ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

FCC Applicant:	CASTLES TECHNOLOGY CO., LTD. 6F., NO. 207-5, SEC. 3, BEIXIN RD., XINDIAN DISTRICT, NEW TAIPEI CITY 23143, TAIWAN (R.O.C)
FCC Manufacturer:	CASTLES TECHNOLOGY CO., LTD. 6F., NO. 207-5, SEC. 3, BEIXIN RD., XINDIAN DISTRICT, NEW TAIPEI CITY 23143, TAIWAN (R.O.C)
ISED Applicant:	CASTLES TECHNOLOGY CO., LTD. 6F., NO. 207-5, SEC. 3, BEISHIN RD., XINDIAN DISTRICT, NEW TAIPEI CITY 23143, Taiwan (R.O.C)
ISED Manufacturer:	CASTLES TECHNOLOGY CO., LTD. 6F., NO. 207-5, SEC. 3, BEISHIN RD., XINDIAN DISTRICT, NEW TAIPEI CITY 23143, Taiwan (R.O.C)
Product Name:	POS Terminal
Brand Name:	CASTLES TECHNOLOGY
Model No.:	S2L
Model Difference:	N/A
Report Number:	TERF2307001823E2
FCC ID	WIYS2L001
IC:	27350-S2L001
Date of EUT Received:	July 24, 2023
Date of Test:	July 24, 2023～December 04, 2023
Issue Date:	December 07, 2023

Approved By _____
Vito Pei

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.225, ISED RSS-210.

The results of this report relate only to the sample identified in this report.

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Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2307001823E2	00	Original	Aug. 28, 2023	Candice Li	
TERF2307001823E2	01	Modify Section 1.1, 2.4, 2.5, 3, 10	Nov. 28, 2023	Candice Li	*
TERF2307001823E2	02	Modify Section 2.4, 2.5, 10.4	Dec. 5, 2023	Candice Li	*
TERF2307001823E2	03	Modify Date of Test	Dec. 7, 2023	Candice Li	*

Note:

1、 The remark "*" indicates modification of the report upon requests from certification body.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	POS Terminal
Brand Name:	CASTLES TECHNOLOGY
Model No.:	S2L
Model Difference:	N/A
Hardware Version:	V1A.00
Software Version:	N/A
EUT Series No.:	173232315138
Power Supply:	12Vdc from Adapter
Test Software (Name/Version)	Test Utility 2.7.2

1.2 RF specification

Radio Technology:	NFC
Operating Frequency	13.56MHz
Transmit Power	34.97 dBuV/m at 30m.
Number of Channels	1
Modulation Type	ASK
Antenna Type	Loop Antenna

Note: Antenna information is provided by the applicant.

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1.3 Test Methodology

FCC Part 15, Subpart C §15.225

RSS-210 issue 10 December 2019

RSS-Gen, Issue 5 April 2018

ANSI C63.10:2013.

1.4 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 2		
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		

Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

1.5 Special Accessories

There is no other accessory attached. This is the worst case condition.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The Tx frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.

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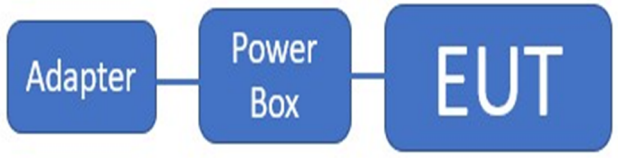
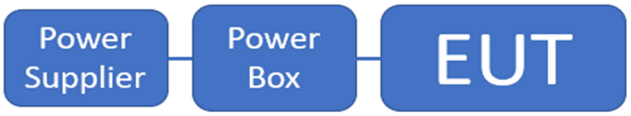
2.4 Test Configuration

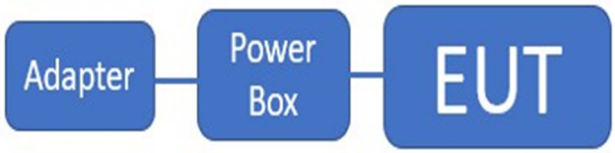
Conduction Setup



Conducted Setup



Radiated Setup



2.5 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Box	CASTLES	SATURN-PX	N/A	N/A	N/A
Adapter	ABP	AD0181-1201000UC	N/A	N/A	N/A

Conducted Emission Test Site: Conducted G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Box	CASTLES	SATURN-PX	N/A	N/A	N/A

Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Box	CASTLES	SATURN-PX	N/A	N/A	N/A
Adapter	ABP	AD0181-1201000UC	N/A	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207	RSS-Gen § 8.8	AC Power Line Conducted Emission	Compliant
§15.225 (a)-(d)	RSS210 Annex B B.6 (a)	Radiated Emission	Compliant
§15.209	RSS-Gen § 8.9	Radiated Emission Limits, general requirement	Compliant
§15.225 (e)	RSS210 Annex B B.6 (b)	Frequency Stability	Compliant
§2.1049 §15.215 (c)	RSS-Gen § 6.7	Emission Bandwidth	Compliant
§15.203	N/A	Antenna Requirement	Compliant
§15.205	RSS-Gen § 8.10	Restricted Bands	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 The Worst Test Modes and Channel Details

1. The EUT stay in continuous transmission mode.
2. The frequency 13.56 MHz is the default channel to test, where it is the only manipulative channel as this application supports.
3. Only one configuration is supported/applicable as follows.

RADIATED EMISSION TEST			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK
FREQUENCY STABILITY			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK
20dB & 99% BANDWIDTH			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK

The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	2.32	dB
Frequency Stability	+/-	1.53	Hz
Emission Bandwidth	+/-	1.53	Hz
Temperature	+/-	0.7	°C
Humidity	+/-	3	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty				
Polarization: Vertical	**+/-**	**2.8**	**dB**	9kHz~30MHz
	+/-	**4.82**	**dB**	30MHz - 1000MHz
	+/-	**4.37**	**dB**	1GHz - 18GHz
	+/-	**4.21**	**dB**	18GHz - 40GHz
Polarization: Horizontal	**+/-**	**2.8**	**dB**	9kHz~30MHz
	+/-	**4.54**	**dB**	30MHz - 1000MHz
	+/-	**4.37**	**dB**	1GHz - 18GHz
	+/-	**4.21**	**dB**	18GHz - 40GHz

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 MEASUREMENT EQUIPMENT USED

6.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	SCHWARZBECK Mess-	NSLK8127	973	04/20/2023	04/19/2024
EMI Test Receiver	R&S	ESCI	101342	04/25/2023	04/24/2024
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2023	03/26/2024
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2023	03/26/2024
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted F					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
H-Loop Near Field Antenna	LANGER EMV-Technik	LF-R 400	02-1597	N.C.R	N.C.R
Temperature Chamber	TERCHY	MHK-120LK	1020582	06/17/2023	06/16/2024
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071574	06/29/2023	06/28/2024
DC Power Supply	Gwinstek	SPS-3610	GEW902165	01/16/2023	01/15/2024

6.3 Radiated Measurement

Radiated Emission Test Site: SAC G					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWARZBECK	VULB 9168	1206	01/17/2023	01/16/2024
Loop Antenna	ETS.LINDGREN	6502	14303	05/23/2023	05/22/2024
3m Site NSA	SGS	966 chamber G	N/A	03/30/2023	03/29/2024
Spectrum Analyzer	KEYSIGHT	N9010A	MY54510568	07/07/2023	07/06/2024
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R
Pre-Amplifier	EMC Instruments	EMC330N	980781	03/15/2023	03/14/2024
Coaxial Cable	EMC Instruments	EMCCFD400-NM-NM-8000-5000-2000	210216、210217、210218	03/15/2023	03/14/2024
Coaxial Cable	EMC Instruments	EMC104-SM-SM-8000-5000-5000	210219、210220、210221	03/15/2023	03/14/2024
Coaxial Cable	EMC Instruments	EMC105-NM-NM-5000-15000	210224、210306	03/15/2023	03/14/2024

NOTE: *N.C.R refers to Not Calibrated Required.*

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7 CONDUCTED EMISSIONS TEST

7.1 Standard Applicable

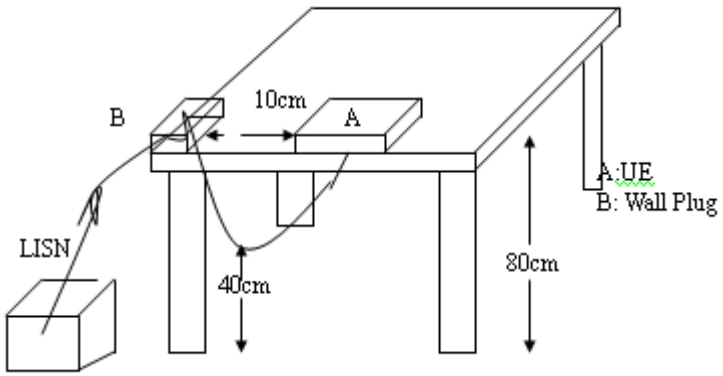
Frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits (dBuV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

7.2 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120-240Vac/60Hz power source.

7.3 Test SET-UP (Block Diagram of Configuration)



7.4 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

7.5 Measurement Result

Note: Refer to next page for measurement data and plots.
Note2: The test data reveals the worst-case results that closest to the limit.

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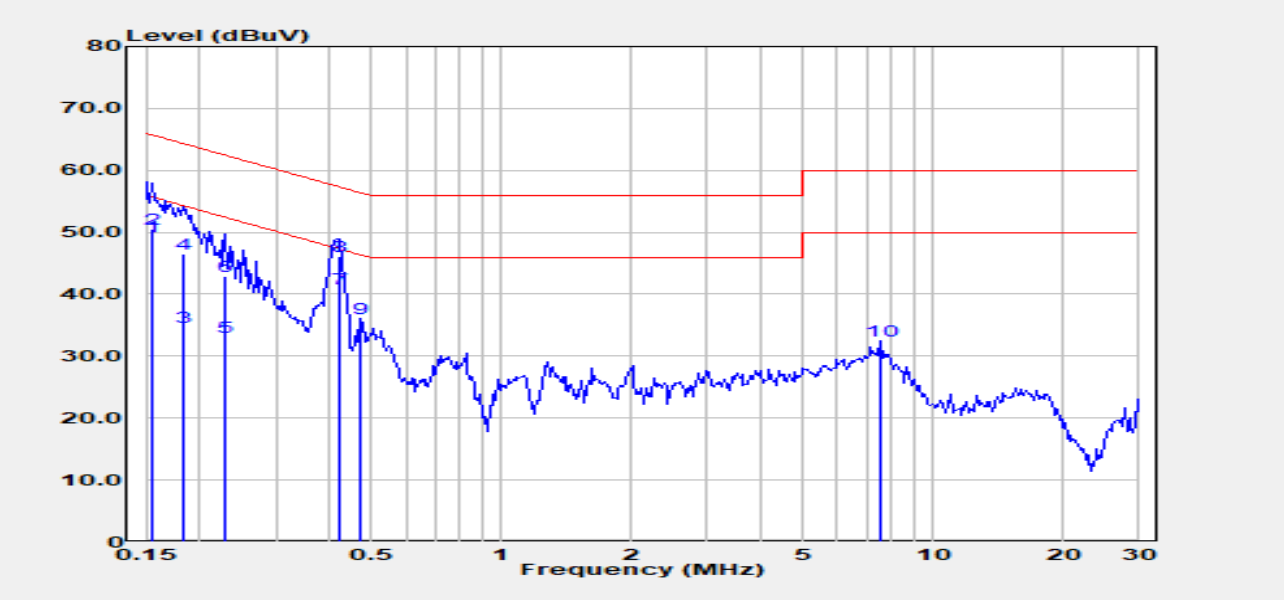
AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:TERF2307001823E2	Test Site	:Conduction C
Test Mode	:NFC	Test Date	:2023-07-28
Power	:120V60Hz	Temp./Humi.	:23.0℃/56%
Probe	:L1	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.155	Average	39.00	10.32	49.32	55.74	-6.42
0.155	QP	40.20	10.32	50.52	65.74	-15.22
0.183	Average	24.30	10.31	34.61	54.33	-19.71
0.183	QP	36.30	10.31	46.61	64.33	-17.71
0.229	Average	22.80	10.31	33.11	52.48	-19.37
0.229	QP	32.50	10.31	42.81	62.48	-19.67
0.419	Average	30.50	10.33	40.83	47.46	-6.64
0.419	QP	35.70	10.33	46.03	57.46	-11.44
0.471	Peak	25.71	10.33	36.04	56.49	-20.45
7.566	Peak	21.80	10.58	32.39	60.00	-27.61

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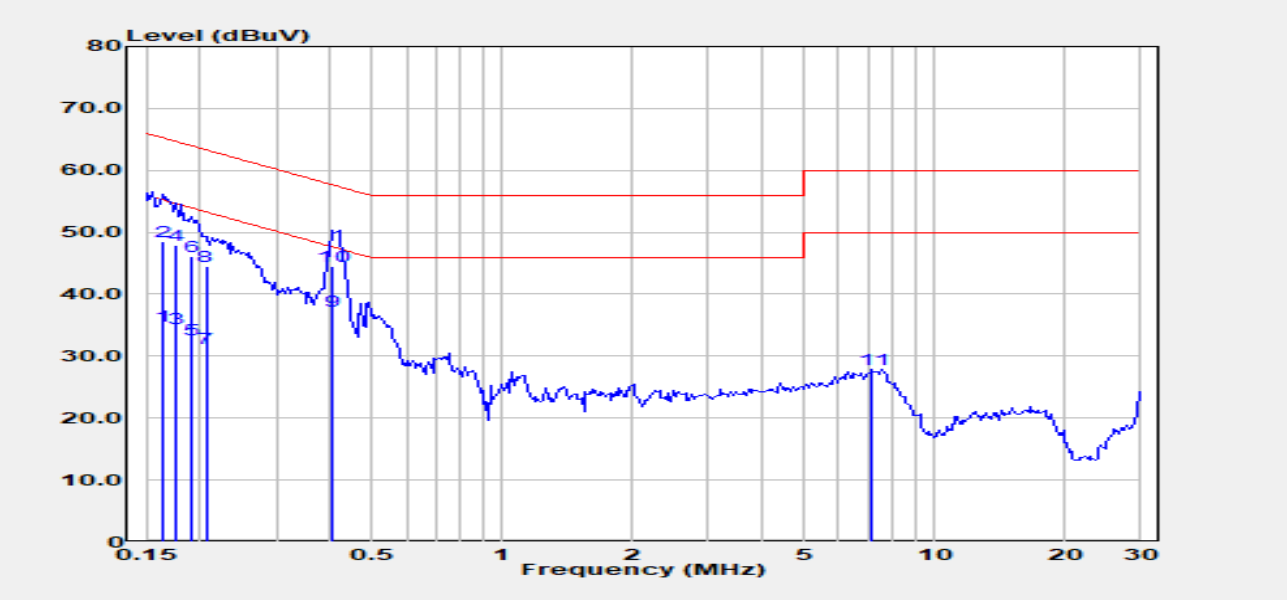
Report Number	:TERF2307001823E2	Test Site	:Conduction C
Test Mode	:NFC	Test Date	:2023-07-28
Power	:120V60Hz	Temp./Humi.	:23.0℃/56%
Probe	:N	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.163	Average	24.50	10.30	34.80	55.30	-20.50
0.163	QP	38.30	10.30	48.60	65.30	-16.70
0.176	Average	24.20	10.30	34.50	54.68	-20.18
0.176	QP	37.70	10.30	48.00	64.68	-16.68
0.191	Average	22.40	10.30	32.70	53.98	-21.28
0.191	QP	35.80	10.30	46.10	63.98	-17.88
0.206	Average	20.90	10.30	31.20	53.36	-22.16
0.206	QP	34.30	10.30	44.60	63.36	-18.76
0.406	Average	27.00	10.31	37.31	47.73	-10.42
0.406	QP	34.30	10.31	44.61	57.73	-13.12
7.175	Peak	17.37	10.60	27.97	60.00	-32.03

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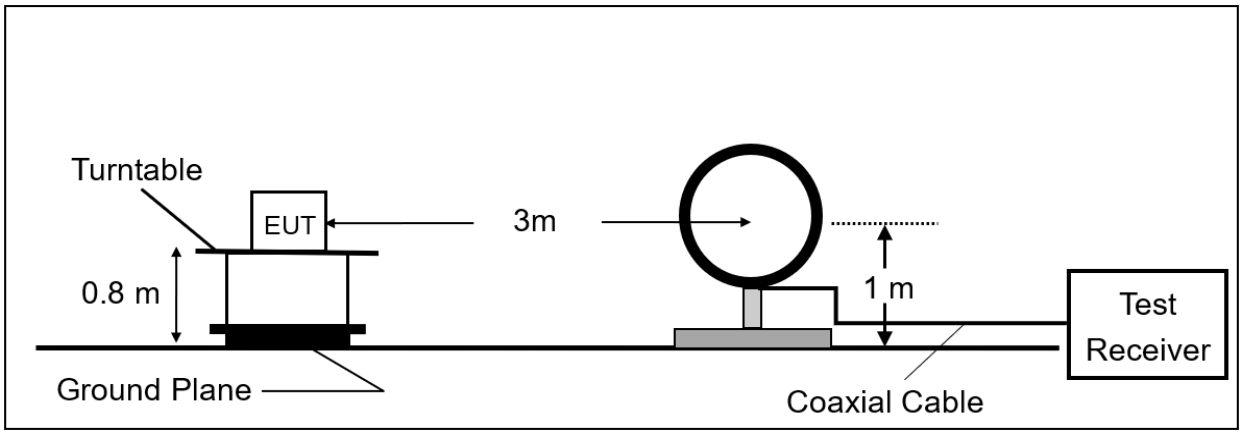
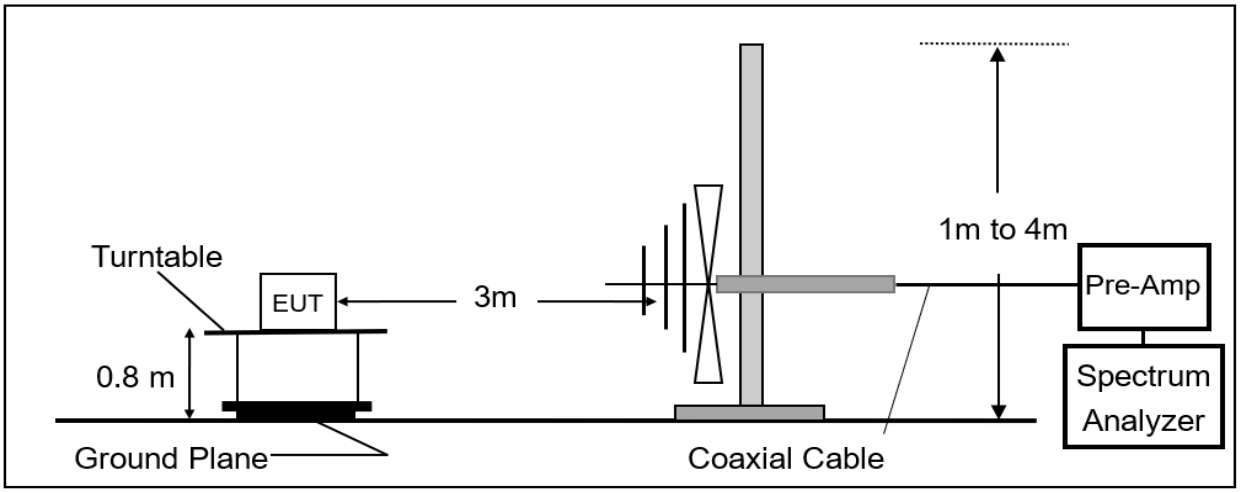
8 RADIATED EMISSION TEST

8.1 Test SET-UP (Block Diagram of Configuration)

(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



8.2 Measurement Procedure

1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all default test channel measured were complete.

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8.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

8.4 Field Strength of Fundamental Emission

8.4.1 Applicable standard

Rules and specifiactions	CFR 47 Part 15 section 15.225(a)-(d)	
Frequency of Emission (MHz)	Field Strength (μV/m)at 30m	Field Strength (dBμV/m)at 30m
1.705~13.110	30	29.5
13.110~13.410	106	40.5
13.410~13.553	334	50.5
13.553~13.567	15848	84
13.567~13.710	334	50.5
13.710~14.010	106	40.5
14.010~30.00	30	29.5

Radiated Mask per ISED RSS 210 Annex B B6

(a) 15.848 millivolts/m (84 dBμV/m) at 30 m, within the band 13.553-13.567 MHz.

(b) 334 microvolts/m (50.5 dBμV/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz.

(c) 106 microvolts/m (40.5 dBμV/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz.

(d) RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz

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8.4.2 Distance Extrapolation Factor

30m to 3m

Distance extrapolation = 40 *log (30/3) = 40 dB

30m to 10m

Distance extrapolation = 40 *log (30/10) = 19.08 dB

10m to 3m

Distance extrapolation = 40 *log (10/3) = 20.92 dB

Note:

1. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
2. The lower limit shall apply at the transition frequencies.
3. KDB 414788 D01 OATS and 3m semi-anechoic chamber Justification:
   Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. OATS and 3m SAC chamber testing had been performed and 3m SAC measured test result is the worst case test result.

Actual FS(dBμV/m) = Spectrum. Reading level(dBμV) + Factor(dB)

Below 30 MHz of Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Distance Factor (dB)

Above 30 MHz of Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amp Gain (dB)

The trace on RE (radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

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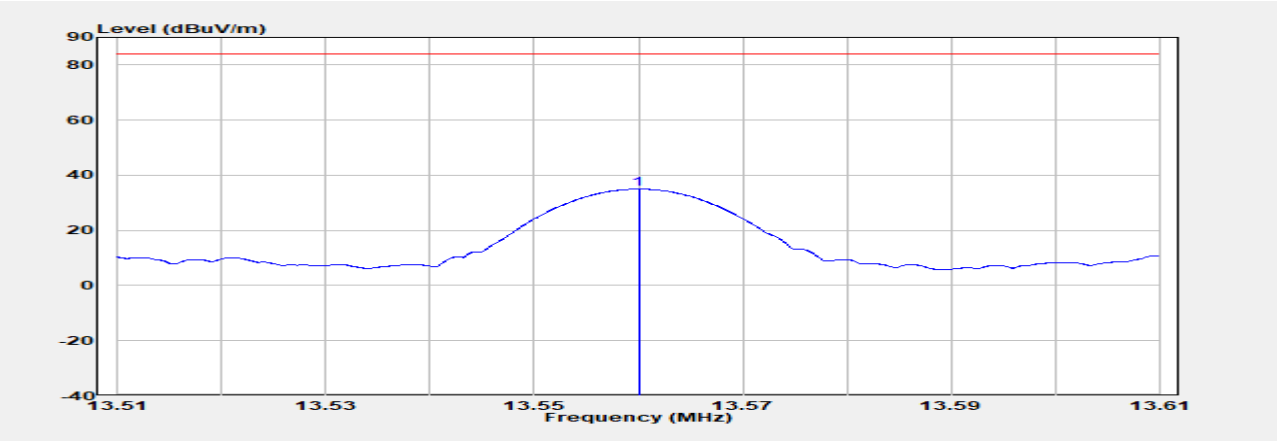
8.4.3 Field Strength of Fundamental Emission Measurement Result

Report Number	:TERF2307001823E2	Test Site	:SAC G Chamber
Operation Mode	:NFC	Test Date	:2023-07-26
Test Frequency	:13.56 MHz	Temp./Humi.	:25.3℃/57%
Test Mode	:Main	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual dBμV/m	Limit dBμV/m	Margin dB
13.560	Peak	63.18	-28.20	34.97	84.00	-49.03

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

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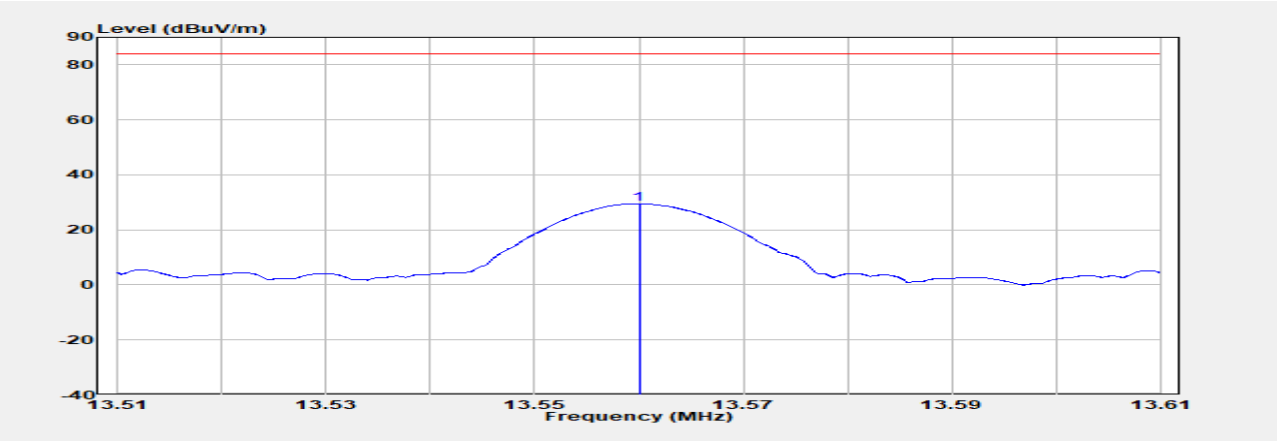
Report Number	:TERF2307001823E2	Test Site	:SAC G Chamber
Operation Mode	:NFC	Test Date	:2023-07-26
Test Frequency	:13.56 MHz	Temp./Humi.	:25.3℃/57%
Test Mode	:Main	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual dBμV/m	Limit dBμV/m	Margin dB
13.560	Peak	57.71	-28.20	29.51	84.00	-54.49

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

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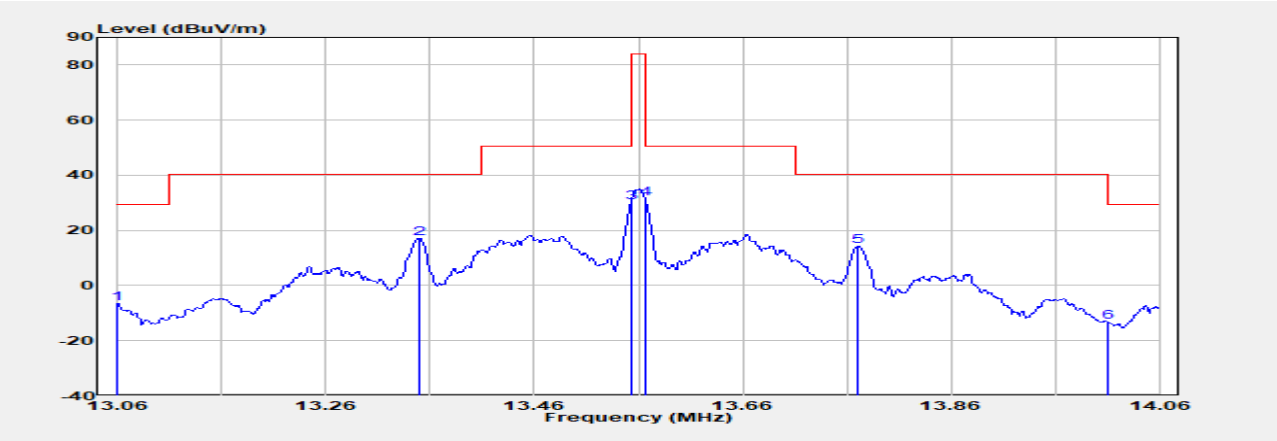
Report Number	:TERF2307001823E2	Test Site	:SAC G Chamber
Operation Mode	:NFC	Test Date	:2023-07-26
Test Frequency	:13.56 MHz	Temp./Humi.	:25.3℃/57%
Test Mode	:Mask	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual dBμV/m	Limit dBμV/m	Margin dB
13.060	Peak	21.65	-28.17	-6.52	29.54	-36.06
13.350	Peak	45.35	-28.19	17.16	40.50	-23.34
13.553	Peak	58.42	-28.20	30.22	50.47	-20.25
13.566	Peak	59.86	-28.20	31.65	84.00	-52.35
13.771	Peak	42.33	-28.22	14.11	40.50	-26.39
14.010	Peak	15.17	-28.24	-13.07	29.54	-42.61

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

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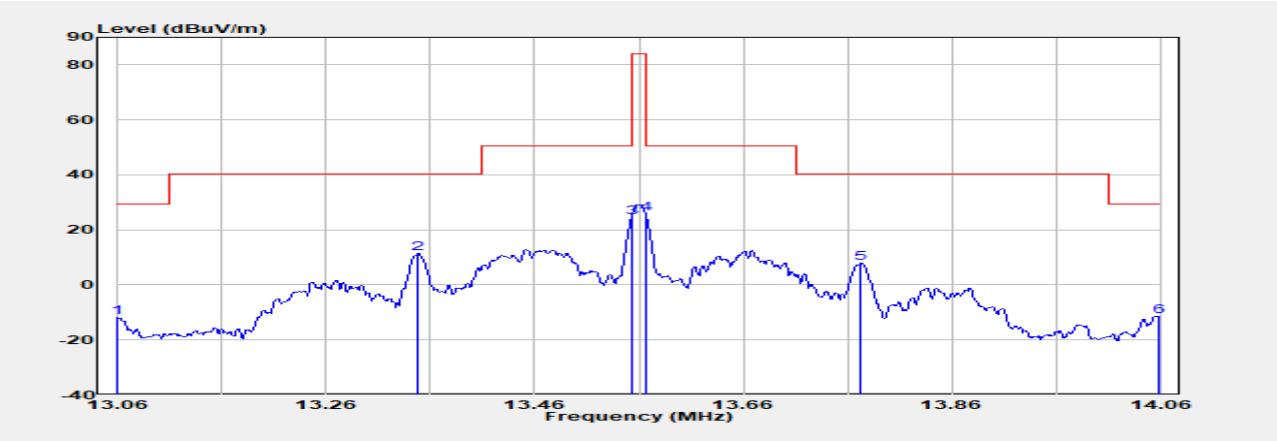
Report Number	:TERF2307001823E2	Test Site	:SAC G Chamber
Operation Mode	:NFC	Test Date	:2023-07-26
Test Frequency	:13.56 MHz	Temp./Humi.	:25.3℃/57%
Test Mode	:Mask	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual dBμV/m	Limit dBμV/m	Margin dB
13.060	Peak	16.47	-28.17	-11.70	29.54	-41.24
13.348	Peak	39.47	-28.19	11.28	40.50	-29.22
13.553	Peak	52.72	-28.20	24.51	50.47	-25.96
13.566	Peak	54.22	-28.20	26.02	84.00	-57.98
13.773	Peak	35.99	-28.22	7.77	40.50	-32.73
14.058	Peak	16.73	-28.24	-11.51	29.54	-41.05

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

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8.5 Radiated Spurious Emission Measurement

8.5.1 Standard Applicable

The field strength of any emissions appearing outside of the 13.110-14.010 MHz shall not exceed the general radiated emission limits as below.

Frequency (MHz)	Field strength (μV/m)	Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

1. Emission level in dBμV/m=20 log (μV/m)
2. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
3. 20*log(30uV/m) = 29.54 dBuV/m
4. The lower limit shall apply at the transition frequencies.
5. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.
6. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of §15.205 and RSS-Gen §8.10.
7. The general radiated emission limits in §15.209 and RSS-Gen §8.9 apply for the spurious emission generate from UE, except for the fundamental emission where the respective section specifies otherwise.

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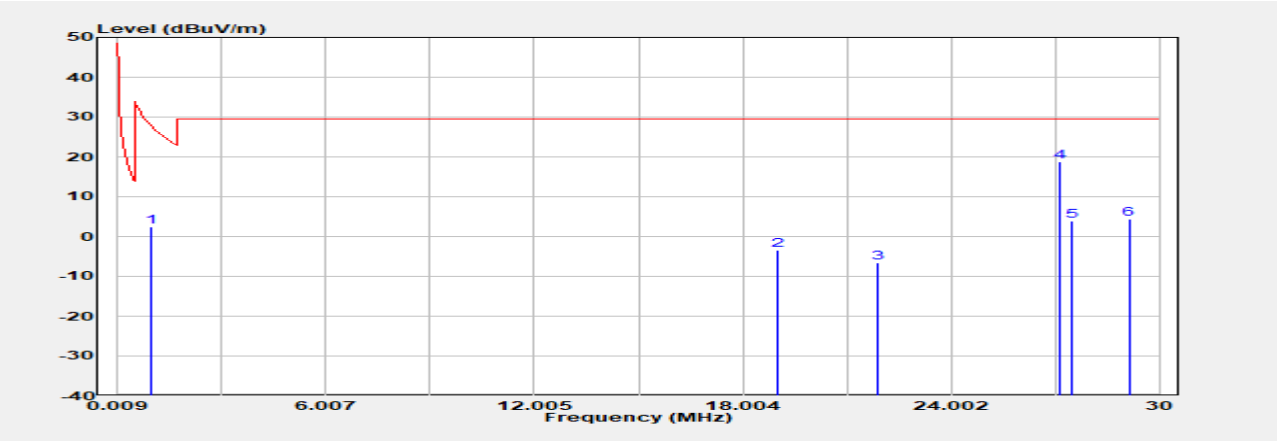
8.5.2 Radiated Spurious Emission Measurement Result

Report Number	:TERF2307001823E2	Test Site	:SAC G Chamber
Operation Mode	:NFC	Test Date	:2023-07-26
Test Frequency	:13.56 MHz	Temp./Humi.	:25.3℃/57%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual dBμV/m	Limit dBμV/m	Margin dB
0.969	Peak	31.14	-28.72	2.42	27.88	-25.46
19.023	Peak	25.01	-28.54	-3.53	29.54	-33.07
21.902	Peak	22.42	-28.99	-6.58	29.54	-36.12
27.121	Peak	48.70	-29.95	18.76	29.54	-10.78
27.511	Peak	33.84	-30.01	3.83	29.54	-25.71
29.130	Peak	34.59	-30.26	4.33	29.54	-25.21

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

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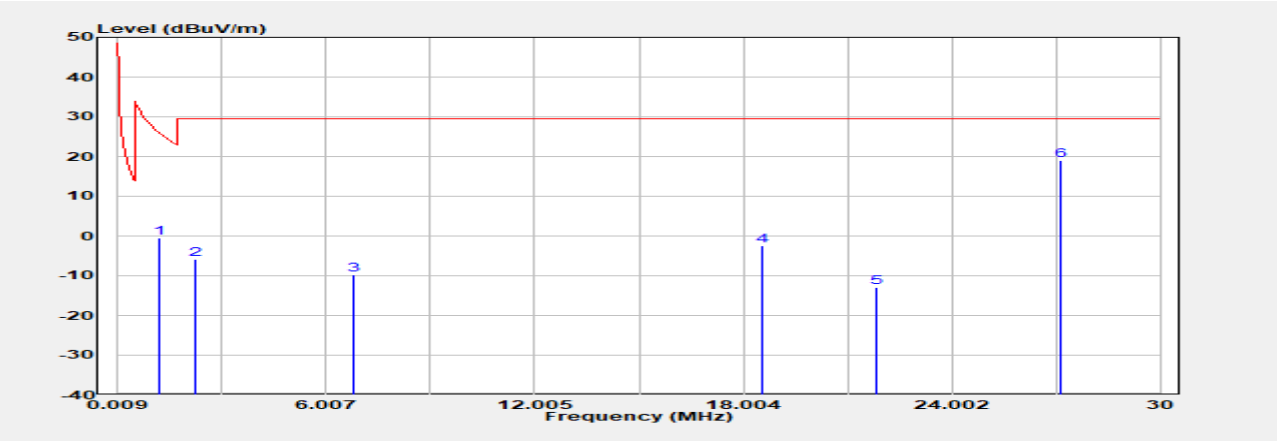
Operation Mode	:NFC	Test Date	:2023-07-26
Test Frequency	:13.56 MHz	Temp./Humi.	:25.3℃/57%
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual dBμV/m	Limit dBμV/m	Margin dB
1.179	Peak	28.35	-28.76	-0.41	26.18	-26.58
2.228	Peak	23.01	-28.92	-5.90	29.54	-35.44
6.817	Peak	18.83	-28.50	-9.67	29.54	-39.21
18.573	Peak	26.12	-28.52	-2.40	29.54	-31.94
21.812	Peak	15.97	-28.98	-13.00	29.54	-42.54
27.121	Peak	49.02	-29.95	19.08	29.54	-10.46

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

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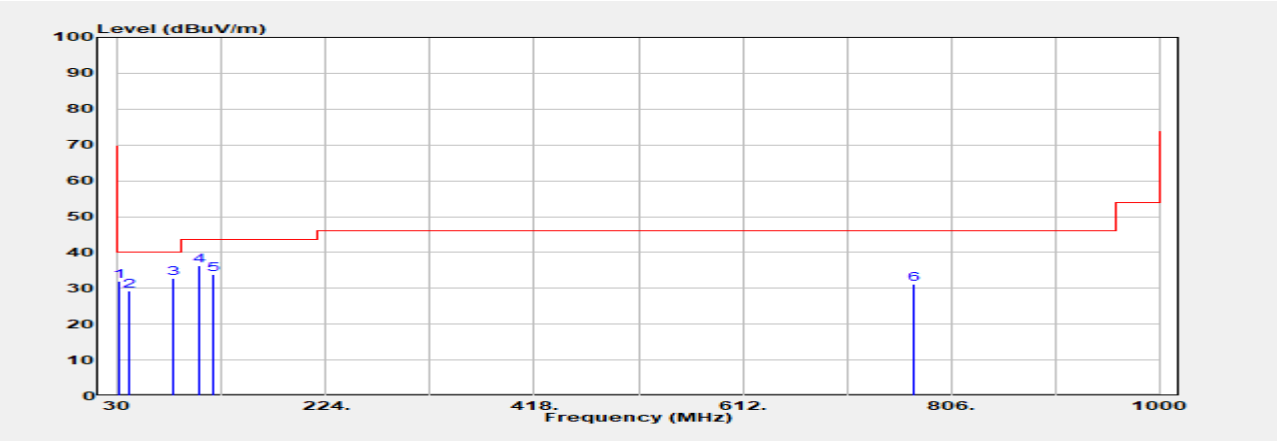
EUT Pol	:E2 Plane	Engineer	:Temo Chen



Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
31.940	QP	46.30	-14.31	31.99	40.00	-8.01
40.680	Peak	42.80	-13.44	29.36	40.00	-10.64
81.410	Peak	50.75	-17.88	32.87	40.00	-7.13
106.630	Peak	52.91	-16.57	36.33	43.50	-7.17
118.270	Peak	49.45	-15.50	33.95	43.50	-9.55
771.080	Peak	33.04	-1.92	31.11	46.00	-14.89

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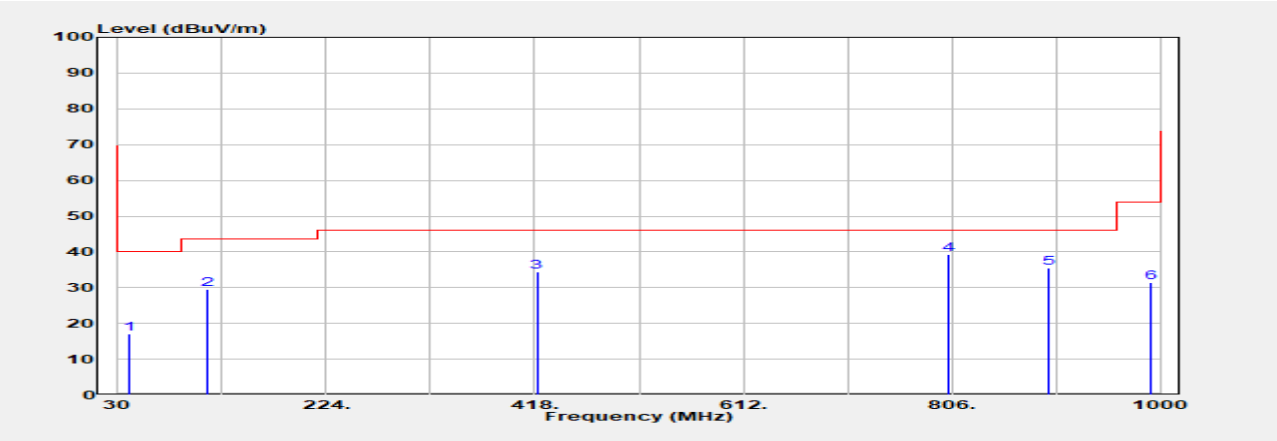

Freq. MHz	Detector Mode PK/QP/AVG	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
40.680	Peak	30.55	-13.44	17.11	40.00	-22.89
112.450	Peak	45.56	-15.95	29.61	43.50	-13.89
419.940	Peak	43.67	-9.31	34.35	46.00	-11.65
803.090	Peak	41.16	-1.89	39.28	46.00	-6.72
897.180	Peak	36.09	-0.54	35.55	46.00	-10.45
992.240	Peak	30.76	0.66	31.42	54.00	-22.58

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9 FREQUENCY STABILITY

9.1 Applicable Standard

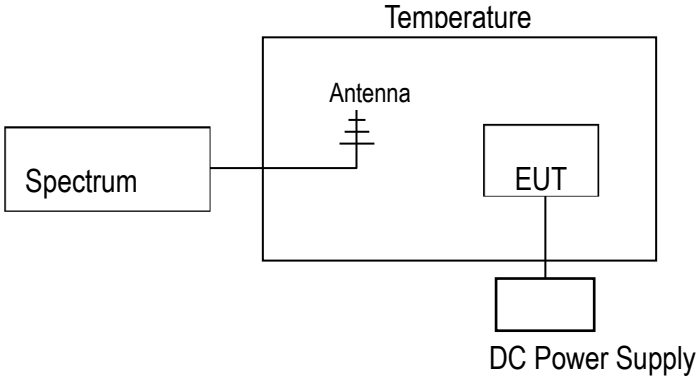
The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Carrier frequency stability shall be maintained to ±0.01% (±100 ppm).
For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F).

9.2 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 10kHz, Span =100kHz.
4. Set SPA Max hold. Mark peak.

9.3 Test SET-UP (Block Diagram of Configuration)



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9.4 Measurement Results

Startup

A. Temperature Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (kHz)	Limit (kHz)
12	0	13.55913	-0.87000	+/- 1.356
12	10	13.5587	-1.30000	+/- 1.356
12	20	13.55921	-0.79000	+/- 1.356
12	30	13.5601	0.10000	+/- 1.356
12	40	13.55892	-1.08000	+/- 1.356
12	50	13.55973	-0.27000	+/- 1.356

B. Supply Voltage Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (kHz)	Limit (kHz)
13.8	20	13.5611	1.10000	+/- 1.356
12	20	13.55988	-0.12000	+/- 1.356
10.2	20	13.5588	-1.20000	+/- 1.356

2 minutes

A. Temperature Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (kHz)	Limit (kHz)
12	0	13.56012	0.12000	+/- 1.356
12	10	13.55954	-0.46000	+/- 1.356
12	20	13.55923	-0.77000	+/- 1.356
12	30	13.55906	-0.94000	+/- 1.356
12	40	13.55942	-0.58000	+/- 1.356
12	50	13.55964	-0.36000	+/- 1.356

B. Supply Voltage Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (kHz)	Limit (kHz)
13.8	20	13.56015	0.15000	+/- 1.356
12	20	13.55923	-0.77000	+/- 1.356
10.2	20	13.55951	-0.49000	+/- 1.356

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5 minutes

A. Temperature Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (kHz)	Limit (kHz)
12	0	13.55921	-0.79000	+/- 1.356
12	10	13.55974	-0.26000	+/- 1.356
12	20	13.55992	-0.08000	+/- 1.356
12	30	13.55981	-0.19000	+/- 1.356
12	40	13.5599	-0.10000	+/- 1.356
12	50	13.55919	-0.81000	+/- 1.356

B. Supply Voltage Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (kHz)	Limit (kHz)
13.8	20	13.5613	1.30000	+/- 1.356
12	20	13.55992	-0.08000	+/- 1.356
10.2	20	13.55958	-0.42000	+/- 1.356

10 minutes

A. Temperature Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (kHz)	Limit (kHz)
12	0	13.55943	-0.57000	+/- 1.356
12	10	13.55925	-0.75000	+/- 1.356
12	20	13.55983	-0.17000	+/- 1.356
12	30	13.55926	-0.74000	+/- 1.356
12	40	13.55993	-0.07000	+/- 1.356
12	50	13.55999	-0.01000	+/- 1.356

B. Supply Voltage Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (kHz)	Limit (kHz)
13.8	20	13.55972	-0.28000	+/- 1.356
12	20	13.55983	-0.17000	+/- 1.356
10.2	20	13.55931	-0.69000	+/- 1.356

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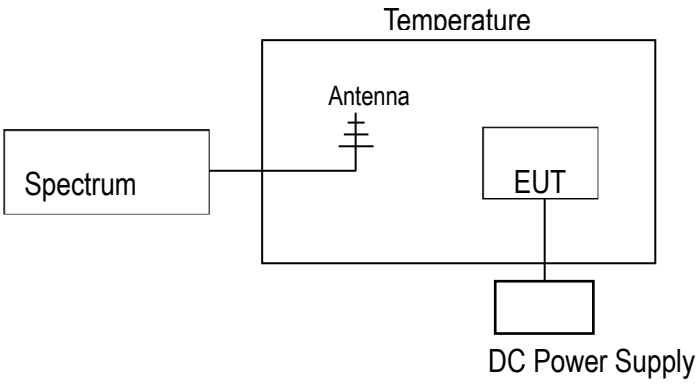
10 EMISSION BANDWIDTH MEASUREMENT

10.1 Applicable Standard:

The 20 dB and 99% bandwidth shall be specified in operating frequency band.

10.2 Test Set-up



10.3 Measurement Procedure

1. Placed the EUT on the testing table.
2. Set the EUT under transmission condition continuously at specific channel frequency.
3. Set SPA Center Frequency = fundamental frequency, RBW=1% to 5% OBW, VBW=3 x RBW, Span = large enough to capture all products of the modulation process.
4. Measured the spectrum width with power higher than 20dB & 99% below carrier.

10.4 Measurement Result

FCC

20dB BW (kHz)
0.324

Opration range	Frequency (MHz)	Limit (MHz)
Low	13.559670	>13.11
High	13.560080	<14.01

IC

99% BW (kHz)
0.409

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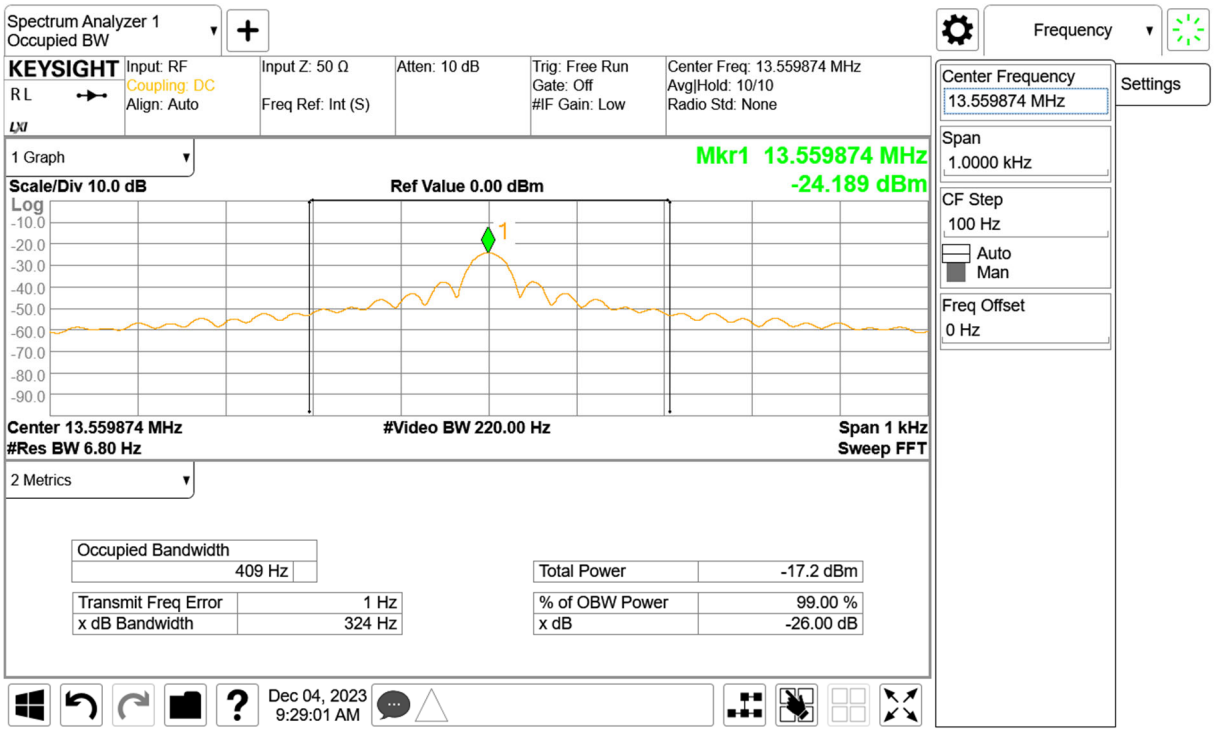
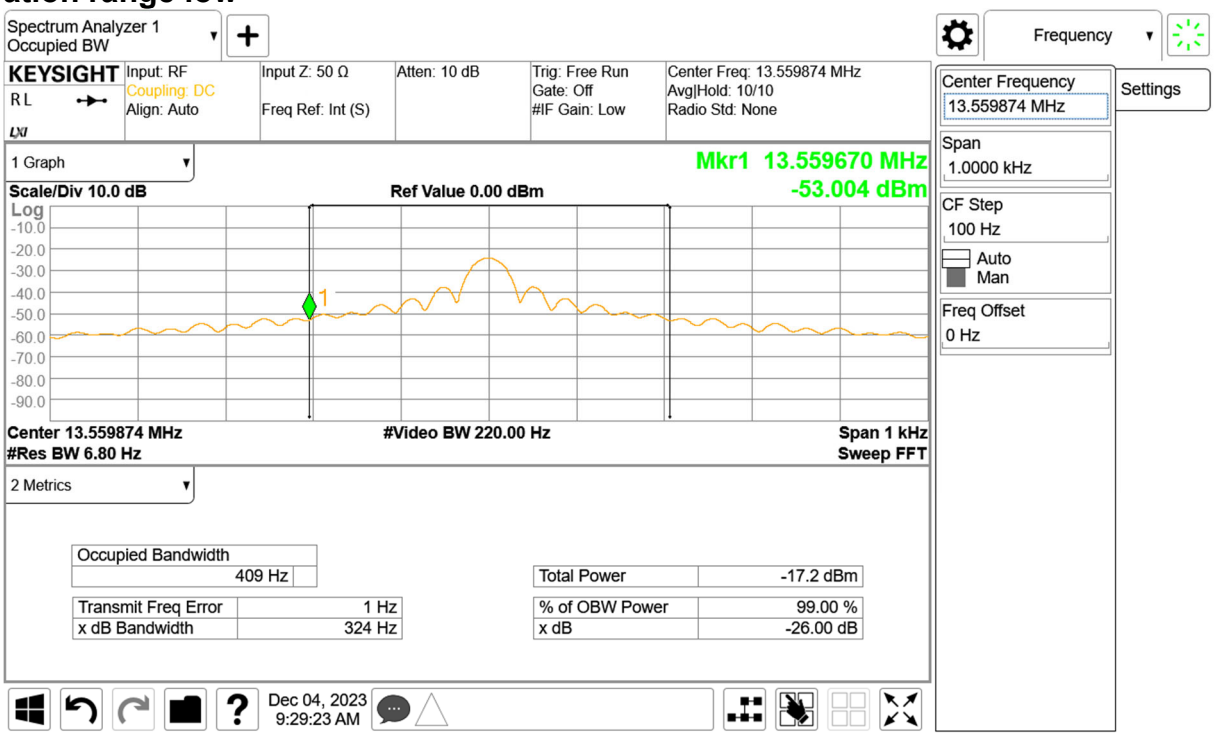
Bandwidth



Operation range low



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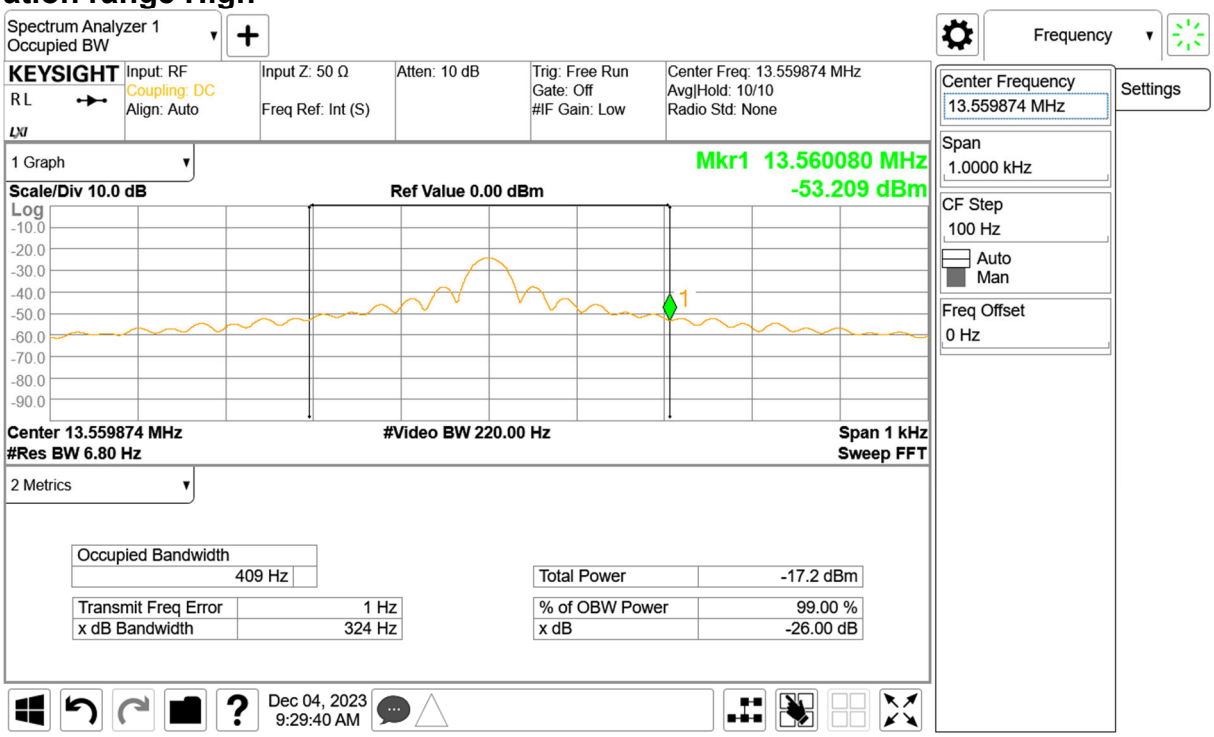
Operation range High



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11 ANTENNA REQUIREMENT

11.1 Standard Applicable:

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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

11.2 Antenna Connected Construction:

The antenna complies with this requirement and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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