

RADIO PERFORMANCE TEST REPORT

Test Report No. : OT-24N-RWD-016
Reception No. : 2408002803
Applicant : LINKFLOW Co., Ltd.
Address : 3,4F, 54, Nonhyeon-ro 2-gil, Gangnam-gu, Seoul, South Korea
Manufacturer : LINKFLOW Co., Ltd.
Address : 3,4F, 54, Nonhyeon-ro 2-gil, Gangnam-gu, Seoul, South Korea
Type of Equipment : LINKFLOW BOLD
FCC ID. : 2AVCKLFE1300
Model Name : LF-E1300
Multiple Model Name : LF-E1000, LF-E1320, LF-E1340, LF-E2300, LF-E2320, LF-E2340, LF-E3300, LF-E3320, LF-E3340, LF-E2000, LF-E3000
Serial number : N/A
Total page of Report : 35 pages (including this page)
Date of Incoming : September 02, 2024
Date of issue : November 12, 2024

SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART C Section 15.247**

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

This report is not correlated with the "KS Q ISO/IEC 17025 and KOLAS accreditation" of Korean Laboratory Accreditation Scheme.



Tested by
 Myeong-Hwa, Jang / Senior Project Engineer
 ONETECH Corp.



Reviewed by
 Tae-Ho, Kim / Chief Engineer
 ONETECH Corp.



Approved by
 Jae-Ho, Lee / Chief Engineer
 ONETECH Corp.

CONTENTS

	Page
1. VERIFICATION OF COMPLIANCE	6
2. TEST SUMMARY.....	7
2.1 TEST ITEMS AND RESULTS	7
2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS.....	7
2.3 RELATED SUBMITTAL(S) / GRANT(S)	7
2.4 PURPOSE OF THE TEST	7
2.5 TEST METHODOLOGY.....	7
2.6 TEST FACILITY.....	7
3. GENERAL INFORMATION.....	8
3.1 PRODUCT DESCRIPTION.....	8
3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT.....	10
4. EUT MODIFICATIONS.....	10
5. SYSTEM TEST CONFIGURATION	11
5.1 JUSTIFICATION.....	11
5.2 PERIPHERAL EQUIPMENT	11
5.3 MODE OF OPERATION DURING THE TEST	12
5.4 CONFIGURATION OF TEST SYSTEM.....	13
5.5 ANTENNA REQUIREMENT	13
6. MEASUREMENT UNCERTAINTY	13
7. PRELIMINARY TEST	14
7.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....	14
7.2 GENERAL RADIATED EMISSIONS TESTS	14
8. MINIMUM 20 dB BANDWIDTH.....	15
8.1 OPERATING ENVIRONMENT	15
8.2 TEST SET-UP	15
8.3 TEST DATE	15
8.4 TEST DATA FOR 1 MBPS	15
8.5 TEST DATA FOR 2 MBPS	15
8.6 TEST DATA FOR 3 MBPS	15
9. HOPPING FREQUENCY SEPARATION.....	16
9.1 OPERATING ENVIRONMENT	16
9.2 TEST SET-UP	16

9.3 TEST DATE	16
9.4 TEST DATA FOR 1 MBPS	16
9.5 TEST DATA FOR 2 MBPS	16
9.6 TEST DATA FOR 3 MBPS	16
10. NUMBER OF HOPPING CHANNELS	17
10.1 OPERATING ENVIRONMENT	17
10.2 TEST SET-UP	17
10.3 TEST DATE	17
10.4 TEST DATA FOR 1 MBPS	17
10.5 TEST DATA FOR 2 MBPS	17
10.6 TEST DATA FOR 3 MBPS	17
11. TIME OF OCCUPANCY	18
11.1 OPERATING ENVIRONMENT	18
11.2 TEST SET-UP	18
11.3 TEST DATE	18
11.4 TEST DATA FOR 1 MBPS	18
11.5 TEST DATA FOR 2 MBPS	19
11.6 TEST DATA FOR 3 MBPS	19
12. MAXIMUM PEAK OUTPUT POWER	20
12.1 OPERATING ENVIRONMENT	20
12.2 TEST SET-UP	20
12.3 TEST DATE	20
12.4 TEST DATA FOR 1 MBPS	21
12.5 TEST DATA FOR 2 MBPS	21
12.6 TEST DATA FOR 3 MBPS	21
13. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND	22
13.1 OPERATING ENVIRONMENT	22
13.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	22
13.3 TEST SET-UP FOR RADIATED MEASUREMENT	22
13.4 TEST DATE	22
13.5 TEST DATA FOR CONDUCTED EMISSION	22
13.6 TEST DATA FOR TRANSMITTING MODE RADIATED EMISSION	23
13.6.1 Radiated Emission which fall in the Restricted Band	23
13.6.2 Spurious & Harmonic Radiated Emission above 1 GHz	26
14. RADIATED EMISSION TEST	29
14.1 OPERATING ENVIRONMENT	29

14.2 TEST SET-UP	29
14.3 TEST DATE	29
14.4 TEST DATA FOR 30 MHz ~ 1 000 MHz	30
14.5 TEST DATA FOR BELOW 30 MHz	31
13.6 TEST DATA FOR ABOVE 1 GHz	31
15. CONDUCTED EMISSION TEST.....	32
15.1 OPERATING ENVIRONMENT	32
15.2 TEST SET-UP	32
15.3 TEST DATE	32
15.4 TEST DATA.....	33
16. LIST OF TEST EQUIPMENT	35

※ Please refer to the Annex section for All test plots

Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-24N-RWD-016	November 12, 2024	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : LINKFLOW Co., Ltd.
Address : 3,4F, 54, Nonhyeon-ro 2-gil, Gangnam-gu, Seoul, South Korea
Contact Person : Chunghee Lee / Senior Engineer
Telephone No. : +82-10-3332-0211
FCC ID : 2AVCKLFE1300
Model Name : LF-E1300
Brand Name : LINKFLOW
Serial Number : N/A
Date : November 12, 2024

EQUIPMENT CLASS	DSS – PART 15 SPREAD SPECTRUM TRANSMITTER
E.U.T. DESCRIPTION	LINKFLOW BOLD
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (1)	Carrier Frequency Separation	Met the Limit / PASS
15.247 (a) (1) (iii)	Minimum Number of Hopping Channels	Met the Limit / PASS
15.247 (a) (1) (iii)	Average Time of Occupancy	Met the Limit / PASS
15.247 (b) (1)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.209	Radiated Emission Limits, General Requirement	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-20122/ C-14617/ G-10666/ T-11842

-. Lab Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The LINKFLOW Co., Ltd., Model LF-E1300 (referred to as the EUT in this report) is a LINKFLOW BOLD. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	LINKFLOW BOLD	
Temperature Range	0 °C ~ 40 °C	
Operating Frequency	Bluetooth LE	2 402 MHz ~ 2 480 MHz
	Bluetooth	2 402 MHz ~ 2 480 MHz
	WLAN 2.4 GHz	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20)) 2 422 MHz ~ 2 452 MHz (802.11n(HT40))
	WLAN	5 180 MHz ~ 5 240 MHz (802.11a/n(HT20))
	5 150 MHz ~	5 190 MHz ~ 5 230 MHz (802.11n(HT40))
	5 250 MHz Band	5 210 MHz (802.11ac(VHT80))
	WLAN	5 745 MHz ~ 5 825 MHz (802.11a/n(HT20))
	5 725 MHz ~	5 755 MHz ~ 5 795 MHz (802.11n(HT40))
	5 850 MHz Band	5 775 MHz (802.11ac(VHT80))
Modulation Type	Bluetooth LE	GFSK for 1 Mbps, 2 Mbps
	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps
	WLAN 2.4 GHz	802.11b: DSSS Modulation (DBPSK/DQPSK/CCK) 802.11g/n(HT20): OFDM Modulation (BPSK/QPSK/16QAM/64QAM)
	WLAN 5 GHz	802.11a/n(HT20)/n(HT40)/ac(VHT80): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)

RF Output Power	Bluetooth LE	1 Mbps	7.19 dBm
		2 Mbps	7.48 dBm
	Bluetooth	1 Mbps	12.23 dBm
		2 Mbps	11.64 dBm
		3 Mbps	11.62 dBm
	WLAN 2.4 GHz	802.11b	17.55 dBm
		802.11g	19.42 dBm
		802.11n(HT20)	19.45 dBm
		802.11n(HT40)	23.44 dBm
	WLAN 5 150 MHz ~ 5 250 MHz Band	802.11a	15.30 dBm
		802.11n(HT20)	15.17 dBm
		802.11n(HT40)	15.82 dBm
		802.11ac(VHT80)	15.50 dBm
	WLAN 5 725 MHz ~ 5 850 MHz Band	802.11a	16.36 dBm
		802.11n(HT20)	16.22 dBm
		802.11n(HT40)	15.99 dBm
		802.11ac(VHT80)	16.65 dBm
Antenna Type	FPCB Antenna		
Antenna Gain	Bluetooth LE	0.32 dBi	
	Bluetooth	0.32 dBi	
	WLAN 2.4 GHz	0.32 dBi	
	WLAN 5 150 MHz ~ 5 250 MHz Band	1.15 dBi	
	WLAN 5 725 MHz ~ 5 850 MHz Band	3.00 dBi	
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)		38.4 MHz	

3.2 Alternative type(s)/model(s); also covered by this test report.

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
LF-E1300	Basic Model	☒
LF-E1000, LF-E1320, LF-E1340, LF-E2300, LF-E2320, LF-E2340, LF-E3300, LF-E3320, LF-E3340, LF-E2000, LF-E3000	This model is identical to the basic model except for the model name (Varies depending on B2C, B2B, B2G) only.	☐

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

2. The Applicant/manufacturer is responsible for the compliance of all variants.

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	LINKFLOW Co., Ltd.	N/A	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
LF-E1300	LINKFLOW Co., Ltd.	LINKFLOW BOLD (EUT)	
RT329OLE	HP	Notebook PC	EUT
PPP009C	CHICONY POWER TECHNOLOGY (Chong Qing) Co., LTD.	AC Adapter	

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed.

For final testing, the EUT was set at 2 402 MHz, 2 441MHz, and 2 480 MHz to get a maximum emission levels from the EUT. The EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “YZ” axis, but the worst data was recorded in this report.

-. Frequency / Channel Operations

Channel	Frequency
0	2 402
39	2 441
78	2 480

-. Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Bluetooth [1 Mbps]	2.886	0.864	76.96	1.14
Bluetooth [2 Mbps]	2.888	0.862	77.02	1.13
Bluetooth [3 Mbps]	2.890	0.860	77.07	1.13

Note – Duty Cycle : $(\text{Tx On Time} / (\text{Tx On Time} + \text{Tx Off Time})) * 100$

Correction Factor : $10 * \text{Log}(1 / (\text{Duty Cycle} / 100))$

5.4 Configuration of Test System

Line Conducted Test: The EUT was tested in the Transmitting mode. All supporting equipment were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

For intentional device, according to 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.

Antenna Construction:

The antenna of the EUT is a FPCB Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

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

The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (dB)
Conducted Output Power	0.90
Conducted Spurious Emission < 26.5 GHz	1.26
Power Spectral Density	1.20
Line Conducted Disturbance (150 kHz ~ 30 MHz)	2.00
Radiated Disturbance (9 kHz ~ 30 MHz)	3.30
Radiated Disturbance (30 MHz ~ 1 GHz)	4.42
Radiated Disturbance (1 GHz ~ 18 GHz)	5.10
Radiated Disturbance (18 GHz ~ 40 GHz)	5.65

7. PRELIMINARY TEST

7.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

7.2 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

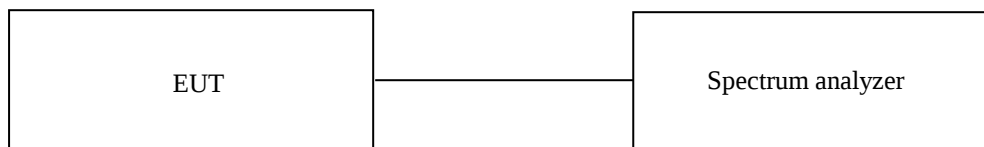
8. MINIMUM 20 dB BANDWIDTH

8.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 20 kHz, and peak detection was used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.



8.3 Test Date

September 09, 2024 ~ October 12, 2024

8.4 Test data for 1 Mbps

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	929.02
Middle	2 441.00	889.09
High	2 480.00	934.14

8.5 Test data for 2 Mbps

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	1 328.64
Middle	2 441.00	1 318.66
High	2 480.00	1 333.50

8.6 Test data for 3 Mbps

CHANNEL	FREQUENCY (MHz)	20 dB Bandwidth (kHz)
Low	2 402.00	1 318.66
Middle	2 441.00	1 298.69
High	2 480.00	1 313.54

9. HOPPING FREQUENCY SEPARATION

9.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % R.H.

9.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 5 MHz. The analyzer is set to peak hold then a pseudo-random hopping sequence of the transmitter is captured. The mark delta function was used to measure the frequency separation between two adjacent hopping channels.



9.3 Test Date

September 09, 2024 ~ October 12, 2024

9.4 Test data for 1 Mbps

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
999.00	592.73	Separated by a minimum of 592.73 kHz

9.5 Test data for 2 Mbps

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
1 004.00	879.11	Separated by a minimum of 879.11 kHz

9.6 Test data for 3 Mbps

-. Test Result : Pass

MEASURED VLAUE (kHz)	Two-third of 20 dB Bandwidth (kHz)	LIMIT
999.00	865.79	Separated by a minimum of 865.79 kHz

10. NUMBER OF HOPPING CHANNELS

10.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The frequency span is set to 100 MHz and the resolution bandwidth is set to 100 kHz. The analyzer is set to peak hold and then complete pseudo-random hopping sequence of the transmitter is captured.



10.3 Test Date

September 09, 2024 ~ October 12, 2024

10.4 Test data for 1 Mbps

-. Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
1 Mbps	79	Minimum of 15	64

10.5 Test data for 2 Mbps

-. Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
2 Mbps	79	Minimum of 15	64

10.6 Test data for 3 Mbps

-. Test Result : Pass

Data Transfer Rate	Measured value (Number)	Limit (Number)	Margin (Number)
3 Mbps	79	Minimum of 15	64

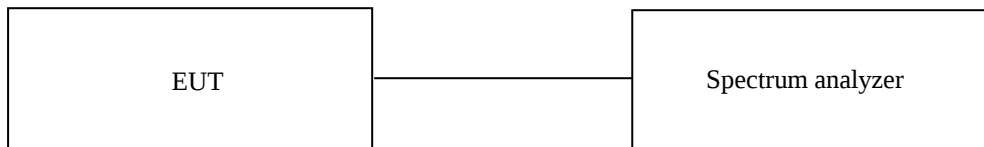
11. TIME OF OCCUPANCY

11.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % R.H.

11.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The transmitter is set to operate in its normal frequency hopping mode. The center frequency of the spectrum analyzer is set to one of hopping channels near the center of the operating band and span is set to zero Hz. The sweep time is set to display one complete pulse. The mark delta function is used to measure the duration of the pulses.



11.3 Test Date

September 09, 2024 ~ October 12, 2024

10.4 Test data for 1 Mbps

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μ s with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second (= 1 600/2/79) for DH1, and 5.06 times (= 1 600/4/79) for DH3, and 3.38 times (= 1 600/6/79) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.38	10.13	31.60	122.37	400.00	PASS
DH3	1.64	5.06	31.60	261.98	400.00	
DH5	2.89	3.38	31.60	308.23	400.00	

Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

11.5 Test data for 2 Mbps

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μ s with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second ($= 1\ 600/2/79$) for DH1, and 5.06 times ($= 1\ 600/4/79$) for DH3, and 3.38 times ($= 1\ 600/6/79$) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.39	10.13	31.60	124.29	400.00	PASS
DH3	1.64	5.06	31.60	262.24	400.00	
DH5	2.89	3.38	31.60	308.47	400.00	

Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

11.6 Test data for 3 Mbps

The system makes worst case 1 600 hops per second or 1 time slot has a length of 625 μ s with 79 channels.

For DH1 packet type, the EUT needs 1 time slot for transmitting and 1 time slot for receiving and for DH3 packet type, the EUT needs 3 times slots for transmitting and 1 time slot for receiving, and DH5 packet needs 5 times slots for transmitting and 1 time slot for receiving. So The EUT has each channel for 10.13 times per second ($= 1\ 600/2/79$) for DH1, and 5.06 times ($= 1\ 600/4/79$) for DH3, and 3.38 times ($= 1\ 600/6/79$) for DH5.

Packet Type	Pulse Time (ms)	Hops per second with channels	Period Time (ms)	Total Dwell Time (ms)	Limit (ms)	Test Result
DH1	0.39	10.13	31.60	124.29	400.00	PASS
DH3	1.64	5.06	31.60	262.07	400.00	
DH5	2.89	3.38	31.60	308.64	400.00	

Total dwell time is calculated as following.

Total Dwell Time = Pulse time * Hops per second with channels * period time

12. MAXIMUM PEAK OUTPUT POWER

12.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % R.H.

12.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to $\geq$ DTS Bandwidth, the video bandwidth is set to 3 times the resolution bandwidth.



12.3 Test Date

September 09, 2024 ~ October 12, 2024

12.4 Test data for 1 Mbps

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	11.84	21.00	9.16
MIDDLE	2 441.00	12.23	21.00	8.77
HIGH	2 480.00	11.42	21.00	9.58

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

12.5 Test data for 2 Mbps

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	11.45	21.00	9.55
MIDDLE	2 441.00	11.64	21.00	9.36
HIGH	2 480.00	10.94	21.00	10.06

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

12.6 Test data for 3 Mbps

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	11.62	21.00	9.38
MIDDLE	2 441.00	11.82	21.00	9.18
HIGH	2 480.00	11.22	21.00	9.78

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

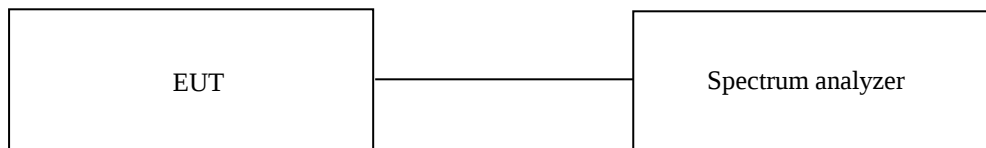
13. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

13.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % R.H.

13.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



13.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

13.4 Test Date

September 09, 2024 ~ October 12, 2024

13.5 Test data for conducted emission

For Test data for conducted emission, please refer to the Annex.

13.6 Test data for Transmitting mode radiated emission

13.6.1 Radiated Emission which fall in the Restricted Band

13.6.1.1 Test data for 1 Mbps

- . Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : 76.96 %
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	ATT (dB)	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel											
2 362.62	52.81	Peak	H	27.65	4.63	41.74	6.11	-	49.46	74.00	24.54
2 388.54	40.87	Average	H	27.55	4.65	41.74	6.11	1.14	38.58	54.00	15.42
2 338.45	52.34	Peak	V	27.75	4.63	41.74	6.09	-	49.07	74.00	24.93
2 354.16	40.98	Average	V	27.68	4.62	41.74	6.09	1.14	38.77	54.00	15.23
Test Data for High Channel											
2 483.55	58.47	Peak	H	27.40	4.83	41.73	6.13	-	55.10	74.00	18.90
2 483.63	42.48	Average	H	27.40	4.83	41.73	6.13	1.14	40.25	54.00	13.75
2 483.57	61.07	Peak	V	27.40	4.83	41.73	6.13	-	57.70	74.00	16.30
2 483.51	42.30	Average	V	27.40	4.83	41.73	6.13	1.14	40.07	54.00	13.93

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{AMP Gain} + \text{ATT} + \text{Duty Factor}$$

13.6.1.2 Test data for 2 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : 77.02 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	ATT (dB)	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel											
2 365.10	52.21	Peak	H	27.64	4.63	41.74	6.11	-	48.85	74.00	25.15
2 374.84	40.70	Average	H	27.60	4.63	41.74	6.11	1.13	38.43	54.00	15.57
2 326.68	53.21	Peak	V	27.79	4.67	41.74	6.11	-	50.04	74.00	23.96
2 333.21	40.90	Average	V	27.77	4.67	41.74	6.11	1.13	38.84	54.00	15.16
Test Data for High Channel											
2 483.53	58.65	Peak	H	27.40	4.83	41.73	6.13	-	55.28	74.00	18.72
2 483.57	42.87	Average	H	27.40	4.83	41.73	6.13	1.13	40.63	54.00	13.37
2 483.51	55.40	Peak	V	27.40	4.83	41.73	6.13	-	52.03	74.00	21.97
2 483.55	42.26	Average	V	27.40	4.83	41.73	6.13	1.13	40.02	54.00	13.98

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{AMP Gain} + \text{ATT} + \text{Duty Factor}$$

13.6.1.3 Test data for 3 Mbps

- . Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : 77.07 %
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	ATT (dB)	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel											
2 334.77	52.29	Peak	H	27.76	4.67	41.74	6.11	-	49.09	74.00	24.91
2 318.87	40.91	Average	H	27.82	4.62	41.74	6.12	1.13	38.86	54.00	15.14
2 354.44	52.27	Peak	V	27.68	4.62	41.74	6.09	-	48.92	74.00	25.08
2 310.51	41.17	Average	V	27.86	4.56	41.75	6.11	1.13	39.08	54.00	14.92
Test Data for High Channel											
2 483.63	55.79	Peak	H	27.40	4.83	41.73	6.13	-	52.42	74.00	21.58
2 483.51	43.07	Average	H	27.40	4.83	41.73	6.13	1.13	40.83	54.00	13.17
2 483.53	55.75	Peak	V	27.40	4.83	41.73	6.13	-	52.38	74.00	21.62
2 483.51	42.44	Average	V	27.40	4.83	41.73	6.13	1.13	40.20	54.00	13.80

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss – AMP Gain + ATT + Duty Factor

13.6.2 Spurious & Harmonic Radiated Emission above 1 GHz

13.6.2.1 Test data for 1 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 76.96 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
4 808.40	50.00	Peak	H	31.20	6.60	41.29	-	46.51	74.00	27.49
4 807.72	37.46	Average	H	31.20	6.60	41.29	1.14	35.11	54.00	18.89
4 798.19	49.25	Peak	V	31.20	6.60	41.29	-	45.76	74.00	28.24
4 804.08	37.29	Average	V	31.20	6.60	41.29	1.14	34.94	54.00	19.06
Test Data for Middle Channel										
4 890.75	48.81	Peak	H	31.28	6.70	41.27	-	45.52	74.00	28.48
4 890.91	37.07	Average	H	31.28	6.70	41.27	1.14	34.92	54.00	19.08
4 888.09	48.97	Peak	V	31.28	6.70	41.27	-	45.68	74.00	28.32
4 875.01	36.93	Average	V	31.25	6.70	41.27	1.14	34.75	54.00	19.25
Test Data for High Channel										
4 955.27	49.13	Peak	H	31.52	6.71	41.25	-	46.11	74.00	27.89
4 964.38	36.97	Average	H	31.56	6.71	41.25	1.14	35.13	54.00	18.87
4 951.79	48.51	Peak	V	31.51	6.71	41.25	-	45.48	74.00	28.52
4 965.22	36.94	Average	V	31.56	6.71	41.25	1.14	35.10	54.00	18.90

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{AMP Gain} + \text{Duty Factor}$$

13.6.2.2 Test data for 2 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 77.02 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
4 799.15	49.22	Peak	H	31.20	6.60	41.29	-	45.73	74.00	28.27
4 801.10	37.21	Average	H	31.20	6.60	41.29	1.13	34.85	54.00	19.15
4 800.48	48.87	Peak	V	31.20	6.60	41.29	-	45.38	74.00	28.62
4 801.40	37.63	Average	V	31.20	6.60	41.29	1.13	35.27	54.00	18.73
Test Data for Middle Channel										
4 877.58	48.60	Peak	H	31.26	6.70	41.27	-	45.29	74.00	28.71
4 885.68	36.95	Average	H	31.27	6.70	41.27	1.13	34.78	54.00	19.22
4 878.06	48.65	Peak	V	31.26	6.70	41.27	-	45.34	74.00	28.66
4 879.28	36.95	Average	V	31.26	6.70	41.27	1.13	34.77	54.00	19.23
Test Data for High Channel										
4 958.26	48.22	Peak	H	31.53	6.71	41.25	-	45.21	74.00	28.79
4 957.30	36.83	Average	H	31.53	6.71	41.25	1.13	34.95	54.00	19.05
4 959.10	48.82	Peak	V	31.54	6.71	41.25	-	45.82	74.00	28.18
4 962.30	37.04	Average	V	31.55	6.71	41.25	1.13	35.18	54.00	18.82

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss – AMP Gain + Duty Factor

13.6.2.3 Test data for 3 Mbps

- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 77.07 %
- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	AMP Gain	Duty Factor (dB)	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel										
4 799.48	49.55	Peak	H	31.20	6.60	41.29	-	46.06	74.00	27.94
4 804.12	37.42	Average	H	31.20	6.60	41.29	1.13	35.06	54.00	18.94
4 800.06	49.14	Peak	V	31.20	6.60	41.29	-	45.65	74.00	28.35
4 796.89	37.37	Average	V	31.19	6.60	41.29	1.13	35.00	54.00	19.00
Test Data for Middle Channel										
4 891.43	48.73	Peak	H	31.28	6.70	41.27	-	45.44	74.00	28.56
4 881.98	36.89	Average	H	31.26	6.70	41.27	1.13	34.71	54.00	19.29
4 873.65	49.17	Peak	V	31.25	6.69	41.27	-	45.84	74.00	28.16
4 872.59	36.96	Average	V	31.25	6.69	41.27	1.13	34.76	54.00	19.24
Test Data for High Channel										
4 964.18	49.09	Peak	H	31.56	6.71	41.25	-	46.11	74.00	27.89
4 959.62	36.97	Average	H	31.54	6.71	41.25	1.13	35.10	54.00	18.90
4 958.90	49.20	Peak	V	31.54	6.71	41.25	-	46.20	74.00	27.80
4 961.98	37.01	Average	V	31.55	6.71	41.25	1.13	35.15	54.00	18.85

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss – AMP Gain + Duty Factor

14. RADIATED EMISSION TEST

14.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % R.H.

14.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

14.3 Test Date

September 09, 2024 ~ October 12, 2024

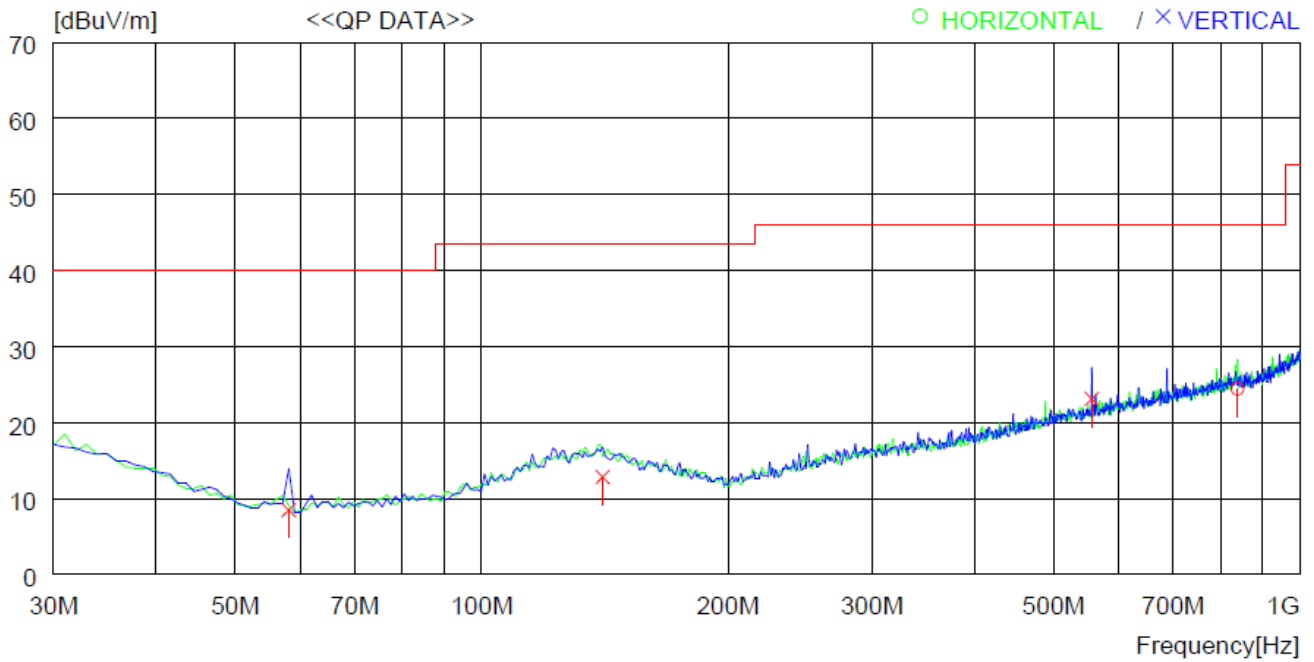
14.4 Test data for 30 MHz ~ 1 000 MHz

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : LINKFLOW BOLD

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	838.971	25.5	27.3	3.8	32.2	24.4	46.0	21.6	300	359
----- Vertical -----										
2	58.130	27.2	12.4	1.0	32.1	8.5	40.0	31.5	300	0
3	140.580	24.0	19.4	1.5	32.1	12.8	43.5	30.7	200	156
4	556.709	28.5	23.8	3.1	32.3	23.1	46.0	22.9	400	359

14.5 Test data for Below 30 MHz

-. Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)

-. Frequency range : 9 kHz ~ 30 MHz

-. Measurement distance : 3 m

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.								

13.6 Test data for above 1 GHz

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode

1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.								

15. CONDUCTED EMISSION TEST

15.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % R.H.

15.2 Test set-up

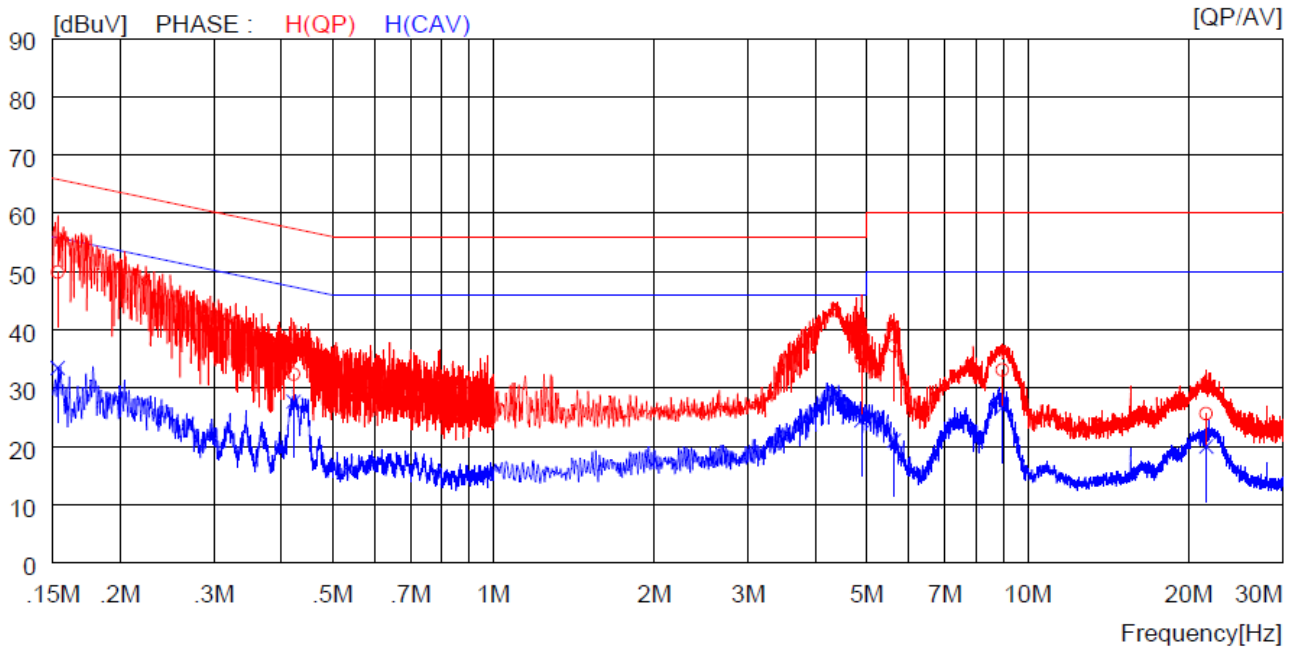
The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a $50\ \Omega$ / $50\ \mu\text{H}$ + $5\ \Omega$ Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

15.3 Test Date

September 09, 2024 ~ October 12, 2024

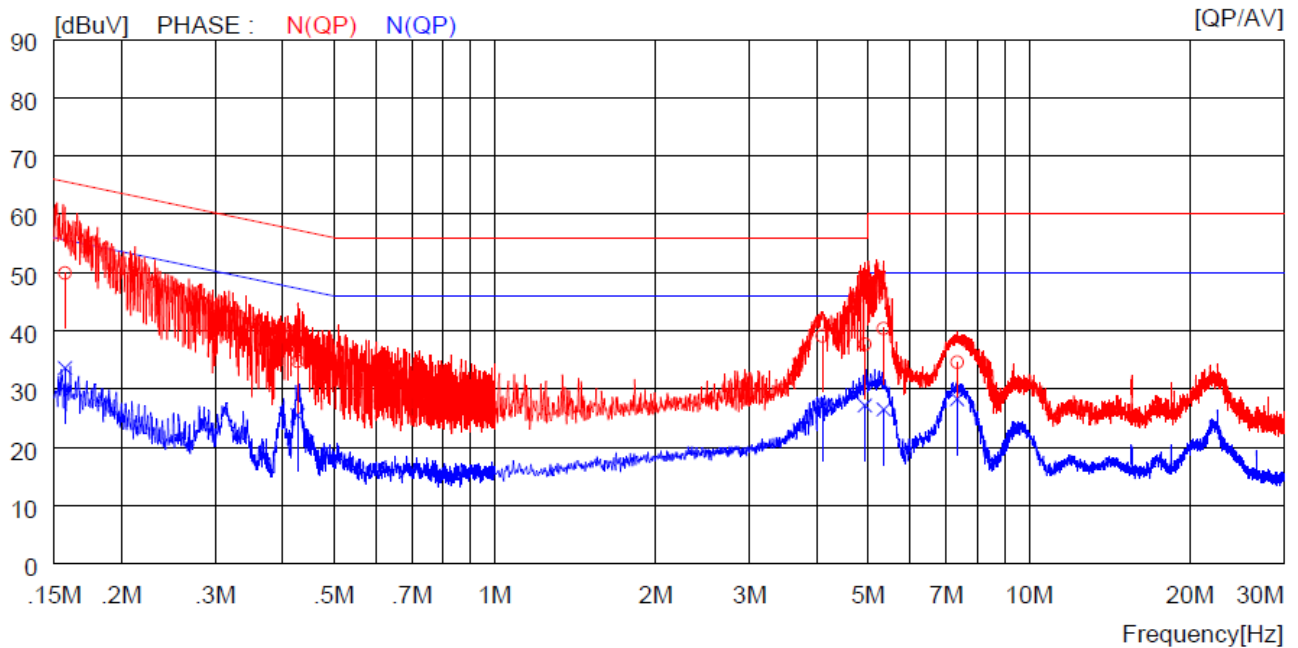
15.4 Test data

- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15300	39.8	----	10.1	49.9	----	65.8	----	15.9	----	H(QP)
2	0.42300	22.3	----	10.1	32.4	----	57.4	----	25.0	----	H(QP)
3	4.88400	24.8	----	10.3	35.1	----	56.0	----	20.9	----	H(QP)
4	5.62500	27.0	----	10.3	37.3	----	60.0	----	22.7	----	H(QP)
5	8.96000	22.8	----	10.3	33.1	----	60.0	----	26.9	----	H(QP)
6	21.59000	14.9	----	10.7	25.6	----	60.0	----	34.4	----	H(QP)
7	0.15300	----	23.4	10.1	----	33.5	----	55.8	----	22.3	H(CAV)
8	0.42300	----	17.6	10.1	----	27.7	----	47.4	----	19.7	H(CAV)
9	4.88400	----	14.2	10.3	----	24.5	----	46.0	----	21.5	H(CAV)
10	5.62500	----	10.7	10.3	----	21.0	----	50.0	----	29.0	H(CAV)
11	8.96000	----	16.4	10.3	----	26.7	----	50.0	----	23.3	H(CAV)
12	21.59000	----	9.3	10.7	----	20.0	----	50.0	----	30.0	H(CAV)

-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15700	39.8	----	10.1	49.9	----	65.6	----	15.7	----	N (QP)
2	0.42800	24.7	----	10.1	34.8	----	57.3	----	22.5	----	N (QP)
3	4.10800	28.9	----	10.2	39.1	----	56.0	----	16.9	----	N (QP)
4	4.92800	27.4	----	10.3	37.7	----	56.0	----	18.3	----	N (QP)
5	5.34500	30.1	----	10.3	40.4	----	60.0	----	19.6	----	N (QP)
6	7.33500	24.3	----	10.3	34.6	----	60.0	----	25.4	----	N (QP)
7	0.15700	----	23.5	10.1	----	33.6	----	55.6	----	22.0	N (CAV)
8	0.42800	----	15.4	10.1	----	25.5	----	47.3	----	21.8	N (CAV)
9	4.10800	----	17.0	10.2	----	27.2	----	46.0	----	18.8	N (CAV)
10	4.92800	----	16.9	10.3	----	27.2	----	46.0	----	18.8	N (CAV)
11	5.34500	----	16.2	10.3	----	26.5	----	50.0	----	23.5	N (CAV)
12	7.33500	----	18.0	10.3	----	28.3	----	50.0	----	21.7	N (CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

16. LIST OF TEST EQUIPMENT

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
FSV30	Rohde & Schwarz	Signal Analyzer	101199	Jan. 15, 2024 (1Y)
ESR3	Rohde & Schwarz	EMI Test Receiver	102602	Mar. 11, 2024 (1Y)
310N	Sonoma Instrument	Pre-Amplifier	392756	Oct. 16, 2023 (1Y)
SCU18	Rohde & Schwarz	Pre-Amplifier	102266	Jul. 04, 2024 (1Y)
SCU40A	Rohde & Schwarz	Pre-Amplifier	100436	Jan. 23, 2024 (1Y)
DT2000-2t	Innco System	Turn Table	N/A	N/A
MA-4640-XPET	Innco System	Antenna Master	MA4640/652/43100318/P	N/A
CO3000	Innco System	Controller	1026/40960617/P	N/A
FMZB 1513	Schwarzbeck	Loop Antenna	1513-235	Mar. 20, 2024 (2Y)
HLP-2008	TDK	Hybrid Antenna	131316	Mar. 09, 2024 (2Y)
BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1349	Jul. 02, 2024 (1Y)
BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 04, 2024 (1Y)
HPF 3GHz	Rohde & Schwarz	High Pass Filter	N/A	Jan. 15, 2024 (1Y)
F-40-10.0-RF	RLC Electronis	High Pass Filter	0427	Mar. 04, 2024 (1Y)
ESCI	Rohde & Schwarz	EMI TEST RECEIVER	101012	Sep. 26, 2024 (1Y)
NSLK8128	Schwarzbeck	AMN	8128216	Mar. 12, 2024 (1Y)
ESH3-Z2	Rohde & Schwarz	PULSE LIMITER	100655	Mar. 12, 2024 (1Y)