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TEST REPORT

According to : FCC 47CFR part 15 subpart C § 15.247

Test Report No. : CTK-2013-00046
Date of Issue : January 14, 2013
FCC ID : ORI-HR110
Model/Type No. : HR110-A3S50xxx
Kind of Product : LED STREET LIGHT
Applicant : KMW INC.
Applicant Address : 183-6 Youngchun-ro, Dongtan-myun, Hwasung-si, Kyungki-do, Republic of Korea
Manufacturer : KMW INC.
Manufacturer Address : 183-6 Youngchun-ro, Dongtan-myun, Hwasung-si, Kyungki-do, Republic of Korea
Contact Person : Sung Seok / Principal Research Engineer
Telephone : +82-31-370-8621
Received Date : December 4, 2012
Test period : Start : December 17, 2012 End : January 8, 2013
Test Results : ☒ In Compliance ☐ Not in Compliance

The test results presented in this report relate only to the object tested.

Tested by

Y. T. Lee

Young-taek Lee
Test Engineer
Date: January 14, 2013

Reviewed by

Y. J. Park

Young-Joon, Park
Technical Manager
Date: January 14, 2013



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REPORT REVISION HISTORY

Date	Revision	Page No
January 14, 2013	Issued (CTK-2013-00046)	All

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1.0 General Product Description

Equipment model name : HR110-A3S50xxx

Serial number : Prototype

EUT condition : Pre-production, not damaged

Antenna type : Planar Inverted F antenna Gain 2.13 dBi

Frequency Range : 2405 MHz – 2480 MHz (DSSS)

RF output power : -0.86 dBm Peak Conducted

Number of channels : 16

Type of Modulation : OQPSK

Rated Channel spacing : 5 MHz

Power Source : AC 100 - 277 V

1.1 Tested Frequency

	LOW	MID	HIGH
Frequency (MHz)	2405	2445	2480

1.2 Model Differences

Not applicable



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1.3 Device Modifications

The following modifications were necessary for compliance:

Not applicable

1.4 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.	FCC ID or DoC
-	-	-	-	-

1.5 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

1.6 Test Facility

The measurement facility is located at 386-1, Ho-dong, Cheoin-gu, Yongin-si, Gyeonggi-do, 449-100, Korea. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.



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1.7 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Logo
USA	FCC	3 m & 10 m SAC and Conducted Test Site to perform FCC Part 15/18 measurements	 805871
JAPAN	VCCI	3 m & 10 m SAC and Conducted Test Site	 R-948, C-986, T-1843
KOREA	KCC	EMI (3 m & 10 m SAC and Conducted Test Site) EMS (ESD, RS, EFT/Burst, Surge, CS, Magnetic, Dips and Interruptions)	 No. 51, KR0025
International	KOLAS	EMC	



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2.0 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	6 dB Bandwidth	> 500 kHz	Conducted	C
15.247(b)	Maximum Output Power	< 1 Watt		C
15.247(d)	Conducted Spurious emission	> 20 dBc		C
15.247(d)	Band Edge	> 20 dBc		C
15.247(e)	Transmitter Power Spectral Density	< 8 dBm @ 3 kHz		C
				C
15.209	Field Strength of Harmonics	15.209(a)	Radiated	C
15.207	AC Conducted Emissions	15.207(a)	Line Conducted	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

The sample was tested according to the following specification:
- FCC Part 15.247, ANSI C63.4-2003

The tests were performed according to the method of measurements prescribed in
558074 D01 DTS Meas Guidance.



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2.1 Technical Characteristic Test

2.1.1 6dB Bandwidth

Procedure:

The bandwidth at 6dB below the highest in-band spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 6dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 6 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

Span = 10 MHz

VBW = 100 kHz (VBW ≥ RBW)

Sweep = auto

Trace = Max hold

Detector function = peak

Measurement Data:

Test mode : Continuous modulated carrier

Frequency (MHz)	Channel No.	Test Results	
		Measured Bandwidth (MHz)	Result
2405	11	1.430	Complies
2445	19	1.528	Complies
2480	26	1.494	Complies

Minimum Standard:

6 dB Bandwidth > 500kHz

See next pages for actual measured spectrum plots.



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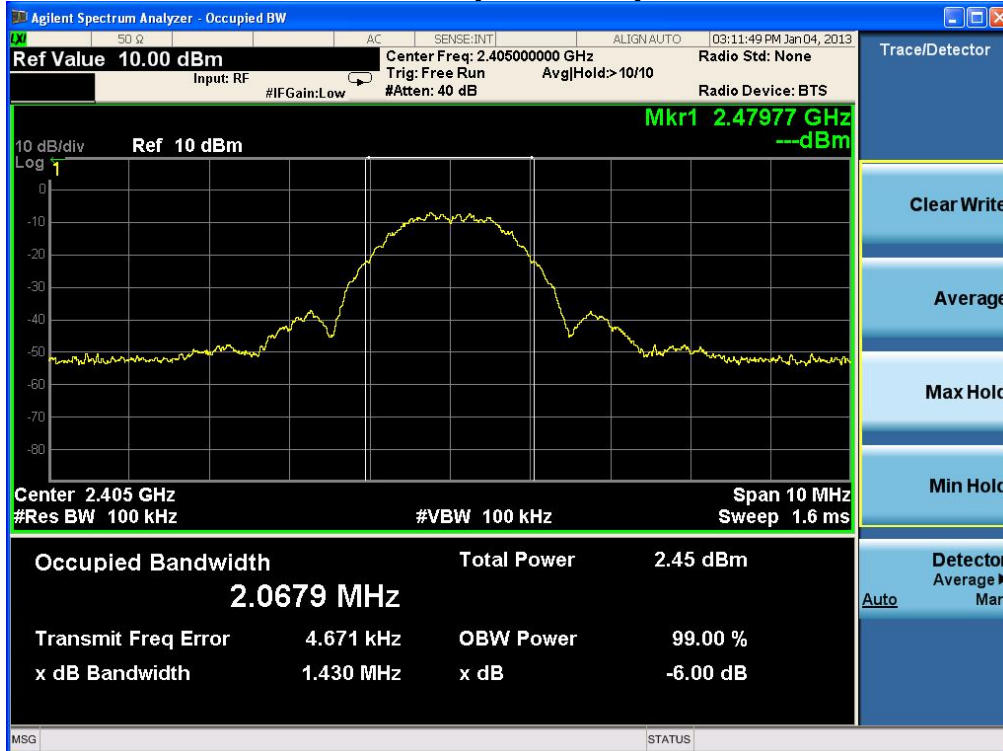
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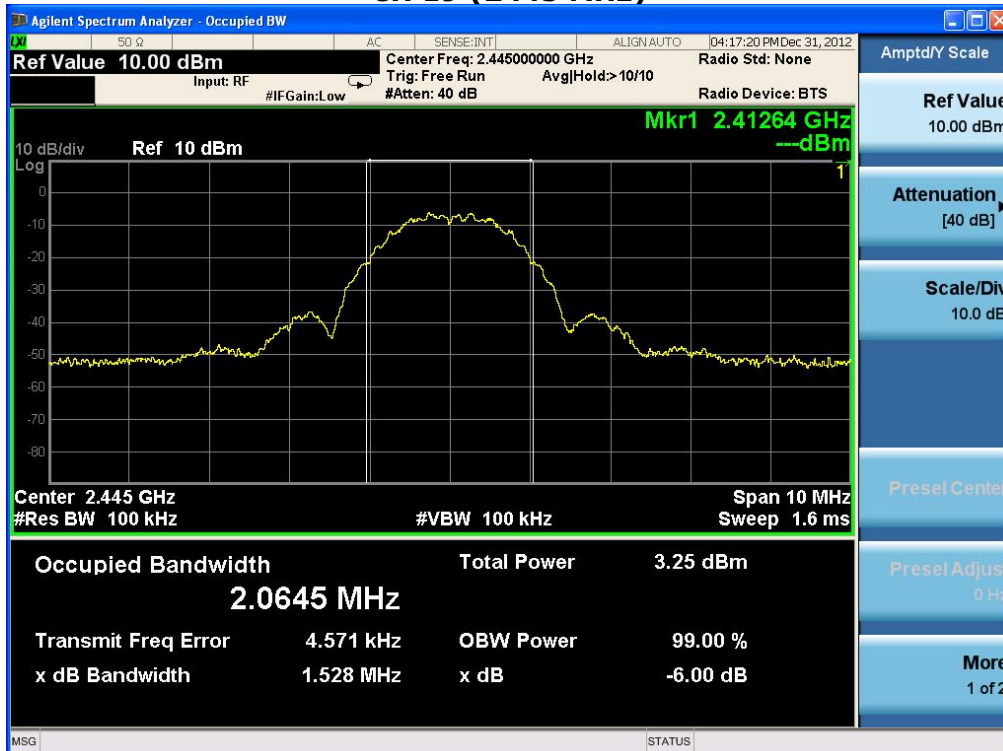
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CH 11 (2405 MHz)



CH 19 (2445 MHz)



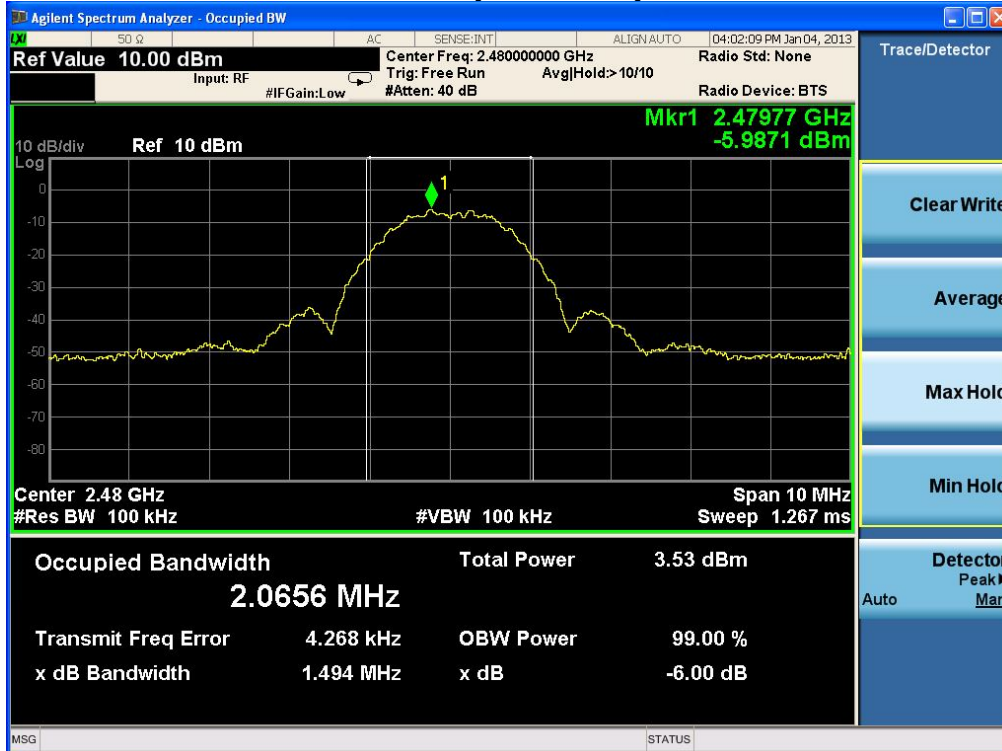


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CH 26 (2480 MHz)



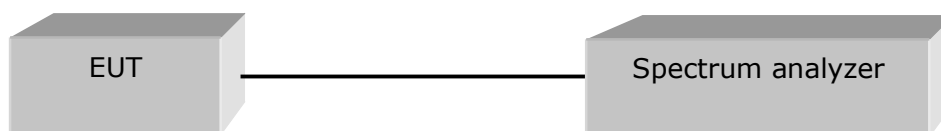
2.1.2 Maximum peak Conducted Output Power

Test Location

RF Test Room

Test Procedures

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.



The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 1 MHz

Span = fully encompass the DTS bandwidth

VBW = 1 MHz (VBW ≥ RBW)

Sweep = auto

Trace = Max hold

Detector function = peak

Limit

< 1 W (30 dBm)

Test Results

Test mode : Continuous modulated carrier

Frequency (MHz)	Channel No.	Reading power(dBm)	Cable loss (dB)	Test results	
				Peak output power (dBm)	Result
2405	11	-2.17	0.63	-1.54	Complies
2445	19	-1.52	0.66	-0.86	Complies
2480	26	-1.74	0.68	-1.06	Complies

See next pages for actual measured spectrum plots.

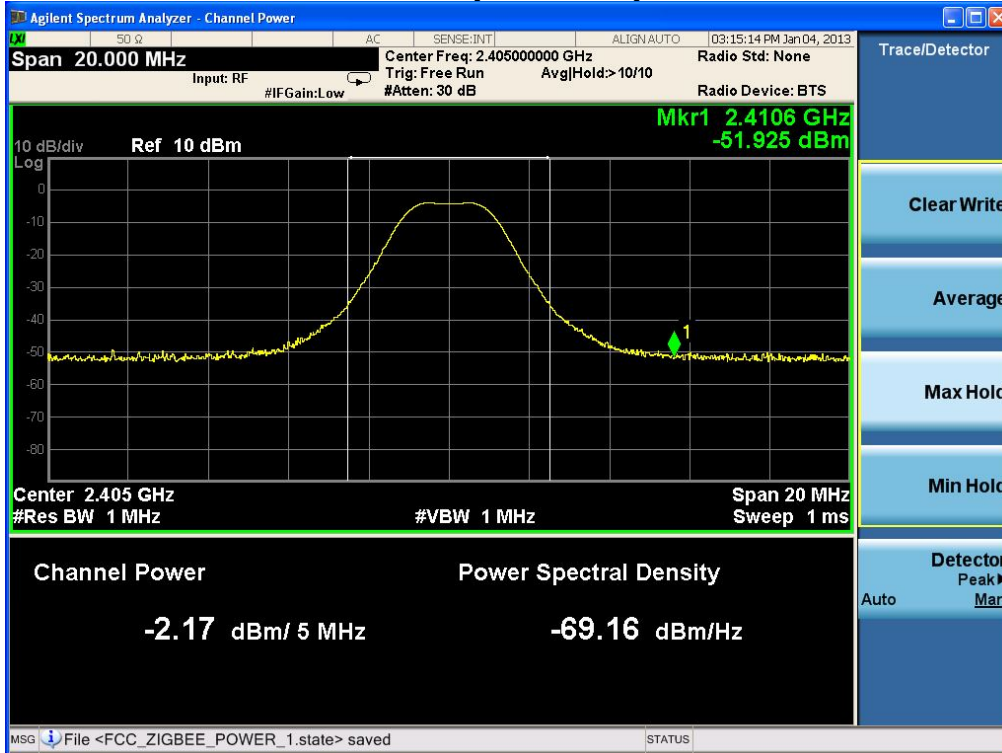


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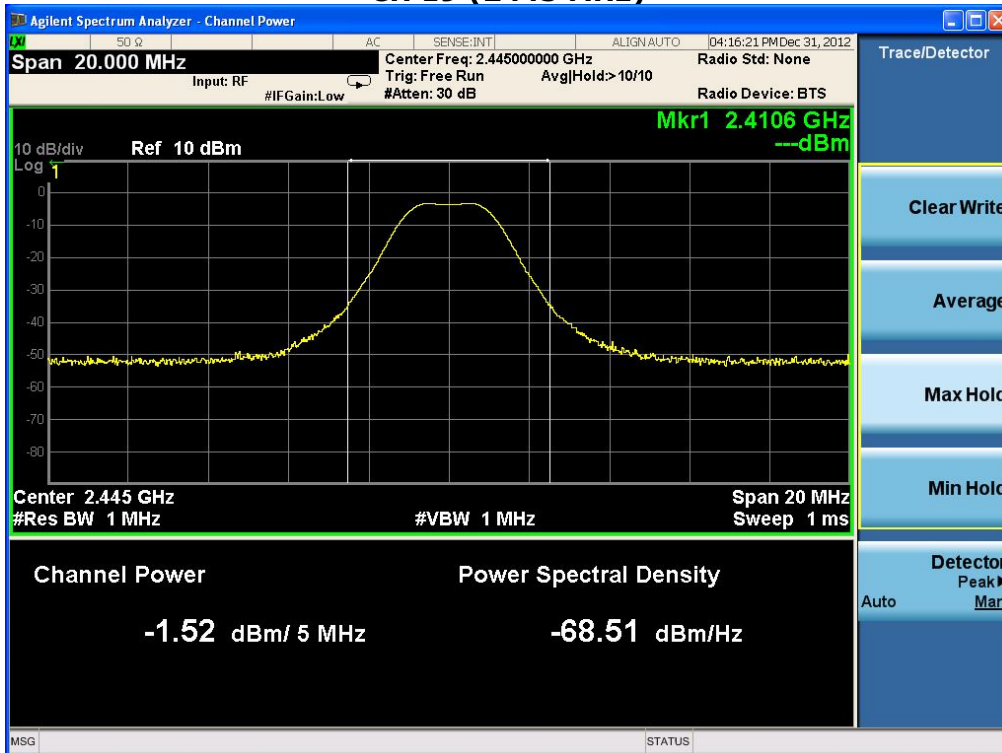
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CH 11 (2405 MHz)



CH 19 (2445 MHz)



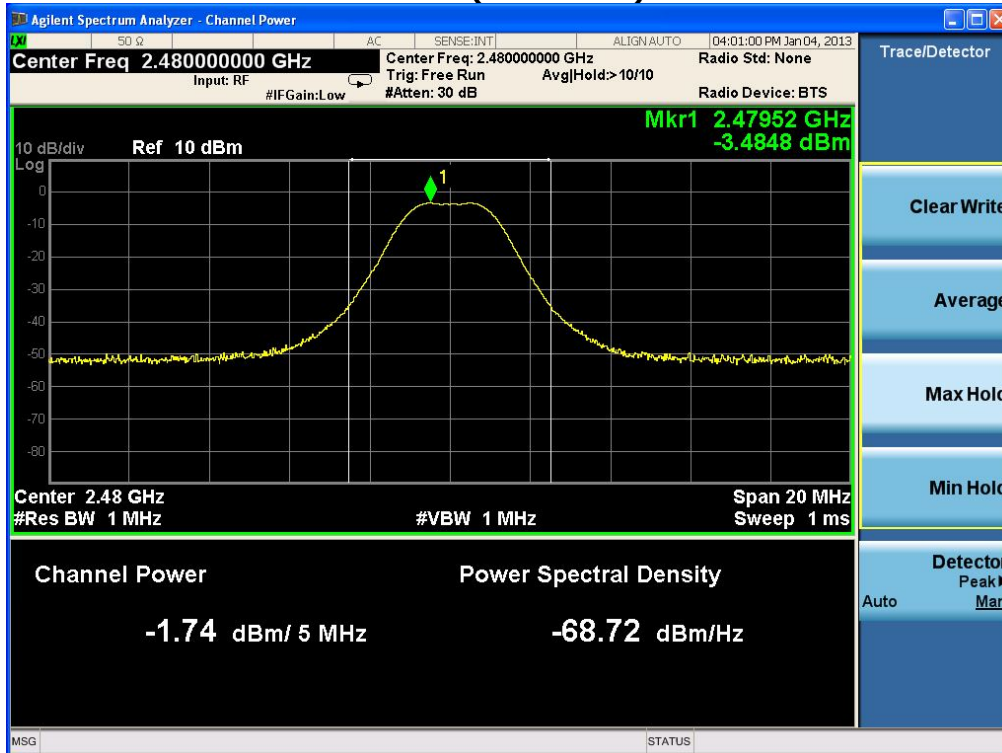


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CH 26 (2480 MHz)



2.1.3 Power Spectral Density



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Procedure:

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The spectrum analyzer is set to:

RBW = 3 kHz

VBW = (VBW $\geq$ RBW)

Sweep = 100 s (Span/3 kHz)

Span = 300 kHz

Detector function = peak

Trace = Max hold

Test mode : Continuous modulated carrier

Frequency (MHz)	Ch.	Test Results	
		dBm	Result
2405	11	-13.901	Complies
2445	19	-13.069	Complies
2480	26	-13.315	Complies

Minimum Standard:

Power Spectral Density	< 8dBm @ 3 kHz BW
------------------------	-------------------

See next pages for actual measured spectrum plots.



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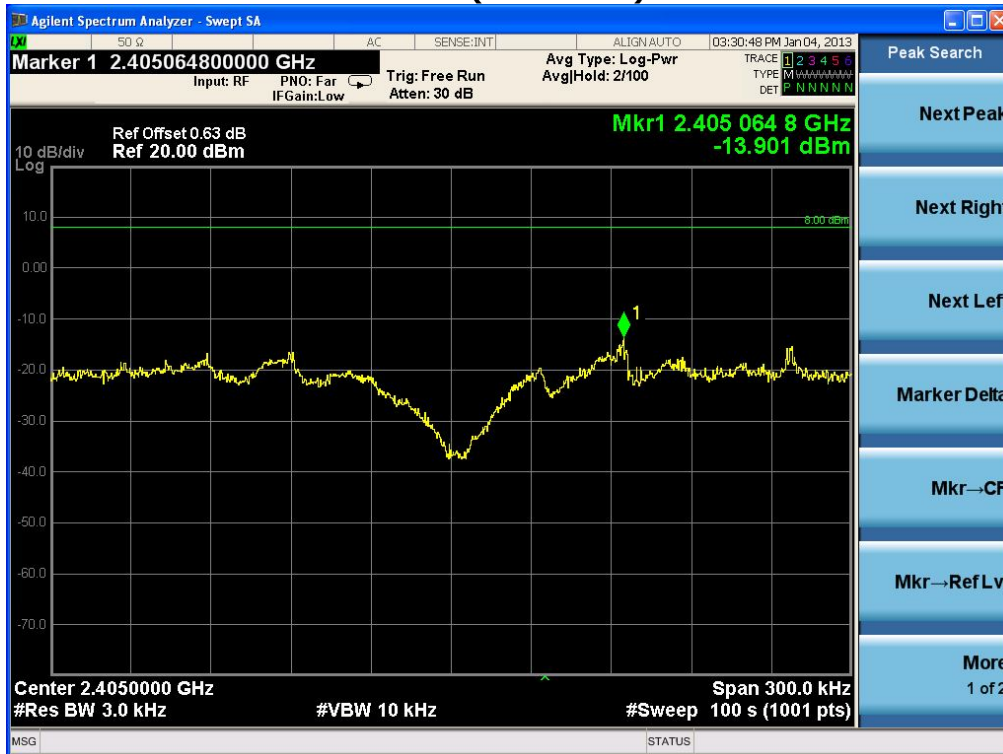
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Power Density Measurement

CH 11 (2405 MHz)



CH 19 (2445 MHz)





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CH 26 (2480 MHz)





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2.1.4 Band - edge

Procedure:

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate frequencies.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

VBW = 100 kHz

Span = 20 MHz

Detector function = peak

Trace = Max hold

Sweep = auto

Measurement Data: Complies

- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.

Minimum Standard:	> 20 dBc
--------------------------	----------

See next pages for actual measured spectrum plots.

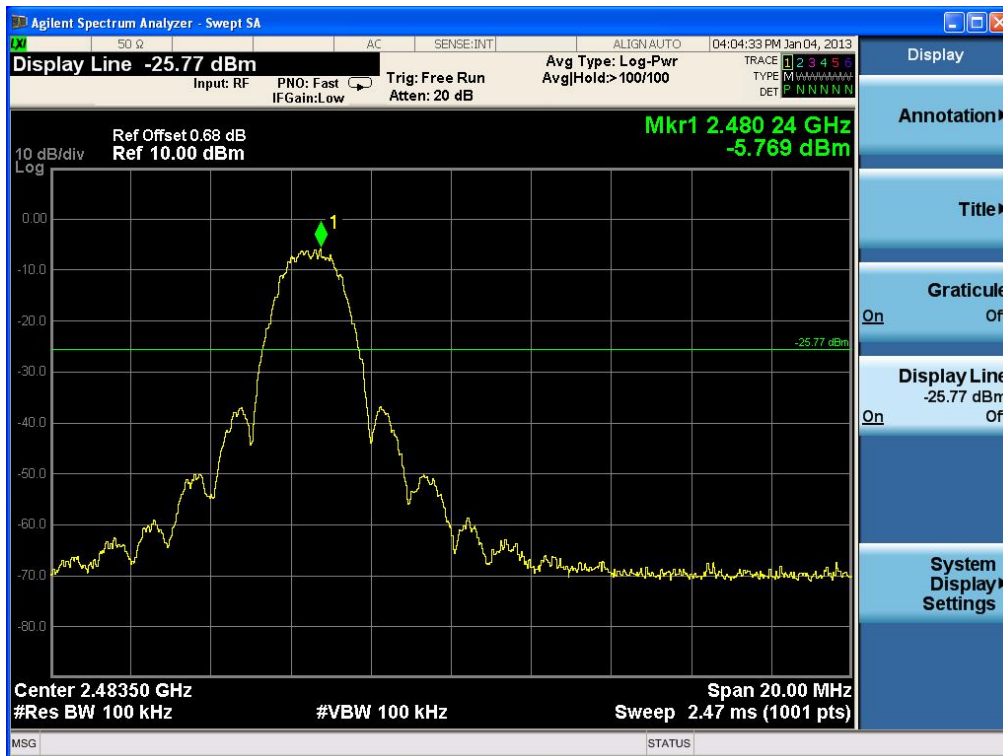


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Band-edge Measurements



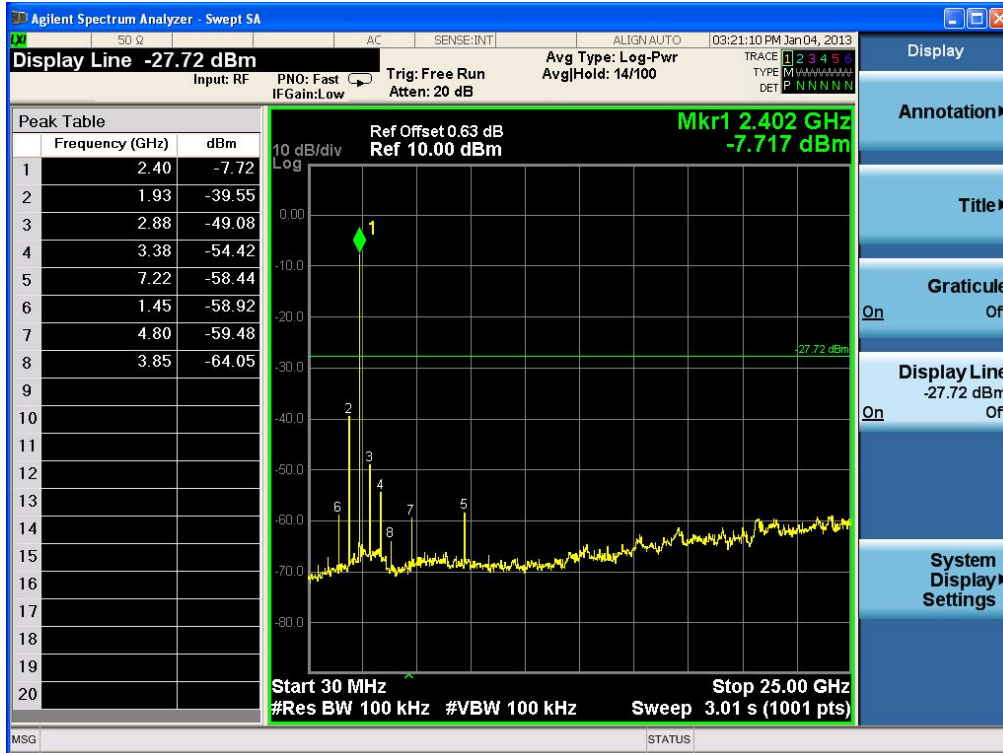


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Band – edge (at 20 dB blow) – Low channel(11) Frequency Range = 30 MHz ~ 10th harmonic





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Agilent Spectrum Analyzer - Swept SA

50.0 AC SENSE:INT ALIGN AUTO 04:19:45 PM Dec 31, 2012

Display Line -27.05 dBm Input: RF PNO: Fast IF Gain: Low Trig: Free Run Atten: 20 dB Avg Type: Log-Pwr Avg/Hold: 14/100

TRACE 1 2 3 4 5 6 TYPE M N N N N N N DET P N N N N N N

Peak Table		
	Frequency (GHz)	dBm
1	2.45	-7.05
2	1.95	-37.29
3	2.93	-51.24
4	3.43	-56.16
5	7.35	-57.74
6	1.48	-58.29
7	3.90	-59.22
8	4.90	-61.71
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Ref Offset 0.66 dB
Ref 10.00 dBm

Mkr1 2.452 GHz -7.045 dBm

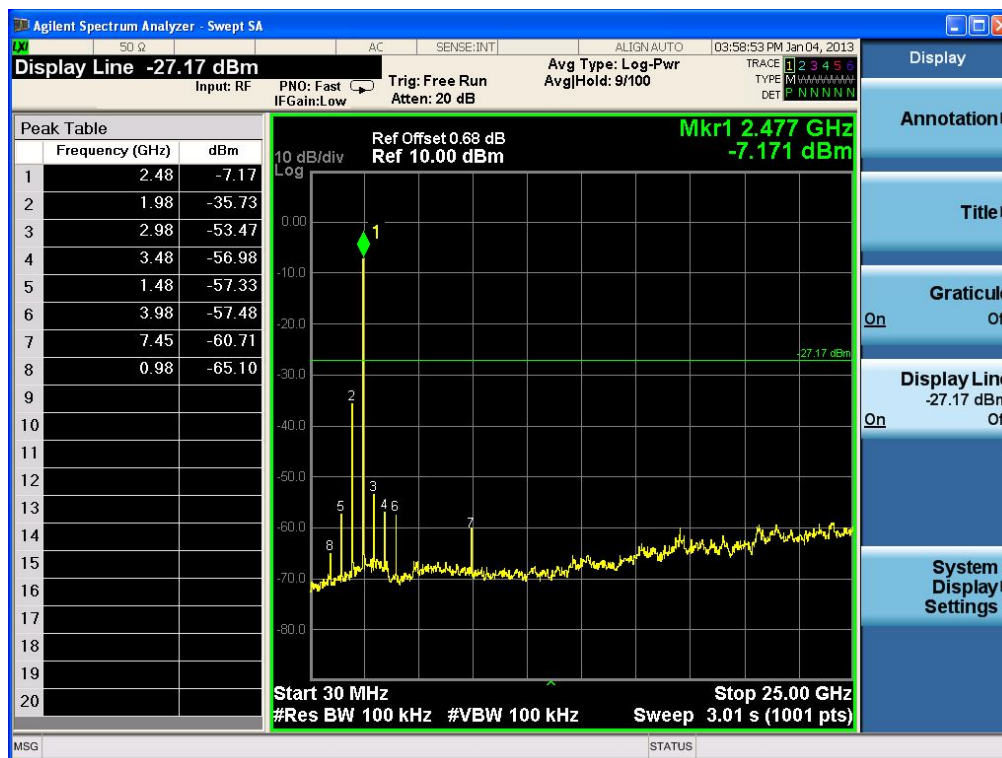
Start 30 MHz Stop 25.00 GHz
#Res BW 100 kHz #VBW 100 kHz Sweep 3.01 s (1001 pts)

MSG STATUS

Display Annotation Title Graticule On Display Line -27.05 dBm On System Display Settings



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2.1.5 Field Strength of Emissions

Test Location

- ☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)
☒ 3 m SAC (test distance : 3 m)

Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

The spectrum analyzer is set to:

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10th harmonic)

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz

VBW $\geq$ RBW

Sweep = auto

Limit

- 15.209(a)

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Measurement 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**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

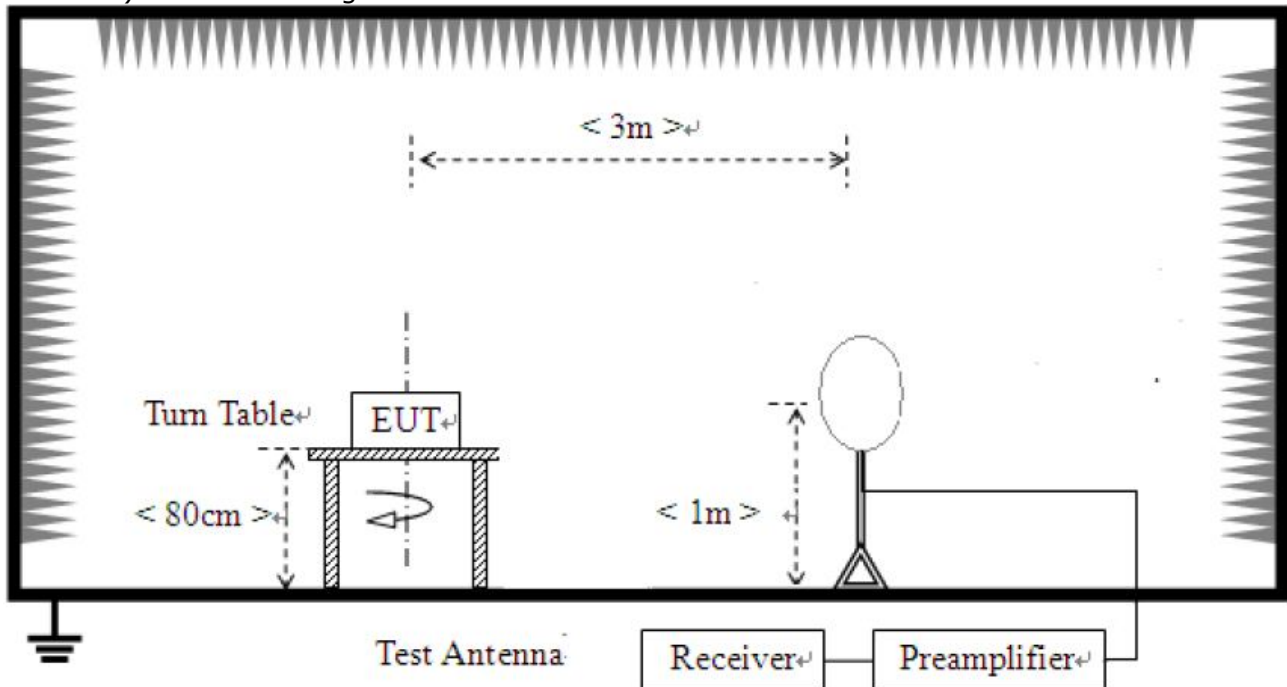
** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

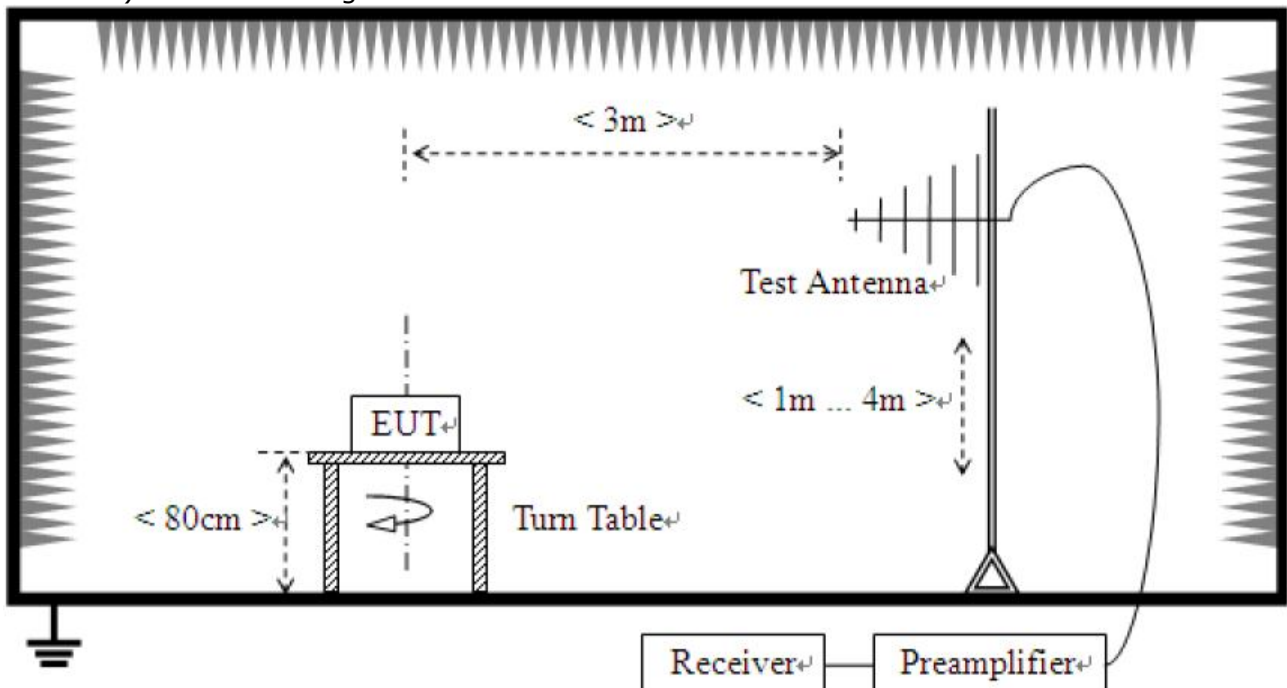
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)

Test Setup:

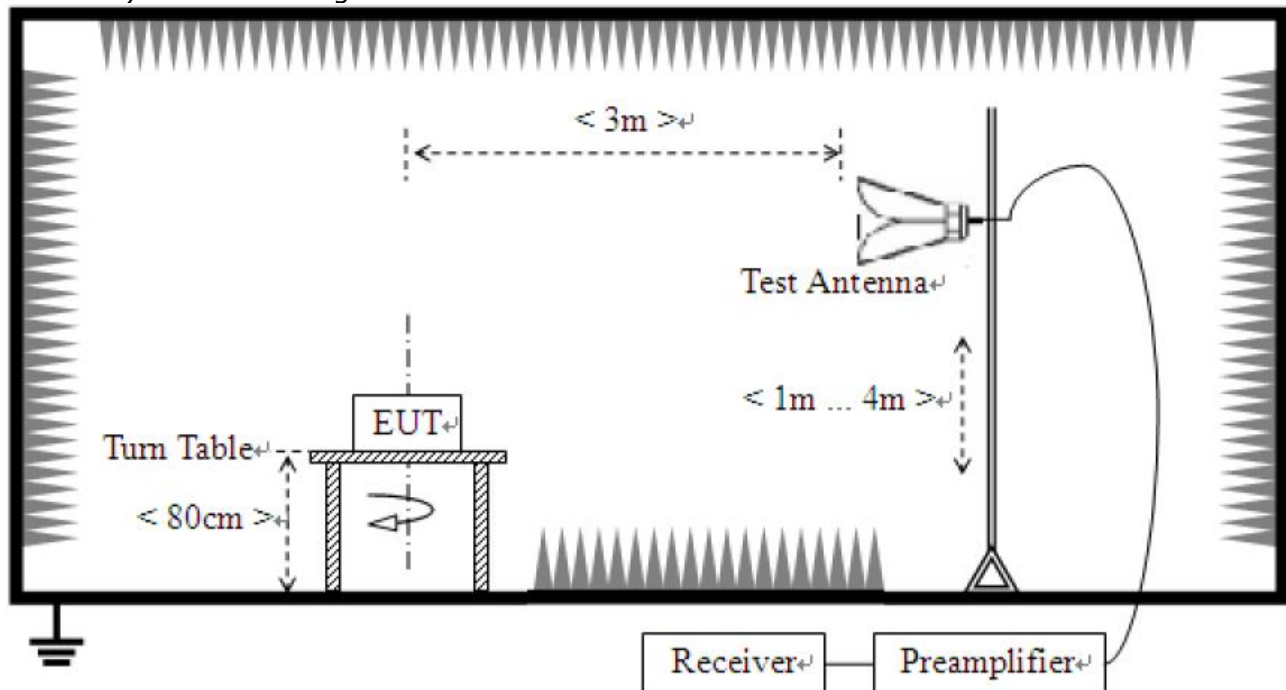
1) For field strength of emissions from 9 kHz to 30 MHz



2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



Test Results

1) 9 kHz to 30 MHz

EUT	LED STREET LIGHT	Measurement Detail	
Model	HR110-A3S50xxx	Frequency Range	9 kHz – 30 MHz
Test mode	Continuous modulated carrier	Detector function	Quasi-Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
-	-	-	See note

Note :

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

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)



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2) 30 MHz to 1 GHz

Test mode : Continuous modulated carrier

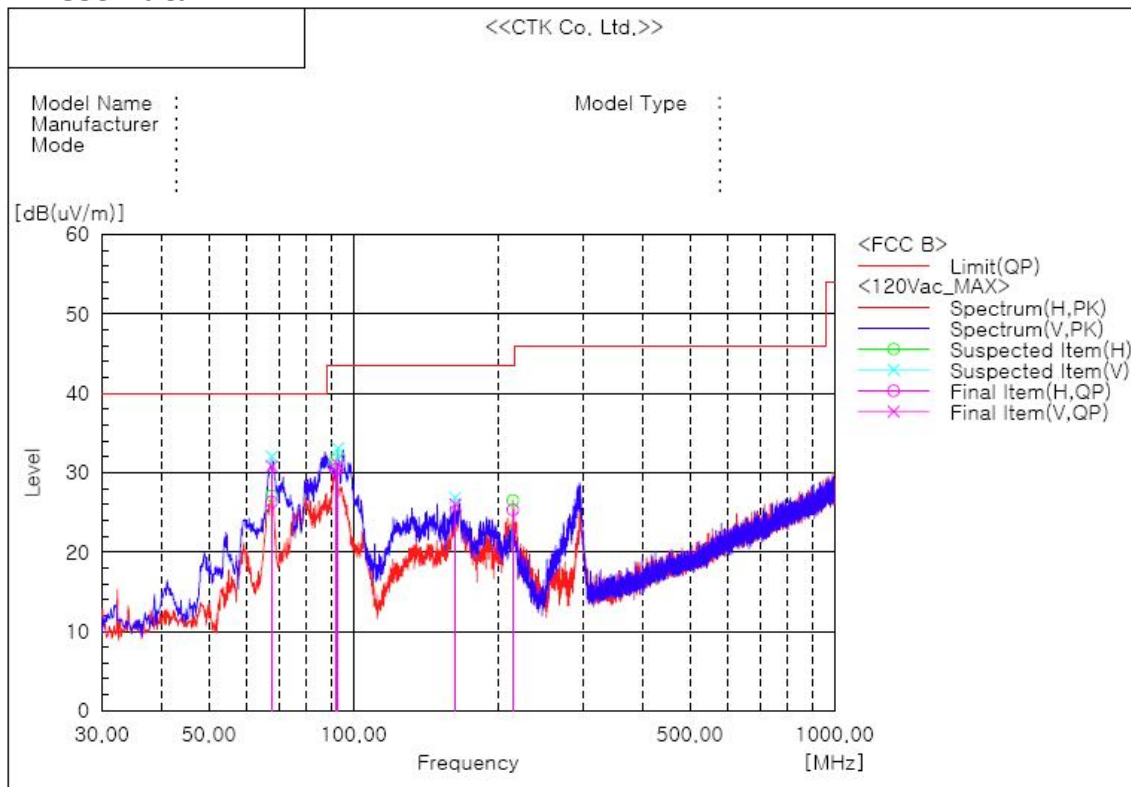
EUT	LED STREET LIGHT	Measurement Detail	
Model	HR110-A3S50xxx	Frequency Range	Below 1000MHz
Mode	Continuous modulated carrier	Detector function	Quasi-Peak

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
67.709	30.8	9.2	Quasi-peak

Test Data



Final Result

No.	Frequency (P)	Reading QP	c.f	Result QP	Limit QP	Margin QP	Height	Angle
	[MHz]	[dB(uV)]	[dB(1/m)]	[dB(uV/m)]	[dB(uV/m)]	[dB]	[cm]	[deg]
1	67.709	46.5	-15.7	30.8	40.0	9.2	100.0	290.0
2	92.808	45.4	-14.4	31.0	43.5	12.5	100.0	290.0
3	92.080	44.9	-14.5	30.4	43.5	13.1	206.0	253.0
4	67.588	41.9	-15.6	26.3	40.0	13.7	400.0	253.0
5	162.769	31.2	-5.2	26.0	43.5	17.5	400.0	130.0
6	214.543	37.8	-12.5	25.3	43.5	18.2	100.0	316.0



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3) above 1 GHz

EUT	LED STREET LIGHT	Measurement Detail	
Model	HR110-A3S50xxx	Frequency Range	1-25GHz
Channel	Channel 11 (2405 MHz)	Detector function	Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
1924	44.9	9.1	Average

Test Data

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Height [m]	Correction Factor			Limits [dBuV/m] AV / Peak	Result [dBuV/m] AV / Peak	Margin [dB] AV / Peak	
					Antenna	Amp. Gain	Cable				
1924.00	48.5	52.6	V	1.0	25.4	35.6	6.6	54.0 : 74.0	44.9 : 49.0	9.1	25.0
2886.00	39.1	43.7	V	1.0	28.5	35.4	8.1	54.0 : 74.0	40.3 : 44.9	13.7	29.1
4810.00	33.0	42.0	V	1.0	32.7	34.9	11.4	54.0 : 74.0	42.2 : 51.2	11.8	22.8

Restricted band edge test data

Measured frequency range : 2310-2390 MHz, 2483.5-2500 MHz

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor			Limits [dBuV/m] AV / Peak	Result [dBuV/m] AV / Peak	Margin [dB] AV / Peak
				Antenna	Amp. Gain	Cable			
No emissions were detected at a level greater than 20dB below limit.									



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386-1, Ho-dong, Cheoin-gu, Yongin-si, Gyeonggi-do, 449-100, Korea
Tel: +82-31-339-9970 Fax: +82-31-339-9855
www.e-ctk.com

EUT	LED STREET LIGHT	Measurement Detail	
Model	HR110-A3S50xxx	Frequency Range	1-25GHz
Channel	Channel 19 (2445 MHz)	Detector function	Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
1956	47.1	6.9	Average

Test Data

Frequency [MHz]	Reading [dBuV/m]		Pol.	Height [m]	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak				Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
1956.00	50.7	53.3	V	1.0	25.4	35.6	6.6	54.0	74.0	47.1	49.7	6.9	24.3
2934.00	33.3	42.5	V	1.0	28.5	35.4	8.1	54.0	74.0	34.5	43.7	19.5	30.3
4890.00	28.9	38.2	V	1.0	32.7	34.9	11.4	54.0	74.0	38.1	47.4	15.9	26.6



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Tel: +82-31-339-9970

Fax: +82-31-339-9855

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EUT	LED STREET LIGHT	Measurement Detail	
Model	HR110-A3S50xxx	Frequency Range	1-25GHz
Channel	Channel 26 (2480 MHz)	Detector function	Peak

Remarks

We have tested three mode (X, Y, Z). The worst mode (X axis) for final test.

The requirements are:

☒ Complies

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
1984.1	48.5	5.5	Average

Test Data

Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Height [m]	Correction Factor			Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
					Antenna	Amp. Gain	Cable						
1984.00	52.1	54.8	V	1.0	25.4	35.6	6.6	54.0	74.0	48.5	51.2	5.5	22.8
4960.00	31.1	41.6	V	1.0	32.7	34.9	11.4	54.0	74.0	40.3	50.8	13.7	23.2

Restricted band edge test data

Measured frequency range : 2310-2390 MHz, 2483.5-2500 MHz

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Height [m]	Correction Factor			Limits [dBuV/m] AV / Peak	Result [dBuV/m] AV / Peak	Margin [dB] AV / Peak
				Antenna	Amp. Gain	Cable			
No emissions were detected at a level greater than 20dB below limit.									



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2.1.6 AC Conducted Emissions

Test Location

Shielded Room

Frequency Range of Measurement

150 kHz to 30 MHz

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

- 15.207(a)

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency.

Test Results

The requirements are:

☒ Complies

Test mode : Continuous modulated carrier

Frequency (MHz)	Measured Data (dBuV/m)	Margin (dB)	Remark
0.8385	41.3	4.7	Average



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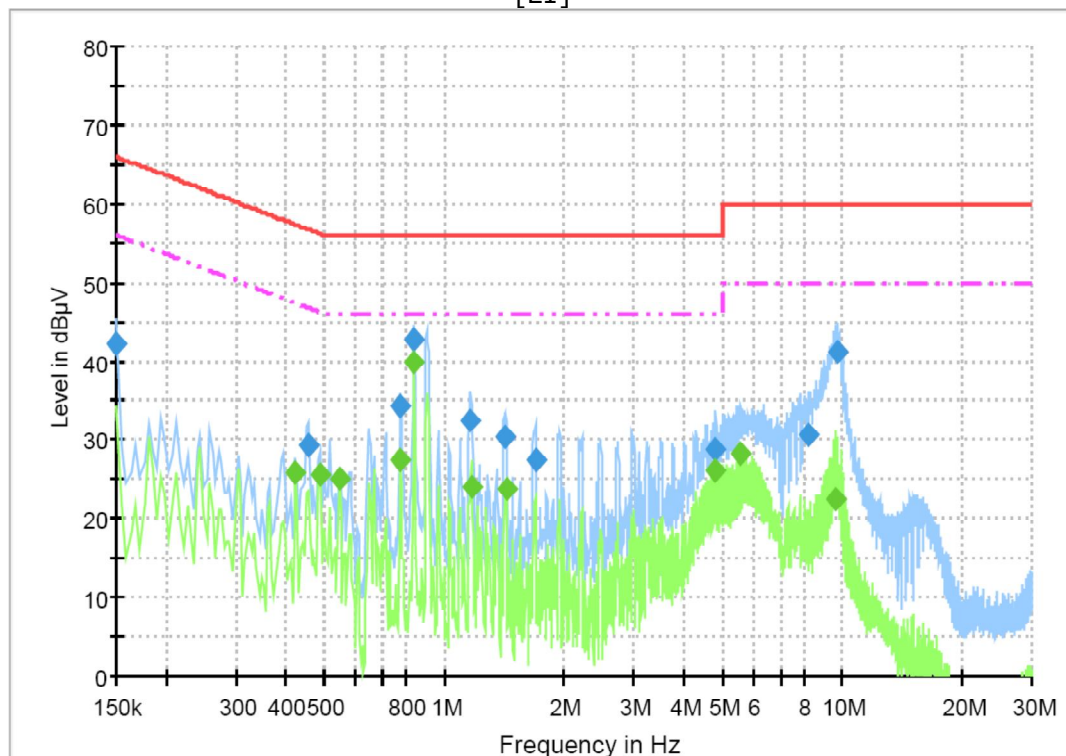
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Test Data

[L1]



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	42.3	20.0	9.000	GND	L1	0.2	23.7	66.0
0.456000	29.3	20.0	9.000	GND	L1	0.2	27.5	56.8
0.775500	34.3	20.0	9.000	GND	L1	0.2	21.7	56.0
0.843000	42.8	20.0	9.000	GND	L1	0.2	13.2	56.0
1.167000	32.6	20.0	9.000	GND	L1	0.2	23.4	56.0
1.428000	30.5	20.0	9.000	GND	L1	0.2	25.5	56.0
1.698000	27.4	20.0	9.000	GND	L1	0.2	28.6	56.0
4.821000	28.7	20.0	9.000	GND	L1	0.2	27.3	56.0
8.272500	30.6	20.0	9.000	GND	L1	0.3	29.4	60.0
9.766500	41.3	20.0	9.000	GND	L1	0.3	18.7	60.0

Final Result 2

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.424500	25.9	20.0	9.000	GND	L1	0.2	21.5	47.4
0.487500	25.5	20.0	9.000	GND	L1	0.2	20.7	46.2
0.546000	25.0	20.0	9.000	GND	L1	0.2	21.0	46.0
0.775500	27.4	20.0	9.000	GND	L1	0.2	18.6	46.0
0.838500	39.8	20.0	9.000	GND	L1	0.2	6.2	46.0
1.176000	24.1	20.0	9.000	GND	L1	0.2	21.9	46.0
1.432500	23.7	20.0	9.000	GND	L1	0.2	22.3	46.0
4.794000	26.1	20.0	9.000	GND	L1	0.2	19.9	46.0
5.581500	28.4	20.0	9.000	GND	L1	0.2	21.6	50.0
9.658500	22.4	20.0	9.000	GND	L1	0.3	27.6	50.0



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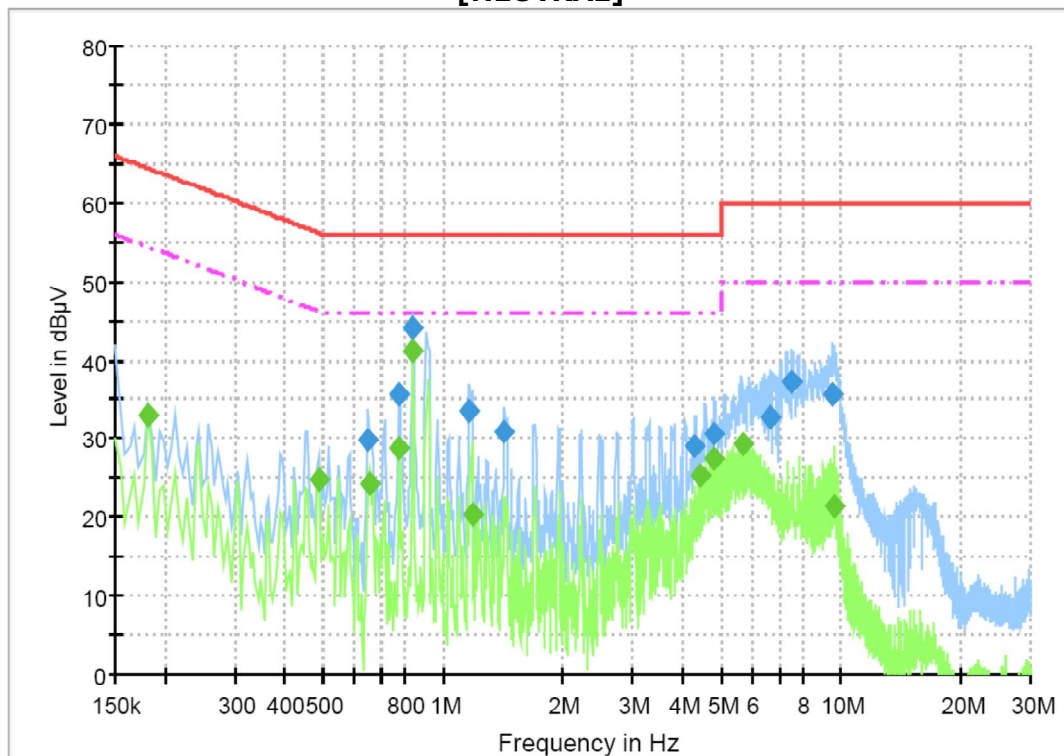
386-1, Ho-dong, Cheoin-gu, Yongin-si, Gyeonggi-do, 449-100, Korea

Tel: +82-31-339-9970

Fax: +82-31-339-9855

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[NEUTRAL]



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.649500	29.9	20.0	9.000	GND	N	0.2	26.1	56.0
0.775500	35.7	20.0	9.000	GND	N	0.2	20.3	56.0
0.843000	44.2	20.0	9.000	GND	N	0.2	11.8	56.0
1.167000	33.6	20.0	9.000	GND	N	0.2	22.4	56.0
1.428000	31.0	20.0	9.000	GND	N	0.2	25.0	56.0
4.303500	28.9	20.0	9.000	GND	N	0.2	27.1	56.0
4.821000	30.6	20.0	9.000	GND	N	0.2	25.4	56.0
6.612000	32.8	20.0	9.000	GND	N	0.3	27.2	60.0
7.530000	37.1	20.0	9.000	GND	N	0.3	22.9	60.0
9.501000	35.5	20.0	9.000	GND	N	0.3	24.5	60.0

Final Result 2

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.181500	33.0	20.0	9.000	GND	N	0.2	21.4	54.4
0.487500	24.9	20.0	9.000	GND	N	0.2	21.3	46.2
0.654000	24.3	20.0	9.000	GND	N	0.2	21.7	46.0
0.775500	28.8	20.0	9.000	GND	N	0.2	17.2	46.0
0.838500	41.3	20.0	9.000	GND	N	0.2	4.7	46.0
1.185000	20.4	20.0	9.000	GND	N	0.2	25.6	46.0
4.429500	25.3	20.0	9.000	GND	N	0.2	20.7	46.0
4.794000	27.3	20.0	9.000	GND	N	0.2	18.7	46.0
5.703000	29.2	20.0	9.000	GND	N	0.2	20.8	50.0
9.591000	21.5	20.0	9.000	GND	N	0.3	28.5	50.0



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APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Due Date
1	Signal Analyzer	Agilent	N9020A	MY48011598	2013-11-08
2	Spectrum Analyzer	Rohde & Schwarz	FSP-30	100994	2013-11-18
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2013-12-15
4	EMI Test Receiver	Rohde & Schwarz	ESCI3	100032	2013-02-09
5	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2013-06-29
6	Trilog Broadband Antenna	SCHWARZBECK	VULB 9161 SE	100203	2014-06-11
7	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2014-06-06
8	Horn Antenna	ETS-Lindgren	3115	00078894	2013-03-22
9	Horn Antenna	ETS-Lindgren	3115	00078895	2013-03-22
10	EPM Series Power Meter	HP	E4418A	GB38272734	2013-11-08
11	Power Sensor	HP	8487A	3318A03524	2013-07-10
12	SYNTHESIZED SWEEPER	HP	8341B	2819A01563	2013-11-08
13	ESG-D Series Signal Generator	Agilent	E4432B	US40054094	2013-11-08
14	6dB Attenuator	Rohde & Schwarz	DNF	272.4110.50	2013-11-09
15	Attenuator	HP	8494A	3308A33351	2013-11-09
16	Attenuator	BIRD	1000-WA-MFN-30	236	2013-11-09
17	OPT H64 AMPLIFIER	HP	8447F	3113A06814	2013-03-27
18	PREAMPLIFIER	Agilent	8449B	3008A02307	2013-11-09
19	AMPLIFIER	Sonoma Instrument Co.	310	291721	2013-03-27
20	LISN	Rohde & Schwarz	ENV216	101235	2013-08-18
21	LISN	Rohde & Schwarz	ENV216	101236	2013-08-06
22	Temp&Humi Chamber	Kunpoong	JT-TH-556-1	9QE5-002	2013-01-12
23	DC POWER SUPPLY	Agilent	E3632A	MY40011638	2013-11-09
24	Band Reject Filter	Wainwright Instruments GmbH	WRCGV 2400/2483- 2375/2505- 50/10EE	2	2013-09-11