

TEST REPORT

Reference No...... : WTN24D08191405W002
FCC ID : VJC-E9XHSM2
Applicant..... : Ad Hoc Electronics, LLC
Address..... : 115 S State St B, Lindon, UT 84042, United States
Manufacturer : Ad Hoc Electronics, LLC
Address..... : 115 S State St B, Lindon, UT 84042, United States
Product..... : Wireless Door Contact Receiver
Model(s) : E9X-HSM-2
Standards..... : FCC 47CFR Part 15.247
Date of Receipt sample : 2024-08-01
Date of Test : 2024-08-01 to 2024-10-11
Date of Issue..... : 2024-10-28
Test Result..... : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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3 Revision History

Test Report No.	Date of Receipt Sample	Date of Test	Date of Issue	Purpose	Comment	Approved
WTN24D08191405W002	2024-08-01	2024-08-01 to 2024-10-11	2024-10-28	Original	-	Valid

4 General Information

4.1 General Description of E.U.T.

Product:	Wireless Door Contact Receiver
Model(s):	E9X-HSM-2
Model Description:	N/A
Test Sample No.:	1-1/1
Hardware Version:	V1.0
Software Version:	V1.2

4.2 Details of E.U.T.

Operation Frequency:	902.875MHz
Max. RF output power:	8.89dBm
Type of Modulation:	2-FSK
Antenna installation:	Wire Antenna
Antenna Gain:	-0.91dBi

Note:

#: The antenna gain is provided by the applicant, and the applicant should be responsible for its authenticity, WALTEK lab has not verified the authenticity of its information.

Ratings: 9-30VAC, 12-40VDC, 0.5W

4.3 Channel List

Channel No.	Frequency (MHz)
0	902.875

4.4 Test Facility

The test facility has a test site registered with the following organizations:

ISED CAB identifier: CN0013. Test Firm Registration No.: 7760A.

Waltek Testing Group Co., Ltd. Has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files.

Registration number 7760A, October 15, 2016.

FCC Designation No.: CN1201. Test Firm Registration No.: 523476.

Waltek Testing Group Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration number 523476, September 10, 2019.

4.5 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test Lab: N/A

Lab address: N/A

Test items: N/A

4.6 Abnormalities from Standard Conditions

None.

4.7 Test Mode

Tests Carried Out Under FCC part 15.247

Test Items	Mode	Channel	TX/RX
Maximum Peak Output Power	TX	0	TX
Power Spectral Density	TX	0	TX
6dB Bandwidth	TX	0	TX
Band Edge	TX	0	TX
Transmitter Spurious Emissions	TX	0	TX

Note: Parameters set by test software during channel & power tests, the software provided by the applicant was used to set the operating channels as well as the maximum output power level. The RF output power set is the power expected by the manufacturer and is going to be fixed on the firmware of the final product.

5 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.247(d) 15.205(a) 15.209(a)	PASS
Conducted Spurious Emissions	15.247(d)	PASS
Conducted Emissions	15.207(a)	PASS
6dB Bandwidth	15.247(a)(2)	PASS
Maximum Peak Output Power	15.247(b)(3),(4)	PASS
Power Spectral Density	15.247(e)	PASS
Band Edge	15.247(d)	PASS
Antenna Requirement	15.203	PASS
Maximum Permissible Exposure (Exposure of Humans to RF Fields)	1.1307(b)(1)	PASS

6 Equipment Used during Test

6.1 Equipments List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date	Calibration Due Date
Conducted Emissions 2#						
1	EMI Test Receiver	R&S	ESCI	101155	2024-07-18	2025-07-17
2	LISN	SCHWARZBECK	NSLK 8128	8128-259	2023-10-31	2024-10-30
3	Pulse Limiter	CYBERTEK	EM5010	261115-001-0024	2024-07-18	2025-07-17
4	Cable	Laplace	RF300	-	2024-07-18	2025-07-17
3m Semi-anechoic Chamber for Radiation Emissions 1#						
1	Spectrum Analyzer	R&S	FSP30	100091	2024-04-22	2025-04-21
2	Amplifier	Agilent	8447D	2944A10178	2024-07-18	2025-07-17
3	Tri-log Broadband Antenna	SCHWARZBECK	VULB9163	336	2024-07-21	2025-07-20
4	Coaxial Cable	Top	TYPE16(13M)	-	2024-04-22	2025-04-21
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120D	667	2024-01-23	2025-01-22
6	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	2024-07-18	2025-07-17
7	Broadband Preamplifier	COMPLIANCE	PAP-1G18	2004	2024-07-18	2025-07-17
8	Coaxial Cable	Top	ZT26-NJ-NJ-8M/FA	-	2024-04-22	2025-04-21
9	Microwave Amplifier	SCHWARZBECK	BBV 9721	100472	2024-07-18	2025-07-17
10	Coaxial Cable	Top	ZT40-2.92J-2.92J-2.0M	17100919	2024-04-22	2025-04-21
3m Semi-anechoic Chamber for Radiation Emissions 2#						
1	Test Receiver	R&S	ESCI	101296	2024-04-22	2025-04-21
2	Trilog Broadband Antenna	SCHWARZBECK	VULB9160	9160-3325	2023-11-04	2024-11-03
3	Active Loop Antenna	Com-Power	AL-130R	10160007	2024-04-27	2025-04-06
4	Amplifier	ANRITSU	MH648A	M43381	2024-04-22	2025-04-21
5	Cable	HUBER+SUHNER	CBL2	525178	2024-04-22	2025-04-21
RF Conducting						
1	Spectrum Analyzer	R&S	FSP40	100501	2024-07-18	2025-07-17
2	Spectrum Analyzer	Agilent	N9020A	MY49100060	2024-07-18	2025-07-17

Test Software:

Test Item	Software name	Software version
Conduction disturbance Radiated Emission(3m)	EZ-EMC	EZ-EMC(RA-03A1-1)

6.2 Description of Support Units

Equipment	Manufacturer	Model No.	Series No.
/	/	/	/

6.3 Measurement Uncertainty

Parameter	Uncertainty
Conducted Emission	± 3.64 dB(AC mains 150KHz~30MHz)
Radiated Spurious Emissions	± 5.08 dB (Bilog antenna 30M~1000MHz)
	± 5.47 dB (Horn antenna 1000M~25000MHz)
Radio Frequency	± 1 x 10 ⁻⁷ Hz
RF Power	± 0.42 dB
RF Power Density	± 0.7dB
Conducted Spurious Emissions	± 2.76 dB (9kHz~26500MHz)
Confidence interval: 95%. Confidence factor:k=2	

6.4 Test Equipment Calibration

All the test equipments used are valid and calibrated by CEPREI Certification Body that address is No.110 Dongguan Zhuang RD. Guangzhou, P.R. China.

7 Conducted Emission

Test Requirement: FCC 47CFR Part 15 Section 15.207

Test Method: ANSI C63.10:2013

Test Result: PASS

Frequency Range: 150kHz to 30MHz

Limit:

Frequency (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5.0	56	46
5.0 to 30	60	50

*Decreases with the logarithm of the frequency.

7.1 E.U.T. Operation

Operating Environment:

Temperature: 21.4 °C

Humidity: 50.7 % RH

Atmospheric Pressure: 101.6kPa

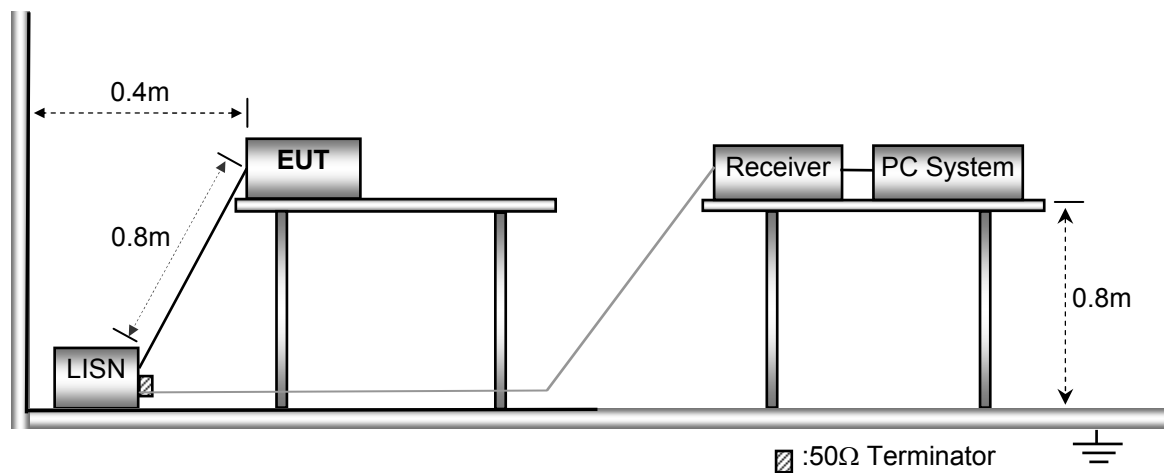
Test Voltage: AC 24V/60Hz

EUT Operation: TX

The test was performed in transmitting mode, the test data were shown in the report.

7.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



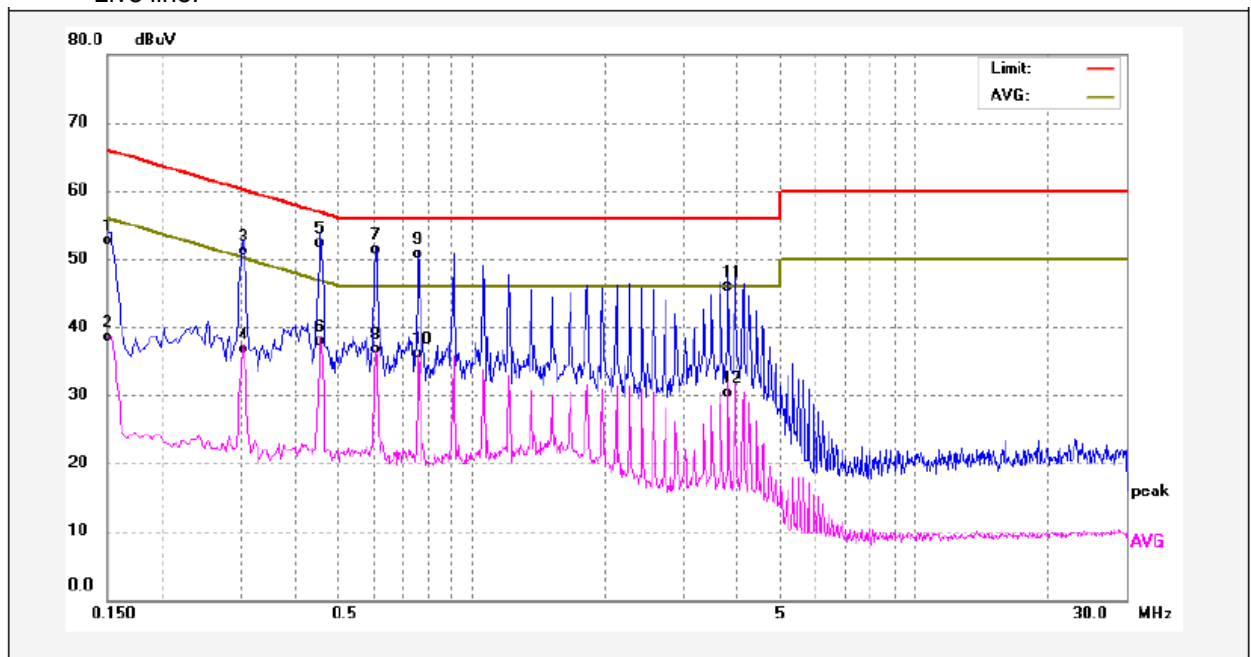
7.3 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

7.4 Conducted Emission Test Result

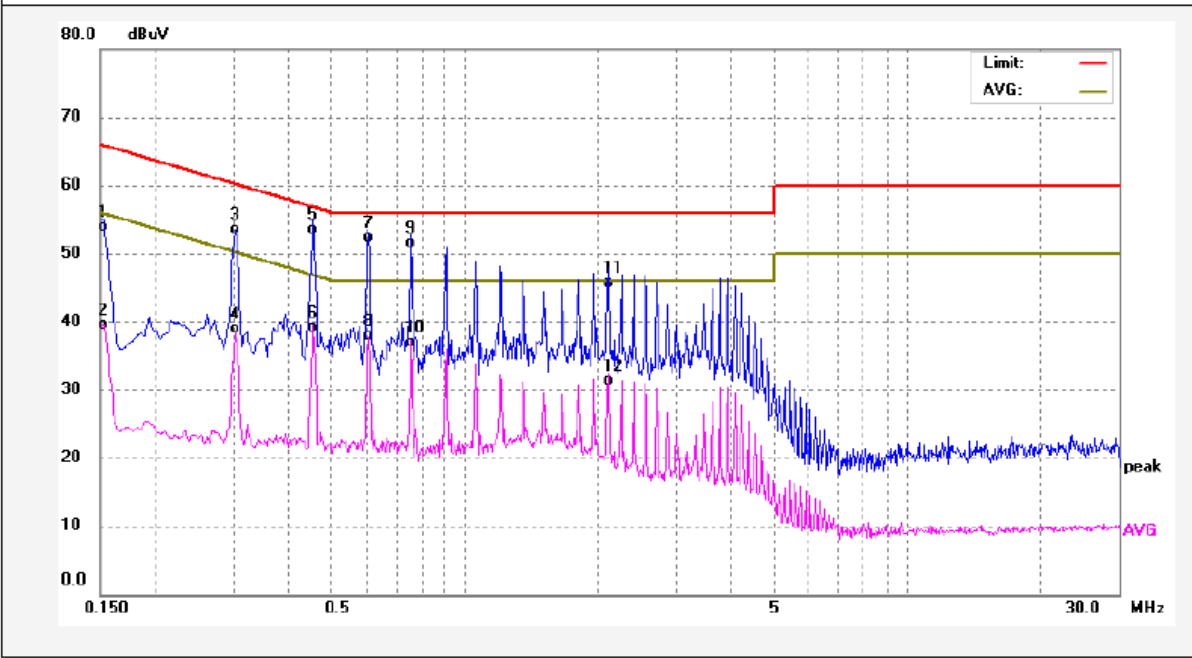
Note: The test voltage range for the pre-test is 9-30VAC, and the test voltage for the final test is 24VAC, and only the worst-case is shown in the report.

Live line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	42.75	10.02	52.77	65.99	-13.22	QP	
2	0.1500	28.54	10.02	38.56	55.99	-17.43	AVG	
3	0.3060	40.77	10.28	51.05	60.08	-9.03	QP	
4	0.3060	26.40	10.28	36.68	50.08	-13.40	AVG	
5	0.4540	41.81	10.52	52.33	56.80	-4.47	QP	
6	0.4540	27.34	10.52	37.86	46.80	-8.94	AVG	
7	0.6060	40.68	10.54	51.22	56.00	-4.78	QP	
8	0.6060	26.14	10.54	36.68	46.00	-9.32	AVG	
9	0.7580	39.97	10.64	50.61	56.00	-5.39	QP	
10	0.7580	25.47	10.64	36.11	46.00	-9.89	AVG	
11	3.7900	35.13	10.84	45.97	56.00	-10.03	QP	
12	3.7900	19.39	10.84	30.23	46.00	-15.77	AVG	

Neutral line:



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit dBuV	Margin (dB)	Detector	Remark
1	0.1500	43.83	9.99	53.82	65.99	-12.17	QP	
2	0.1500	29.42	9.99	39.41	55.99	-16.58	AVG	
3	0.3020	43.07	10.34	53.41	60.19	-6.78	QP	
4	0.3020	28.55	10.34	38.89	50.19	-11.30	AVG	
5	0.4540	42.96	10.51	53.47	56.80	-3.33	QP	
6	0.4540	28.54	10.51	39.05	46.80	-7.75	AVG	
7	0.6060	41.93	10.47	52.40	56.00	-3.60	QP	
8	0.6060	27.39	10.47	37.86	46.00	-8.14	AVG	
9	0.7580	40.94	10.51	51.45	56.00	-4.55	QP	
10	0.7580	26.44	10.51	36.95	46.00	-9.05	AVG	
11	2.1140	34.98	10.66	45.64	56.00	-10.36	QP	
12	2.1140	20.66	10.66	31.32	46.00	-14.68	AVG	

8 Radiated Emissions

Test Requirement: FCC 47CFR Part 15 Section 15.209 & 15.247

Test Method: ANSI C63.10:2013

Test Result: PASS

Measurement Distance: 3m

Limit:

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist.	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	$2400/F(\text{kHz})$	300	$10000 * 2400/F(\text{kHz})$	$20\log^{(2400/F(\text{kHz}))} + 80$
0.490 ~ 1.705	$24000/F(\text{kHz})$	30	$100 * 24000/F(\text{kHz})$	$20\log^{(24000/F(\text{kHz}))} + 40$
1.705 ~ 30	30	30	$100 * 30$	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

8.1 EUT Operation

Operating Environment:

Temperature: 23.5 °C

Humidity: 52.1 % RH

Atmospheric Pressure: 101.2kPa

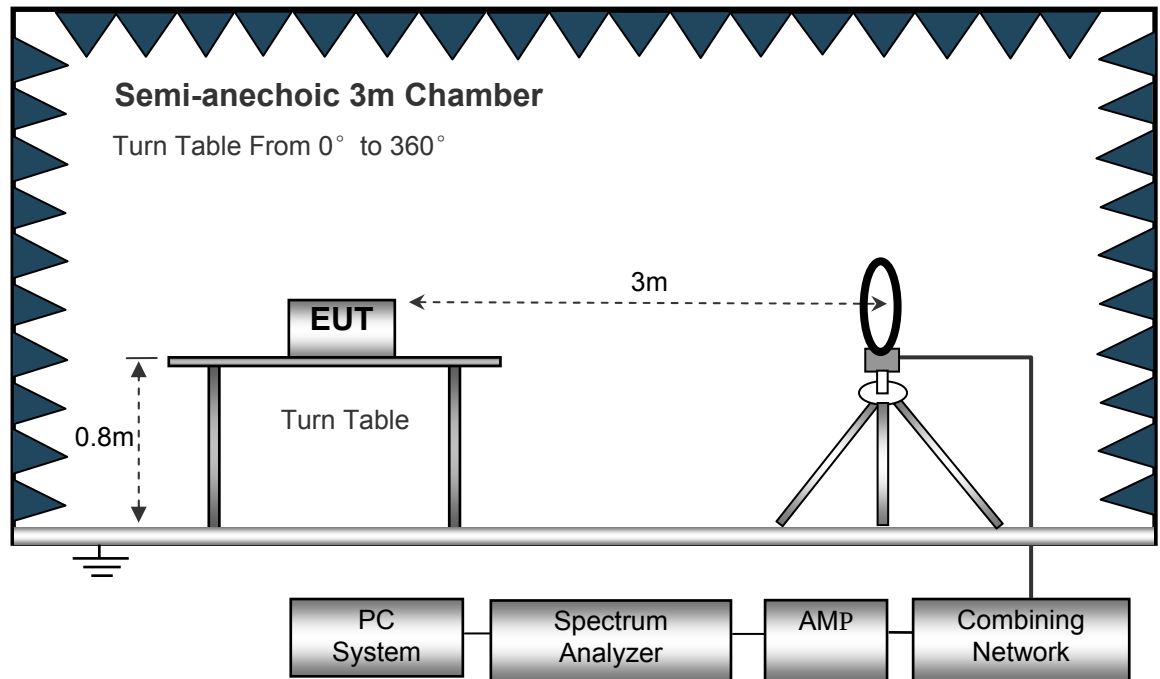
EUT Operation: TX

The test was performed in transmitting mode, the test data were shown in the report.

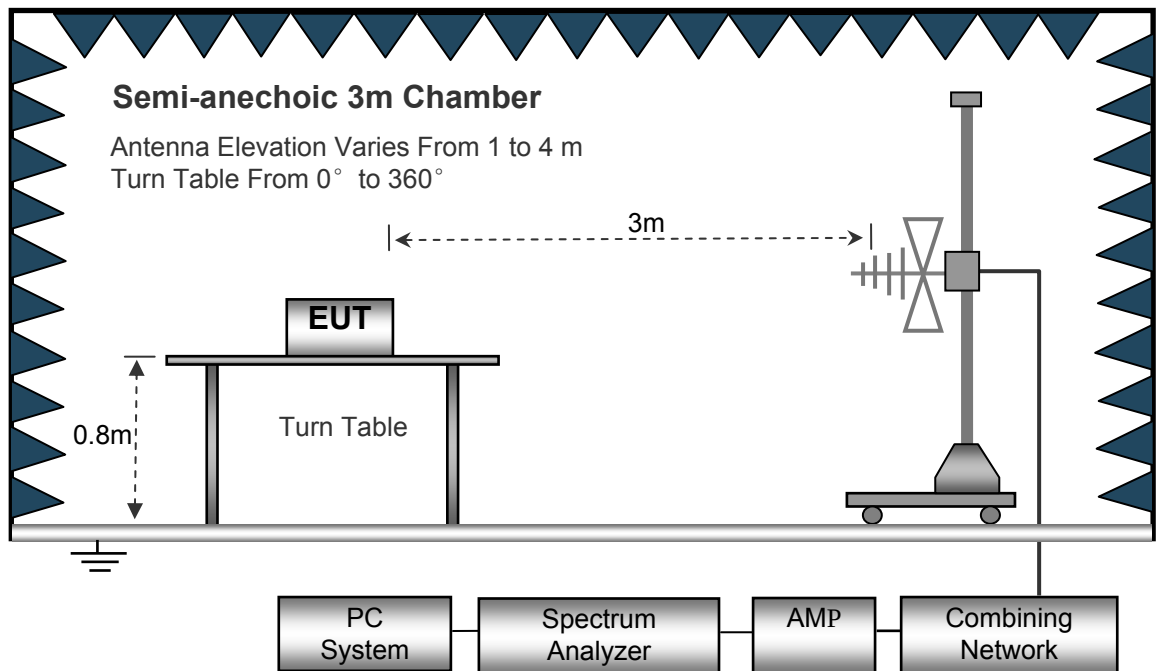
8.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10.

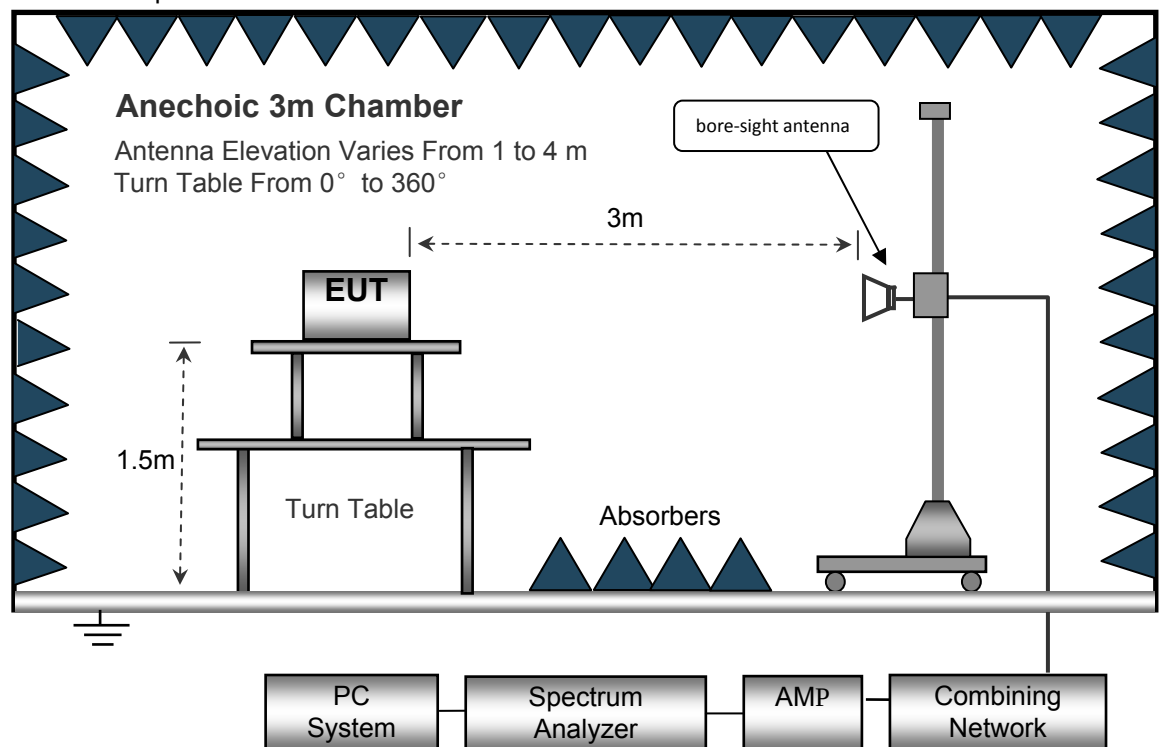
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.



8.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed Auto
 IF Bandwidth..... 10kHz
 Video Bandwidth..... 10kHz
 Resolution Bandwidth..... 10kHz

30MHz ~ 1GHz

Sweep Speed Auto
 Detector PK
 Resolution Bandwidth..... 100kHz
 Video Bandwidth..... 300kHz

Above 1GHz

Sweep Speed Auto
 Detector PK
 Resolution Bandwidth..... 1MHz
 Video Bandwidth..... 3MHz
 Detector Ave.
 Resolution Bandwidth..... 1MHz
 Video Bandwidth..... 10Hz

8.4 Test Procedure

1. The EUT is placed on a turntable, which is 0.8m above ground plane for below 1GHz and 1.5m for above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The radiation measurements are performed in X,Y and Z axis positioning(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand),the worst condition was tested putting the eut in Z axis,so the worst data were shown as follow.
8. A 2.4GHz high –pass filter is used during radiated emissions above 1GHz measurement.

8.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

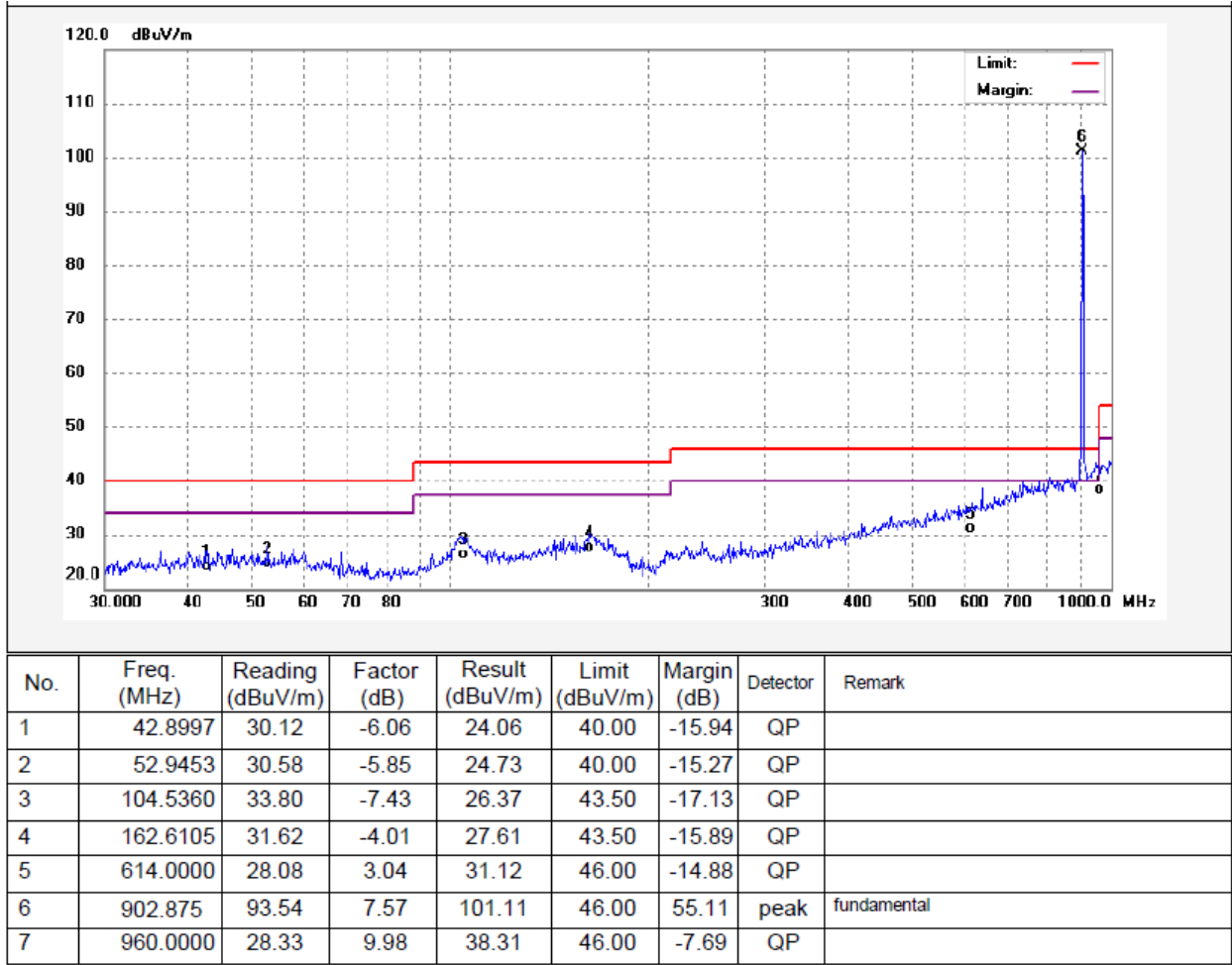
8.6 Summary of Test Results

Test Frequency: 9kHz~30MHz

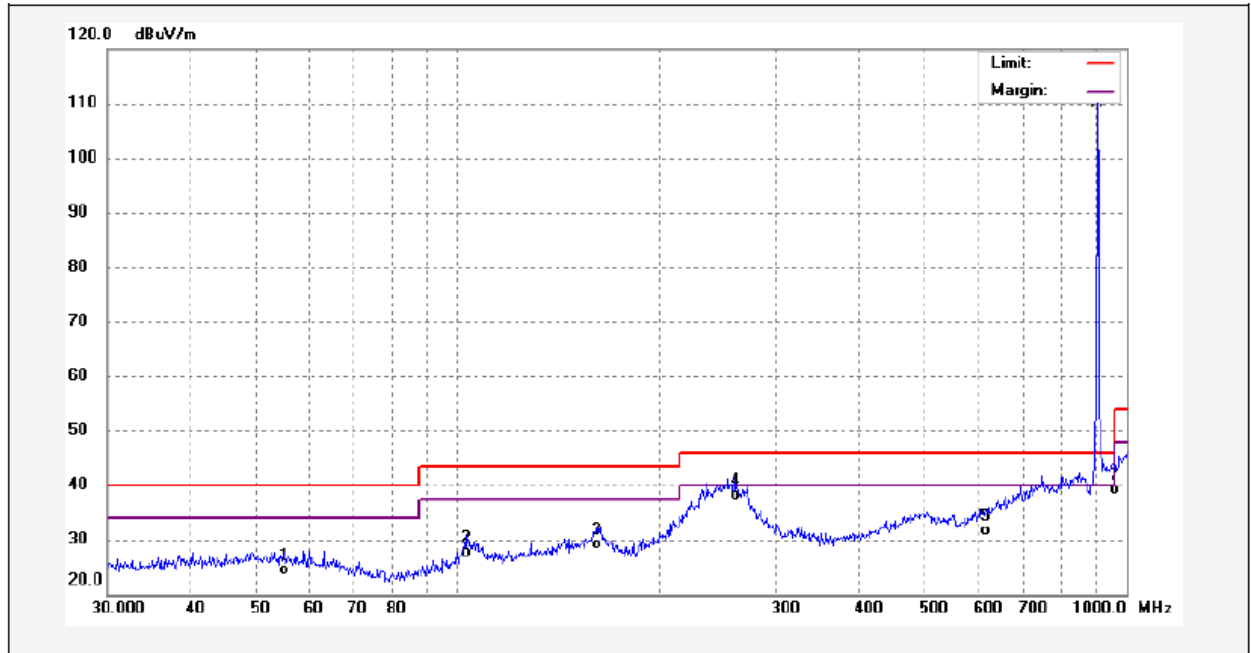
The measurements were more than 20 dB below the limit and not reported.

Test Frequency: 30MHz ~1GHz

Antenna Polarization: Vertical



Antenna Polarization: Horizontal



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	55.2207	30.26	-5.94	24.32	40.00	-15.68	QP	
2	103.0800	35.08	-7.57	27.51	43.50	-15.99	QP	
3	161.4740	33.00	-3.87	29.13	43.50	-14.37	QP	
4	260.1444	37.75	0.46	38.21	46.00	-7.79	QP	
5	614.0000	29.52	2.04	31.56	46.00	-14.44	QP	
6	902.875	101.44	8.67	110.11	46.00	64.11	peak	fundamental
7	960.0000	29.17	9.98	39.15	46.00	-6.85	QP	

Test Frequency: Above 1GHz

Frequency	Reading	Detector	Turn table Angle	RX Ant.		Corrected Factor	Corrected Amplitude	Limit	Margin
				Height	Polar				
(MHz)	(dBμV)	(PK/QP/AV)	Degree	(m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
2-FSK Channel 902.875MHz									
1805.750	58.50	PK	180	1.5	H	-10.72	47.78	74.00	-26.22
-	-	-	-	-	-	-	-	-	-
1805.750	66.50	PK	0	1.5	V	-10.72	55.78	74.00	-18.22
1805.750	66.50	AV	90	1.5	V	-10.72	42.64	54.00	-11.36
-	-	-	-	-	-	-	-	-	-

Note: The measurements were more than 20 dB below the limit and not reported.

9 Conducted Spurious Emissions

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019

Regulation 15.247 (d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the

Test Limit: the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions 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)).

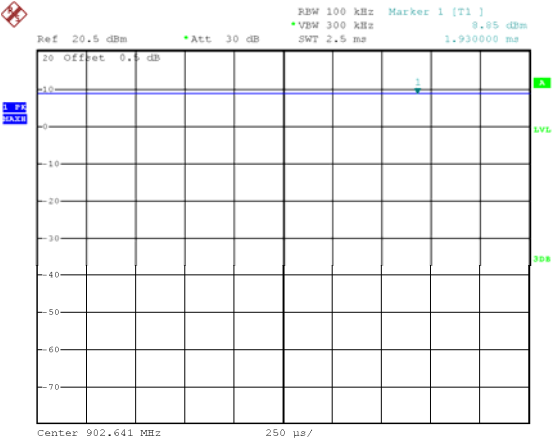
Test Mode: Transmitting

9.1 Test Produce

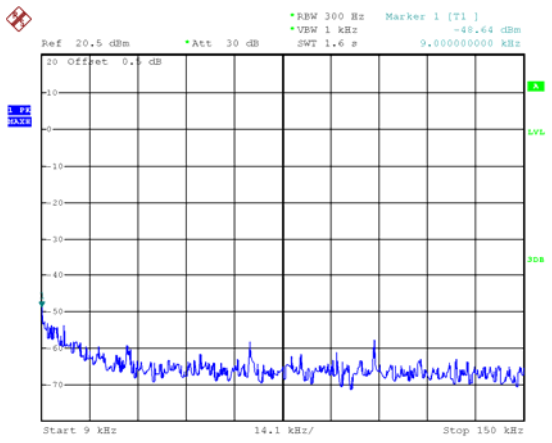
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

9.2 Test Result

9kHz – 150kHz

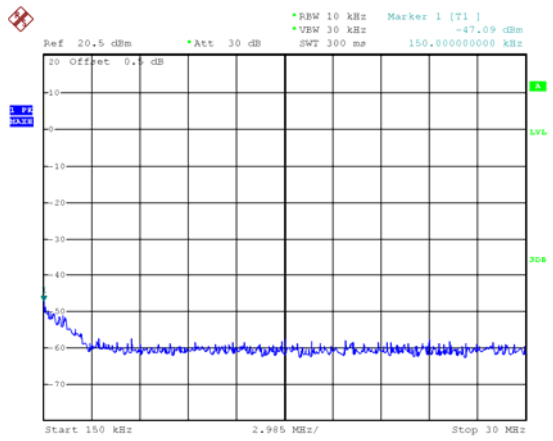


Date: 11.OCT.2024 18:13:38

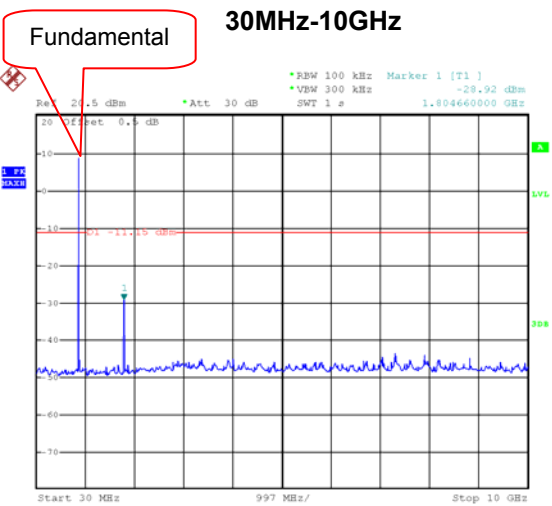


Date: 8.OCT.2024 17:11:27

150kHz – 30MHz



Date: 8.OCT.2024 17:11:00



Date: 11.OCT.2024 18:14:23

10 6 dB Bandwidth Measurement

Test Requirement: FCC 47CFR Part 15 Section 15.247
Test Method: ANSI C63.10:2013
KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
Test Limit: §15.247(a)(2)
Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
Test Mode: Transmitting

10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. 6dB Bandwidth Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

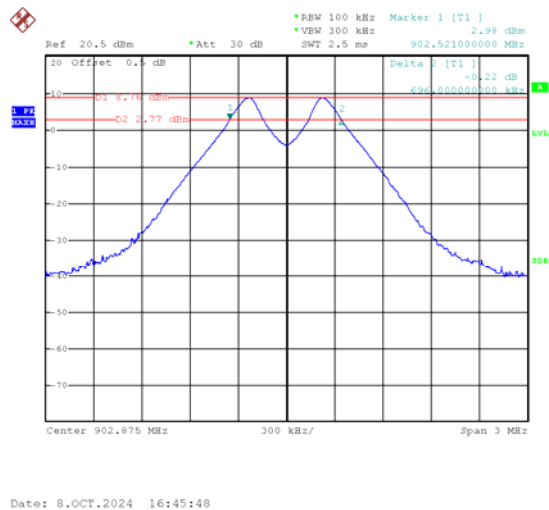
10.2 Test Result

Operation mode	Test Channel	6dB Bandwidth (MHz)
TX_FSK	Channel 0	0.696

Note: please refer to next page for test plot.

Test plot:

Mode: TX 2-FSK channel 0



11 Maximum Peak Output Power

Test Requirement: FCC 47CFR Part 15 Section 15.247
Test Method: ANSI C63.10:2013
KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
Test Limit: §15.247(b)
The maximum peak conducted output power of the intentional radiator shall not exceed 1W.
Test Mode: Transmitting

11.1 Test Procedure

According to KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019

Section 8.3.1.1 RBW ≥ DTS bandwidth

Subclause 11.9.1.1 of ANSI C63.10 is applicable.

Section 8.3.1.2 Integrated band power method

For measuring the output power of a device transmitting a wide-band noise-like signal where the peak power amplitude is a statistical parameter, the preferred methodology is to use an integrated average power measurement, as described in 8.3.2. The peak integrated band power method of 11.9.1 in ANSI C63.10 is not applicable.

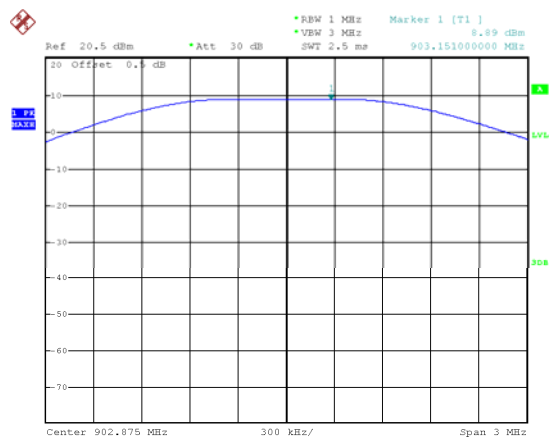
Subclause 11.9.2 of ANSI C63.10 is applicable.

11.2 Test Result

Operation mode	Channel Frequency (MHz)	Maximum Peak Output Power (dBm)	Limit
TX_FSK	902.875MHz	8.89	1W/30dBm

Test Plot

Mode: TX 2-FSK channel 0



Date: 8.OCT.2024 16:46:35

12 Power Spectral density

Test Requirement: FCC 47CFR Part 15 Section 15.247
Test Method: ANSI C63.10:2013
KDB 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
§15.247(e)
Test Limit: For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
Test Mode: Transmitting

12.1 Test Procedure

According to KDB 558074 D01 15.247 Meas Guidance v05r02 April 2, 2019 section 8.4

Subclause 11.10 of ANSI C63.10 is applicable.

Choose the test procedure according to the product type

Peak PSD

Subclause 11.10.2 of ANSI C63.10 is applicable.

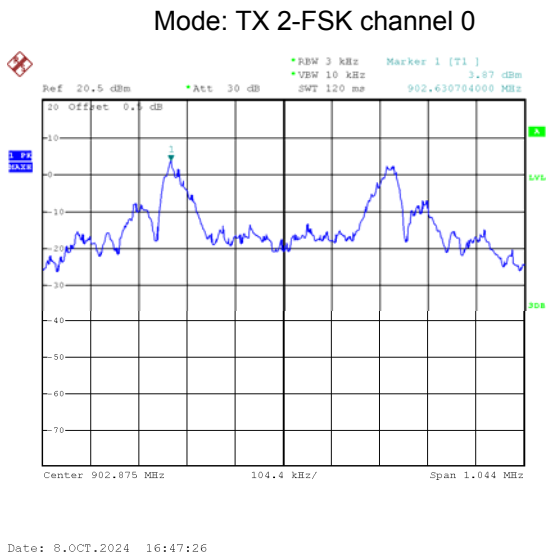
AVG PSD

Subclause 11.10.3/4/5/6/7/8 of ANSI C63.10 is applicable.

12.2 Test Result

Operation mode	Channel Frequency (MHz)	Power Spectral (dBm per 3kHz)	Limit
TX_FSK	902.875MHz	3.87	8dBm per 3kHz

Test Plot



13 Antenna Requirement

According to the FCC Part 15 Paragraph 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. This product has a whip antenna fulfil the requirement of this section.

Note: Please refer to EUT photos for more details.

14 RF Exposure

Remark: Please refer to MPE test report: WTN24D08191405W003.

15 Photographs of test setup and EUT.

Note: Please refer to appendix: Appendix- E9X-HSM-2-Photos.

=====End of Report=====