

Johnson Health Tech. Co., Ltd.

TEST REPORT

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Radio Spectrum TEST REPORT

Applicant:	Johnson Health Tech. Co., Ltd. No.999, Sec. 2, Dongda Rd., Daya Dist Taichung City 428, Taiwan
Product:	Console for Exercise Machine
Model No.:	Target Training Console
Brand Name:	Matrix Fitness
FCC ID:	TN7PHOENIX
Test Method/ Standard:	47 CFR FCC Part 15.225
Test By:	Intertek Testing Services Taiwan Ltd., Hsinchu Laboratory No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li, Shiang-Shan District, Hsinchu City, Taiwan



Prepared and Checked by:

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TEST REPORT**Revision History**

Report No.	Issue Date	Revision Summary
180200312TWN-001	May 30, 2018	Same as NFC module, then the test datas based on report of 171000226TWN-001.

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Summary of Test Data

Test Requirement	Applicable Rule (Section 15.225)	Result
Fundamental emission	15.225 (a)	Pass
20 dB Bandwidth	15.215	Pass
Frequency Satiability	15.225 (e)	Pass
In band Radiated Emissions	15.225(b),15.225(c)	Pass
Out of band Radiated Emissions	15.225(d)	Pass
AC Power Line Conducted Emission	15.207	Pass
Antenna Requirement	15.203	Pass

1. General Information

1.1 Identification of the EUT

Product:	Console for Exercise Machine
Model No.:	Target Training Console
Radio Module:	RM310
Operating Frequency:	13.56 MHz
Access scheme:	ASK
Rated Power:	DC 5V
Power Cord:	N/A
Sample receiving date:	1. Oct. 19, 2017 2. Mar. 01, 2018
Sample condition:	Workable
Test Date(s):	1. Nov. 15, 2017 ~ Dec. 12, 2017 2. Apr. 25, 2018

1.2 Description of EUT

The EUT transmit 13.56MHz signal continuously while we power on the EUT.

For more detail features, please refer to User's manual as file name "Installation guide.pdf"

1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Type : Loop Antenna
Connector Type : I-PEX

1.4 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Data cable
Adapter	LITEON	PA-1041-0	N/A	N/A

2. Fundamental emission

2.1 Operating environment

Temperature:	25	°C
Relative Humidity:	55	%
Atmospheric Pressure	1008	hPa
Requirement & Test method	15.225 (a)	

2.2 Limit for Fundamental emission

The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 uV/m(83.99 dBuV/m) at 30 meters.

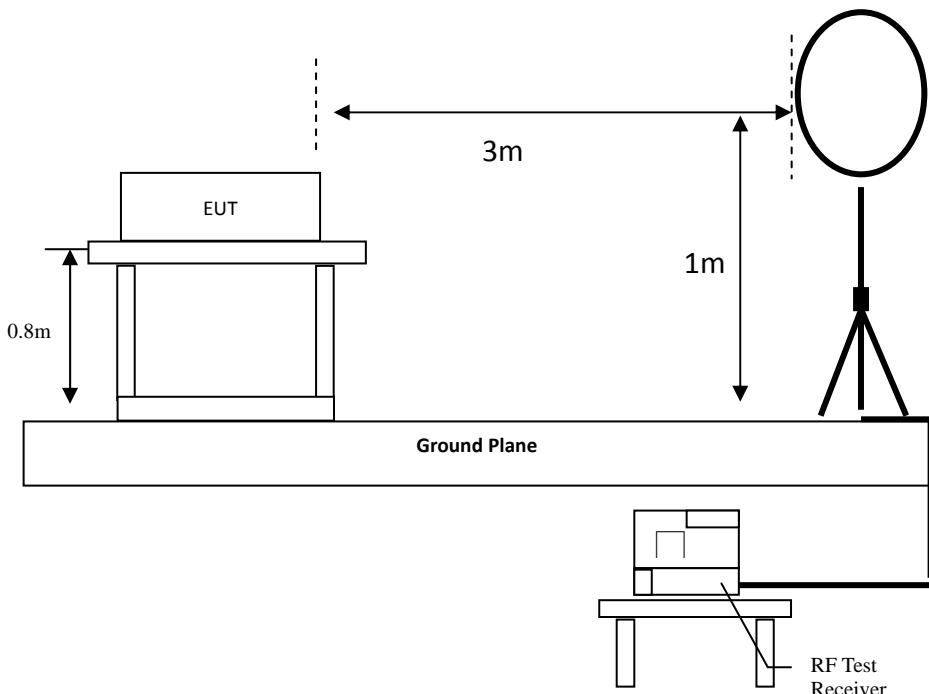
2.3 Measuring instrument setting

Spectrum analyzer settings	
Spectrum Analyzer function	Setting
Detector	QP
RBW	10 kHz
Sweep	Auto couple
Trace	Max hold
Span	900 kHz
Attenuation	Auto

2.4 Test procedure

1. Configure the EUT according to ANSI C63.10:2013. The EUT was placed on the top of the turntable 0.8 meter above ground. The center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the companion devices. The turntable was rotated by 360 degree to find the position of the maximum emission level.
3. The height of the receiving antenna was one meter above ground to find the maximum emission field strength of the both plane and coaxial polarity
4. Set the test-receiver system to peak or CISPR quasi-peak detector with specified bandwidth under maximum hold mode.

2.5 Test diagram



2.6 Test result

Polarity (circle)	Frequency (MHz)	Detection value	factor (dB/m)	Reading (dB μ V)	value (dB μ V/m)	Limit @ 3m (dB μ V/m)	Tolerance (dB)
Plane	13.56	QP	21.03	48.39	69.42	124.00	-54.58

13.56MHz , Limit= 84dB μ V +40 dB (decade) = 124 dB

3. 20 dB Bandwidth

3.1 Operating environment

Temperature:	25	°C
Relative Humidity:	55	%
Atmospheric Pressure	1008	hPa
Requirement & Test method	15.215	

3.2 Limit for 20 dB bandwidth

None

3.3 Measuring instrument setting

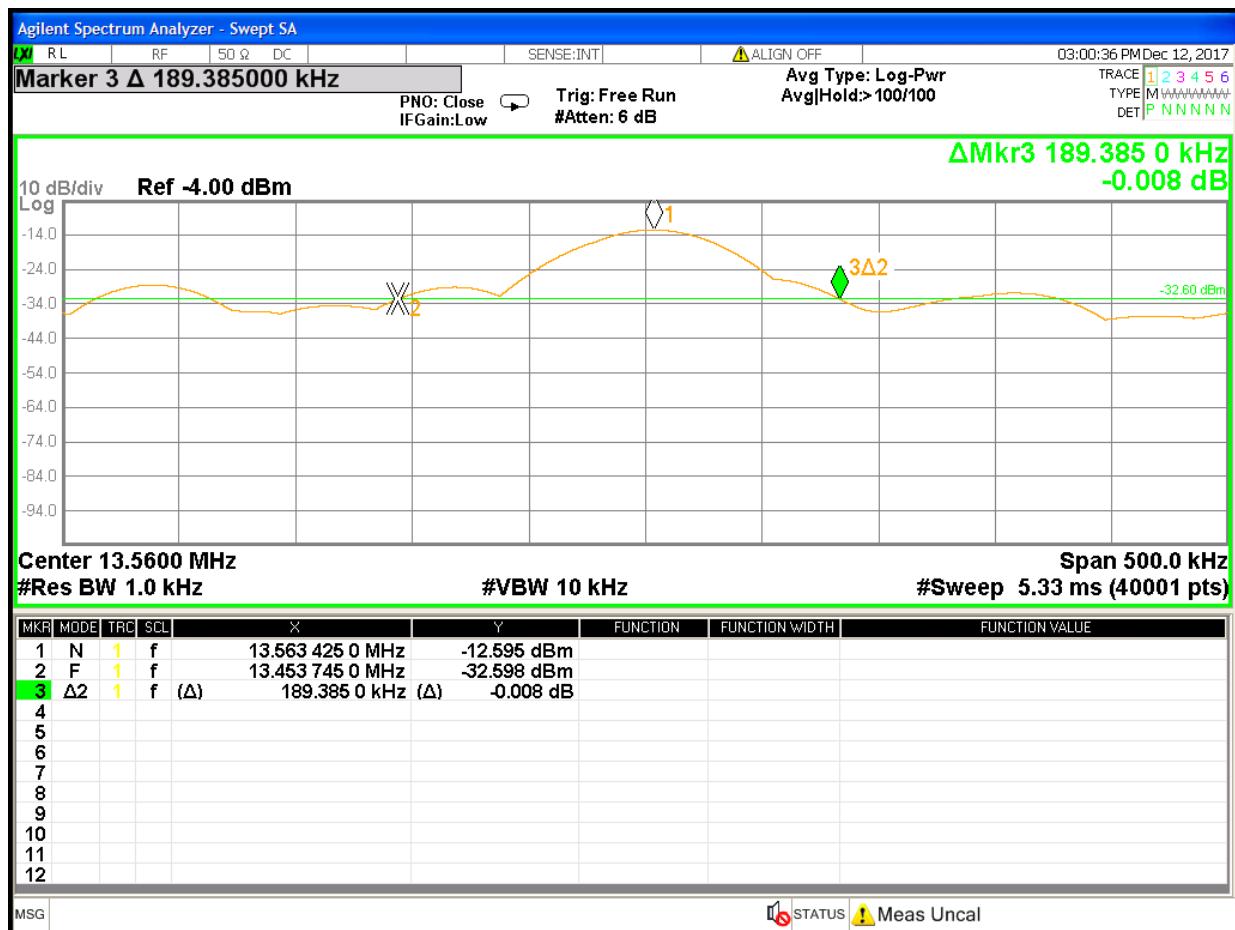
Spectrum analyzer settings	
Spectrum Analyzer function	Setting
Detector	Peak
RBW	1kHz
VBW	$\geq 3 \times$ RBW
Sweep	Auto couple
Trace	Allow the trace to stabilize.
Span	\geq 1.2 times the 20 dB bandwidth
Attenuation	Auto

3.4 Test procedure

The 20 dB bandwidth was measured by spectrum analyzer connected to a receive antenna placed near the test sample while it is transmitting.

3.5 Test results

20dB Bandwidth @ NFC Mode



4. Frequency Satiability

4.1 Operating environment

Temperature:	25	°C
Relative Humidity:	55	%
Atmospheric Pressure	1008	hPa
Requirement & Test method	15.225(e)	

4.2 Limit for Frequency Satiability

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ 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.

4.3 Measuring instrument setting

Spectrum analyzer settings	
Spectrum Analyzer function	Setting
Detector	Peak
RBW	1kHz
VBW	1kHz
Sweep	Auto couple
Trace	Allow the trace to stabilize.
Span	Sufficient to see the complete emission BW
Attenuation	Auto

4.4 Test procedure

Turn the EUT on, and couple its output to a frequency counter or other frequency-measuring device of sufficient accuracy, considering the frequency tolerance with which the EUT shall comply.

4.5 Test result

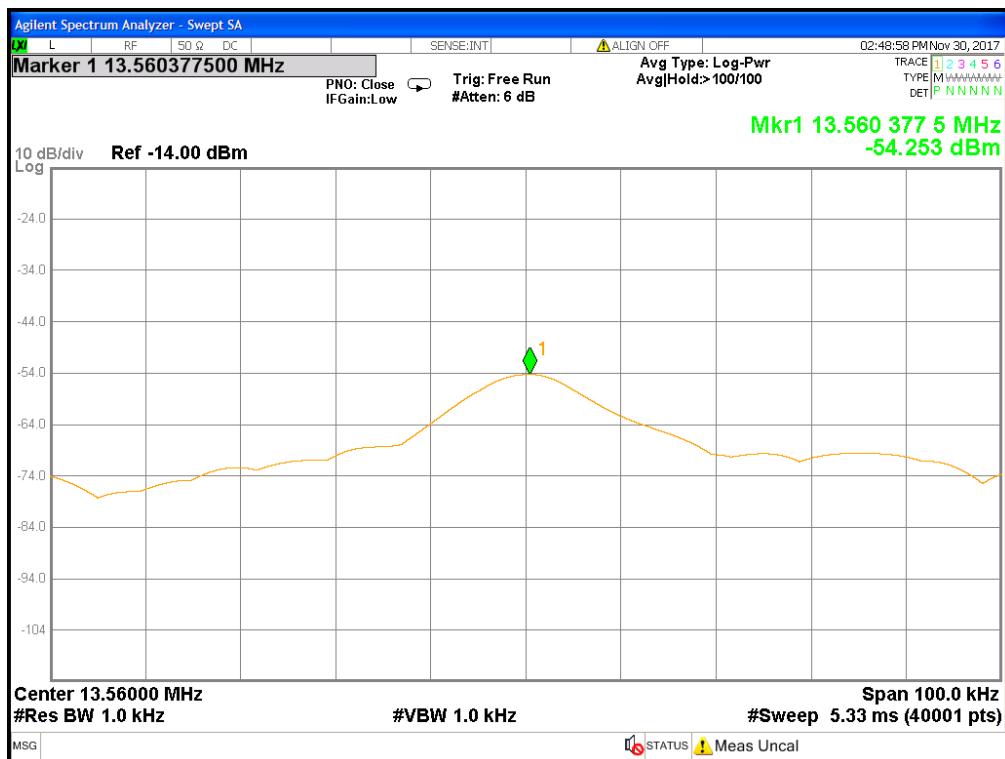
Temperature	Measuring frequency (MHz)	Voltage	Comparison frequency	Difference (MHz)	Difference (%)	Limit (%)	Result
-20	13.560235	120Vac	13.56	0.000235	0.001733%	±0.01	Pass
-10	13.560378	120Vac	13.56	0.000377	0.002784%	±0.01	Pass
0	13.560398	120Vac	13.56	0.000398	0.002931%	±0.01	Pass
10	13.559075	120Vac	13.56	-0.000925	-0.006822%	±0.01	Pass
20	13.560358	120Vac	13.56	0.000357	0.002636%	±0.01	Pass
30	13.559653	120Vac	13.56	-0.000348	-0.002563%	±0.01	Pass
40	13.559763	120Vac	13.56	-0.000238	-0.001751%	±0.01	Pass
50	13.559525	120Vac	13.56	-0.000475	-0.003503%	±0.01	Pass
20	13.559738	102Vac	13.56	-0.000262	-0.001936%	±0.01	Pass
	13.560358	120Vac	13.56	0.000357	0.002636%	±0.01	Pass
	13.559583	138Vac	13.56	-0.000418	-0.003079%	±0.01	Pass

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-20°C



-10°C

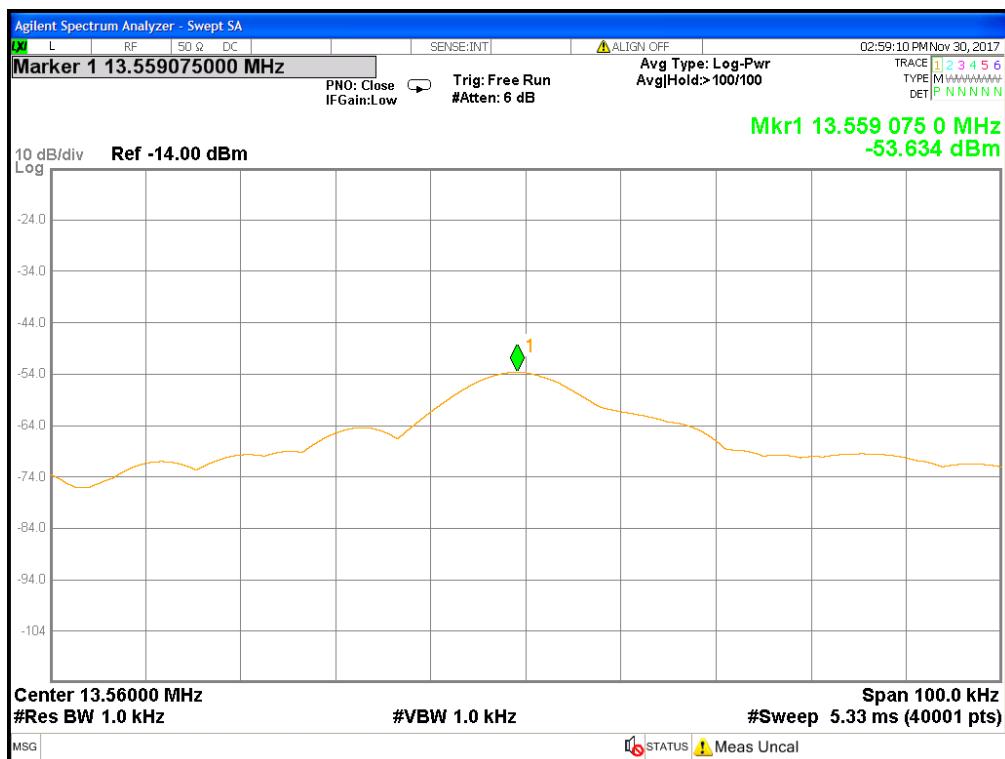


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0°C

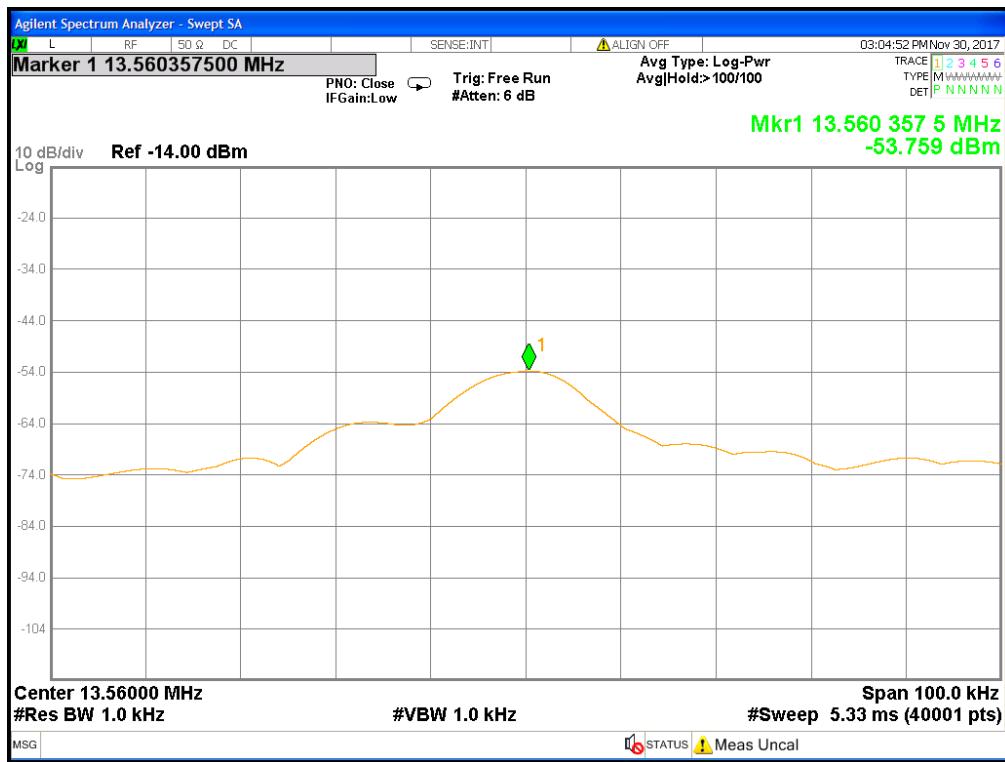


10°C

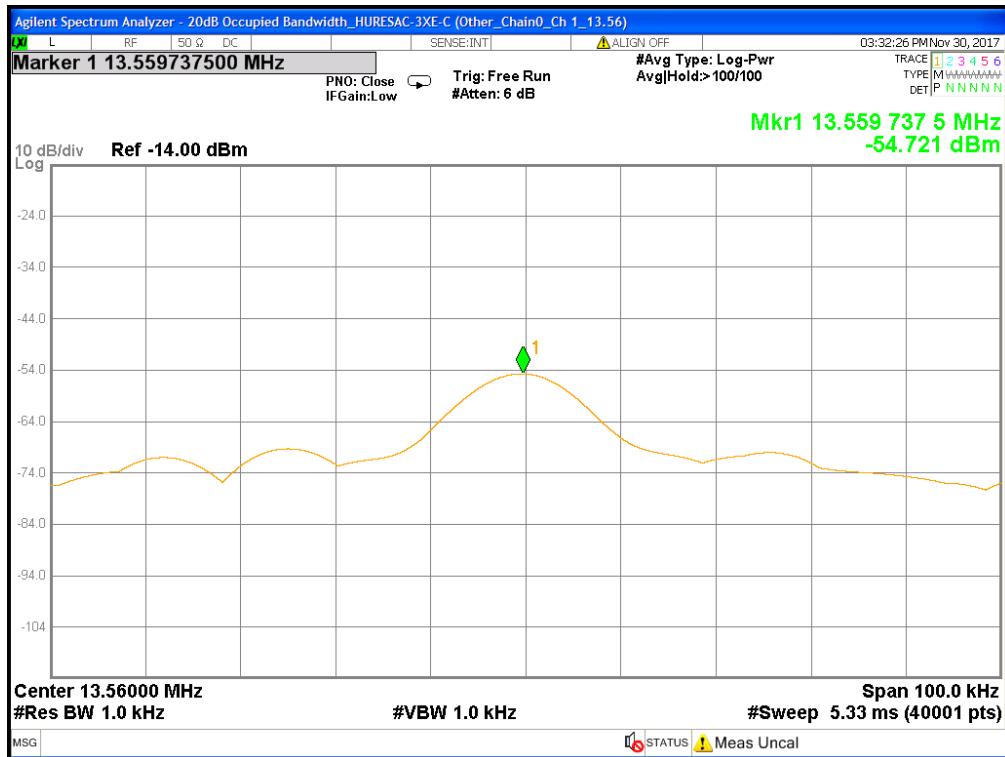


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20°C 120Vac



20°C 102Vac

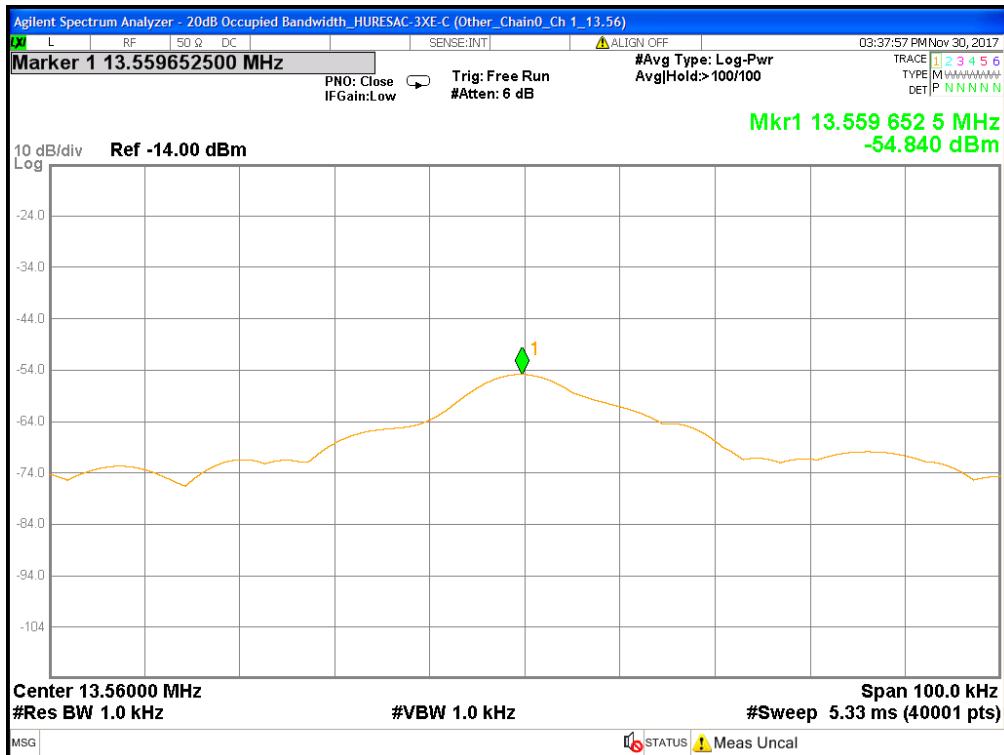


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20°C 138Vac

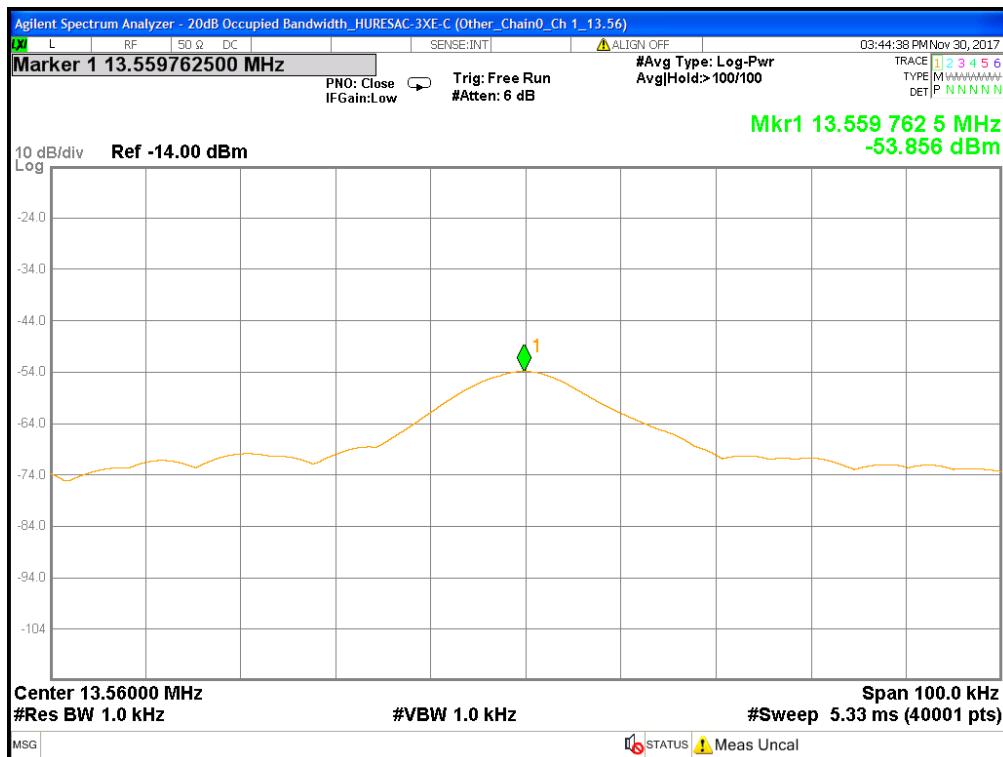


30°C

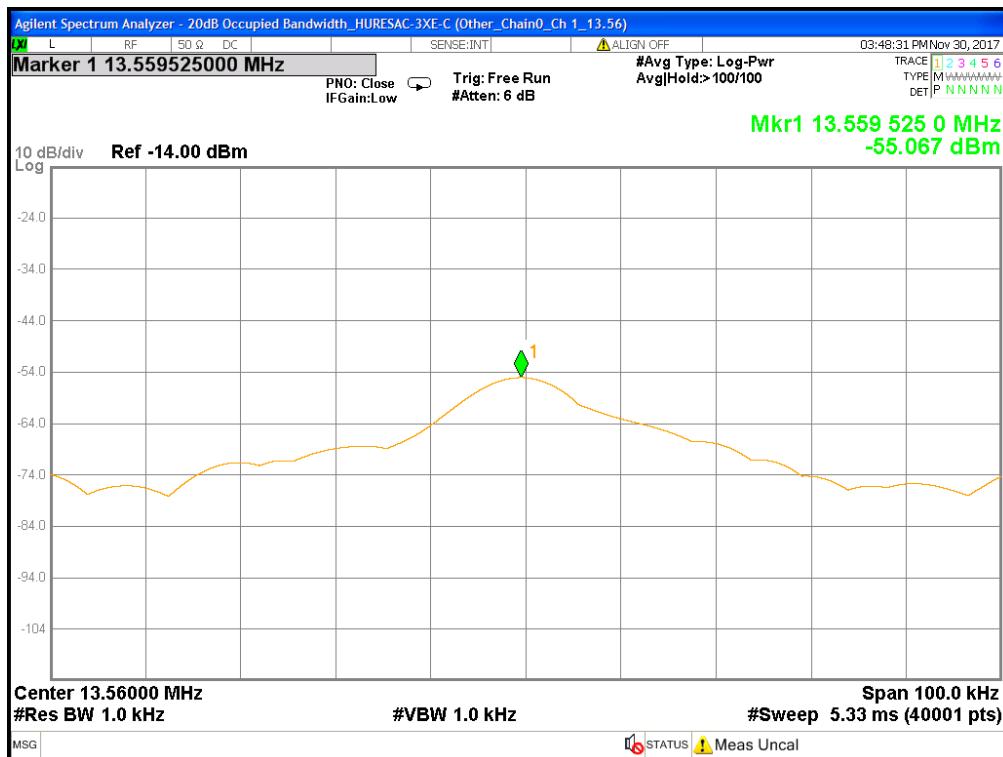


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40°C



50°C



5. In band Radiated Emissions

5.1 Operating environment

Temperature:	25	°C
Relative Humidity:	55	%
Atmospheric Pressure	1008	hPa
Requirement	15.225(b),15.225(c)	

5.2 Limit for emissions in non-restricted frequency bands

Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

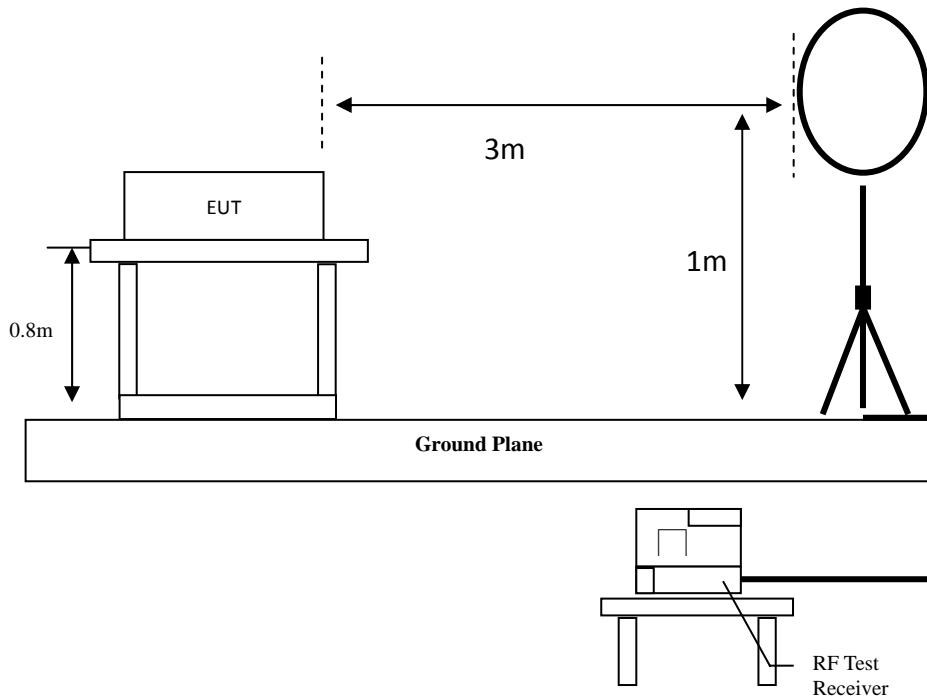
5.3 Measuring instruments setting

Spectrum analyzer settings	
Spectrum Analyzer function	Setting
Detector	QP
RBW	10 kHz
Sweep	Auto couple
Trace	Max hold
Span	900 kHz
Attenuation	Auto

5.4 Test procedure

1. Configure the EUT according to ANSI C63.10:2013. The EUT was placed on the top of the turntable 0.8 meter above ground. The center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the companion devices. The turntable was rotated by 360 degree to find the position of the maximum emission level.
3. The height of the receiving antenna is one meter above ground to find the maximum emission field strength of the both plane and coaxial polarity
4. Set the test-receiver system to peak or CISPR quasi-peak detector with specified bandwidth under maximum hold mode.

5.5 Test diagram



5.6 Test results

Unwanted_emission_in_the_spurious_domain @ 13.56MHz



6. Out of band Radiated Emissions

6.1 Operating environment

Temperature:	25	°C
Relative Humidity:	55	%
Atmospheric Pressure	1008	hPa
Requirement	15.225(d), 15.205, 15.209	

6.2 Limit for emission in restricted frequency bands (Radiated emission measurement)

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	2400/F(kHz)	30
1.705~30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

6.3 Measuring instrument setting

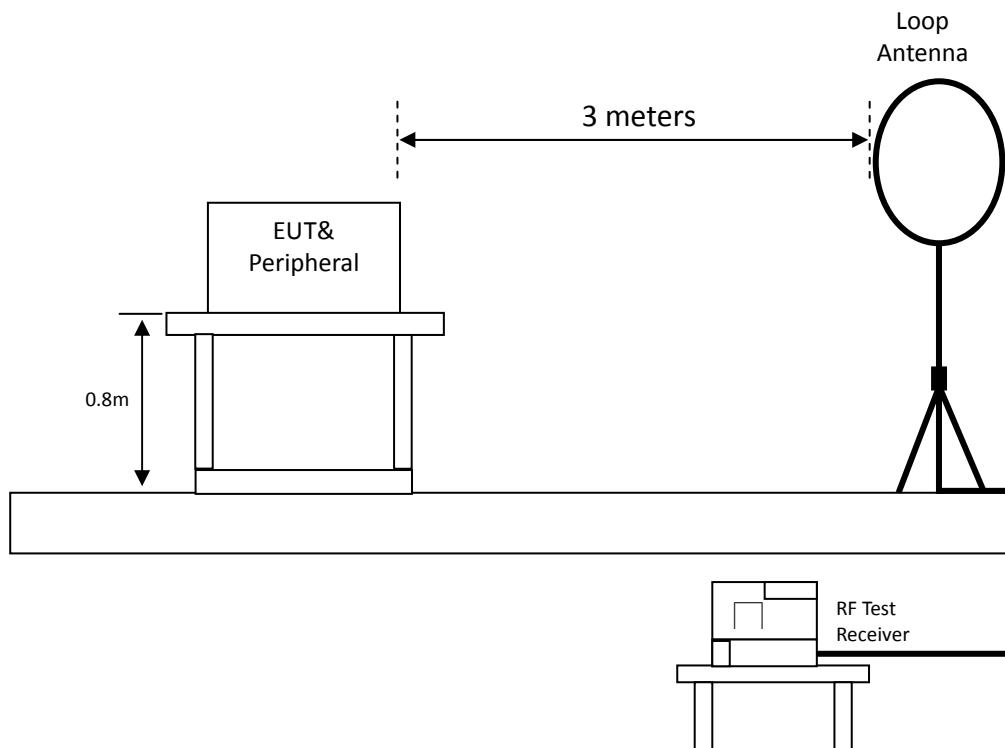
Receiver settings	
Receiver function	Setting
Detector	QP
RBW	9-150 kHz ; 200-300 Hz 0.15-30 MHz; 9-10 kHz 30-1000 MHz; 100-120 kHz
VBW	$\geq 3 \times$ RBW
Sweep	Auto couple
Attenuation	Auto

6.4 Test procedure

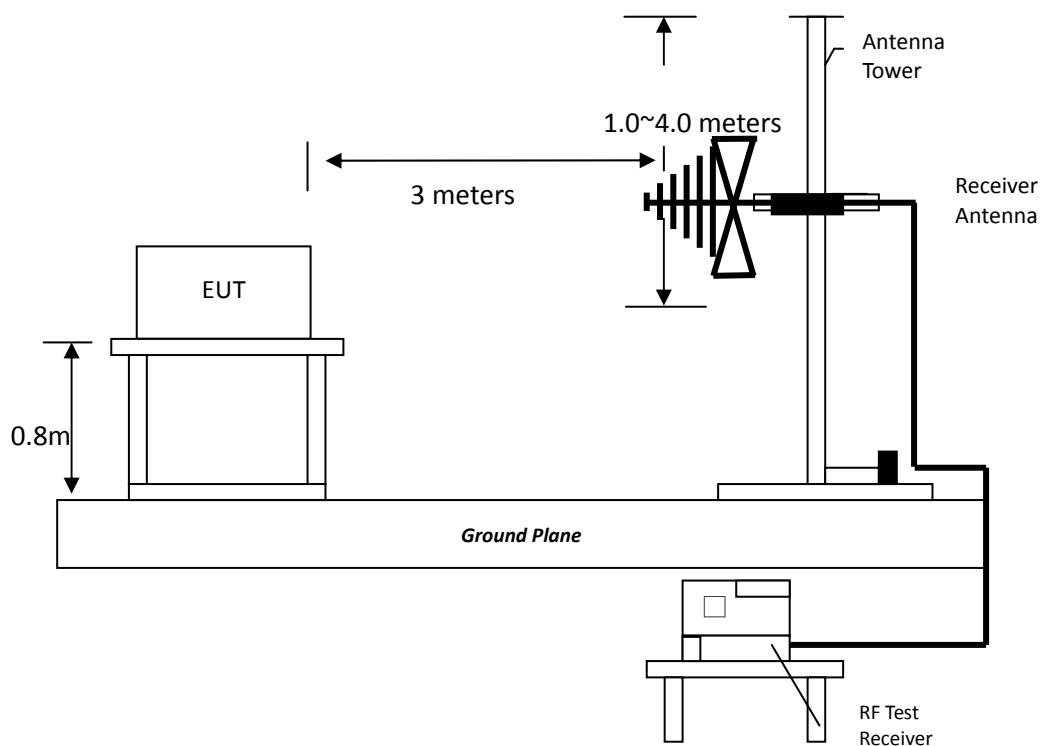
1. Configure the EUT according to ANSI C63.10:2013. The EUT was placed on the top of the turntable 0.8 meter above ground. The center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the companion devices. The turntable was rotated by 360 degree to find the position of the maximum emission level.
3. The height of the receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of the both horizontal and vertical polarization
4. If find the frequencies above the limit or below within 3dB, the antenna tower was scan (from 1m to 4m) and then the turntable was rotated to find the maximum reading.
5. Set the test-receiver system to peak or CISPR quasi-peak detector with specified bandwidth under maximum hold mode.
6. If the emissions level of the EUT in peak mode was 3dB lower than the average limit specified then testing will be stopped and peak values of the EUT will be reported. Otherwise, the emissions which do not have 3dB margin will be measured using the quasi-peak method for below 1GHz.
7. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be quasi-peak measured by receiver.

6.5 Test configuration

6.5.1 Radiated emission from 9kHz to 30MHz uses Loop Antenna:



6.5.2 Radiated emission below 1GHz using Bilog Antenna



6.6 Test result**6.6.1 Measurement results: frequency range from 9 kHz to 30 MHz**

The test was performed on EUT under continuously transmitting mode.

EUT : Target Training Console
Worst Case : Tx mode

Polarity (circle)	Frequency (MHz)	Detection value	factor	Reading (dB μ V)	value (dB μ V/m)	Limit @ 3m (dB μ V/m)	Tolerance (dB)
Plane	0.02	PK	20.27	22.53	42.80	121.58	-78.78
Plane	0.05	PK	19.62	26.35	45.97	113.62	-67.65
Plane	0.07	PK	19.47	27.01	46.48	110.70	-64.22
Plane	0.09	PK	19.17	24.76	43.93	108.52	-64.59
Plane	0.11	PK	19.06	20.14	39.20	106.78	-67.58
Plane	0.12	PK	19.05	22.36	41.41	106.02	-64.61
Plane	0.15	PK	19.05	31.54	50.59	104.08	-53.49
Plane	0.69	QP	19.12	23.61	42.73	70.83	-28.10
Plane	1.94	QP	19.06	16.86	35.92	69.54	-33.62
Plane	12.09	QP	20.83	13.11	33.94	69.54	-35.60
Plane	12.51	QP	20.89	21.39	42.28	69.54	-27.26
Plane	12.93	QP	20.94	28.20	49.14	69.54	-20.40

6.6.2 Measurement results: frequencies below 1 GHz

The test was performed on EUT under continuously transmitting mode.

EUT : Target Training Console

Worst Case : Tx mode

Antenna Polariz. (V/H)	Freq. (MHz)	Detection value	factor (dB/m)	Reading (dB μ V)	value (dB μ V/m)	Limit @ 3m (dB μ V/m)	Tolerance (dB)
V	39.70	QP	20.02	12.32	32.34	40.00	-7.66
V	47.46	QP	19.45	10.01	29.46	40.00	-10.54
V	59.10	QP	19.50	8.54	28.04	40.00	-11.96
V	70.74	QP	18.06	11.28	29.34	40.00	-10.66
V	95.96	QP	14.91	22.80	37.71	43.50	-5.79
V	111.48	QP	17.37	9.88	27.25	43.50	-16.25
H	41.64	QP	20.16	4.92	25.08	40.00	-14.92
H	55.22	QP	19.08	6.69	25.77	40.00	-14.23
H	86.26	QP	14.95	7.65	22.60	40.00	-17.40
H	95.96	QP	14.91	18.50	33.41	43.50	-10.09
H	128.94	QP	18.98	7.58	26.56	43.50	-16.94
H	134.76	QP	19.67	7.36	27.03	43.50	-16.47

Remark:

1. Corr. Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Corr. Factor

Note: The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

7. AC Power Line Conducted Emission

7.1 Operating environment

Temperature:	26	°C
Relative Humidity:	52	%
Atmospheric Pressure	1005	hPa
Requirement	15.207	

7.2 Limit for AC power line conducted emission

Freq. (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56*	56 – 46*
0.50~5.00	56	46
5.00~30.0	60	50

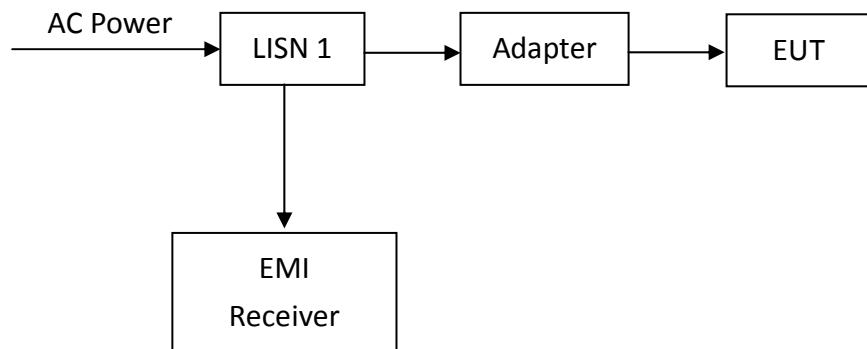
7.3 Measuring instrument setting

Receiver settings	
Receiver function	Setting
Detector	QP
Start frequency	0.15MHz
Stop frequency	30MHz
IF bandwidth	9 kHz
Attenuation	10dB

7.4 Test procedure

1. Configure the EUT according to ANSI C63.10:2013. The EUT or host of EHT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network.
3. All the companion devices are connected to the other LISN. The LISN should provide 50Uh/50ohms coupling impedance.
4. The frequency range from 150 kHz to 30MHz was searched
5. Set the test-receiver system to peak detector and specified bandwidth with maximum hold mode.
6. The measurement has to be done between each power line and ground at the power terminal.

7.5 Test diagram



Note: The EUT was tested while in normal communication mode.

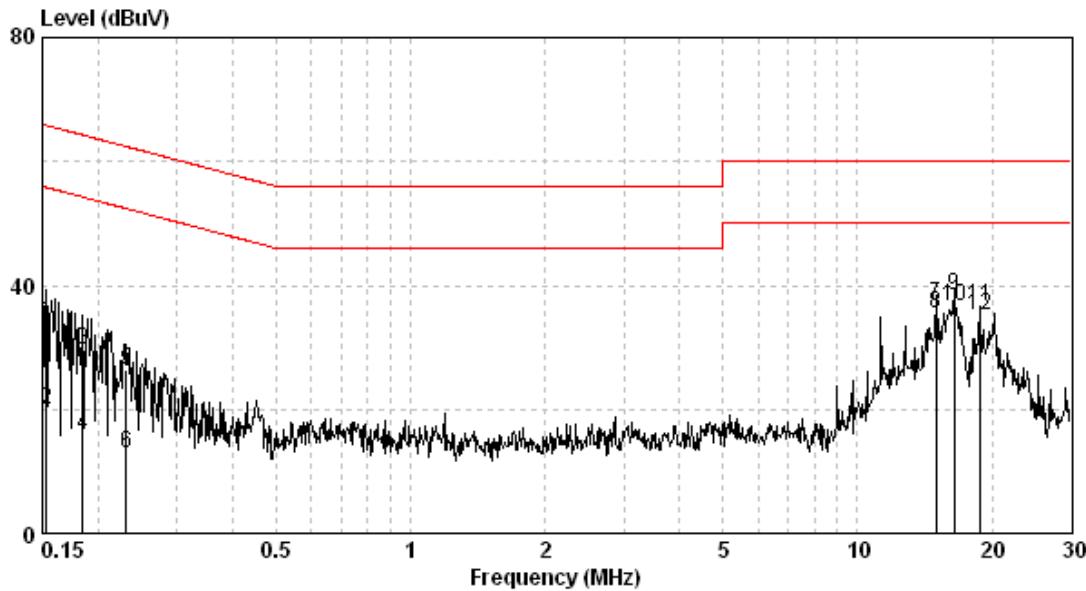
7.6 Test results

Phase : Live Line
EUT : Target Training Console
Test Condition : Tx mode

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB)	QP	AV
0.153	9.34	24.66	34.00	65.82	10.59	19.93	55.82	-31.83	-35.90	
0.184	9.34	20.23	29.57	64.28	6.48	15.82	54.28	-34.71	-38.46	
0.232	9.35	16.94	26.28	62.39	3.52	12.87	52.39	-36.11	-39.52	
14.986	9.54	27.38	36.92	60.00	25.79	35.33	50.00	-23.08	-14.67	
16.486	9.54	28.71	38.25	60.00	27.21	36.74	50.00	-21.75	-13.26	
18.721	9.53	26.97	36.50	60.00	25.55	35.08	50.00	-23.50	-14.92	

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)

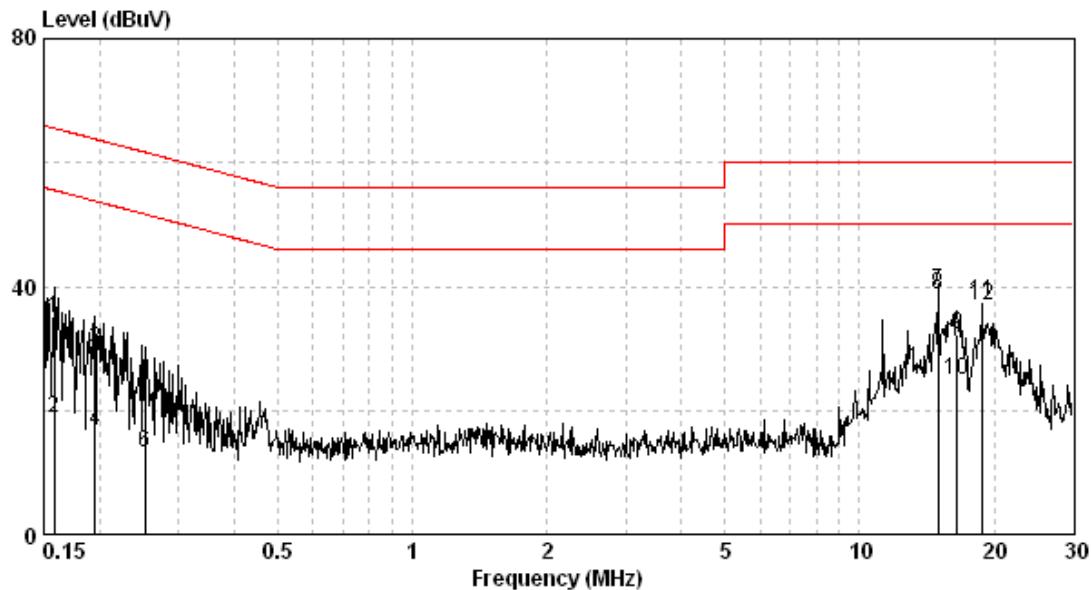


Phase : Neutral Line
EUT : Target Training Console
Test Condition : Tx mode

Frequency (MHz)	Corr. Factor (dB)	Reading QP (dBuV)	Level QP (dBuV)	Limit QP (dBuV)	Reading AV (dBuV)	Level AV (dBuV)	Limit AV (dBuV)	Margin (dB) QP	Margin (dB) AV
0.158	9.60	25.15	34.75	65.56	9.12	18.72	55.56	-30.81	-36.84
0.195	9.60	20.27	29.87	63.80	6.96	16.56	53.80	-33.93	-37.24
0.252	9.61	14.75	24.36	61.69	3.71	13.31	51.69	-37.33	-38.38
14.986	9.85	29.48	39.33	60.00	28.73	38.58	50.00	-20.67	-11.42
16.573	9.86	22.44	32.29	60.00	14.93	24.79	50.00	-27.71	-25.21
18.721	9.87	27.77	37.63	60.00	27.02	36.89	50.00	-22.37	-13.11

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)



Appendix A: Test equipment list

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
ESCI EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2017/11/21	2018/11/20
Spectrum Analyzer	Rohde & Schwarz	FSP30	100137	2017/02/15	2018/02/14
Broadband Antenna	SHWARZBECK	VULB 9168	9168-172	2017/04/05	2018/04/04
Signal Analyzer	Agilent	N9030A	MY51380492	2017/08/29	2018/08/28
966-2(A) Cable	SUHNER	SMA / EX 100	N/A	2017/08/15	2018/08/14
966-2(B) Cable	JUNFLON	SMA / J12J100880-00	AUG-26-08-002	2017/05/04	2018/05/03
RF Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 102	CB0006	2017/05/04	2018/05/03
966-2_3m Semi-Anechoic Chamber	966_2	CEM-966_2	N/A	2017/03/29	2018/03/28
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIC	FMZB1519	1519-067	2017/03/30	2018/03/29
EMI Test Receiver	Rohde & Schwarz	ESR-7	101232	2017/01/23	2018/01/22
Test software	ADT	Radiated test system	7.5.14	NCR	NCR
EMI Receiver	R&S	ESCI	100059	2017/11/13	2018/11/12
Two-Line V-Network	R&S	ENV216	101159	2017/06/03	2018/06/02
Artificial Mains Network (LISN)	SCHAFFNER	MN2050D	1586	2017/05/31	2018/05/30
CON-1 Shielded Room	N/A	N/A	N/A	NCR	NCR
CON-1 Cable	SUHNER	SUCOFLEX-104	26438414	2017/05/04	2018/05/03
Test software	Audix	e3	4.20040112L	NCR	NCR

Note: No Calibration Required (NCR).

Appendix B: Measurement Uncertainty

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of $k=2$.

Item	Uncertainty
Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.14 dB
Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m	5.22 dB
Vertically polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	3.64 dB
Horizontally polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m	3.64 dB
Vertically polarized Radiated disturbances from 18GHz~40GHz in a semi-anechoic chamber at a distance of 3m	2.68 dB
Horizontally polarized Radiated disturbances from 18GHz~40GHz in a semi-anechoic chamber at a distance of 3m	2.68 dB
Conducted Output power	0.86 dB
Radiated electromagnetic disturbances in the frequency range from 9kHz to 30MHz	3.54 dB
Conducted disturbance measurements at a mains port from 9 kHz to 30 MHz using a $50\ \Omega/50\ \mu\text{H}+5\Omega$ artificial mains network (AMN)	2.48 dB