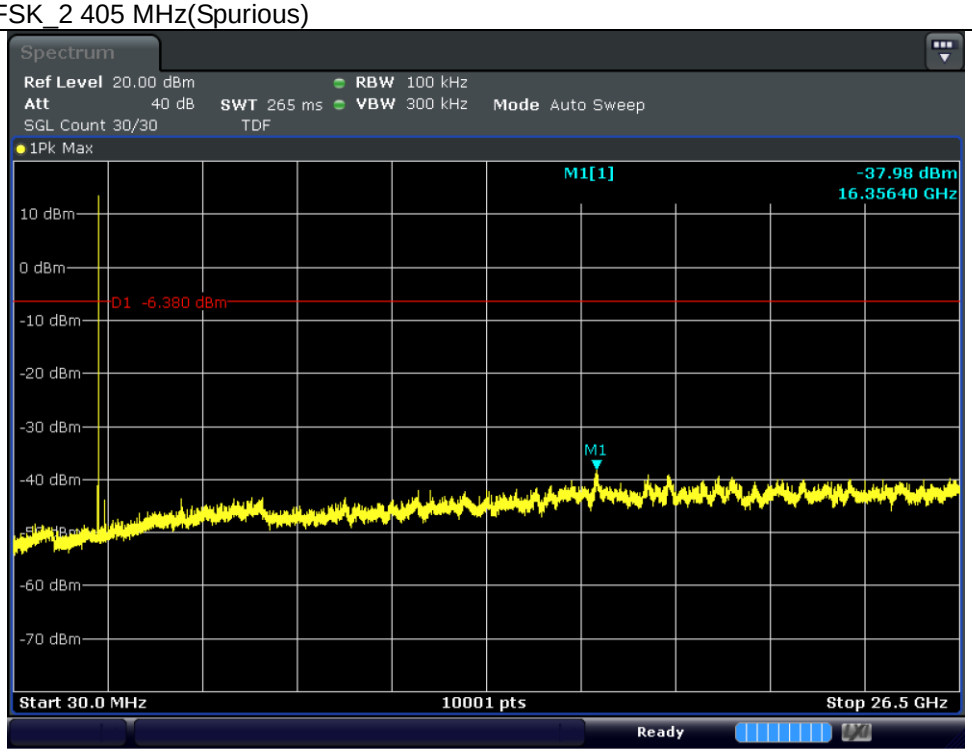
NOTE: F1 : 2 390 MHz, F2 : 2 400 MHz

GFSK_2 405 MHz(Bandedge_Hopping)

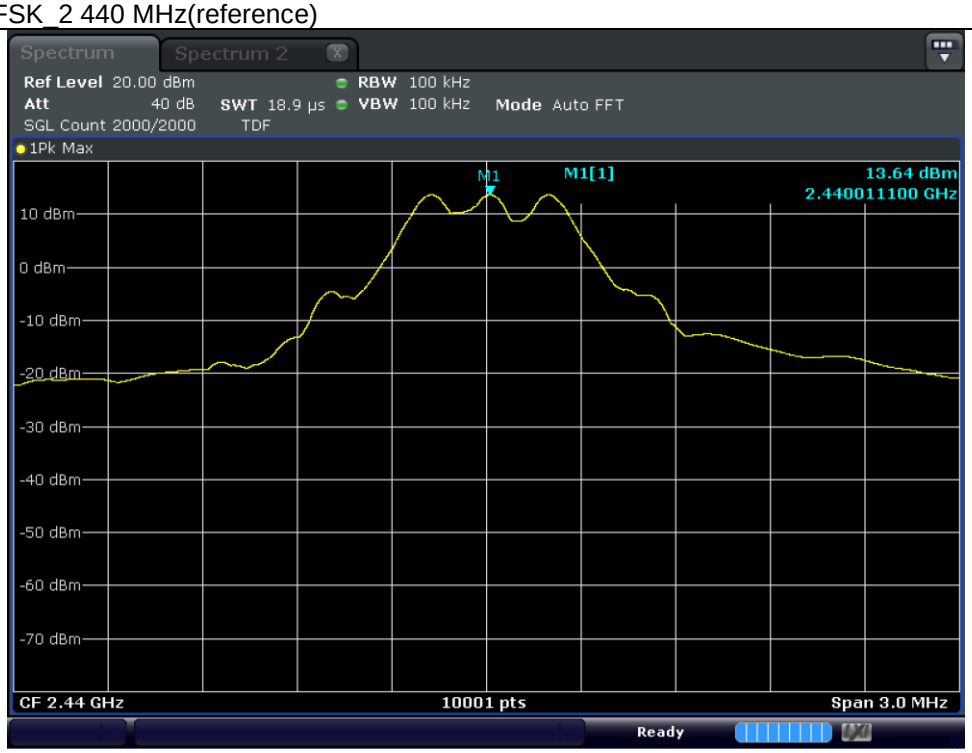


NOTE: F1 : 2 390 MHz, F2 : 2 400 MHz

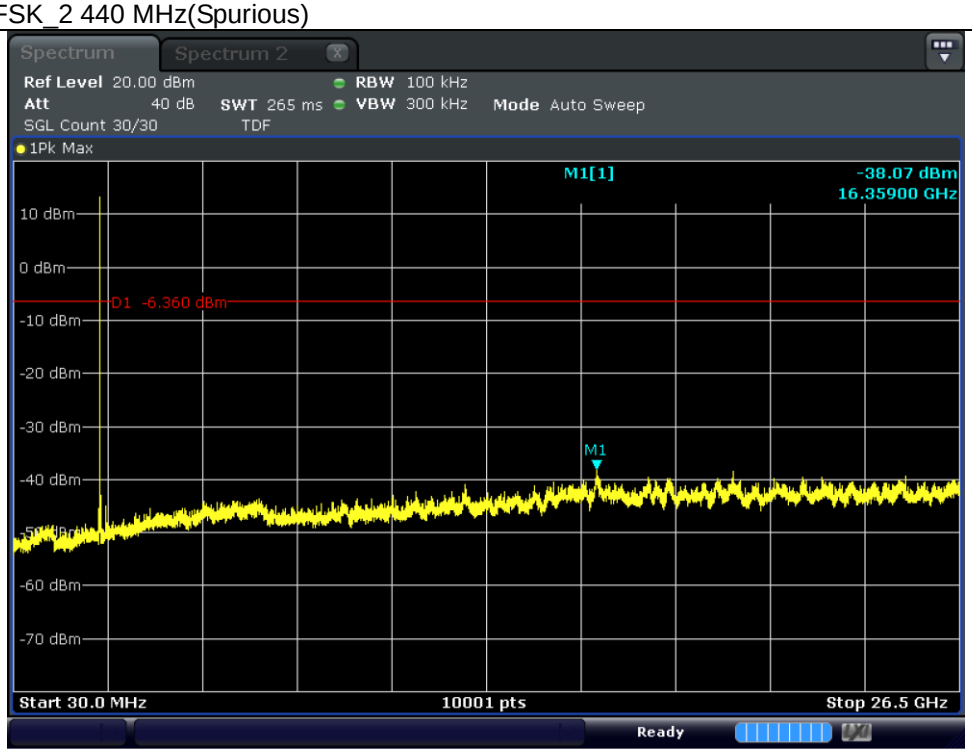
GFSK_2 405 MHz(Spurious)



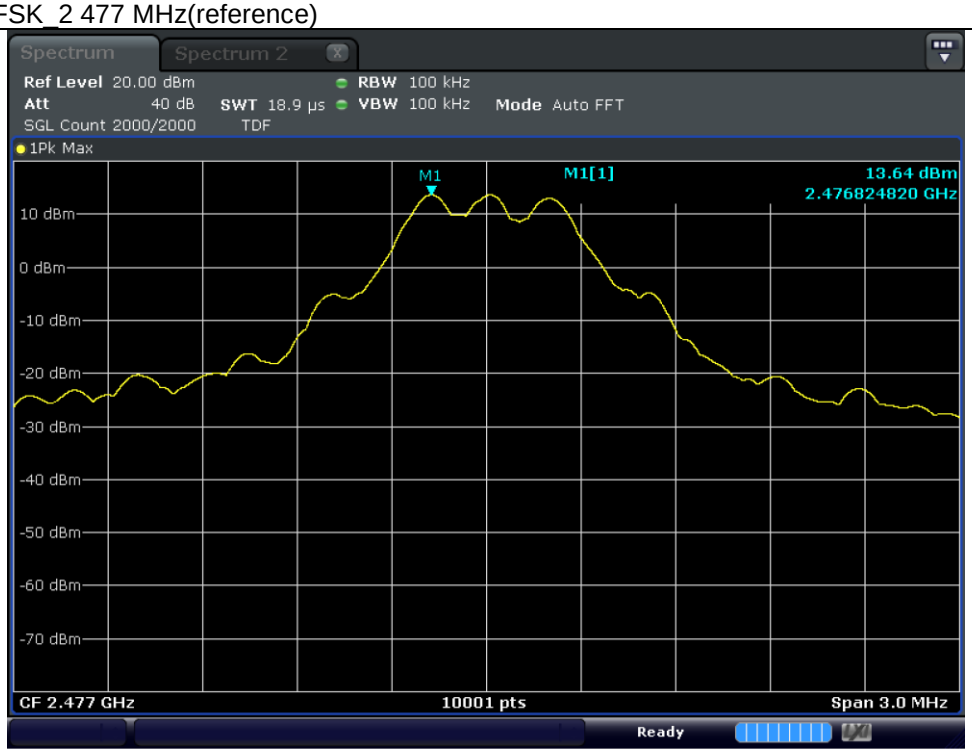
GFSK_2 440 MHz(reference)



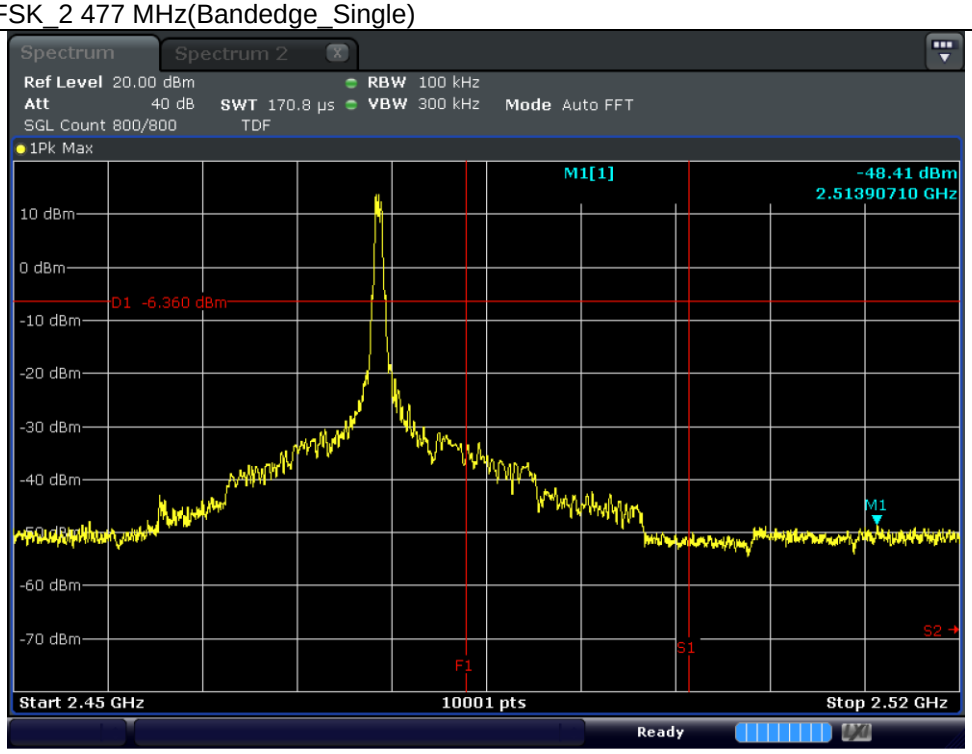
GFSK_2 440 MHz(Spurious)



GFSK_2 477 MHz(reference)

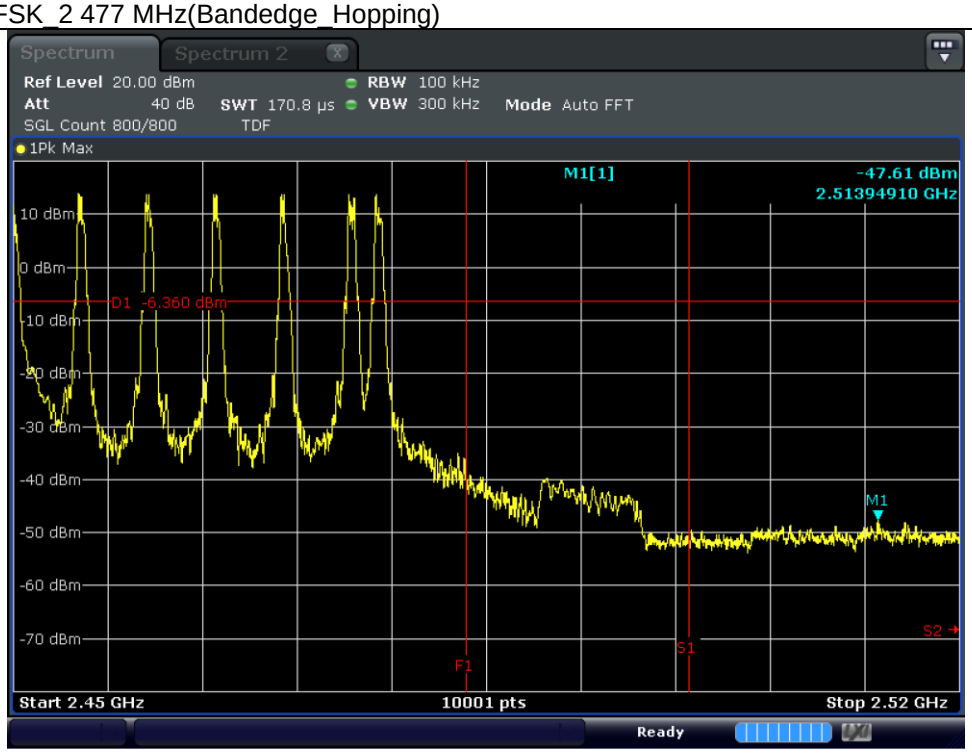


GFSK_2 477 MHz(Bandedge_Single)



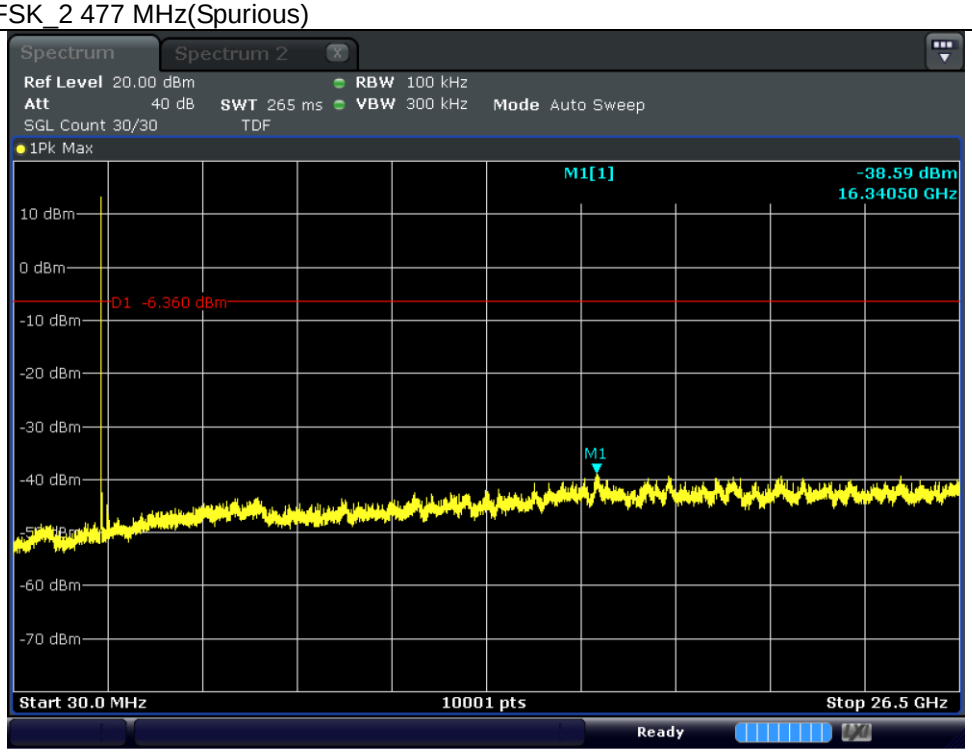
NOTE: F1 : 2 483.5 MHz, F2 : 2 500 MHz

GFSK_2 477 MHz(Bandedge_Hopping)



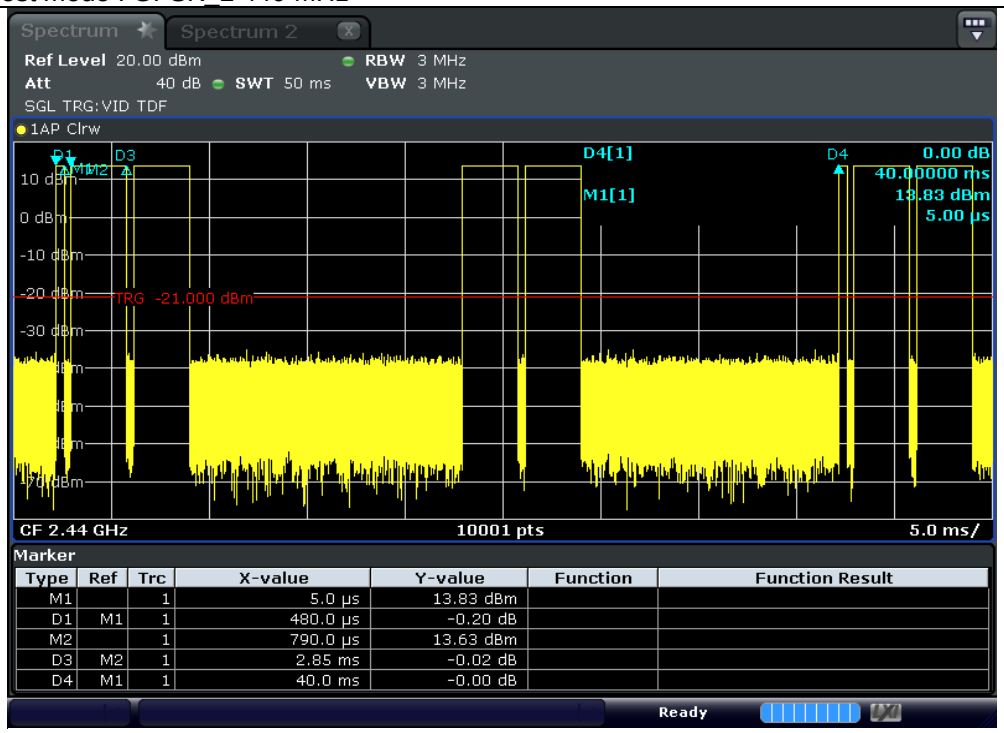
NOTE: F1 : 2 483.5 MHz, F2 : 2 500 MHz

GFSK_2 477 MHz(Spurious)



4.4.7.7 Measurement Plot_Dutycycle

Test mode : GFSK_2 440 MHz



NOTE: Burst On Time(ms) = 0.48+(2.85*4) = 11.88 ms
Dwell time: on time*No. of hop
Dutycycle Factor : 20log(dwell time/100) = 20log((11.88*1)/100) = -18.50

4.4.8 Conducted Emission

4.4.8.1 Regulation

According to §15.207(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω line impedance stabilization network (LISN).
Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Qausi-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.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

4.4.6.2 Measurement Procedure

1) The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5 m away from the side wall of the shielded room.

2) Each current-carrying conductor of the EUT power cord was individually connected through a 50 Ω/50 μH LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.

3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.

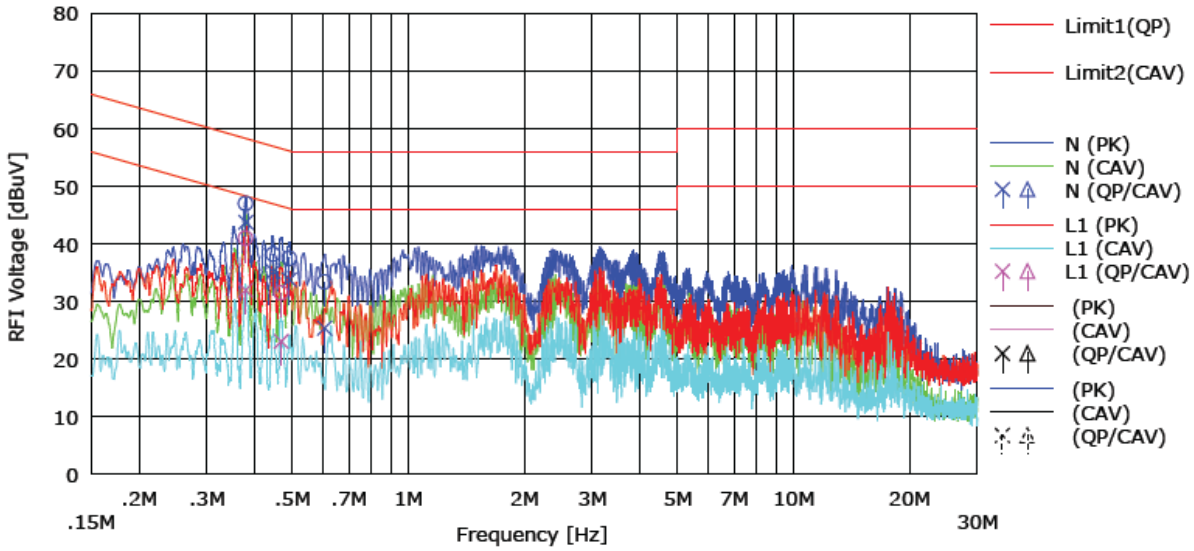
4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.

5) The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASIPEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

4.4.8.3 Result

Comply (measurement data : refer to the next page)

4.4.8.4 Measurement data



NO	FREQ	READING QP	READING CAV	C.FACTOR	RESULT QP	RESULT CAV	LIMIT QP	LIMIT CAV	MARGIN QP	MARGIN CAV	PHASE
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.37826	27.1	23.9	19.9	47.0	43.8	58.3	48.3	11.3	4.5	N
2	0.44583	18.3	15.3	19.9	38.2	35.2	57.0	47.0	18.8	11.8	N
3	0.49070	17.6	13.9	19.9	37.5	33.8	56.2	46.2	18.7	12.4	N
4	0.60639	13.5	5.5	19.9	33.4	25.4	56.0	46.0	22.6	20.6	N
5	0.37798	21.1	12.1	19.9	41.0	32.0	58.3	48.3	17.3	16.3	L1
6	0.46798	11.6	3.2	19.9	31.5	23.1	56.5	46.5	25.0	23.4	L1

APPENDIX I

TEST EQUIPMENT USED FOR TESTS

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment.

Equipment	Manufacturer	Model	Serial No.	Cal. Date (yy.mm.dd)	Next Cal.Date (yy.mm.dd)
FSV Signal Analyzer	ROHDE&SCHWARZ	FSV40	101010	2018-04-24	2019-04-24
Power Sensor	KEYSIGHT	U2022XA	MY55320008	2018-08-17	2019-08-17
DC Power Supply	AGILENT	E3632A	MY51160055	2018-04-23	2019-04-23
Digital MultiMeter	HP	34401A	US36025428	2019-01-10	2020-01-10
ATTENUATOR	WEINSCHEL	54A-10	69672	2018-10-15	2019-10-15
Signal Generator	ROHDE&SCHWARZ	SMB100A	178384	2018-10-15	2019-10-15
EMI Test Receiver	ROHDE&SCHWARZ	ESU40	100445	2017-12-15	2018-12-15
BiLog Antenna	Schwarzbeck	VULB9160	9160-3381	2017-06-15	2019-06-15
Attenuator	JFW	50FPE-006N	-	2018-04-23	2019-04-23
Preamplifier	TSJ	MLA-10k01-b01-27	1870369	2018-04-23	2019-04-23
Antenna Mast(10 m)	TOKIN	5977	-	-	-
Antenna Mast(10 m)	Innco	MA4640-XPET-0800	578	-	-
Controller(10 m)	TOKIN	5909L	141909L-1	-	-
Controller(10 m)	Innco	CO3000	40040217	-	-
Turn Table(10 m)	TOKIN	5983-1.5	-	-	-
10 m Semi-Anechoic Chamber	SY CORPORATION	-	-	-	-
Active Loop H-Field	ETS	6502	00150598	2017-06-01	2019-06-01
Double Ridege Horn Antenna	ETS	3117	00168719	2017-09-01	2019-09-01
Double Ridege Horn Antenna	A.H Systems, Inc	SAS-574	465	2017-04-25	2019-04-25
PREAMPLIFIER	Agilent	8449B	3008A02110	2019-01-14	2020-01-14
PREAMPLIFIER	A.H Systems, Inc	PAM-1840VH	166	2019-01-14	2020-01-14