RADIO PERFORMANCE TEST REPORT

Test Report No. : **OT-247-RWD-008**

Reception No. : **2405001696**

Applicant : **JCFTechnology Inc.**

Address : **B-805, Woolim Lions Valley, 168, Gasan digital 1-ro, Geumcheon-gu, Seoul, South Korea**

Manufacturer : **JCFTechnology Inc.**

Address : **B-805, Woolim Lions Valley, 168, Gasan digital 1-ro, Geumcheon-gu, Seoul, South Korea**

Type of Equipment : **Vital signs monitoring Radar sensor**

FCC ID : **2BHHG-VSR22-WR**

Model Name : **VSR22-WR**

Multiple Model Name : **N/A**

Serial number : **N/A**

Total page of Report : **24 pages (including this page)**

Date of Incoming : **May 22, 2024**

Date of Issuing : **July 15, 2024**

SUMMARY

The equipment complies with the requirements of ***FCC CFR 47 PART 15 SUBPART C Section 15.249***

This test report contains only 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	Reviewed by	Approved by
Si-eon Lee / Senior Project Engineer	Tae-Ho, Kim / Chief Engineer	Jae-Ho, Lee / Chief Engineer
ONETECH Corp.	ONETECH Corp.	ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-247-RWD-008	July 15, 2024	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

Applicant	: JCFTechnology Inc.
Address	: B-805, Woolim Lions Valley, 168, Gasan digital 1-ro, Geumcheon-gu, Seoul, South Korea
Contact Person	: HOYOUNG JI / Assistant Manager
Telephone No.	: +82 2-867-7733/+82 2-867-7744
FCC ID	: 2BHHG-VSR22-WR
Model Name	: VSR22-WR
Brand Name	: -
Serial Number	: N/A
Date	: July 15, 2024

DEVICE TYPE	DXX – Low Power Communication Device Transmitter
E.U.T. DESCRIPTION	Vital signs monitoring Radar sensor
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 CFR47 Part 15 Subpart C Section 15.249
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None

-. 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.

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2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.249 (a)	Field Strength of Emission	Met the Limit / PASS
15.249 (c)	Measurement distance	Met the Requirement / PASS
15.249 (d)	Emissions Radiated Outside of the Specified Frequency Band	Met the Limit / PASS
15.249, 15.215	Minimum 20 dB Bandwidth	Met the Limit / PASS
15.249 (e)	Radiated Emissions above 1 000 MHz	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 the Requirement / PASS

2.2 Related Submittal(s) / Grant(s)

Original submittal only

2.3 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in section 2.1.

2.4 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.

2.5 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

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

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

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

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3. GENERAL INFORMATION

3.1 Product Description

The JCFTechnology Inc., Model VSR22-WR (referred to as the EUT in this report) is an Vital signs monitoring Radar sensor, Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Vital signs monitoring Radar sensor
OPERATING FREQUENCY	24.128 6 GHz 2 402 MHz ~ 2 480 MHz, 2 412 MHz ~ 2 462 MHz
Field Strength of Fundamental	106.48 dBμV/m
ANTENNA TYPE	Array Antenna
ANTENNA GAIN	0 dBi

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

-. None

4. EUT MODIFICATIONS

-. None

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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	JCFTechnology Inc.	VSR2x-W-VR4	N/A
Power Board	JCFTechnology Inc.	VSR2X-WR_VB04-DD4-03_R035	N/A
Adapter	N/A	MKA-0901000C	N/A
Wi-Fi & Bluetooth Module	ESPRESSIF SYSTEMS (SHANGHAI) CO., LTD	ESP32-WROVER-E	2AC7Z-ESP32WROVERE

5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
VSR22-WR	JCFTechnology Inc.,	EUT	-
MKA-0901000C	N/A	Adapter	EUT

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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 24.128 6 GHz 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 “XY” axis, but the worst data was recorded in this report.

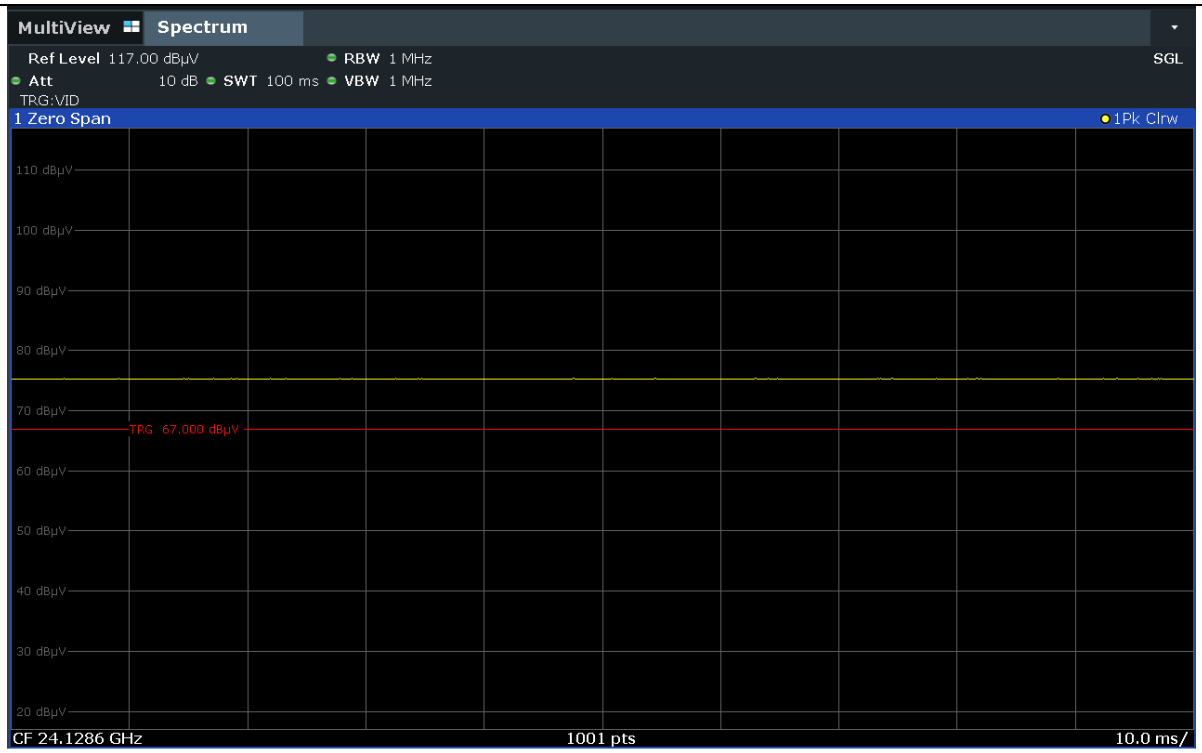
-. Duty Cycle

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
-	-	-	100.00	-

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

-. Test Plot



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5.4 Configuration of Test System

Line Conducted Test: The EUT was connected to DC power supply and the power of DC power supply was connected to LISN. 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. The radiated emissions measurements were performed on the 10 m Semi Anechoic Chamber.

For frequencies from 150 kHz to 30 MHz measurements were made of the magnetic H field. The measuring antenna is an electrically screened loop antenna.

The frequency spectrum from 30 MHz to 1 000 MHz was scanned and maximum emission levels maximized 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 both horizontal and vertical polarization of the receiving antenna.

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 Array Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating modes were investigated

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

6.2 Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

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

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7. MINIMUM 20 dB BANDWIDTH

7.1 Operating environment

Temperature	:	22 °C
Relative humidity	:	46 % R.H.

7.2 Test set-up

20 dB bandwidth measurements were on the 1 m, semi anechoic chamber. The resolution bandwidth is set to 50 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.

7.3 Test Date

May 23, 2024 ~ May 28, 2024

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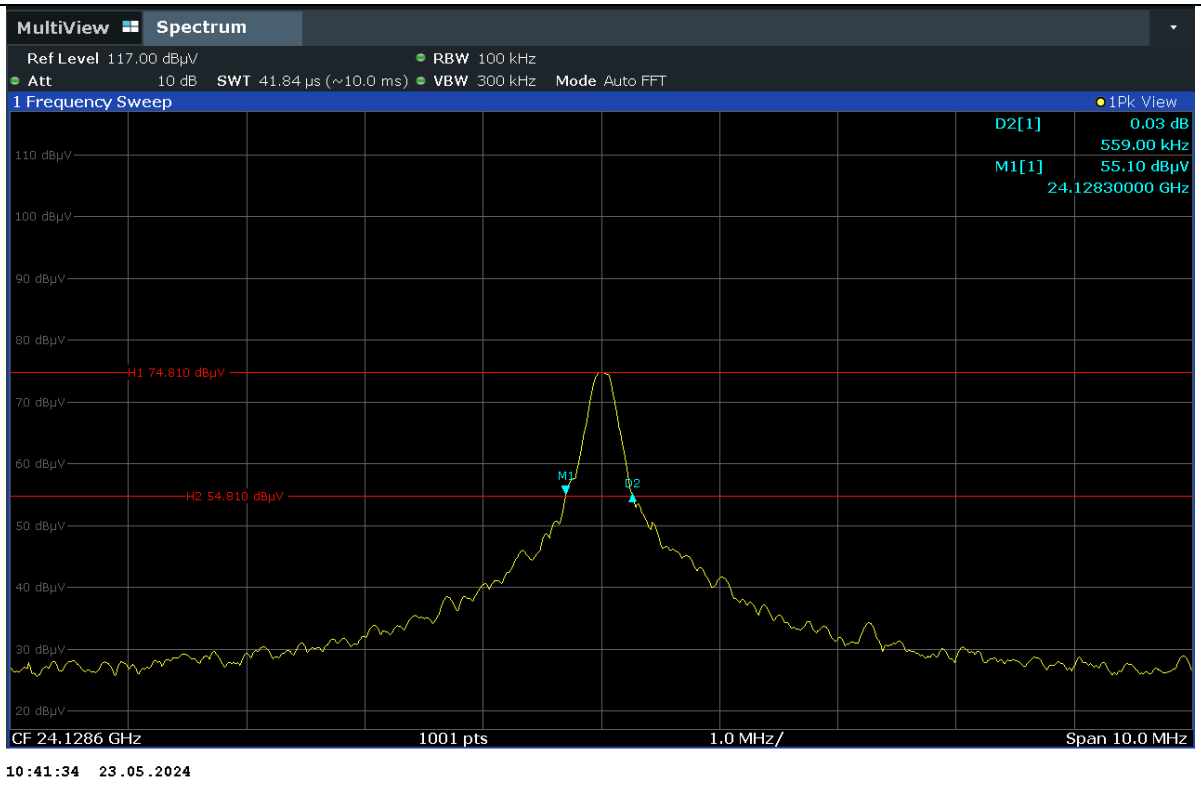
7.4 Test data

-. Test Result : Pass

Mode	Frequency (GHz)	20 dB Bandwidth (MHz)
CW	24.128 6	0.559

Remark. Margin = Measured Value - Limit



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8. RADIATED EMISSION TEST

8.1 Operating environment

Temperature : 22 °C

Relative humidity : 46 % R.H.

8.2 Test set-up

The radiated emissions measurements were on the 1 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 up to 40 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.

Test set-up photos are included in appendix I.

8.3 Measurement uncertainty

Radiated emission electric field intensity, 0.15 MHz ~ 30 MHz : ± 2.61 dB

Radiated emission electric field intensity, 30 MHz ~ 300 MHz : ± 4.43 dB

Radiated emission electric field intensity, 300 MHz ~ 1 000 MHz : ± 3.80 dB

Radiated emission electric field intensity, 1 000 MHz ~ 3 000 MHz: ± 4.40 dB

Measurement uncertainty is calculated in accordance with CISPR 16-4-2. The measurement uncertainty is given with a confidence of 95 % with the coverage factor, k = 2.

8.4 Test Date

May 23, 2024 ~ May 28, 2024

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8.5 Final Result of Measurement

8.5.1 Field Strength of the Fundamental Frequency

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249(a)

Result : PASSED

EUT : Vital signs monitoring Radar sensor

Operating Condition : TX mode

Distance : 1 m

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant Pol.	Ant. Factor (dB)	Cable Loss (dB)	Distance Factor (dB)	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
24.19	74.72	Peak	H	38.80	2.50	9.54	106.48	127.96	21.48
	74.56	Average	H	38.80	2.50	9.54	106.32	107.96	1.64
	74.66	Peak	V	38.80	2.50	9.54	106.42	127.96	21.54
	74.47	Average	V	38.80	2.50	9.54	106.23	107.96	1.73

*Remark: To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes, but the worst plane data were recorded in the report.

Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss - Distance Factor

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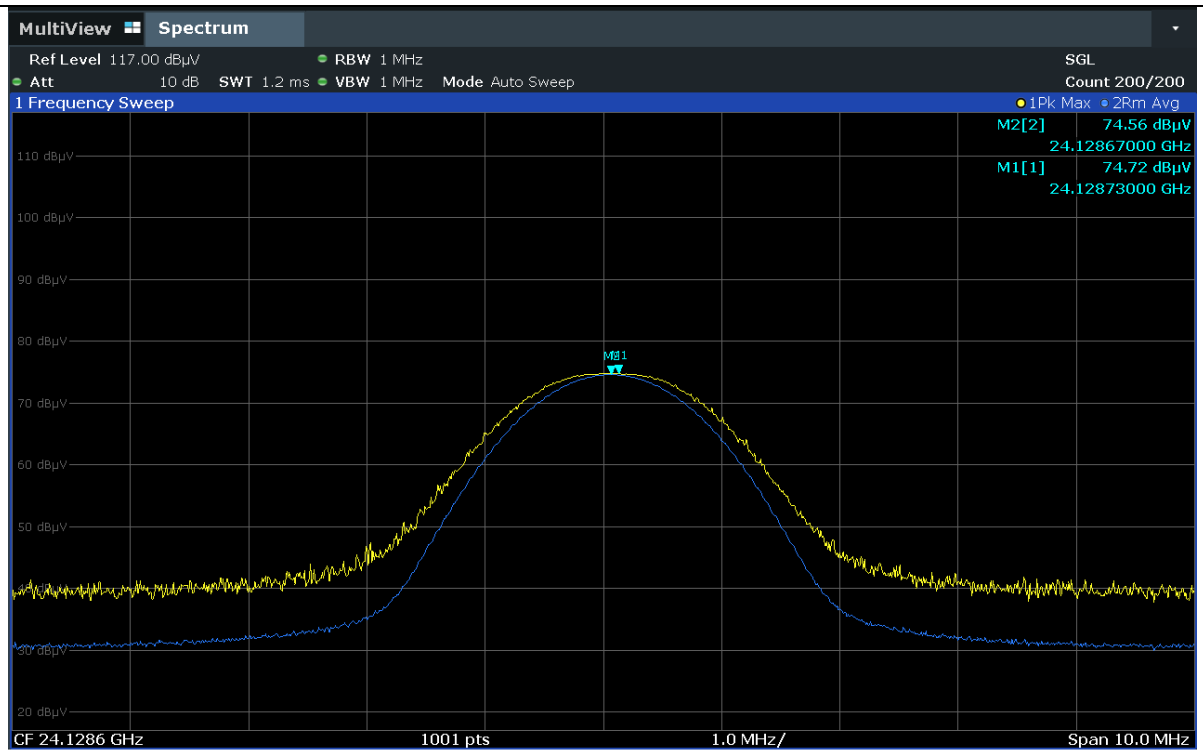

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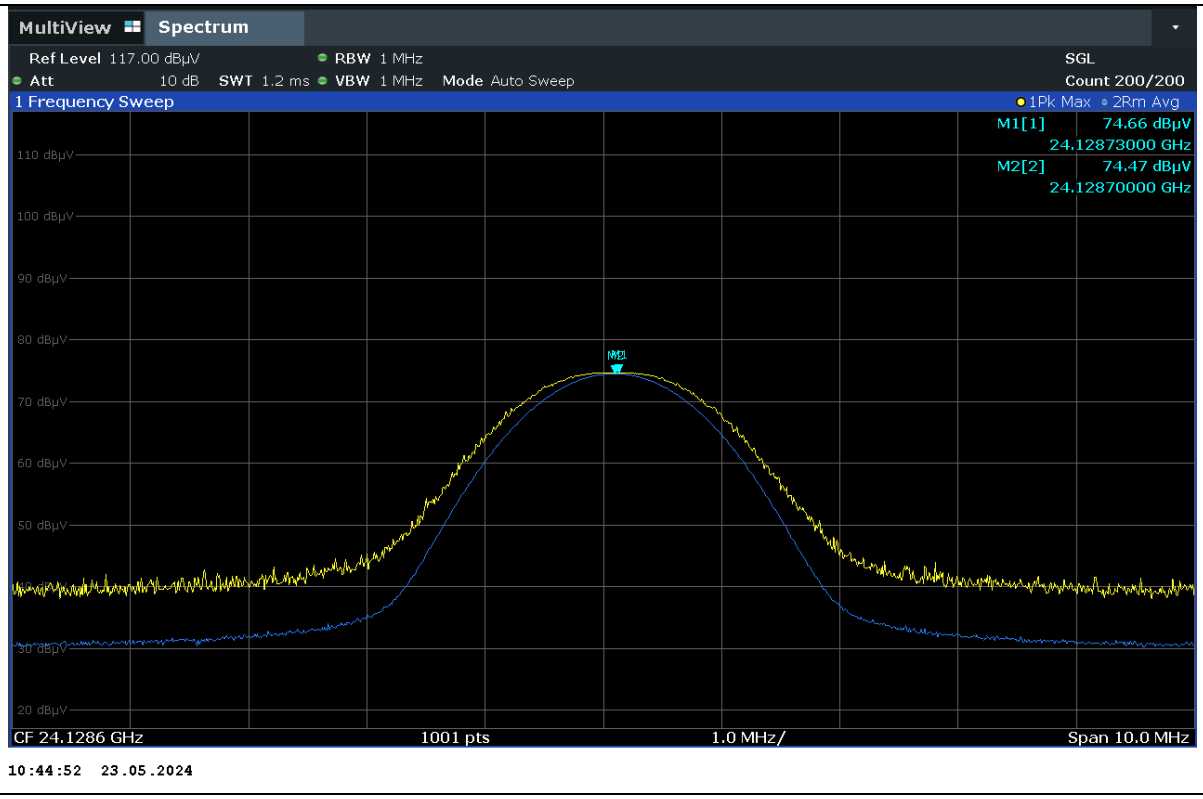

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8.5.2 Emissions Radiated Outside of the Specified Frequency Bands

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249(a)

Result : PASSED

EUT : Vital signs monitoring Radar sensor

Operating Condition : TX mode

Distance : 0.5 m

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant Pol.	Ant. Factor (dB)	Cable Loss (dB)	Conversion Loss(dB)	Distance Factor (dB)	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
48.25	31.15	Peak	H	41.40	0.80	20.51	15.56	78.30	87.96	9.66
48.25	18.10	Average	H	41.40	0.80	20.51	15.56	65.25	67.96	2.71
48.25	31.10	Peak	V	41.40	0.80	20.51	15.56	78.25	87.96	9.71
48.25	18.09	Average	V	41.40	0.80	20.51	15.56	65.24	67.96	2.72

Remark: “H”: Horizontal, “V”: Vertical, “*” Frequency fall in restricted band

Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss + Conversion Loss - Distance Factor

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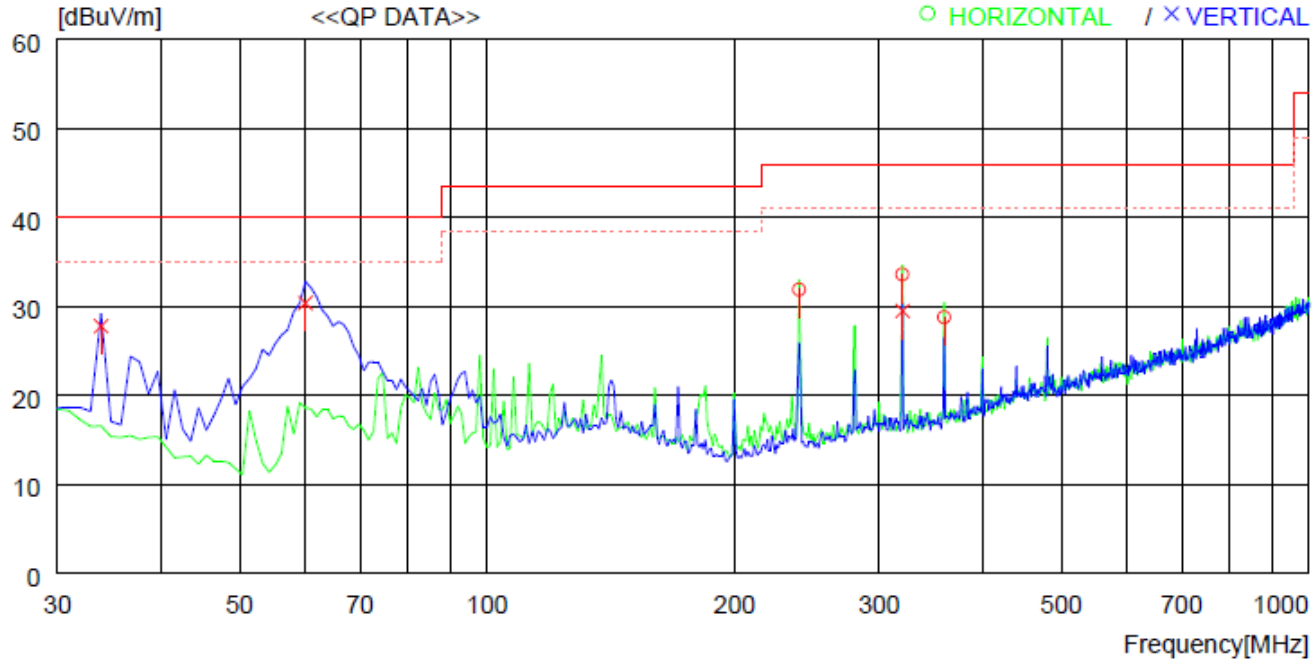
8.5.3 Test Data for Frequency range: 30 MHz ~ 1 000 MHz

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

Result : PASSED

EUT : Vital signs monitoring Radar sensor

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



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	239.520	45.3	17.1	2.5	33.0	31.9	46.0	14.1	100	359
2	320.030	44.4	19.4	2.8	33.0	33.6	46.0	12.4	100	115
3	359.800	38.8	20.0	3.0	33.0	28.8	46.0	17.2	100	359
----- Vertical ------										
4	33.880	40.2	19.7	0.9	33.0	27.8	40.0	12.2	200	0
5	60.070	49.9	12.3	1.2	33.0	30.4	40.0	9.6	100	0
6	320.030	40.3	19.4	2.8	33.0	29.5	46.0	16.5	100	0

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8.5.4 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

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

8.5.5 Test Data above 1 GHz except for harmonic

-. 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 ~ 40 GHz

-. Measurement distance : 3 m

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

8.5.6 Test Data above 40 GHz except for harmonic

-. 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 : 40 GHz ~ 100 GHz

-. Measurement distance : 0.5 m

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

- Result : PASSED

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

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8.5.7 Band Edge

-. 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 : 1 m

-. Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.249 (d)

-. Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant Pol.	Ant. Factor (dB)	Cable Loss (dB)	Distance Factor (dB)	Total (dBuV/m)	Limits (dBuV/m)	Margin (dB)
23.990	31.10	Peak	H	38.80	2.50	9.54	62.86	74.00	11.14
23.987	20.45	Average	H	38.80	2.50	9.54	52.21	54.00	1.79
23.984	31.06	Peak	V	38.80	2.50	9.54	62.82	74.00	11.18
23.982	20.53	Average	V	38.80	2.50	9.54	52.29	54.00	1.71
24.265	31.54	Peak	H	38.70	2.60	9.54	63.30	74.00	10.70
24.261	20.56	Average	H	38.70	2.60	9.54	52.32	54.00	1.68
24.275	31.38	Peak	V	38.70	2.60	9.54	63.14	74.00	10.86
24.262	20.68	Average	V	38.70	2.60	9.54	52.44	54.00	1.56

Remark. Margin (dB) = Limit (dBuV/m) – Total (dBuV/m)

Total = Reading + Antenna Factor + Cable Loss - Distance Factor

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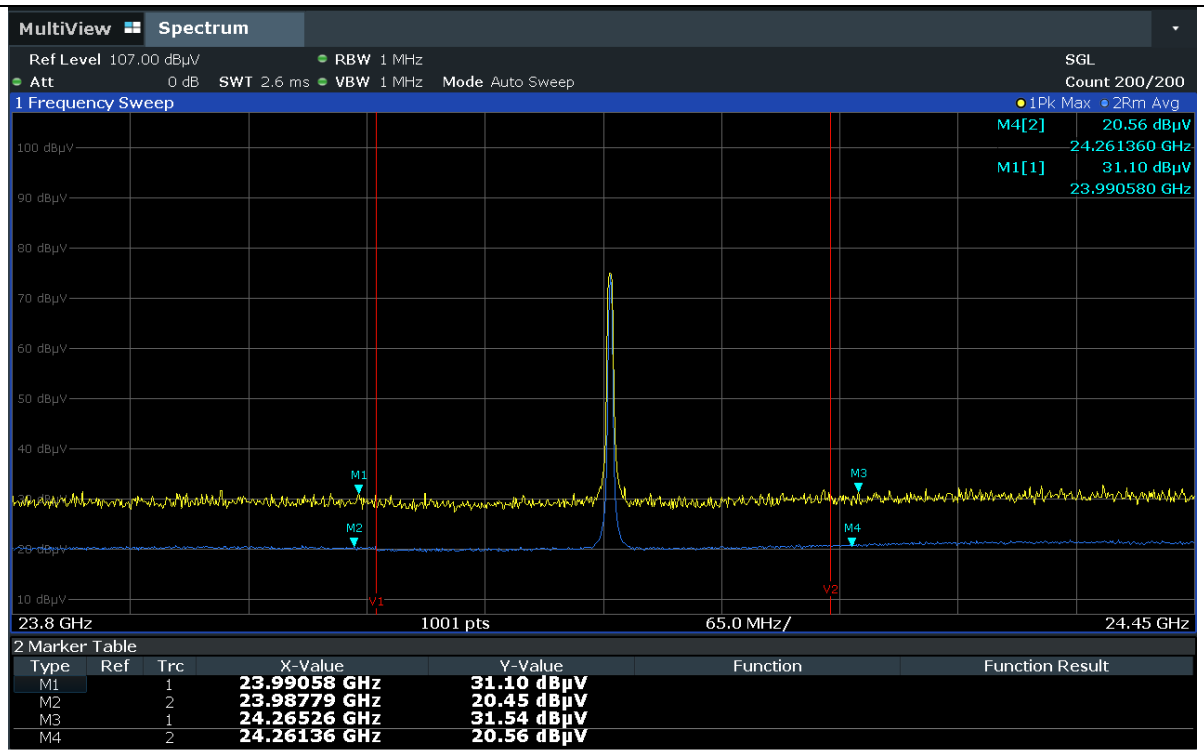

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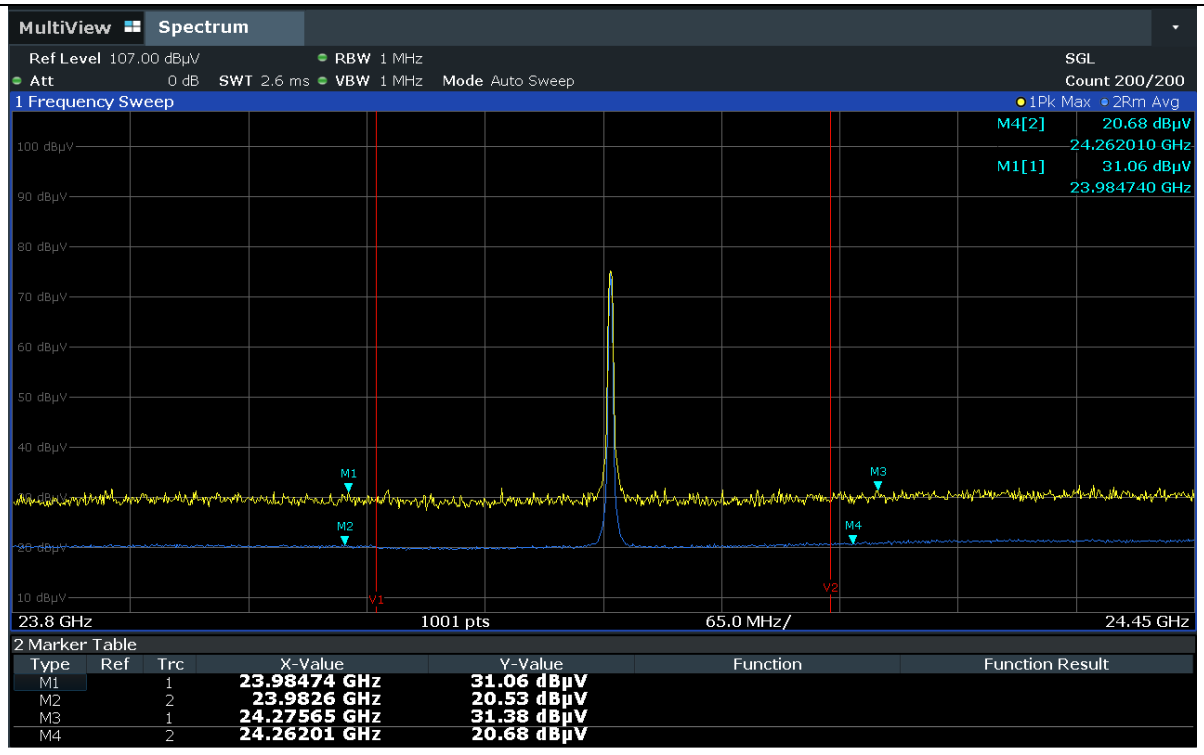

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9. CONDUCTED EMISSION TEST

9.1 Operating environment

Temperature	:	22 °C
Relative humidity	:	46 % R.H.

9.2 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 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

9.3 Test Date

May 23, 2024 ~ May 28, 2024

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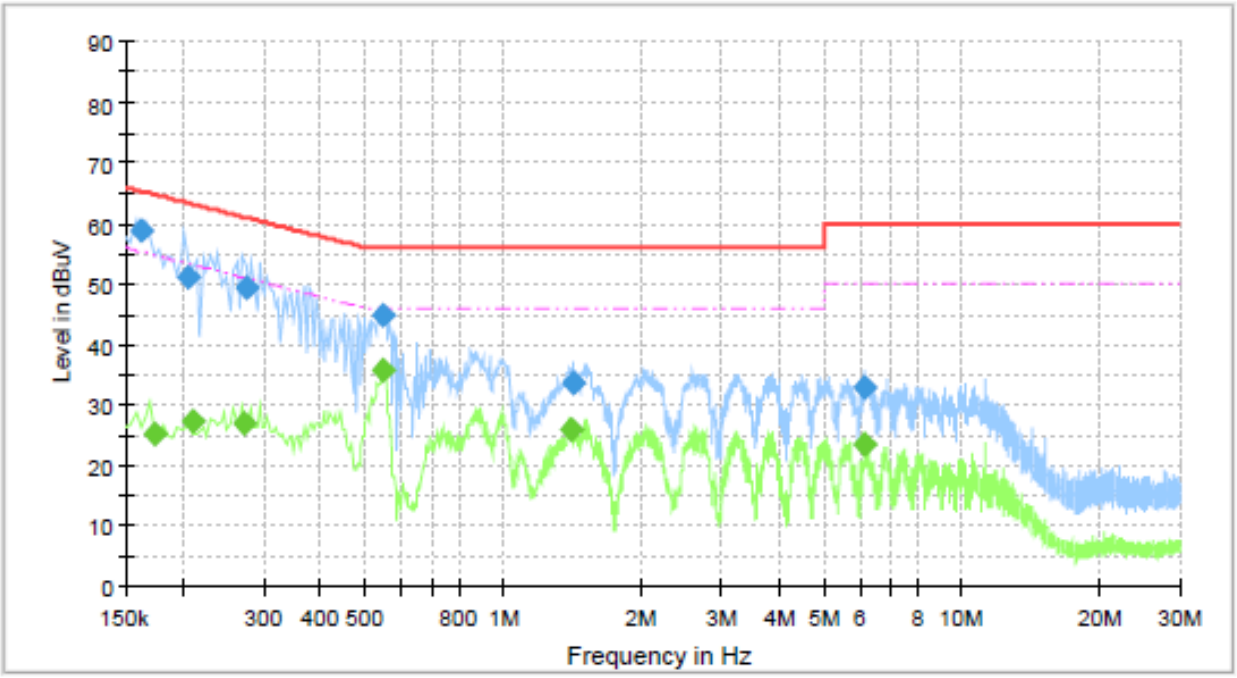
9.4 Test data

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : HOT LINE



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.161	58.80	---	65.39	6.59	9.0	L1	10.17
0.174	---	25.25	54.79	29.54	9.0	L1	10.16
0.206	50.99	---	63.39	12.40	9.0	L1	10.16
0.210	---	27.28	53.23	25.95	9.0	L1	10.16
0.274	---	26.95	51.01	24.06	9.0	L1	10.16
0.275	49.48	---	60.98	11.50	9.0	L1	10.16
0.545	---	35.82	46.00	10.18	9.0	L1	10.18
0.549	44.76	---	56.00	11.24	9.0	L1	10.18
1.404	---	25.97	46.00	20.03	9.0	L1	10.23
1.420	33.77	---	56.00	22.23	9.0	L1	10.23
6.141	32.93	---	60.00	27.07	9.0	L1	10.42
6.141	---	23.52	50.00	26.48	9.0	L1	10.42

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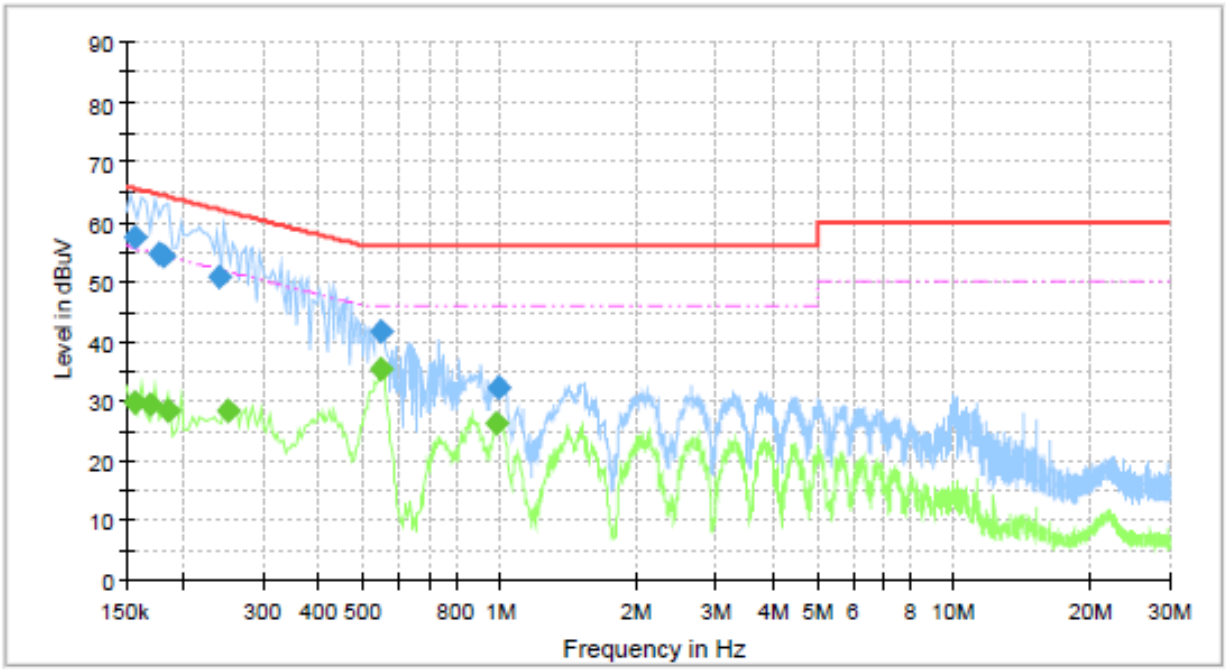
-. Tested Line : NEUTRAL LINE



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.157	---	29.74	55.60	25.85	9.0	N	10.20
0.157	57.31	---	65.60	8.28	9.0	N	10.20
0.170	---	29.43	54.99	25.56	9.0	N	10.20
0.179	54.51	---	64.56	10.05	9.0	N	10.19
0.181	54.44	---	64.42	9.97	9.0	N	10.19
0.185	---	28.52	54.24	25.72	9.0	N	10.19
0.241	50.79	---	62.04	11.25	9.0	N	10.18
0.251	---	28.22	51.74	23.52	9.0	N	10.18
0.549	---	35.41	46.00	10.59	9.0	N	10.19
0.549	41.83	---	56.00	14.17	9.0	N	10.19
0.984	---	26.20	46.00	19.80	9.0	N	10.22
0.992	32.18	---	56.00	23.82	9.0	N	10.22

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.

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ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

10. LIST OF TEST EQUIPMENT

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
FSW43	Rohde & Schwarz	Signal & Spectrum Analyzer	104544	Jul. 14, 2023 (1Y)
ESW44	Rohde & Schwarz	EMI Test Receiver	101851	Mar. 06, 2024 (1Y)
310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 11, 2024 (1Y)
SCU18	Rohde & Schwarz	Pre-Amplifier	102266	Jul. 11, 2023 (1Y)
ELNA40	EXYNOD	Pre-Amplifier	25339-27648	Jan. 23,2024 (1Y)
HLP-2008	TDK RF Solutions	Hybrid Antenna	131313	Apr. 05, 2023 (2Y)
BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1349	Jul. 04, 2023 (1Y)
FMZB 1513	Schwarzbeck	Loop Antenna	1513-235	Mar. 20, 2024 (2Y)
BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jan. 23, 2024 (1Y)
M19RH	OML, Inc.	Millimeter Wave Horn Antenna	180912-1	Jul. 04, 2023 (1Y)
M12RH	OML, Inc.	Millimeter Wave Horn Antenna	180912-1	Jun. 28, 2023 (1Y)
M08RH	OML, Inc.	Millimeter Wave Horn Antenna	180912-1	Jun. 28, 2023 (1Y)
M19HWD	OML, Inc.	Harmonic Mixer	180912-1	Jun. 30, 2023 (1Y)
M12HWD	OML, Inc.	Harmonic Mixer	180912-1	Jun. 30, 2023 (1Y)
M08HWD	OML, Inc.	Harmonic Mixer	180912-1	Jun. 30, 2023 (1Y)
ESR 3	Rohde & Schwarz	EMI Test Receiver	102602	Mar. 11, 2024 (1Y)
NSLK8126	Schwarzbeck	AMN	8126-404	Mar. 12, 2024 (1Y)
VTSD 9561-F	Schwarzbeck	PULSE LIMITER	01337	Nov. 23, 2023 (1Y)
CO3000	Innco Systems GmbH	Controller	N/A	N/A
DT5000	Innco Systems GmbH	Turn Table	N/A	N/A
MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509/ 37211215/L	N/A

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