

EVERSPRING INDUSTRY CO., LTD.

TEST REPORT

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Radio Spectrum TEST REPORT

Applicant:	EVERSPRING INDUSTRY CO., LTD. 3F., No.50, Sec. 1, Zhonghua Rd., Tucheng Dist., New Taipei City 23666, Taiwan
Product:	PIR Sensor Module
Model No.:	ES160-1, HS-FLS100+
Brand Name:	 HomeSeer, Everspring
FCC ID:	FU5ES160-1
Test Method/ Standard:	47 CFR FCC Part 15.249 & ANSI C63.10 2013
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



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Revision History

Report No.	Issue Date	Revision Summary
180400393TWN-001	Apr. 30, 2018	Original report

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Summary of Tests

Test	Reference	Results
20dB Bandwidth	15.215(c)	Pass
Radiated Emission test	15.249(c), 15.209	Pass
Emission on the Band Edge	15.249(d)	Pass
Conducted Emission of AC Power	15.207	Pass
Antenna Requirement	15.203	Pass

1. General Information

1.1 Identification of the EUT

Product:	PIR Sensor Module
Model No.:	ES160-1
Operating Frequency:	908.4 MHz, 916 MHz
Channel Number:	2 channels
Access scheme:	Z-wave
Rated Power:	100-240Vac, 50/60Hz, 300W
Power Cord:	N/A
Sample receiving date:	Apr. 24, 2018
Sample condition:	Workable
Test Date(s):	Apr. 26, 2018 ~ Apr. 30, 2018

1.2 Additional information about the EUT

The customer confirmed HS-FLS100+ is a series model to ES160-1 (EUT), the model is identical in hardware aspect, and the different is in color only.

1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Type: Coil Antenna

Connector Type: Fixed

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Paragraph 15.249 for non-spread spectrum devices.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

TX mode: The EUT power on to entering test mode, and press the button to change different channel.

The signal is maximized through rotation and placement in the three orthogonal axes.



X axis



Y axis



Z axis

After verifying three axes, we found the maximum electromagnetic field was occurred at Z axis. The final test data was executed under this configuration.

3. 20dB Bandwidth test

3.1 Operating environment

Temperature:	25	°C
Relative Humidity:	50	%
Atmospheric Pressure:	1008	hPa

3.2 Test setup & procedure

Step 1: The 20dB bandwidth was measured using a 50 ohm spectrum analyzer

Step 2: The span range for the SA display shall be between two times and five times the OBW.

Step 3: The nominal IF filter bandwidth (3 dB RBW) should be approximately 1 % to 5 % of the OBW, unless otherwise specified, depending on the applicable requirement.

Step 4: The test was performed at 1 channel. The maximum 20dB modulation bandwidth is in the following Table.

3.3 Measured data of modulated bandwidth test results

Mode	Frequency (MHz)	20dB Occupied Bandwidth (MHz)
Z-wave	908.4	0.10998
	916.0	0.16112

Please see the plot below.

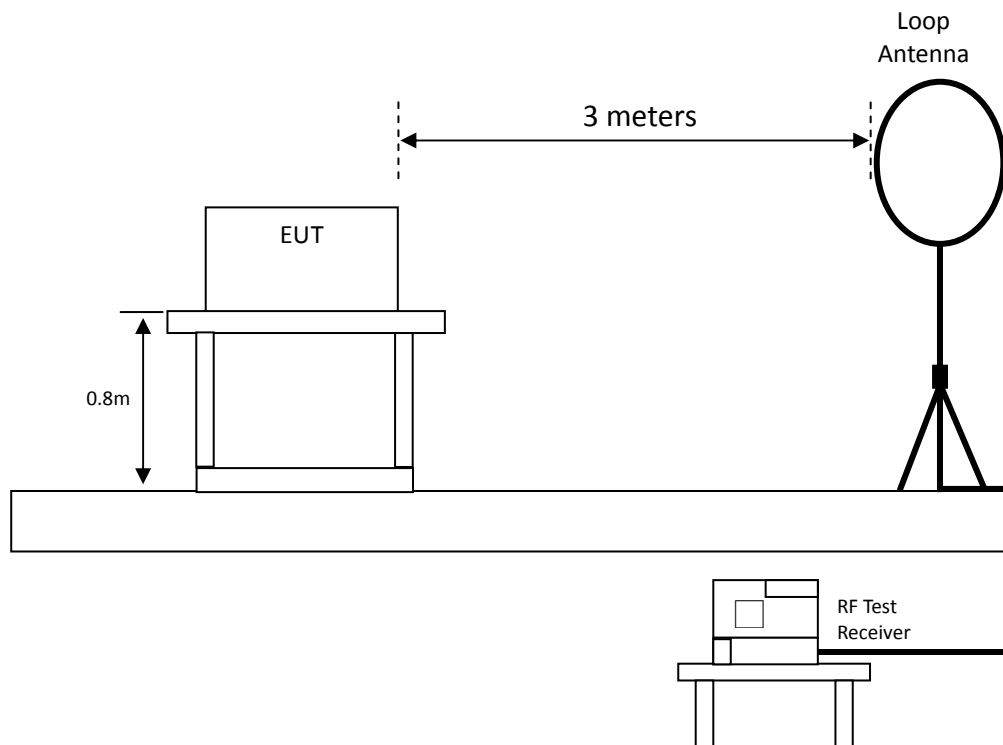
4. Radiated emission test FCC 15.249 (C)

4.1 Operating environment

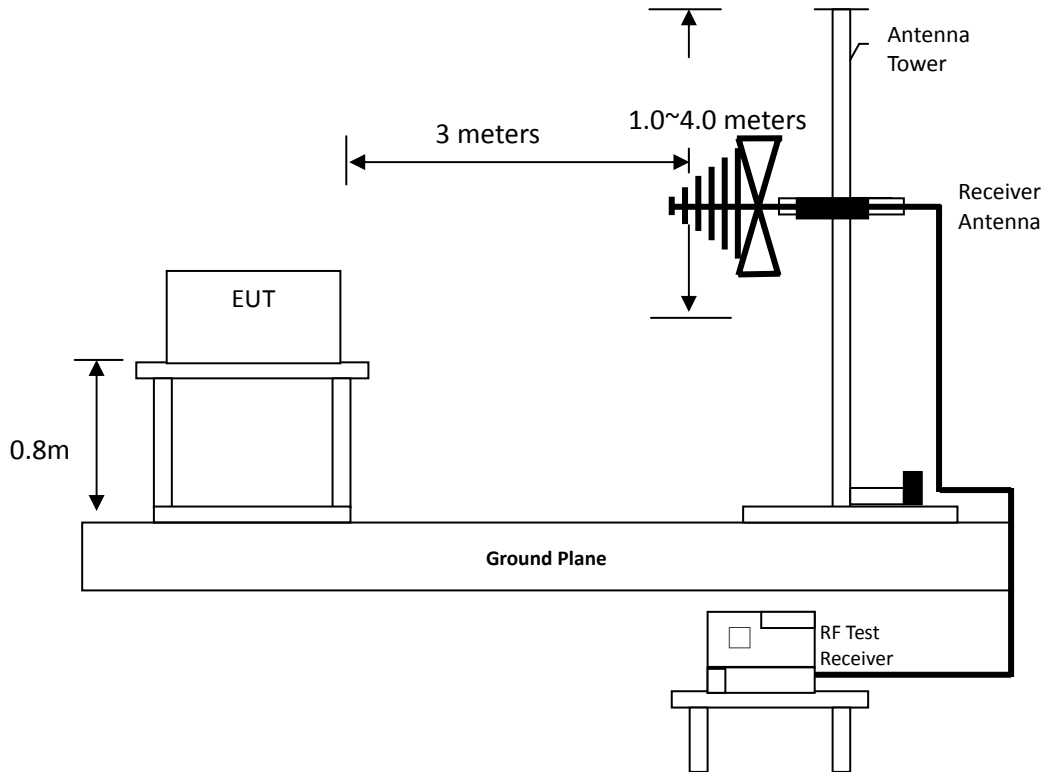
Temperature:	25	°C
Relative Humidity:	50	%
Atmospheric Pressure:	1008	hPa

4.2 Test setup & procedure

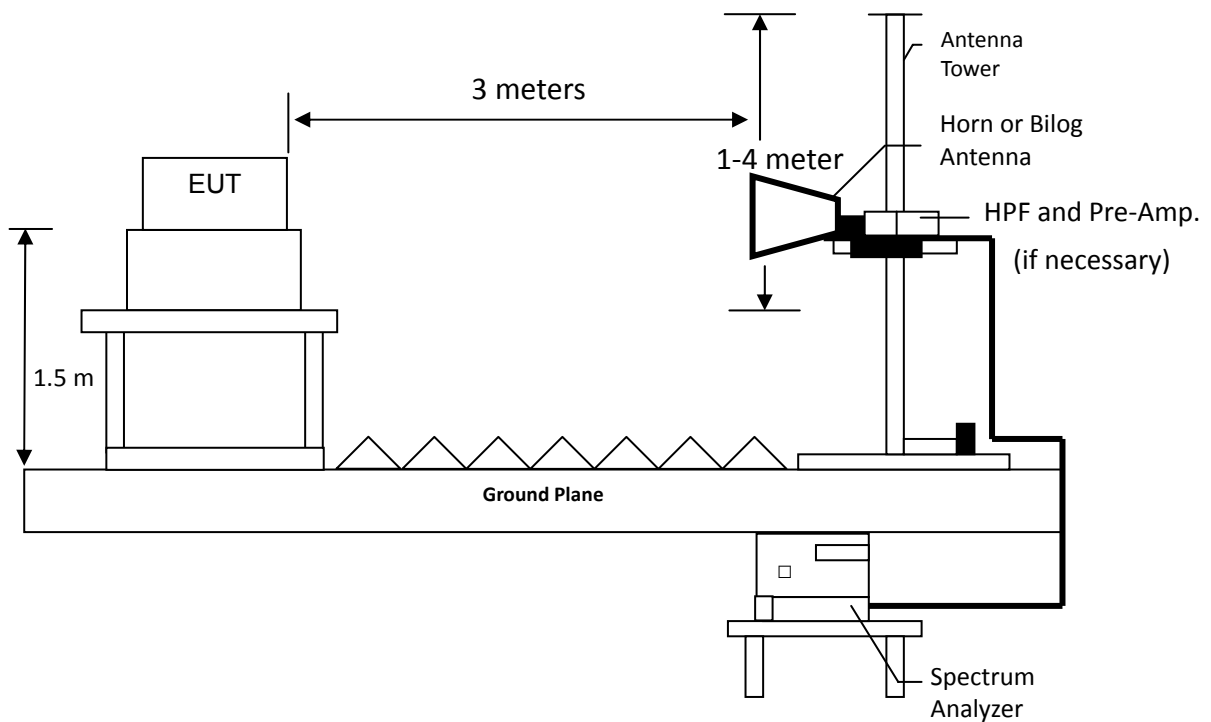
Radiated emission from 9kHz to 30MHz uses Loop Antenna:



Radiated emission below 1GHz using Bilog Antenna



Radiated emission above 1GHz using Horn Antenna



Radiated emissions were investigated cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 10Hz VBW record Average reading. (15.209 paragraph), the Peak reading (1 MHz RBW/ 3 MHz VBW) recorded also on the report.

The EUT for testing is arranged on a turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

4.3 Emission limit

4.3.1 Fundamental and harmonics emission limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(mV/m@3m)	(dBuV/m@3m)	(uV/m@3m)	(dBuV/m@3m)
2400-2483.5	50	94	500	54

4.3.2 General radiated emission limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

Frequency MHz	15.209 Limits (dBµV/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

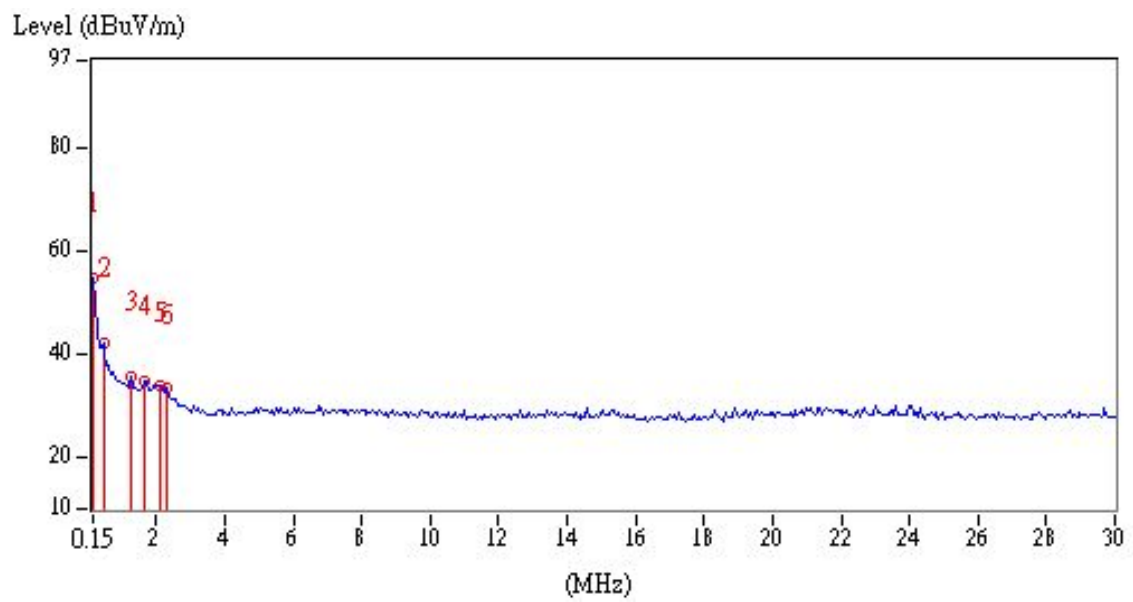
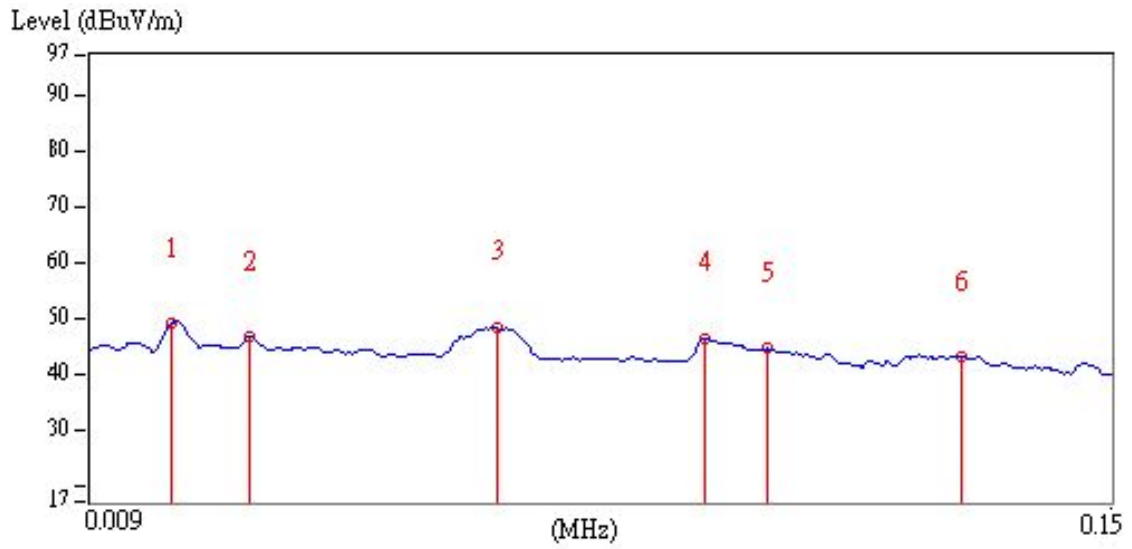
Remark:

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

4.4 Radiated spurious emission test data

4.4.1 Measurement results: frequency range from 9 kHz to 30 MHz

Polarity (circle)	Frequency (MHz)	Detection value	Factor (dB/m)	Reading (dBµV)	Value (dBµV/m)	Limit @ 3m (dBµV/m)	Tolerance (dB)
Plane	0.02	PK	19.24	29.72	48.96	121.58	-72.62
Plane	0.03	PK	19.52	26.99	46.51	118.06	-71.55
Plane	0.07	PK	18.95	29.28	48.23	110.70	-62.47
Plane	0.09	QP	18.78	27.46	46.24	108.52	-62.28
Plane	0.10	PK	18.74	25.71	44.45	107.60	-63.15
Plane	0.13	PK	18.74	24.26	43.00	105.33	-62.33
Plane	0.15	PK	18.73	36.14	54.87	104.08	-49.21
Plane	0.45	PK	18.67	23.63	42.30	94.54	-52.24
Plane	1.28	QP	18.58	17.20	35.78	65.46	-29.68
Plane	1.64	QP	15.55	16.44	31.99	63.31	-31.32
Plane	2.12	QP	15.51	15.32	30.83	69.54	-38.71
Plane	2.30	QP	18.49	15.00	33.49	69.54	-36.05



4.4.2 Measurement results: frequencies equal to or less than 1 GHz

The test was performed on EUT under Z-wave mode. The worst case occurred at Z-wave mode at 916 MHz.

EUT: ES160-1
 Worst case: 916 MHz

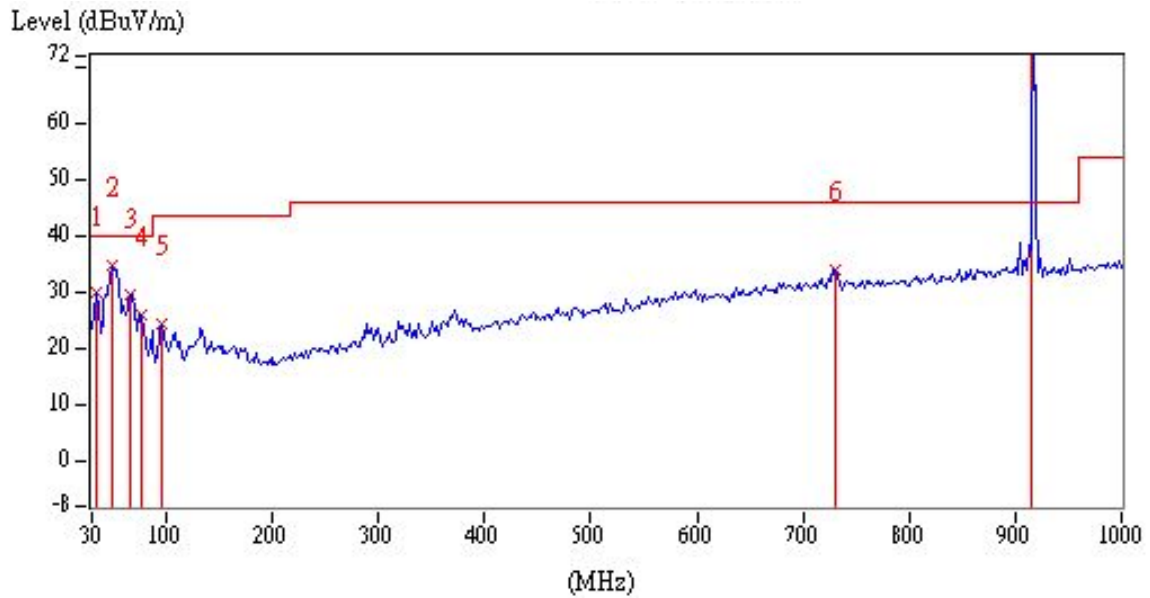
Antenna Polarized (V/H)	Freq. (MHz)	Receiver Detector	Corr. Factor (dB/m)	Reading (dBuV)	Corrected Level (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
V	33.88	QP	19.35	10.49	29.84	40.00	-10.16
V	49.40	QP	20.48	14.33	34.81	40.00	-5.19
V	66.86	QP	18.65	10.91	29.56	40.00	-10.44
V	76.56	QP	16.83	9.32	26.15	40.00	-13.85
V	95.96	QP	14.91	9.62	24.53	43.50	-18.97
V	730.34	QP	31.21	2.96	34.17	46.00	-11.83
H	49.40	QP	20.48	2.03	22.51	40.00	-17.49
H	103.72	QP	16.05	5.38	21.43	43.50	-22.07
H	130.88	QP	19.19	5.63	24.82	43.50	-18.68
H	319.06	QP	22.24	3.28	25.52	46.00	-20.48
H	369.50	QP	23.54	2.25	25.79	46.00	-20.21
H	728.40	QP	31.18	2.42	33.60	46.00	-12.40

Remark:

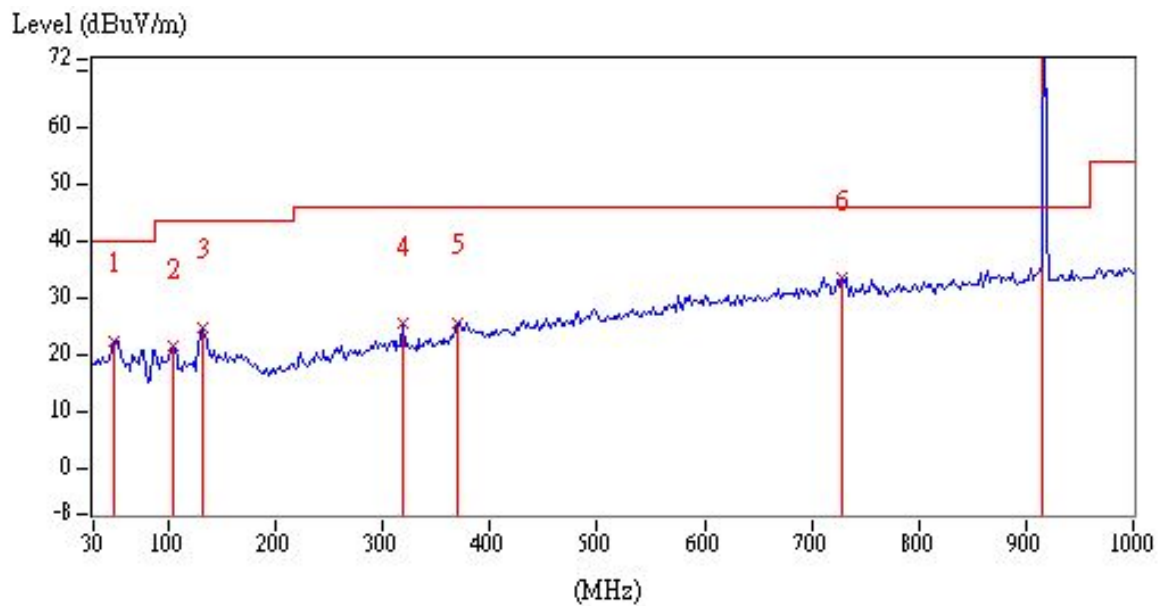
1. Corr. Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Corr. Factor

Channel High

Vertical



Horizontal



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4.4.3 Measurement results: frequency above 1GHz

EUT : ES160-1

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Z-wave Channel Low	2725.2	PK	V	36.00	17.47	53.47	74.00	-20.53
	3633.6	PK	V	2.24	39.28	41.52	74.00	-32.48
	4542.0	PK	V	4.59	40.60	45.19	74.00	-28.81
	6358.0	PK	V	9.41	33.90	43.31	74.00	-30.69
	8175.6	PK	V	15.17	30.77	45.94	74.00	-28.06
	2725.2	PK	H	36.00	18.47	54.47	74.00	-19.53
	2725.2	AV	H	36.00	16.89	52.89	54.00	-1.11
	3633.6	PK	H	2.24	42.19	44.43	74.00	-29.57
	4542.0	PK	H	4.59	39.90	44.49	74.00	-29.51
	6358.0	PK	H	9.41	37.02	46.43	74.00	-27.57
	8175.6	PK	H	15.17	34.60	49.77	74.00	-24.23
	9992.4	PK	H	17.62	27.31	44.93	74.00	-29.07
Z-wave Channel High	2748.0	PK	V	36.08	17.99	54.07	74.00	-19.93
	2748.0	AV	V	36.08	17.01	53.09	54.00	-0.91
	3664.0	PK	V	2.34	45.07	47.41	74.00	-26.59
	4580.0	PK	V	4.74	42.87	47.61	74.00	-26.39
	6412.0	PK	V	9.59	37.64	47.23	74.00	-26.77
	8244.0	PK	V	15.12	34.61	49.73	74.00	-24.27
	11908.0	PK	V	22.20	26.39	48.59	74.00	-25.41
	2748.0	PK	H	36.08	18.99	55.07	74.00	-18.93
	2748.0	AV	H	36.08	17.25	53.33	54.00	-0.67
	3664.0	PK	H	2.34	48.69	51.03	74.00	-22.97
	4580.0	PK	H	4.74	41.70	46.44	74.00	-27.56
	6412.0	PK	H	9.59	37.98	47.57	74.00	-26.43
	8244.0	PK	H	15.12	30.31	45.43	74.00	-28.57

Remark: Correction Factor = Antenna Factor + Cable Loss– Preamp. Gain

4.4.4 Measurement results: Fundamental

EUT : ES160-1

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)
Z-wave	908.4	PK	V	33.62	60.60	94.22	114.00	-19.78
	908.4	AV	V	33.62	59.80	93.42	94.00	-0.58
	908.4	PK	H	33.62	60.85	94.47	114.00	-19.53
	908.4	AV	H	33.62	59.90	93.52	94.00	-0.48
	916.0	PK	V	33.62	60.78	94.40	114.00	-19.60
	916.0	AV	V	33.62	59.80	93.42	94.00	-0.58
	916.0	PK	H	33.62	61.10	94.72	114.00	-19.28
	916.0	AV	H	33.62	60.00	93.62	94.00	-0.38

Remark: Correction Factor = Antenna Factor + Cable Loss– Preamp. Gain

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5. Radiated emission on the band edge FCC 15.249(d)

5.1 Operating environment

Temperature:	25	°C
Relative Humidity:	50	%
Atmospheric Pressure:	1008	hPa

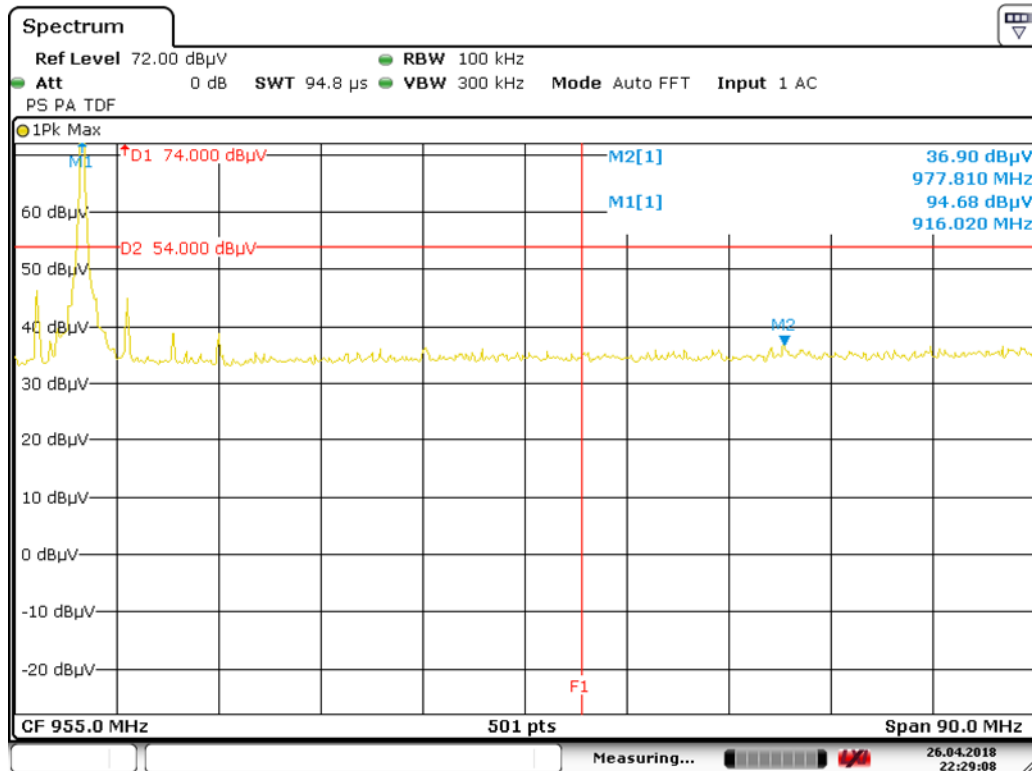
5.2 Radiated emission on the band edge test data

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental (908.4 MHz, 916 MHz) or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Mode	Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBμV)	Corrected Reading (dBμV/m)	Limit @ 3 m (dBμV/m)	Margin (dB)	Restricted band (MHz)
Z-wave	977.81	PK	H	34.52	2.38	36.90	74	-37.10	960~1000
	997.22	AV	H	34.87	-12.34	22.53	54	-31.47	

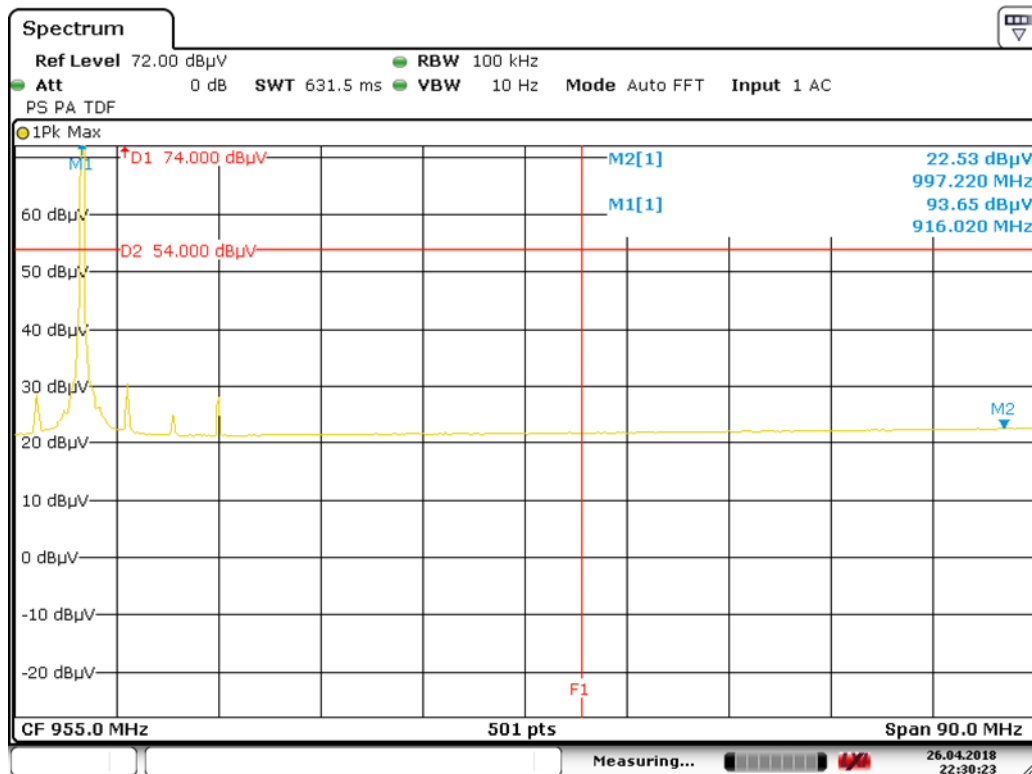
Remark: Correction Factor = Antenna Factor + Cable Loss

Bandedge @ mode Z-wave 916MHz Peak



Date: 26.APR.2018 22:29:08

Bandedge @ mode Z-wave 916MHz Average



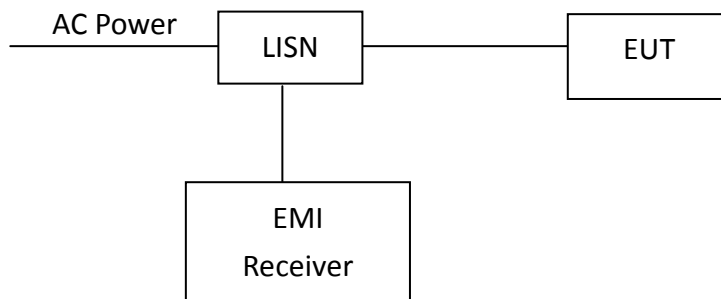
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6. Conducted emission test FCC 15.207

6.1 Operating environment

Temperature:	24	°C
Relative Humidity:	51	%
Atmospheric Pressure:	1009	hPa

6.2 Test setup & procedure



The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50 ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination.

Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4/2003 on conducted measurement. The bandwidth of the field strength meter (R & S Test Receiver ESCI 30) is set at 9kHz.

6.3 Emission limit

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

*Decreases with the logarithm of the frequency.

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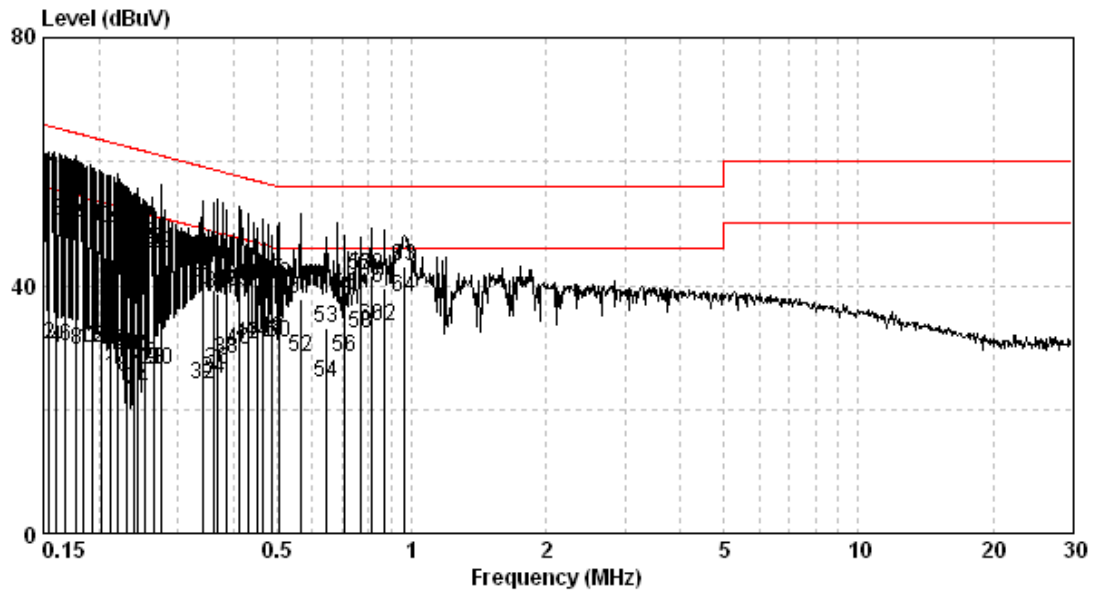
6.4 Conducted emission data FCC 15.207

Phase: Live Line
 Model No.: ES160-1

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
0.155	9.61	45.01	54.62	65.74	20.75	30.36	55.74	-11.12	-25.37
0.161	9.61	40.77	50.38	65.43	20.26	29.87	55.43	-15.04	-25.56
0.169	9.61	40.69	50.30	65.03	20.44	30.05	55.03	-14.73	-24.98
0.178	9.61	43.75	53.36	64.59	19.96	29.57	54.59	-11.23	-25.02
0.184	9.61	40.19	49.80	64.28	20.31	29.92	54.28	-14.49	-24.37
0.193	9.61	39.94	49.55	63.89	20.18	29.79	53.89	-14.34	-24.10
0.203	9.61	39.57	49.18	63.49	20.46	30.07	53.49	-14.31	-23.42
0.212	9.61	39.20	48.81	63.14	19.96	29.57	53.14	-14.33	-23.57
0.220	9.61	40.68	50.29	62.83	15.70	25.31	52.83	-12.54	-27.52
0.230	9.61	38.30	47.91	62.44	19.16	28.78	52.44	-14.52	-23.66
0.239	9.61	37.85	47.46	62.13	18.98	28.59	52.13	-14.67	-23.54
0.244	9.61	38.51	48.12	61.95	13.68	23.29	51.95	-13.83	-28.66
0.253	9.61	36.96	46.57	61.64	17.64	27.25	51.64	-15.07	-24.39
0.266	9.61	36.19	45.81	61.25	16.63	26.24	51.25	-15.44	-25.01
0.276	9.61	35.59	45.21	60.94	16.80	26.41	50.94	-15.73	-24.53
0.341	9.62	30.86	40.47	59.18	14.41	24.03	49.18	-18.71	-25.15
0.360	9.62	29.64	39.25	58.74	15.40	25.01	48.74	-19.49	-23.73
0.369	9.62	29.21	38.82	58.52	16.80	26.41	48.52	-19.70	-22.11
0.387	9.62	29.09	38.71	58.12	18.40	28.02	48.12	-19.41	-20.11
0.410	9.62	29.42	39.04	57.64	19.97	29.59	47.64	-18.60	-18.05
0.431	9.62	30.26	39.88	57.24	20.76	30.38	47.24	-17.36	-16.87
0.452	9.62	30.62	40.24	56.85	21.17	30.79	46.85	-16.61	-16.06
0.466	9.62	30.92	40.54	56.58	21.08	30.70	46.58	-16.05	-15.88
0.489	9.62	31.08	40.70	56.19	21.79	31.41	46.19	-15.48	-14.77
0.507	9.62	30.67	40.29	56.00	21.10	30.72	46.00	-15.71	-15.28
0.564	9.63	28.12	37.74	56.00	18.90	28.53	46.00	-18.26	-17.47
0.644	9.64	23.57	33.21	56.00	14.62	24.26	46.00	-22.79	-21.74
0.705	9.64	28.85	38.49	56.00	18.68	28.33	46.00	-17.51	-17.67
0.767	9.65	31.94	41.59	56.00	22.68	32.33	46.00	-14.41	-13.67
0.813	9.65	32.05	41.70	56.00	23.70	33.35	46.00	-14.30	-12.65
0.871	9.65	29.79	39.44	56.00	23.87	33.52	46.00	-16.56	-12.48
0.963	9.66	33.55	43.21	56.00	28.43	38.09	46.00	-12.79	-7.91

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)



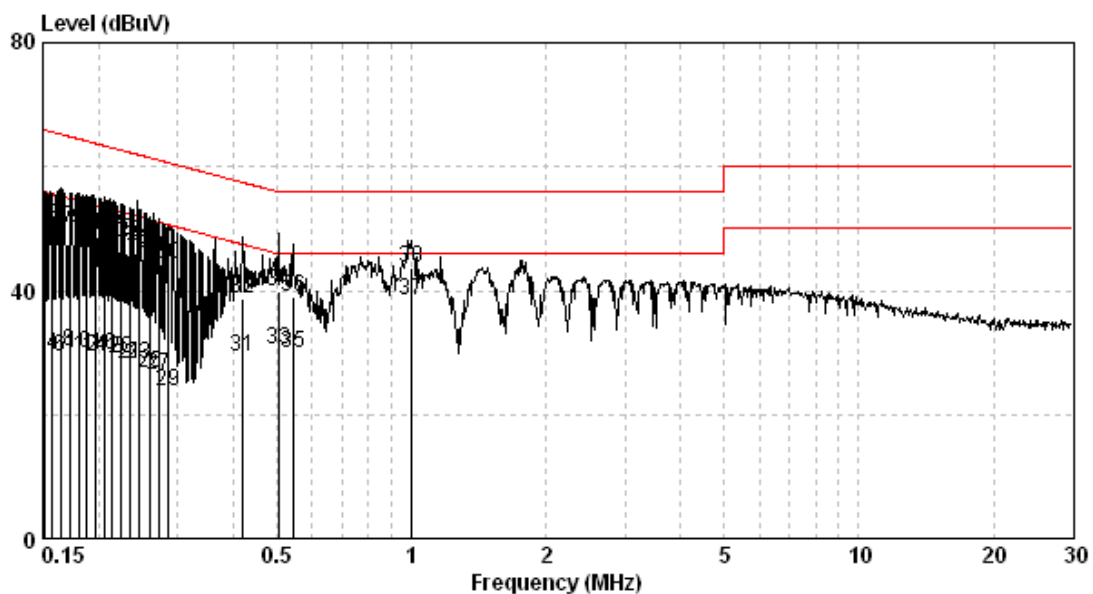
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Phase: Neutral Line
 Model No.: ES160-1

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
0.152	9.64	40.65	50.29	65.91	19.91	29.55	55.91	-15.63	-26.36
0.157	9.64	40.68	50.32	65.60	19.91	29.55	55.60	-15.29	-26.06
0.164	9.64	40.69	50.33	65.25	19.79	29.43	55.25	-14.92	-25.83
0.172	9.64	40.33	49.97	64.86	20.52	30.16	54.86	-14.88	-24.69
0.181	9.64	40.26	49.90	64.46	20.11	29.75	54.46	-14.56	-24.71
0.187	9.64	39.94	49.58	64.15	19.76	29.40	54.15	-14.57	-24.75
0.197	9.64	39.73	49.37	63.76	19.66	29.30	53.76	-14.38	-24.46
0.206	9.64	39.22	48.86	63.36	20.07	29.71	53.36	-14.50	-23.65
0.214	9.64	38.98	48.62	63.05	19.44	29.08	53.05	-14.43	-23.97
0.223	9.64	38.53	48.17	62.70	19.23	28.87	52.70	-14.53	-23.83
0.234	9.64	37.98	47.63	62.30	18.55	28.19	52.30	-14.68	-24.11
0.246	9.64	37.39	47.04	61.91	18.36	28.01	51.91	-14.87	-23.90
0.260	9.64	36.46	46.11	61.42	16.96	26.61	51.42	-15.32	-24.82
0.273	9.64	35.77	45.41	61.03	16.60	26.24	51.03	-15.62	-24.78
0.286	9.64	34.74	44.39	60.63	14.20	23.84	50.63	-16.24	-26.79
0.419	9.65	29.16	38.80	57.46	19.75	29.40	47.46	-18.66	-18.06
0.505	9.65	30.35	40.00	56.00	20.95	30.60	46.00	-16.00	-15.40
0.544	9.65	29.23	38.88	56.00	20.14	29.80	46.00	-17.12	-16.20
1.000	9.68	34.04	43.72	56.00	28.83	38.51	46.00	-12.28	-7.49

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

Test Equipment/ Test site	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	100245	2018/02/23	2019/02/22
Horn Antenna (1-18G)	SHWARZBECK	BBHA 9120 D	9120D-456	2018/01/23	2019/01/22
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2017/09/04	2020/09/02
Broadband Antenna	SHWARZBECK	VULB 9168	9168-172	2018/04/23	2019/04/22
Pre-Amplifier	EMC Co.	EMC12635SE	980205	2017/11/28	2018/11/27
Pre-Amplifier	MITEQ	JS4-26004000--27-8A	828825	2017/08/23	2018/08/22
Power Meter	Anritsu	ML2495A	0844001	2017/10/18	2018/10/17
Power Sensor	Anritsu	MA2411B	0738452	2017/05/23	2018/05/22
Signal Analyzer	Agilent	N9030A	MY51380492	2017/08/29	2018/08/28
966-2(A) Cable 9kHz~26.5GHz	SUHNER	SMA / EX 100	N/A	2017/08/15	2018/08/14
966-2(B) Cable 9kHz~26.5GHz	SUHNER	SUCOFLEX 104P	CB0005	2017/08/15	2018/08/14
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	2018/03/28	2019/03/27
High Pass Filter	Wainwright	WHKX3.0/18G-12SS	N/A	2017/06/02	2018/06/01
Active Loop Antenna	SCHWARZBECK MESS-ELEKTRONIC	FMZB1519	1519-067	2018/04/17	2019/04/16

Note: No Calibration Required (NCR).

TEST REPORT

Test Equipment/ Test site	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	R&S	ESR7	101822	2017/06/01	2018/05/31
Two-Line V-Network	R&S	ENV216	101160	2017/07/17	2018/07/16
Two-Line -V-Network	R&S	ESH3-Z5	838979/014	2017/09/13	2018/09/12
CON-2 Shielded Room	N/A	N/A	N/A	NCR	NCR
CON-2 Cable	SUHNER	EMCCFD300-B M-NM-6000	170502	2018/05/07	2019/05/06
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
Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m	3.54 dB
Emission on the Band Edge Test	3.64 dB
20dB Bandwidth	1.22 dB
AC Power Line Conducted Emission	2.48 dB