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TEST REPORT

of

FCC Part 15 Subpart C §15.247
IC RSS-247 Issue 2 and RSS-Gen Issue 5

FCC ID: 2BAKQGG02F
IC Certification: 30242-GG02I

Equipment Under Test	:	Gateway
Model Name	:	GLSD-PLC-GW-2
Variant Model Name(s)	:	-
Applicant	:	FCC: Glassdome IC: Glassdome
Manufacturer	:	Glassdome
Date of Receipt	:	2023.01.09
Date of Test(s)	:	2023.01.09 ~ 2023.03.28
Date of Issue	:	2023.04.04

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

1) The results of this test report are effective only to the items tested.
2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
3) This test report cannot be reproduced, except in full, without prior written permission of the Company.
4) The data marked ※ in this report was provided by the customer and may affect the validity of the test results.
We are responsible for all the information of this test report except for the data(※) provided by the customer.

Tested by: Murphy Kim

Technical Manager: Jinhyoung Cho

SGS Korea Co., Ltd. Gunpo Laboratory

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

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1.2. Details of Applicant

Applicant : Glassdome
Address : 22F, 755, Hanbat-daero, Seo-gu, Daejeon, South Korea, 35209
Contact Person : Cho, Jun-beom
Phone No. : +82 10 9603 3500

1.3. Details of Manufacturer

Company : Same as applicant
Address : Same as applicant

1.4. Description of EUT

Kind of Product	Gateway
Model Name	GLSD-PLC-GW-2
Approved Module	FCC ID: 2AF6B-RAK5146 IC Certification: 25908-RAK5146
Serial Number	GG02F000001
Power Supply	DC 12 V
Frequency Range	923.3 ㎒ ~ 927.5 ㎒ (Lora-DTS) 903.9 ㎒ ~ 905.3 ㎒ (Lora-Hybrid)
Modulation Technique	Lora
Number of Channels	8 channels (Lora-DTS) 8 channels (Lora-Hybrid)
Antenna Type	Dipole antenna
Antenna Gain※	2.3 ㏈i
H/W Version	V1.0.0
S/W Version	V1.0.0
FVIN	N/A

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMA10013	106887	Oct. 13, 2022	Annual	Oct. 13, 2023
Signal Generator	R&S	SMBV100A	255834	May 25, 2022	Annual	May 25, 2023
Spectrum Analyzer	R&S	FSV30	103210	Dec. 07, 2022	Annual	Dec. 07, 2023
Spectrum Analyzer	Agilent	N9020A	MY53421758	Aug. 26, 2022	Annual	Aug. 26, 2023
Attenuator	AEROFLEX / INMET	40AH2W-10	40G-1	Jun. 08, 2022	Annual	Jun. 08, 2023
High Pass Filter	Wainwright Instrument GmbH	WHKX10-900-1000-18000-40SS	7	Mar. 02, 2023	Annual	Mar. 02, 2024
Power Sensor	R&S	NRP-Z81	100669	May 06, 2022	Annual	May 06, 2023
DC Power Supply	Agilent	U8002A	MY54110041	Sep. 15, 2022	Annual	Sep. 15, 2023
Preamplifier	H.P.	8447F	2944A03909	Aug. 04, 2022	Annual	Aug. 04, 2023
Signal Conditioning Unit	R&S	SCU-18	10117	Jun. 13, 2022	Annual	Jun. 13, 2023
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 23, 2021	Biennial	Aug. 23, 2023
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB9163	390	Feb. 24, 2023	Annual	Feb. 24, 2024
Horn Antenna	R&S	HF906	100326	Feb. 28, 2023	Annual	Feb. 28, 2024
Test Receiver	R&S	ESU26	100109	Jan. 18, 2023	Annual	Jan. 18, 2024
Test Receiver	R&S	ESCI 7	100911	Feb. 24, 2023	Annual	Feb. 24, 2024
Two-Line V-network	R&S	ENV216	100190	May 13, 2022	Annual	May 13, 2023
Shield Room	SY Corporation	L × W × H (6.5 m × 3.5 m × 3.5 m)	N/A	N.C.R.	N/A	N.C.R.
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/38330516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/38330516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	RFONE	MWX221-NMSNMS (4 m)	J1023142	Oct. 04, 2022	Semi-Annual	Apr. 04, 2023
Coaxial Cable	Qualwave Inc.	QA500-18-NN-10 (10 m)	22200114	Oct. 04, 2022	Semi-Annual	Apr. 04, 2023
Coaxial Cable	RADIALL	TESTPRO 3	182287	Feb. 18, 2023	Semi-Annual	Aug. 18, 2023

Note;

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

1.8. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part15 Subpart C, IC RSS-247 Issue 2 and RSS-Gen Issue 5			
Section in FCC	**Section in IC**	**Test Item(s)**	**Result**
15.205(a) 15.209 15.247(d)	RSS-247 Issue 2 5.5 RSS-Gen Issue 5 8.9	Transmitter Radiated Spurious Emissions	Complied
15.205(a) 15.209 15.247(d)	RSS-247 Issue 2 5.5 RSS-Gen Issue 5 8.9	Conducted Spurious Emission	N/A[1)]
15.247(a)(2)	RSS-247 Issue 2 5.2(a) RSS-Gen Issue 5 6.7	6 ㏈ Bandwidth	N/A[1)]
15.247(a)(1)	RSS-247 Issue 2 5.1(a) RSS-Gen Issue 5 6.7	20 ㏈ Bandwidth and 99 % Bandwidth	N/A[1)]
15.247(b)(2) 15.247(b)(3)	RSS-247 Issue 2 5.4(a) 5.4(d)	Maximum Peak Conducted Output Power	Complied
15.247(a)(1)	RSS-247 Issue 2 5.1(b)	Carrier Frequency Separation	N/A[1)]
15.247(e)	RSS-247 Issue 2 5.2(b)	Power Spectral Density	N/A[1)]
15.247(a)(1)(ⅲ)	RSS-247 Issue 2 5.1(d)	Number of Hopping Frequencies	N/A[1)]
15.247(a)(1)(ⅰ)	RSS-247 Issue 2 5.3	Time of Occupancy (Dwell Time)	N/A[1)]
15.207	RSS-Gen Issue 5 8.8	AC Power Line Conducted Emission	Complied

Note;

1) The test items were not conducted because the approved module was used.
Approved module information
Model Name: RAK5146
FCC ID: 2AF6B-RAK5146
IC Certification: 25908-RAK5146

1.9. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 15.247 Meas Guidance v05r02 were used in the measurement of the DUT.

1.10. Sample Calculation

Where relevant, the following sample calculation is provided:

1.10.1. Conducted Test

Offset value (㏈) = Directional coupler (㏈) + Cable loss (㏈)

1.10.2. Radiation Test

Field strength level (㏈㎶/m) = Measured level (㏈㎶) + Antenna factor (㏈) + Cable loss (㏈) - Amplifier gain (㏈)
+ Duty factor (㏈)

1.11. Information of software for test

- Using the software of ttermpro(Version 4.94.0.0) to testing of EUT.

1.12. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL003963	2023.04.04	Initial

1.13. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty	
Maximum Peak Conducted Output Power	0.33 ㏈	
Radiated Emission, 9 ㎑ to 30 ㎒	H	3.40 ㏈
	V	3.40 ㏈
Radiated Emission, below 1 ㎓	H	4.50 ㏈
	V	5.10 ㏈
Radiated Emission, above 1 ㎓	H	3.70 ㏈
	V	3.90 ㏈

All measurement uncertainty values are shown with a coverage factor *k* = 2 to indicate a 95 % level of confidence.

1.14. Spot Check Data

Operation Mode	Approved Module		Basic Model		Deviation (dB)	Remark
	RAK5146		GLSD-PLC-GW-2			
	FCC ID: 2AF6B-RAK5146 IC Certification: 25908-RAK5146		FCC ID: 2BAKQGG02F IC Certification: 30242-GG02I			
	(dB m)	(W)	(dB m)	(W)		
Lora DTS SF7	24.69	0.294	20.80	0.120	-3.89	-
Lora DTS SF12	24.69	0.294	20.77	0.119	-3.92	-
Lora Hybrid SF7	19.49	0.089	18.65	0.073	-0.84	-
Lora Hybrid SF9	19.77	0.095	18.71	0.074	-1.06	-
Lora Hybrid SF10	19.54	0.090	18.72	0.074	-0.82	-

Note;

All conducted output power was measured.
Output power compared the approved module with the host equipment.

1.15. Descriptions of Test Mode

Preliminary tests were performed in different data rates and recorded the RF output power in the following table:

Operation Mode	Channel	Frequency (㎒)	RF Output Power (㏈m)
Lora Hybrid SF7	Low	903.9	18.62
	Middle	904.5	18.62
	High	905.3	18.65
Lora Hybrid SF9	Low	903.9	18.71
	Middle	904.5	18.62
	High	905.3	18.65
Lora Hybrid SF10	Low	903.9	18.68
	Middle	904.5	18.68
	High	905.3	**18.72**

Note;

1. For transmitter radiated spurious emissions, Lora Hybrid SF7, Lora Hybrid SF9 and Lora Hybrid SF10 are tested as worst condition.

1.16. Operation Modes.

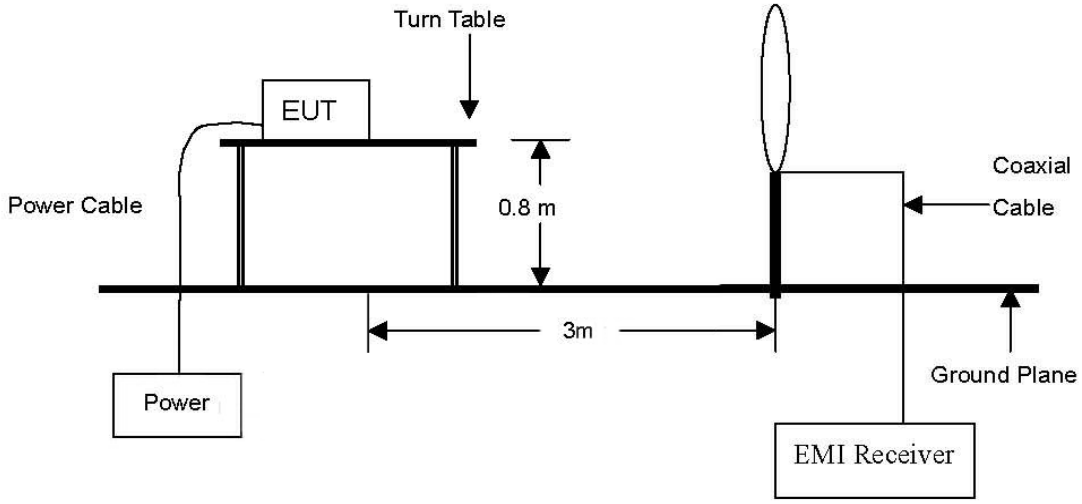
The hybrid can operate in DTS mode and frequency hopping mode.

2. Transmitter Radiated Spurious Emissions

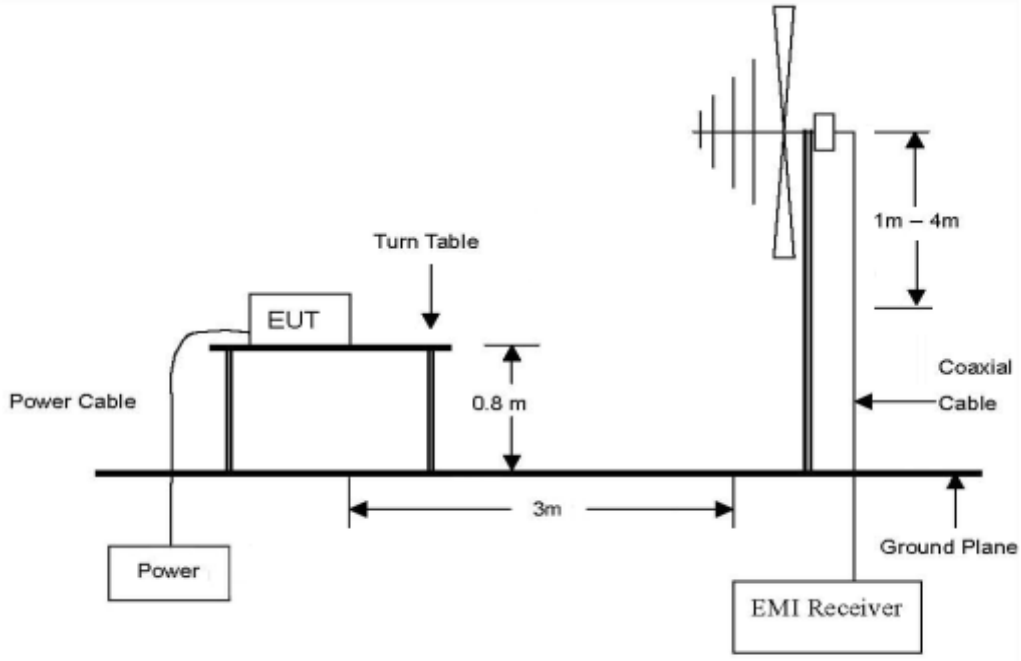
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

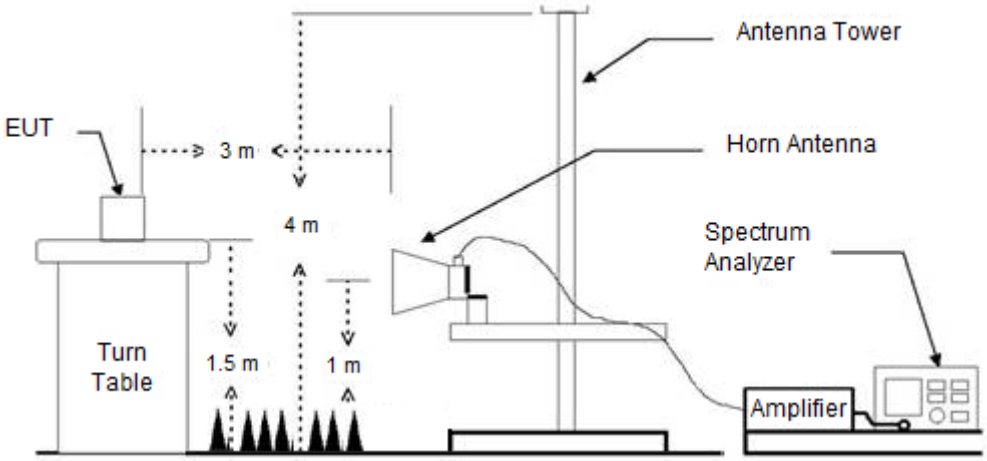
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒.



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



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated form 1 ㎓ to the 10th harmonic of the highest fundamental frequency or 40 ㎓, whichever is lower.



2.2. Limit

2.2.1. FCC

According to §15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emission which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

According to §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 (㎒)	Field Strength (㎶/m)	Measurement Distance (Meters)
0.009-0.490	2 400/F(㎑)	300
0.490-1.705	24 000/F(㎑)	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 shall not be located in the frequency bands 54-72 ㎒, 76-88 ㎒, 174-216 ㎒ or 470-806 ㎒. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

2.2.2. IC

According to RSS-247 Issue 2, 5.5, in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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(d), the attenuation required shall be 30 ㏈ instead of 20 ㏈. Attenuation below the general field strength limits specified in RSS-Gen is not required.

According to RSS-Gen Issue 5, 8.9, except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Table 5 – General Field Strength Limits at frequencies above 30 ㎒

Frequency (㎒)	Field Strength (㎶/m at 3 m)
30-88	100
88-216	150
216-960	200
Above 960	500

Table 6 – General Field Strength Limits at frequencies below 30 ㎒

Frequency	Magnetic Field Strength (H-Field) (㎂/m)	Measurement Distance (meters)
9-490 ㎑ [1]	6.37/F (F in ㎑)	300
490-1 705 ㎑	63.7/F (F in ㎑)	30
1.705-30 ㎒	0.08	30

Note[1]: The emission limits for the ranges 9-90 ㎑ and 110-490 ㎑ are based on measurements employing a linear average detector.

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10-2013.

2.3.1. Test Procedures for emission below 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from above 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 ㎓ and 1.5 meter above the ground at a 3 meter anechoic chamber test site above 1 ㎓. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. For measurements below 1 ㎓ resolution bandwidth is set to 100 ㎑ for peak detection measurements or 120 ㎑ for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.
6. For measurements Above 1 ㎓ resolution bandwidth is set to 1 ㎒, the video bandwidth is set to 3 ㎒ for peak measurements and as applicable for average measurements.

Note;

1. Definition of DUT Axis.
   The test orthogonal plan of EUT was investigated with three axis described in the test setup photo.
   The X-axis was worst-case, all radiated testing of EUT was performed with **X-axis**.

2.4. Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

2.4.1. Radiated Spurious Emission below 1 000 ㎒

The frequency spectrum from 9 ㎑ to 1 000 ㎒ was investigated. All reading values are peak values.

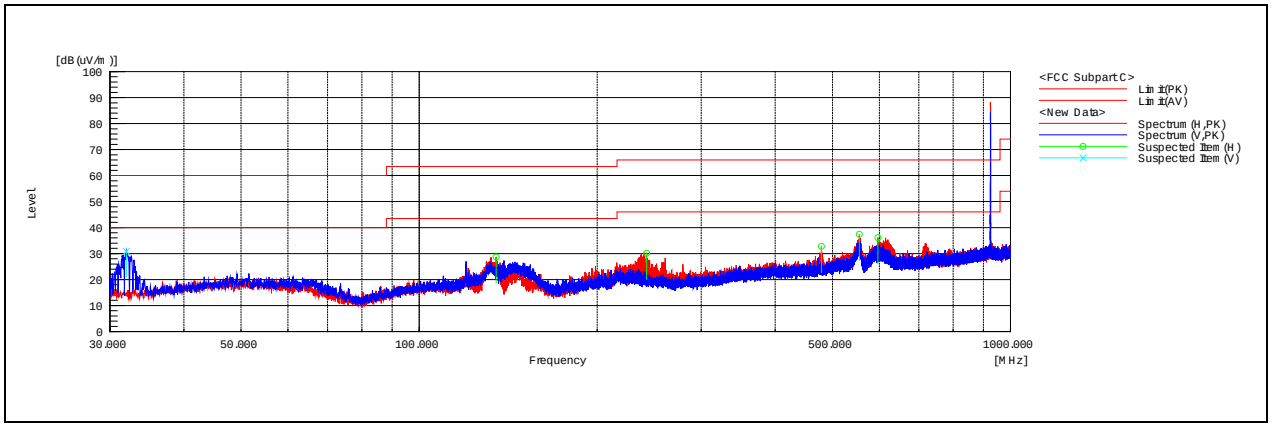
-DTS_SF7

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
31.98	42.30	Peak	V	20.20	-27.77	34.73	40.00	5.27
134.96	41.20	Peak	H	18.30	-26.60	32.90	43.50	10.60
242.51	38.10	Peak	H	22.25	-26.21	34.14	46.00	11.86
478.91	36.20	Peak	H	26.66	-26.07	36.79	46.00	9.21
555.34	39.80	Peak	H	27.81	-26.06	**41.55**	46.00	4.45
596.64	37.00	Peak	H	29.23	-26.03	40.20	46.00	5.80
Above 600.00	Not detected	-	-	-	-	-	-	-

Remark;

1. Spurious emissions for all channels and modes were investigated and almost the same below 1 ㎓.
2. Reported spurious emissions are in **DTS / SF7 / Middle channel** as worst case among other modes.
3. Radiated spurious emission measurement as below.
   (Actual = Reading + AF + AMP + CL)
4. According to §15.31(o), emission levels are not report much lower than the limits by over 20 ㏈.

- Test plot



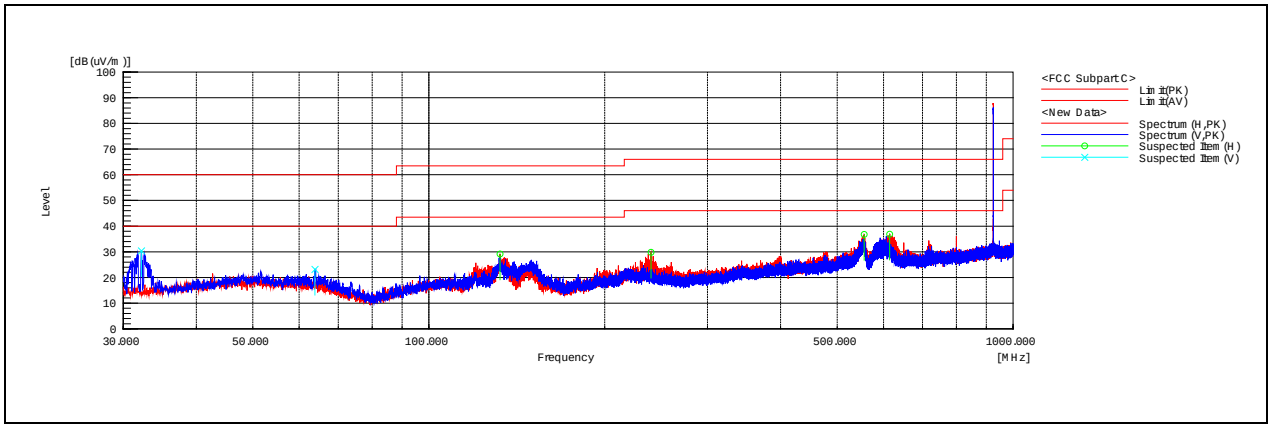
-DTS_SF12

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
32.22	41.80	Peak	V	20.22	-27.76	34.26	40.00	5.74
63.87	33.10	Peak	V	21.54	-27.24	27.40	40.00	12.60
132.38	41.40	Peak	H	18.56	-26.55	33.41	43.50	10.09
240.01	37.90	Peak	H	22.20	-26.25	33.85	46.00	12.15
556.35	39.10	Peak	H	27.83	-26.03	40.90	46.00	5.10
615.11	37.60	Peak	H	29.40	-26.12	40.88	46.00	5.12
Above 700.00	Not detected	-	-	-	-	-	-	-

Remark;

1. Spurious emissions for all channels and modes were investigated and almost the same below 1 ㎓.
2. Reported spurious emissions are in **DTS / SF12 / Middle channel** as worst case among other modes.
3. Radiated spurious emission measurement as below.
   (Actual = Reading + AF + AMP + CL)
4. According to §15.31(o), emission levels are not report much lower than the limits by over 20 ㏈.

- Test plot



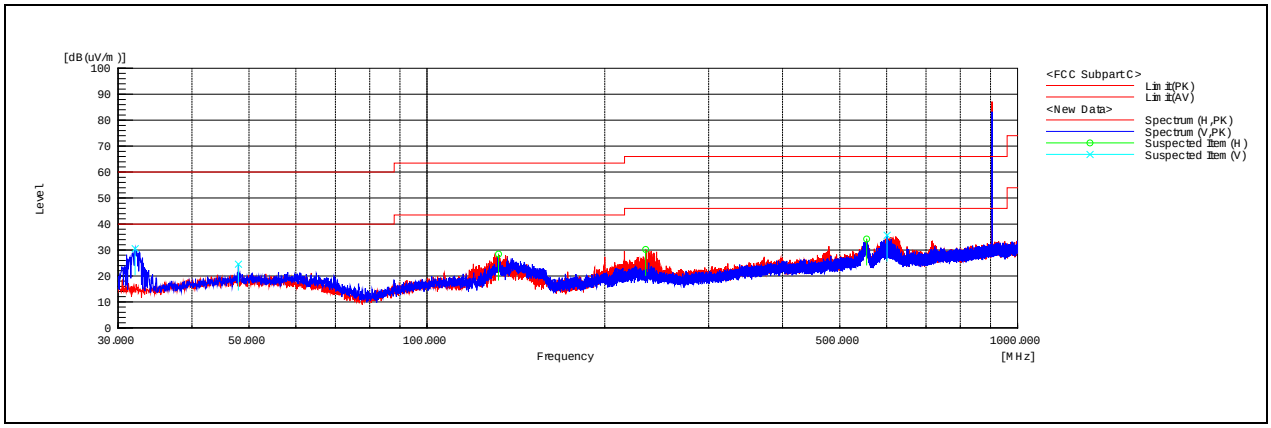
-Hybrid_SF10

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
32.06	41.90	Peak	V	20.21	-27.77	34.34	40.00	5.66
47.95	32.50	Peak	V	23.90	-27.56	28.84	40.00	11.16
132.21	40.70	Peak	H	18.58	-26.55	32.73	43.50	10.77
234.59	38.60	Peak	H	21.98	-26.20	34.38	46.00	11.62
555.09	36.60	Peak	H	27.80	-26.07	38.33	46.00	7.67
601.05	36.40	Peak	V	29.34	-26.05	39.69	46.00	6.31
Above 700.00	Not detected	-	-	-	-	-	-	-

Remark;

1. Spurious emissions for all channels and modes were investigated and almost the same below 1 ㎓.
2. Reported spurious emissions are in **Hybrid / SF10 / High channel** as worst case among other modes.
3. Radiated spurious emission measurement as below.
   (Actual = Reading + AF + AMP + CL)
4. According to §15.31(o), emission levels are not report much lower than the limits by over 20 ㏈.

- Test plot



2.4.2. Radiated Spurious Emission above 1 000 ㎒

The frequency spectrum above 1 000 ㎒ was investigated. All reading values are peak values.

Operating Mode: DTS SF7

A. Low Channel (923.3 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1 199.68	52.96	Peak	H	24.90	-39.85	38.01	74.00	35.99
*1 319.92	53.61	Peak	H	25.10	-39.26	39.45	74.00	34.55
Above 1 400.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (925.1 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1 199.75	52.53	Peak	H	24.90	-39.85	37.58	74.00	36.42
*1 319.67	53.89	Peak	H	25.10	-39.26	39.73	74.00	34.27
Above 1 400.00	Not detected	-	-	-	-	-	-	-

C. High Channel (927.5 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1 199.90	52.41	Peak	H	24.90	-39.85	37.46	74.00	36.54
*1 320.21	54.15	Peak	H	25.10	-39.26	39.99	74.00	34.01
Above 1 400.00	Not detected	-	-	-	-	-	-	-

Operating Mode: DTS SF12

A. Low Channel (923.3 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1 199.80	52.80	Peak	H	24.90	-39.85	37.85	74.00	36.15
*1 319.89	53.51	Peak	H	25.10	-39.26	39.35	74.00	34.65
Above 1 400.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (925.1 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1 199.78	52.09	Peak	H	24.90	-39.85	37.14	74.00	36.86
*1 319.80	55.13	Peak	H	25.10	-39.26	40.97	74.00	33.03
Above 1 400.00	Not detected	-	-	-	-	-	-	-

C. High Channel (927.5 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1 199.97	52.71	Peak	H	24.90	-39.85	37.76	74.00	36.24
*1 320.07	54.57	Peak	H	25.10	-39.26	40.41	74.00	33.59
Above 1 400.00	Not detected	-	-	-	-	-	-	-

Operating Mode: Hybird SF10

A. Low Channel (903.9 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1 199.94	53.28	Peak	H	24.90	-39.85	38.33	74.00	35.67
*1 320.15	52.90	Peak	H	25.10	-39.26	38.74	74.00	35.26
Above 1 400.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (904.5 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1 199.88	53.24	Peak	H	24.90	-39.85	38.29	74.00	35.71
*1 319.49	52.43	Peak	H	25.10	-39.26	38.27	74.00	35.73
Above 1 400.00	Not detected	-	-	-	-	-	-	-

C. High Channel (905.3 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*1 199.62	53.25	Peak	H	24.90	-39.85	38.30	74.00	35.70
*1 320.07	53.01	Peak	H	25.10	-39.26	38.85	74.00	35.15
Above 1 400.00	Not detected	-	-	-	-	-	-	-

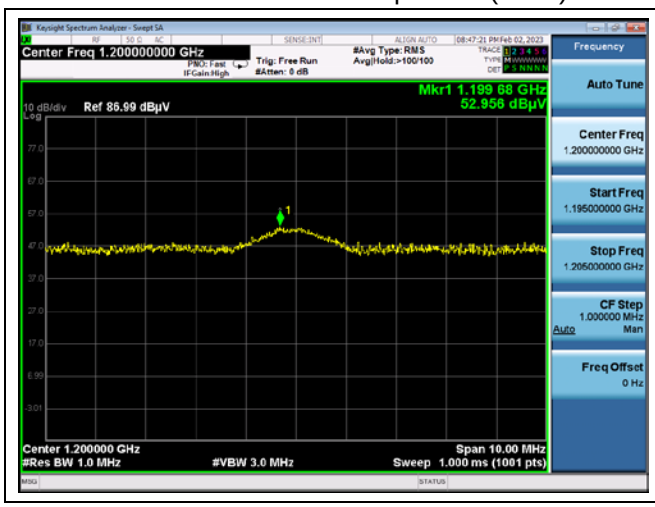
Remark;

1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + CL + (DF) or Reading + AF + AMP + CL + (DF).
5. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 ㏈.
6. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.

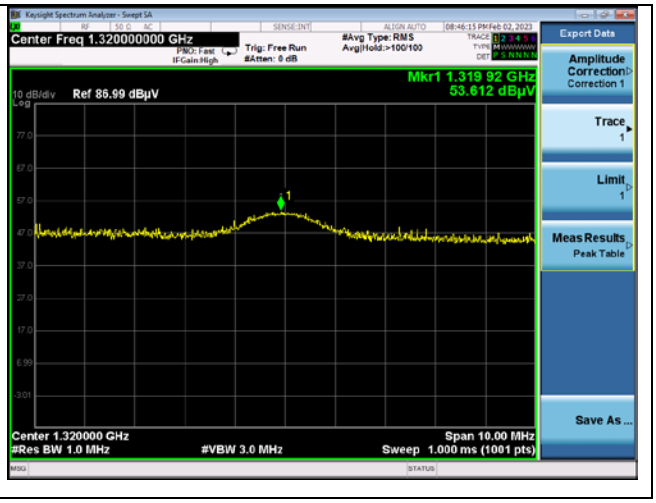
- Test plots

Operating Mode: DTS SF7

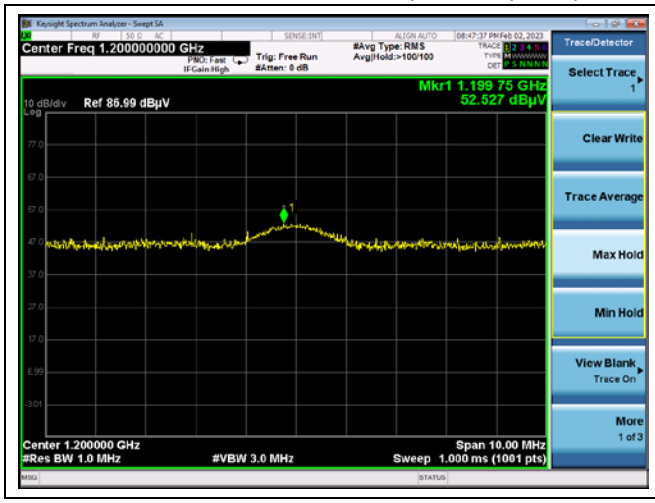
Low channel 1 200 ㎒ Spurious (Peak)



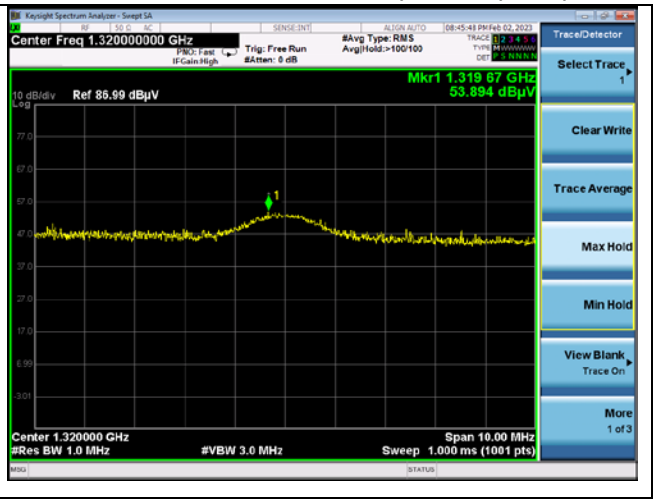
Low channel 1 320 ㎒ Spurious (Peak)



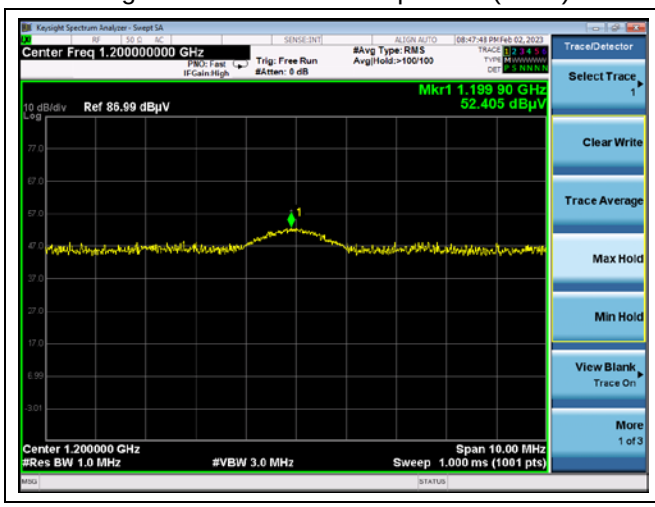
Middle channel 1 200 ㎒ Spurious (Peak)



Middle channel 1 320 ㎒ Spurious (Peak)



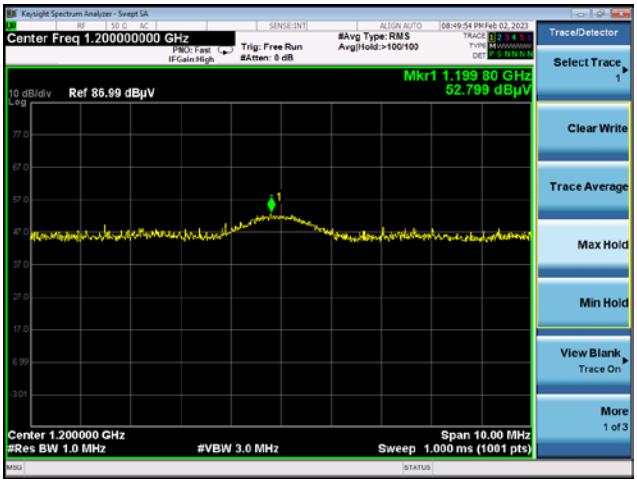
High channel 1 200 ㎒ Spurious (Peak)



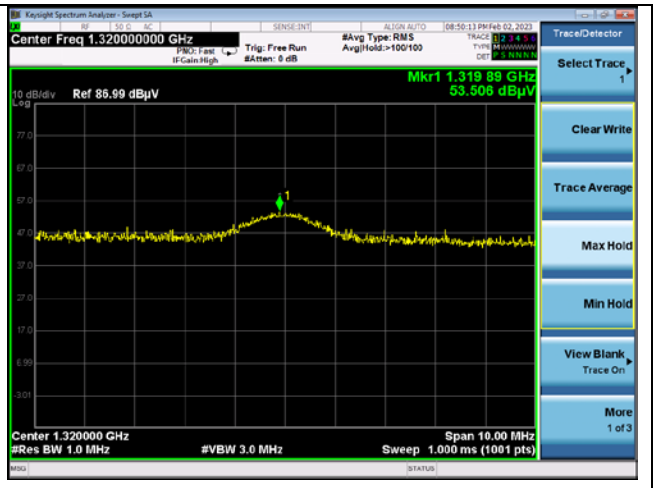
High channel 1 320 ㎒ Spurious (Peak)

Operating Mode: DTS SF12

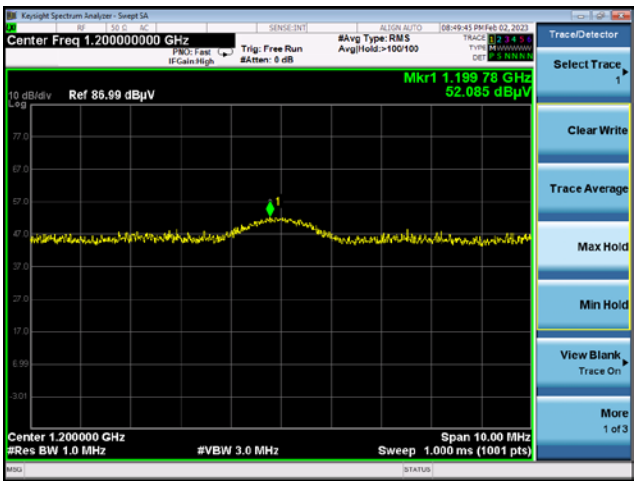
Low channel 1 200 ㎒ Spurious (Peak)



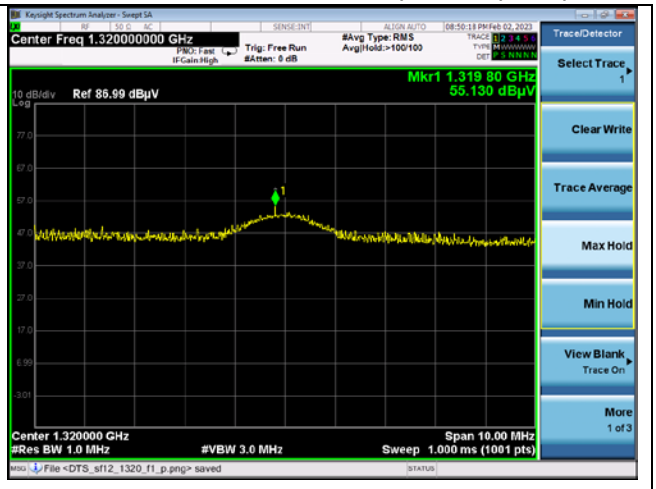
Low channel 1 320 ㎒ Spurious (Peak)



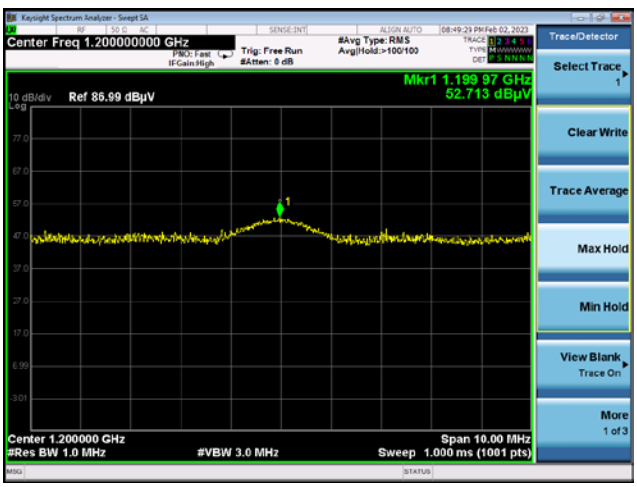
Middle channel 1 200 ㎒ Spurious (Peak)



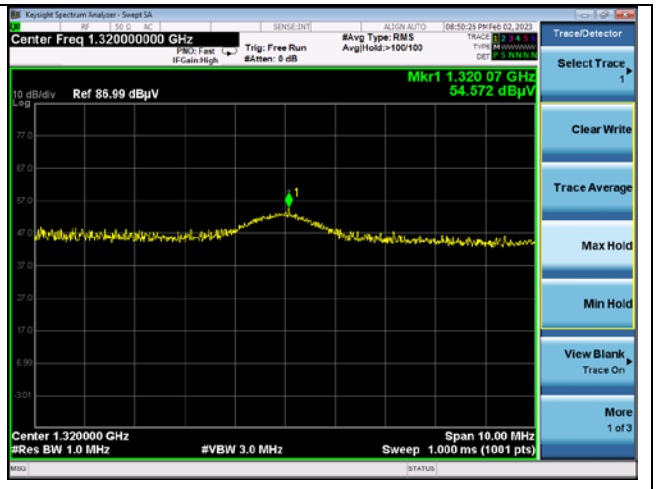
Middle channel 1 320 ㎒ Spurious (Peak)



High channel 1 200 ㎒ Spurious (Peak)



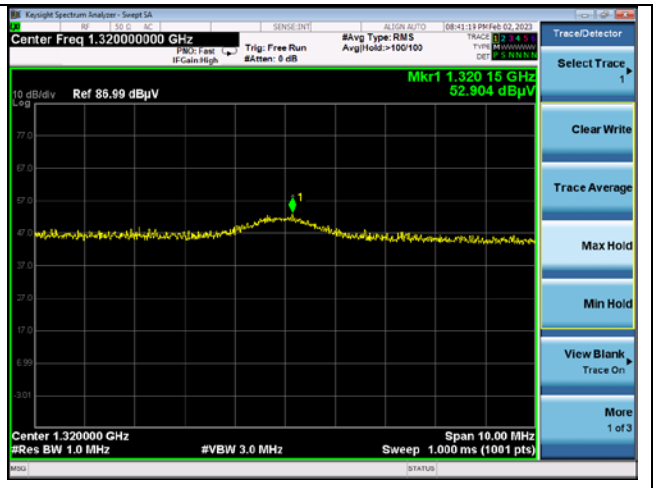
High channel 1 320 ㎒ Spurious (Peak)



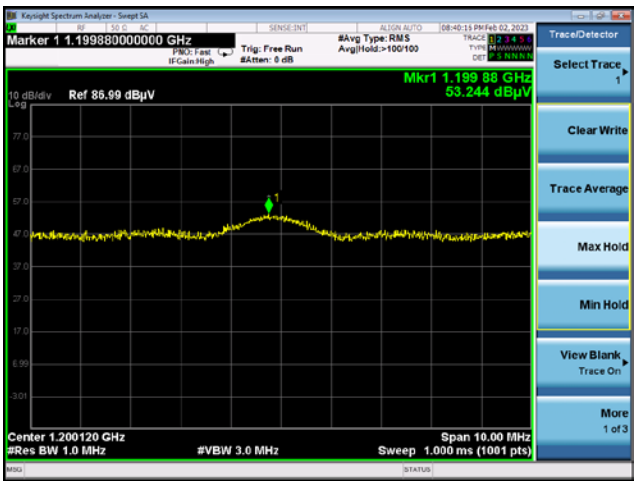
Operating Mode: Hybrid SF10

Low channel 1 200 ㎒ Spurious (Peak)

Low channel 1 320 ㎒ Spurious (Peak)



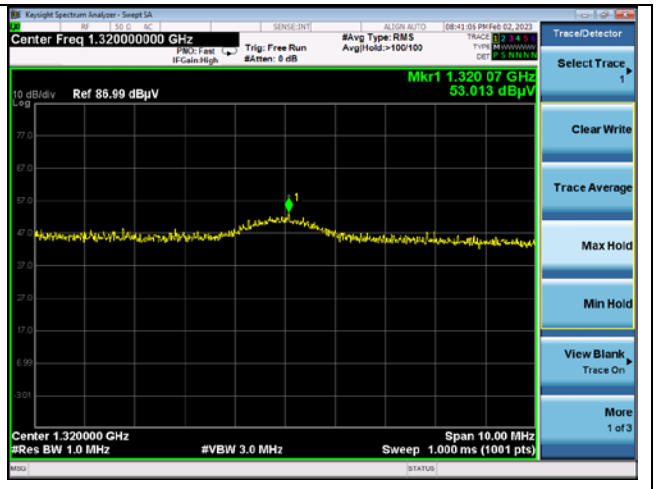
Middle channel 1 200 ㎒ Spurious (Peak)



Middle channel 1 320 ㎒ Spurious (Peak)

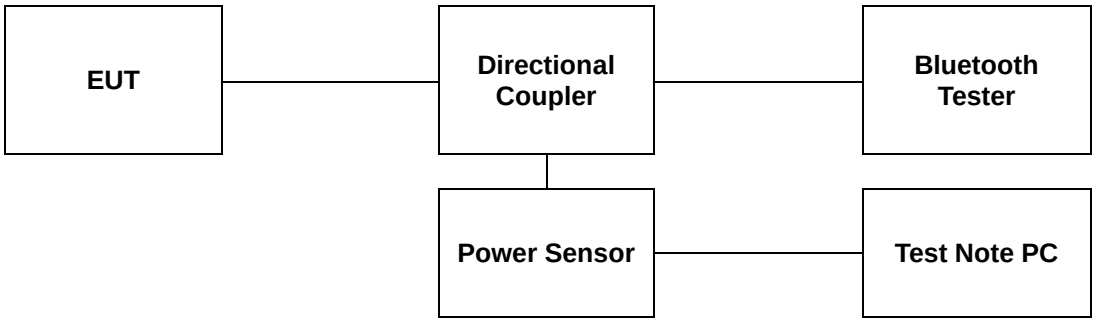
High channel 1 200 ㎒ Spurious (Peak)

High channel 1 320 ㎒ Spurious (Peak)



3. Maximum Peak Conducted Output Power

3.1. Test Setup



3.2. Limit

3.2.1. FCC

1. §15.247(b)(2), For frequency hopping systems operating in the 902-928 ㎒ band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

2. §15.247(b)(3), For systems using digital modulation in the 902-928 ㎒, 2400-2483.5 ㎒, and 5725-5850 ㎒ bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

3.2.2. IC

1. According to RSS-247 Issue 2, 5.4(a), For FHSs operating in the band 902-928 ㎒, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.
2. According to RSS-247 Issue 2, 5.4(d), For DTSs employing digital modulation techniques operating in the bands 902-928 ㎒ and 2400-2483.5 ㎒, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

3.3. Test Procedure

The test follows ANSI C63.10-2013. Using the power sensor instead of a spectrum analyzer.

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.
3. Test program: (S/W name: R&S Power Viewer, Version: 3.2.0)
4. Measure each channel.

3.4. Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

- Lora DTS

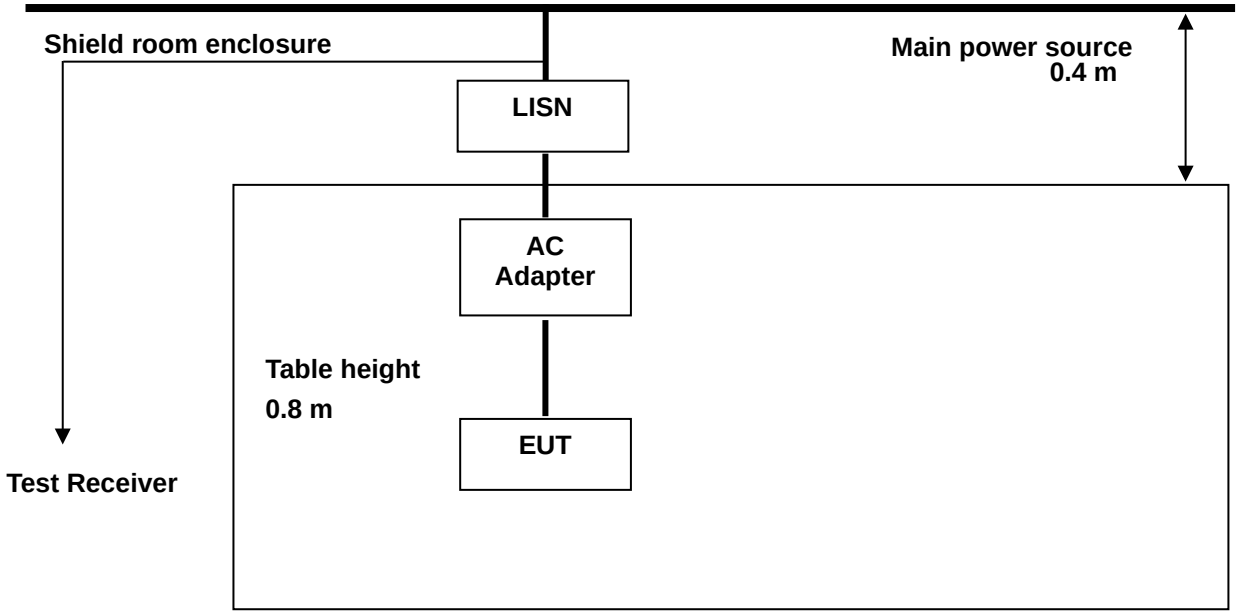
Operation Mode	Channel	Frequency (㎒)	Average Power Result (㏈m)	Peak Power Result (㏈m)	Limit (㏈m)
Lora DTS SF7	Low	923.3	20.12	20.40	30
	Middle	925.1	**20.71**	**20.80**	
	High	927.5	18.63	18.76	
Lora DTS SF12	Low	923.3	20.14	20.42	
	Middle	925.1	**20.67**	**20.77**	
	High	927.5	18.62	18.79	

- Lora Hybrid

Operation Mode	Channel	Frequency (㎒)	Average Power Result (㏈m)	Peak Power Result (㏈m)	Limit (㏈m)
Lora Hybrid SF7	Low	903.9	18.55	18.62	23.98
	Middle	904.5	18.57	18.62	
	High	905.3	**18.58**	**18.65**	
Lora Hybrid SF9	Low	903.9	**18.66**	**18.71**	
	Middle	904.5	18.55	18.62	
	High	905.3	18.58	18.65	
Lora Hybrid SF10	Low	903.9	18.62	18.68	
	Middle	904.5	18.62	18.68	
	High	905.3	**18.66**	**18.72**	

4. AC Power Line Conducted Emission

4.1. Test Setup



4.2. Limit

4.2.1 FCC

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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 ㎕H /50 ohms line impedance stabilization network (LISN).

Compliance with the provision 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 (㎒)	Conducted limit (㏈㎶)	
	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.

4.2.2 IC

RSS-Gen Issue 5, 8.8, Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 ㎑ to 30 ㎒ shall not exceed the limits in table 4, as measured using a 50 ㎌ / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Table 4 - AC power-line conducted emissions limits

Frequency (㎒)	Conducted limit (㏈㎶)	
	Quasi-peak	Average**
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

Note 1: The level decreases linearly with the logarithm of the frequency.

For an EUT with a permanent or detachable antenna operating between 150 ㎑ and 30 ㎒, the AC power-line conducted emissions must be measured using the following configurations:

(a) Perform the AC power-line conducted emissions test with the antenna connected to determine compliance with the limits of table 4 outside the transmitter's fundamental emission band.

(b) Retest with a dummy load instead of the antenna to determine compliance with the limits of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

4.3. Test Procedures

AC conducted emissions from the EUT were measured according to the dictates of ANSI C63.10-2013

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

4.4. Test Results

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Frequency range : 0.15 ㎒ - 30 ㎒
Measured Bandwidth : 9 ㎑

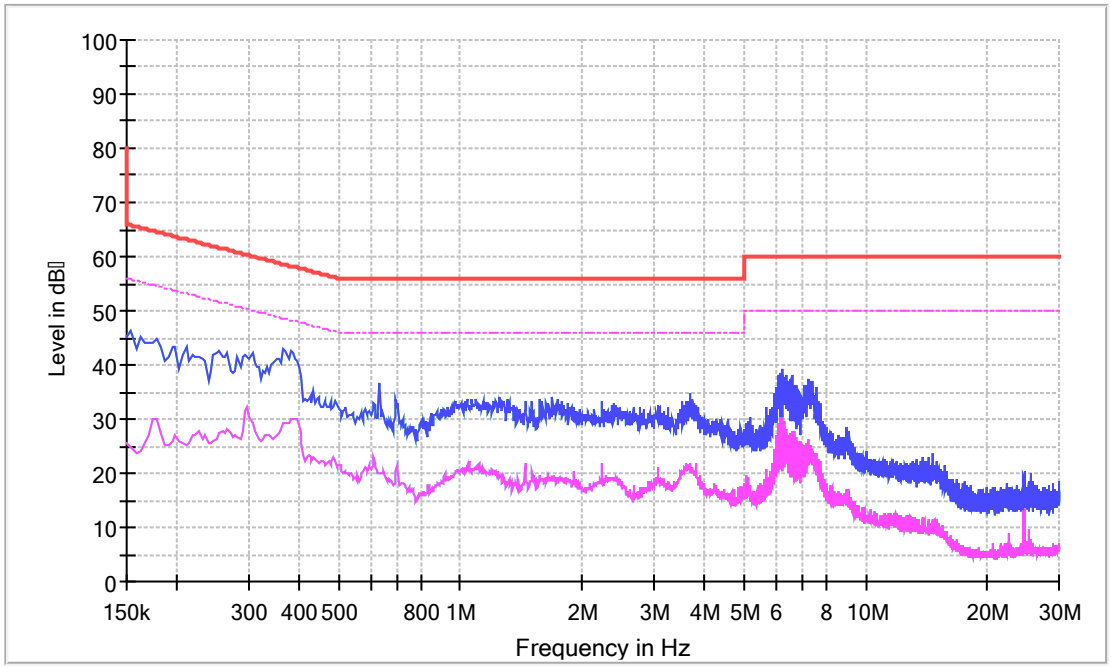
FREQ.	LEVEL (dB㎶)		LINE	LIMIT (dB㎶)		MARGIN (dB)	
(㎒)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.37	40.10	31.20	N	58.50	48.50	18.40	17.30
0.63	30.90	20.90	N	56.00	46.00	25.10	25.10
1.23	31.20	22.30	N	56.00	46.00	24.80	23.70
3.62	27.20	20.00	N	56.00	46.00	28.80	26.00
6.21	34.70	28.70	N	60.00	50.00	25.30	21.30
7.31	30.60	21.70	N	60.00	50.00	29.40	28.30
0.25	36.60	27.00	H	61.76	51.76	25.16	24.76
0.38	40.80	31.40	H	58.28	48.28	17.48	16.88
0.61	33.00	24.70	H	56.00	46.00	23.00	21.30
1.09	31.30	23.30	H	56.00	46.00	24.70	22.70
6.29	35.70	27.60	H	60.00	50.00	24.30	22.40
22.33	12.20	7.10	H	60.00	50.00	47.80	42.90

Remark;

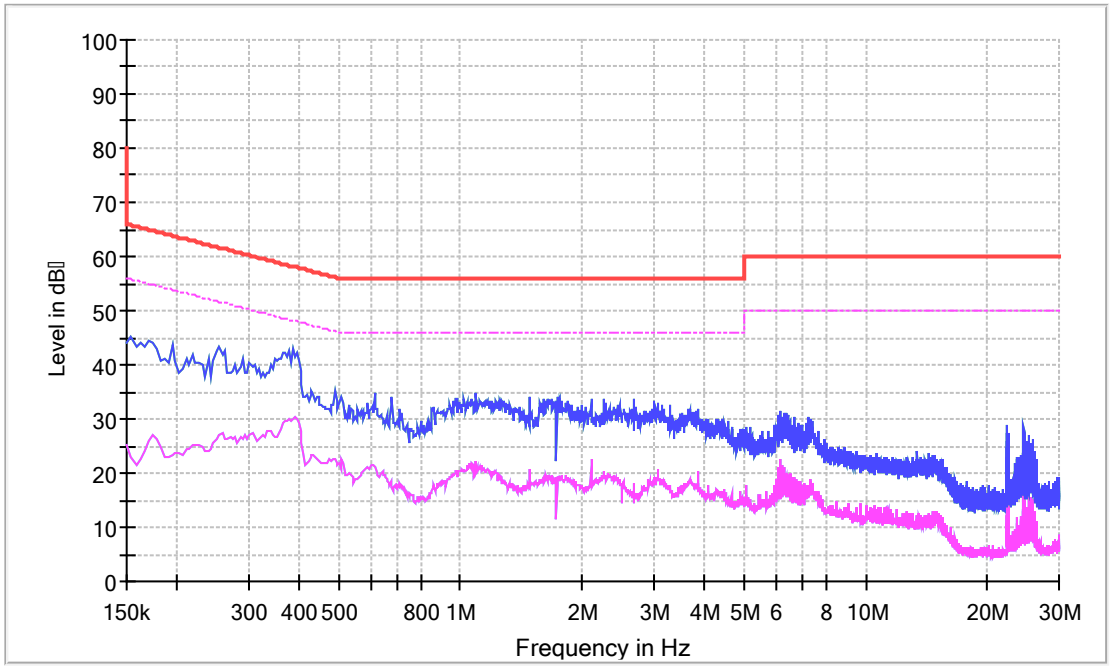
1. Line (H): Hot, Line (N): Neutral.
2. All data rates and modes of operation were investigated and the worst-case emissions were reported using **DTS / SF7 / Middle channel.**
3. The limit for Class B device(s) from 150 ㎑ to 30 ㎒ are specified in Section of the Title 47 CFR.
4. Traces shown in plot were made by using a Quasi peak detector and average detector.
5. Deviations to the Specifications: None.

- Test plots

Test mode: (Neutral)



Test mode: (Hot)



5. Antenna Requirement

5.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §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. And according to FCC 47 CFR Section §15.247(b) if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

5.2. Antenna Connected Construction

Antenna used in this product is Dipole antenna with gain of 2.3 dBi

- End of the Test Report -