FCC Part 15C
Measurement and Test Report

For

Beijing Hanshow Technology Co., Ltd.

Floor 18, Building C, Ruipu Plaza, No.15 Hongjunying South Rd,

Chaoyang District, Beijing, China

FCC ID: 2AD43-HS-EL5100

FCC Rule(s):	FCC Part 15.249
Product Description:	Electronic Shelf Labels
Tested Model:	Stellar Classic-290-N
Report No.:	STR14128171I
Tested Date:	2014-12-23 to 2015-01-29
Issued Date:	2015-01-29
Tested By:	Mark Chen / Engineer
Reviewed By:	Lahm Peng / EMC Manager
Approved & Authorized By:	Jandy so / PSQ Manager

Prepared By:

Shenzhen SEM.Test Technology Co., Ltd.
1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road,
Bao'an District, Shenzhen, P.R.C.（518101）
Tel.: +86-755-33663308 Fax.: +86-755-33663309 Website: www.semtest.com.cn

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	Beijing Hanshow Technology Co., Ltd.
Address of applicant:	Floor 18, Building C, Ruipu Plaza, No.15 Hongjunying South Rd, Chaoyang District, Beijing, China
Manufacturer:	Zhejiang Hanshow Technology Co., Ltd.
Address of manufacturer:	Shanghai jiao Tong University Jiaxing Science Park, No.321, Jiachuang Road, Xiuzhou District, Jiaxing City, Zhejiang Province

General Description of EUT	
Product Name:	Electronic Shelf Labels
Trade Name:	/
Model No.:	Stellar Classic-290-N
Adding Model(s):	Stellar Classic-213-N, Stellar Classic-213-C,
	Stellar Classic-290-C, Stellar Classic-420-N,
	Stellar Magic-213-N, Stellar Magic-213-C,
	Stellar Magic-290-N, Stellar Magic-290-C,
	Stellar Magic-420-N, Stellar Magic-580-N,
	Stellar Magic-580-C
Rated Voltage:	Battery DC 3V
Power Adapter Model:	/
Note: The test data is gathered from a production sample, provided by the manufacturer. The appearance of others models listed in the report is different from main-test model Stellar Classic-290-N, but the circuit and the electronic construction do not change, declared by the manufacturer.	

Technical Characteristics of EUT	
Frequency Range:	2410-2480MHz
Max. Field Strength:	74.05 dBuV/m (at 3m distance)
Data Rate:	2Kbps to 500Kbps
Modulation:	FSK/GFSK
Quantity of Channels:	141
Channel Separation:	500kHz
Antenna Type:	PCB Antenna
Antenna Gain:	2dBi
Lowest Internal Frequency of EUT:	16MHz

1.2 Test Standards

The following report is prepared on behalf of the Beijing Hanshow Technology Co., Ltd. in accordance with FCC Part 15, Subpart B, Subpart C, and section 15.107, 15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.107,15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commissions rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which results in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.4 Test Facility

FCC – Registration No.: 934118

Shenzhen SEM.Test Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files and the Registration is 934118.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Shenzhen SEM.Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

CNAS Registration No.: L4062

Shenzhen SEM.Test Technology Co., Ltd. is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L4062. All measurement facilities used to collect the measurement data are located at 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C (518101).

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low Channel	2410MHz
TM2	Middle Channel	2445MHz
TM3	High Channel	2480MHz

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 15.203	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§ 15.207(a)	Conducted Emission	N/A
§ 15.209(a)(f)	Radiated Spurious Emissions	Compliant
§15.249(a)	Field Strength of Emissions	Compliant
§15.249(d)	Out of Band Emission	Compliant
§15.215 (c)	Emission Bandwidth	Compliant

3. Antenna Requirements

3.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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.

3.2 Test Result

This product has an integral antenna, fulfill the requirement of this section.

4. Radiated Emissions

4.1 Measurement Uncertainty

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is ±5.10 dB.

4.2 Standard Applicable

According to §15.249(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency	Field strength of fundamental (milli-volts/meter)	Field strength of Harmonics (micro-volts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

(d) 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 or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

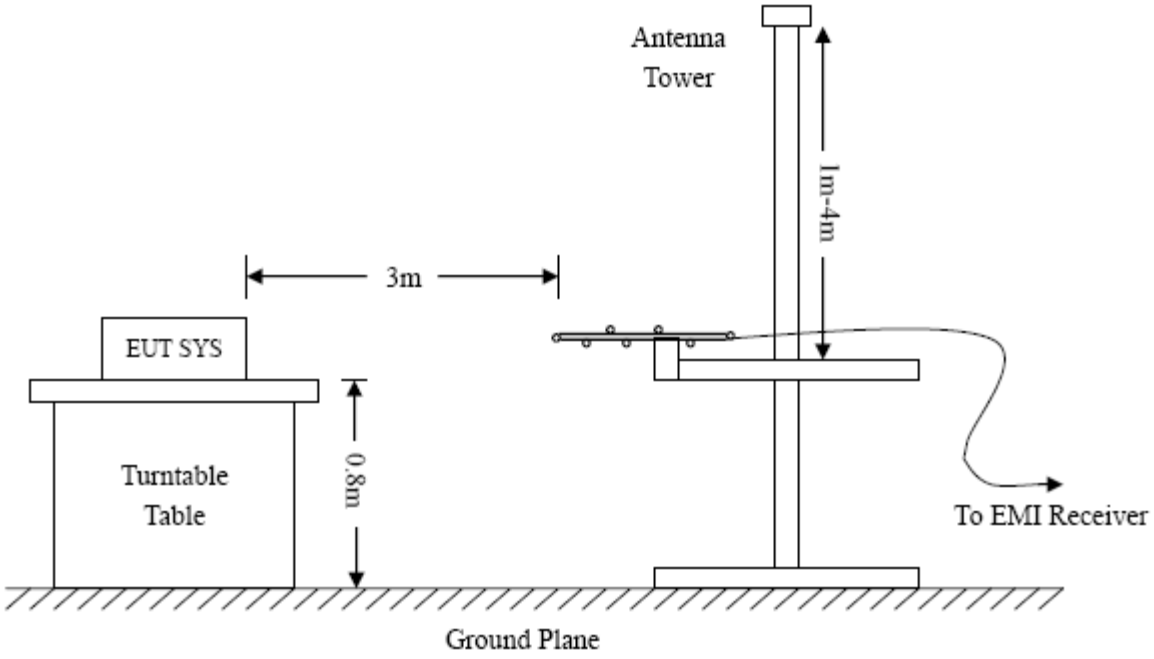
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

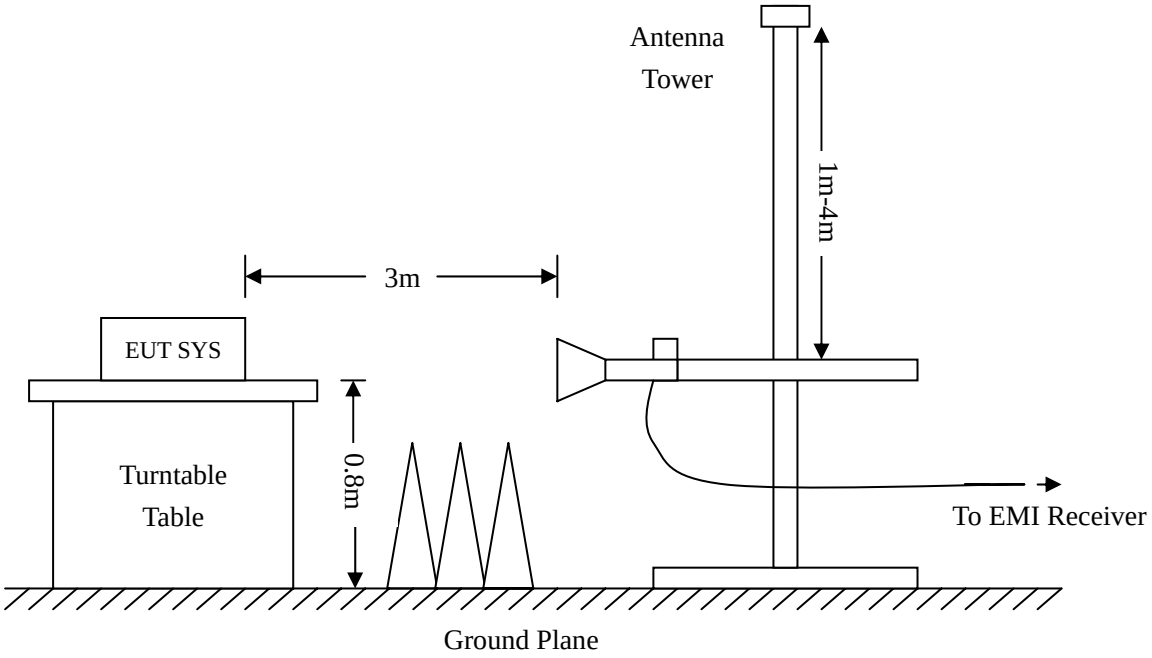
4.3 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Spectrum Analyzer	R&S	FSP	836079/035	2014-05-28	2015-05-27
EMI Test Receiver	R&S	ESVB	825471/005	2014-05-28	2015-05-27
Pre-amplifier	Agilent	8447F	3113A06717	2014-05-28	2015-05-27
Pre-amplifier	Compliance Direction	PAP-0118	24002	2014-05-28	2015-05-27
Trilog Broadband Antenna	SCHWARZBECK	VULB9163	9163-333	2014-05-24	2015-05-23
Horn Antenna	ETS	3117	00086197	2014-05-24	2015-05-23
Horn Antenna	ETS	3116B	00088203	2014-05-24	2015-05-23
Loop Antenna	SCHWARZECK	HFRA 5165	9365	2014-05-24	2015-05-23

4.4 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.205 15.249(a) and FCC Part 15.209 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.





Frequency :9kHz-30MHz	Frequency :30MHz-1GHz	Frequency :Above 1GHz
RBW=10KHz,	RBW=120KHz,	RBW=1MHz,
VBW =30KHz	VBW=300KHz	VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto	Sweep time= Auto	Sweep time= Auto
Trace = max hold	Trace = max hold	Trace = max hold
Detector function = peak	Detector function = peak, QP	Detector function = peak, AV

4.5 Corrected Amplitude & Margin Calculation

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

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – FCC Part 15C Limit

4.6 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	60 %
ATM Pressure:	1012 mbar

4.7 Summary of Test Results/Plots

According to the data below, the FCC Part 15.205, 15.209 and 15.249 standards, and had the worst margin of:

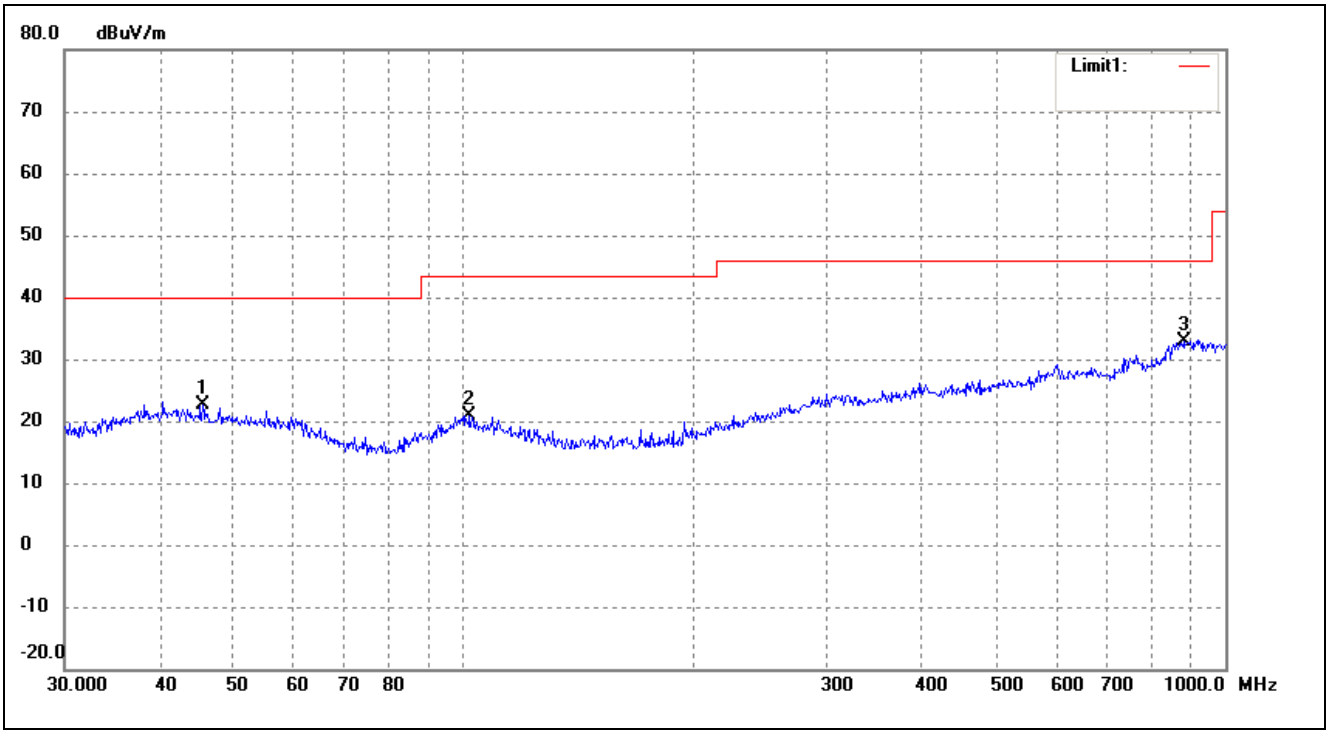
-12.55 dB at **952.0937 MHz** in the **Vertical** polarization, **Middle Channel, 9 kHz to 25 GHz, 3Meters**

Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

Plot of Radiated Emissions Test Data (30MHz to 1GHz)

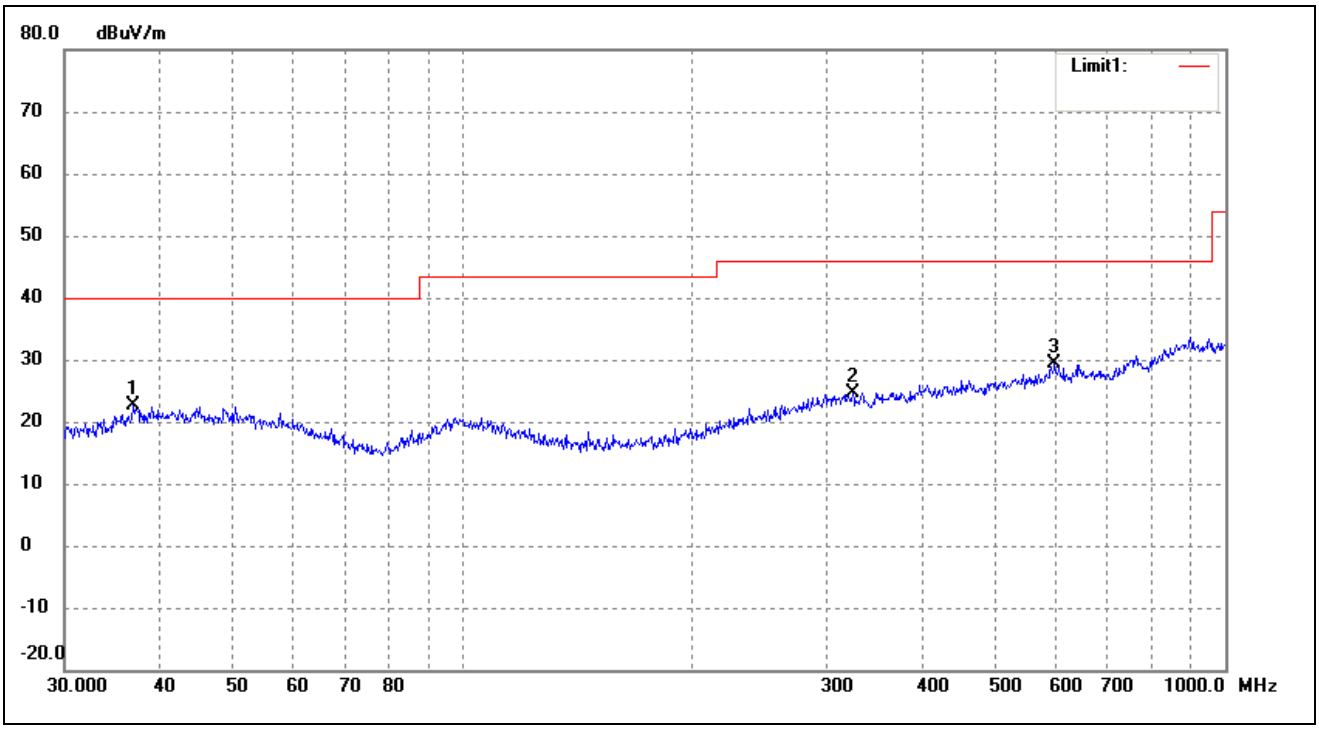
EUT: *Electronic Shelf Labels*
Tested Model: *Stellar Classic-290-N*
Operating Condition: *Transmitting Low Channel (2410MHz)*
Comment: *DC 3V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	45.5348	15.84	6.71	22.55	40.00	-17.45	264	100	peak
2	102.0014	15.07	5.91	20.98	43.50	-22.52	113	200	peak
3	881.4067	16.06	16.82	32.88	46.00	-13.12	287	100	peak

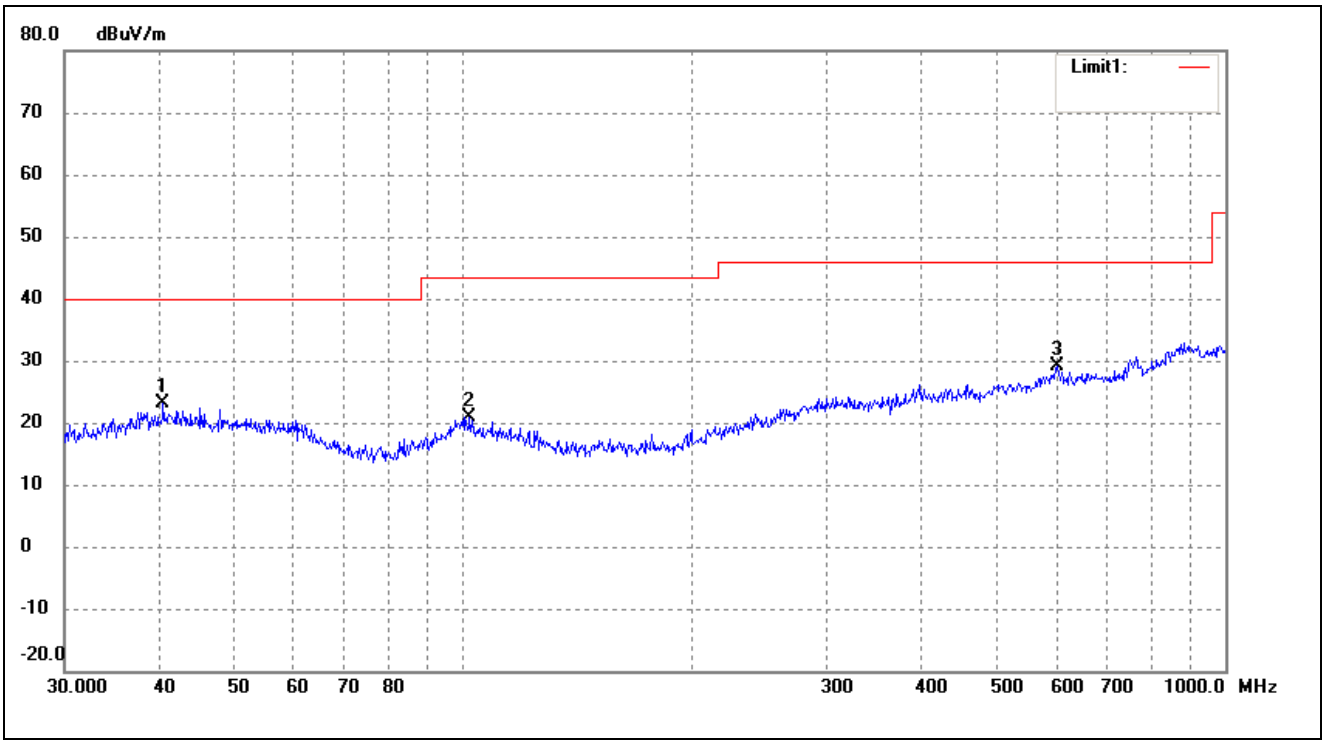
Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	36.8953	13.81	8.72	22.53	40.00	-17.47	234	100	peak
2	324.4561	15.53	9.16	24.69	46.00	-21.31	118	100	peak
3	597.2234	16.14	13.21	29.35	46.00	-16.65	164	100	peak

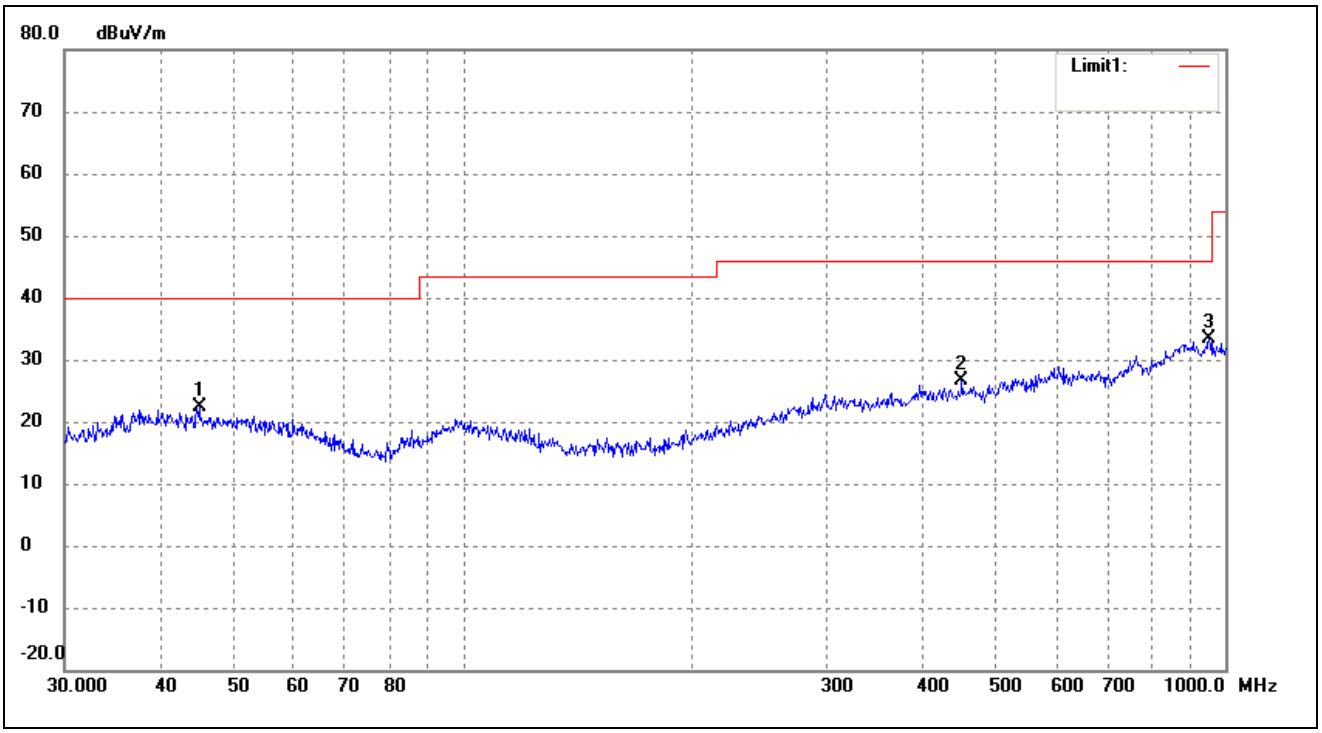
Operating Condition: *Transmitting Middle Channel (2445MHz)*
Comment: *DC 3V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	40.4172	15.88	7.21	23.09	40.00	-16.91	162	100	peak
2	102.0014	15.07	5.91	20.98	43.50	-22.52	187	100	peak
3	601.4265	15.94	13.22	29.16	46.00	-16.84	203	100	peak

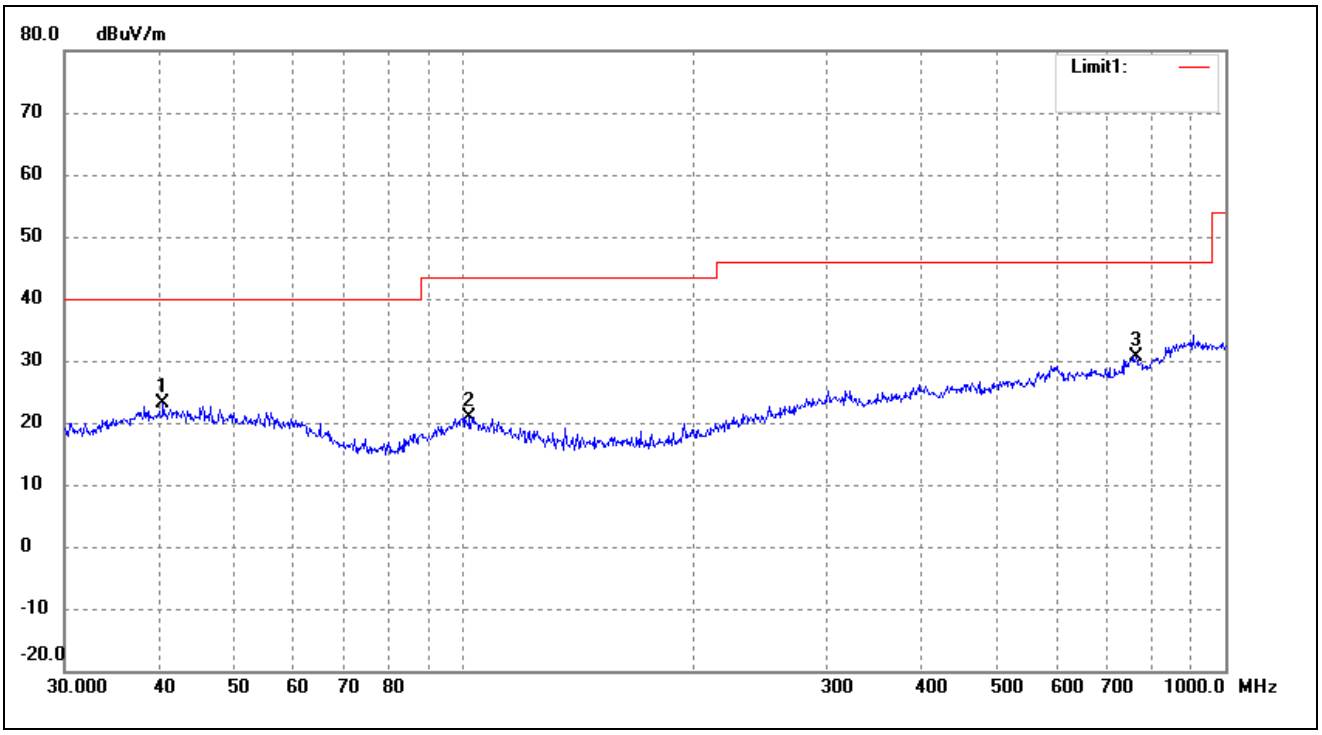
Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	45.0583	14.62	7.74	22.36	40.00	-17.64	240	100	peak
2	451.1350	16.22	10.32	26.54	46.00	-19.46	187	100	peak
3	952.0937	17.16	16.29	33.45	46.00	-12.55	220	100	peak

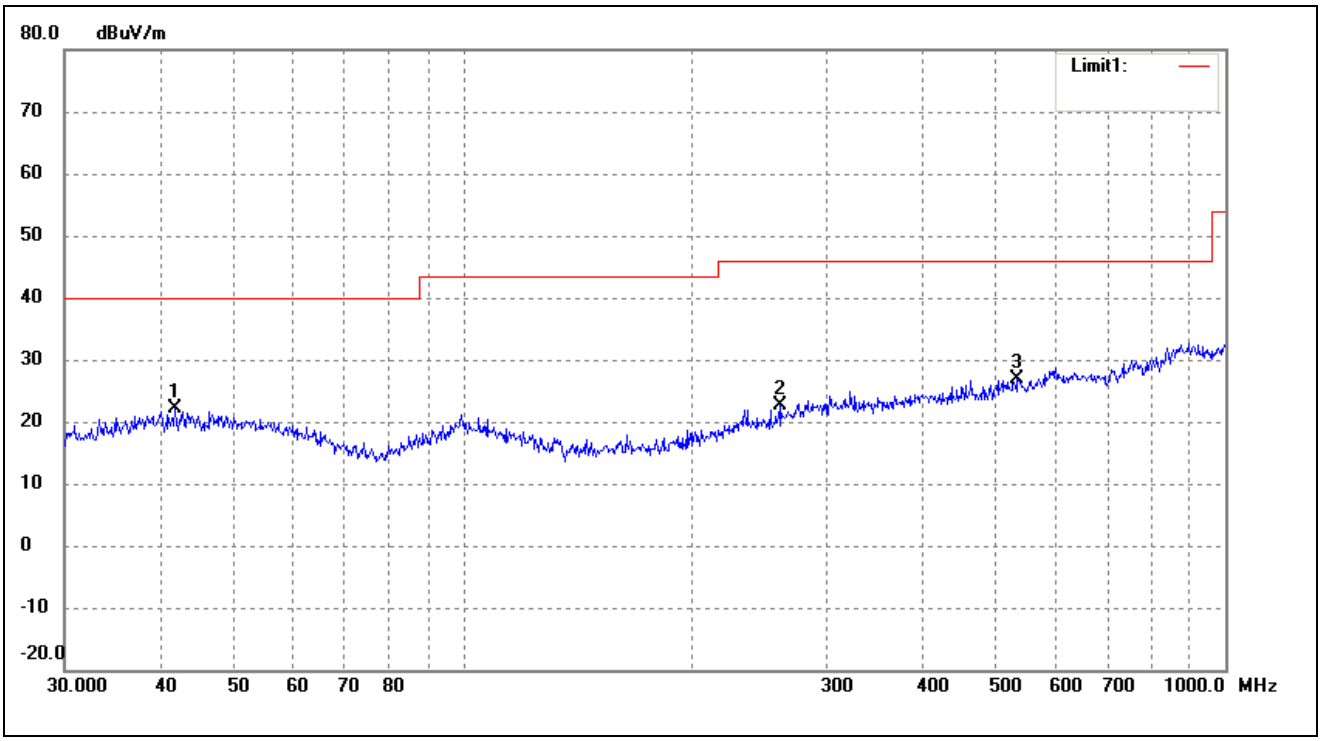
Operating Condition: *Transmitting High Channel (2480MHz)*
Comment: *DC 3V*

Test Specification: *Horizontal*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	40.4172	15.88	7.21	23.09	40.00	-16.91	162	100	peak
2	102.0014	15.07	5.91	20.98	43.50	-22.52	200	100	peak
3	763.3757	16.07	14.46	30.53	46.00	-15.47	234	100	peak

Test Specification: *Vertical*



No.	Frequency	Reading	Correct	Result	Limit	Margin	Degree	Height	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	(•)	(cm)	
1	41.8596	13.35	8.69	22.04	40.00	-17.96	240	100	peak
2	260.1444	15.47	7.04	22.51	46.00	-23.49	187	100	peak
3	533.8321	15.50	11.32	26.82	46.00	-19.18	220	100	peak

Spurious Emissions Above 1GHz

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2410MHz							
2410	64.50	-3.48	61.02	114.00	-52.98	H	PK
2410	49.23	-3.49	45.74	94.00	-48.26	H	AV
4820	43.84	0.57	44.41	74.00	-29.59	H	PK
4820	31.04	0.57	31.61	54.00	-22.39	H	AV
7230	29.81	3.68	33.49	74.00	-40.51	H	PK
7230	22.79	3.82	26.61	54.00	-27.39	H	AV
2410	71.70	-3.48	68.22	114.00	-45.78	V	PK
2410	58.27	-3.49	54.78	94.00	-39.22	V	AV
4820	41.33	0.57	41.90	74.00	-32.10	V	PK
4820	30.33	0.49	30.82	54.00	-23.18	V	AV
7230	30.63	3.68	34.31	74.00	-39.69	V	PK
7230	21.86	3.77	25.63	54.00	-28.37	V	AV
Middle Channel-2445MHz							
2445	69.60	-3.41	66.19	114.00	-47.81	H	PK
2445	58.41	-3.41	55.00	94.00	-39.00	H	AV
4890	45.48	0.68	46.16	74.00	-27.84	H	PK
4890	31.78	0.68	32.46	54.00	-21.54	H	AV
7335	35.23	3.76	38.99	74.00	-35.01	H	PK
7335	22.34	3.88	26.22	54.00	-27.78	H	AV
2445	75.91	-3.41	72.50	114.00	-41.50	V	PK
2445	65.14	-3.41	61.73	94.00	-32.27	V	AV
4890	44.34	0.66	45.00	74.00	-29.00	V	PK
4890	31.92	0.68	32.60	54.00	-21.40	V	AV
7335	32.52	3.76	36.28	74.00	-37.72	V	PK
7335	22.58	3.82	26.40	54.00	-27.60	V	AV

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2480MHz							
2480	71.17	-3.33	67.84	114.00	-46.16	H	PK
2480	59.55	-3.33	56.22	94.00	-37.78	H	AV
4960	31.85	0.77	32.62	54.00	-21.38	H	PK
4960	41.62	0.77	42.39	74.00	-31.61	H	AV
7440	22.33	3.82	26.15	54.00	-27.85	H	PK
7440	32.98	3.85	36.83	74.00	-37.17	H	AV
2480	77.38	-3.33	74.05	114.00	-39.95	V	PK
2480	65.66	-3.33	62.33	94.00	-31.67	V	AV
4960	45.54	0.77	46.31	74.00	-27.69	V	PK
4960	32.87	0.77	33.64	54.00	-20.36	V	AV
7440	22.30	3.82	26.12	54.00	-27.88	V	PK
7440	34.91	3.85	38.76	74.00	-35.24	V	AV

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, which above 5th Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
The measurements greater than 20dB below the limit from 9kHz to 30MHz..

5. Out of Band Emissions

5.1 Standard Applicable

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 or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

5.2 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Spectrum Analyzer	R&S	FSP	836079/035	2014-05-28	2015-05-27
EMI Test Receiver	R&S	ESVB	825471/005	2014-05-28	2015-05-27
Pre-amplifier	Agilent	8447F	3113A06717	2014-05-28	2015-05-27
Pre-amplifier	Compliance Direction	PAP-0118	24002	2014-05-28	2015-05-27
Trilog Broadband Antenna	SCHWARZBECK	VULB9163	9163-333	2014-05-24	2015-05-23
Horn Antenna	ETS	3117	00086197	2014-05-24	2015-05-23

5.3 Test Procedure

As the radiation test, set the Lowest and Highest Transmitting Channel, observed the outside band of 2400MHz to 2483.5MHz, than mark the higher-level emission for comparing with the FCC rules.

5.4 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	60 %
ATM Pressure:	1012 mbar

5.5 Summary of Test Results/Plots

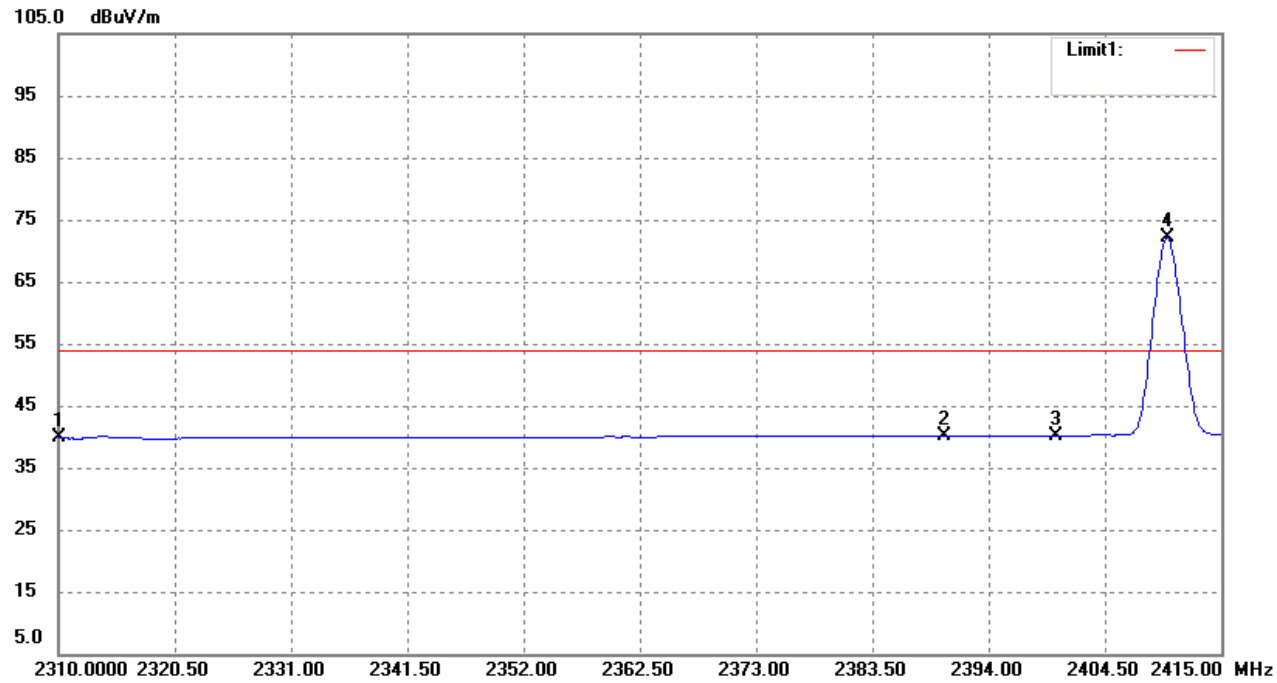
Test mode	Frequency	Limit	Result
	MHz	dBuV / dBc	
Lowest	2310.00	<54 dBuV	Pass
	2390.00	<54 dBuV	Pass
	2400.00	<54 dBuV	Pass
Highest	2483.50	<54 dBuV	Pass
	2500.00	<54 dBuV	Pass

The edge emissions are below the FCC 15.209 Limits or complies with the 15.249 requirements.

Please refer to the test plots as below.

Lowest Bandedge

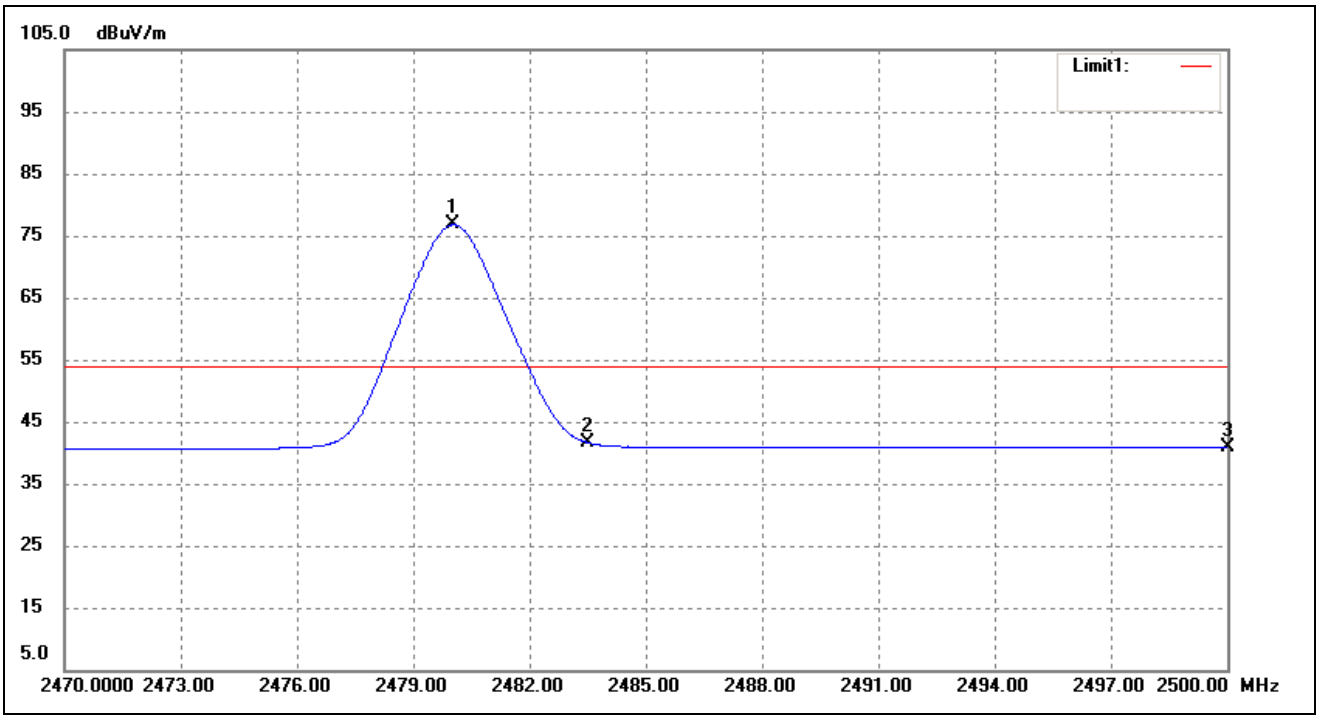
Horizontal (Worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2310.000	23.47	16.34	39.81	54.00	-14.19	Ave Detector
	2310.000	36.45	16.34	52.79	74.00	-21.21	Peak Detector
2	2390.000	23.14	17.03	40.17	54.00	-13.83	Ave Detector
	2390.000	35.36	17.03	52.39	74.00	-21.61	Peak Detector
3	2400.000	23.08	17.11	40.19	54.00	-13.81	Ave Detector
	2400.000	35.32	17.11	52.43	74.00	-21.57	Peak Detector
4	2410.170	54.84	17.19	72.03	/	/	Ave Detector

Highest Bandedge

Horizontal (Worst case)



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
1	2480.020	59.09	17.71	76.80	/	/	Average Detector
	2480.020	59.79	17.71	77.50	/	/	Peak Detector
2	2483.500	23.93	17.73	41.66	54.00	-12.34	Average Detector
	2483.500	35.69	17.73	53.42	74.00	-20.58	Peak Detector
3	2500.000	23.02	17.86	40.88	54.00	-13.12	Average Detector
	2500.000	35.58	17.86	53.44	74.00	-20.56	Peak Detector

6. Emission Bandwidth

6.1 Standard Applicable

According to 15.215 (c), intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

6.2 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Cal. Date	Due. Date
Spectrum Analyzer	Agilent	E4402B	US41192821	2014-05-28	2015-05-27
Attenuator	ATTEN	ATS100-4-20	/	2014-05-28	2015-05-27

6.3 Test Procedure

According to the ANSI 63.4-2014, the emission bandwidth test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Set span = 1MHz, centered on a transmitting channel
RBW ≥1% 20dB Bandwidth, VBW ≥RBW
Sweep = auto
Detector function = peak
Trace = max hold
All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down and 99% bandwidth of the emission.

6.4 Environmental Conditions

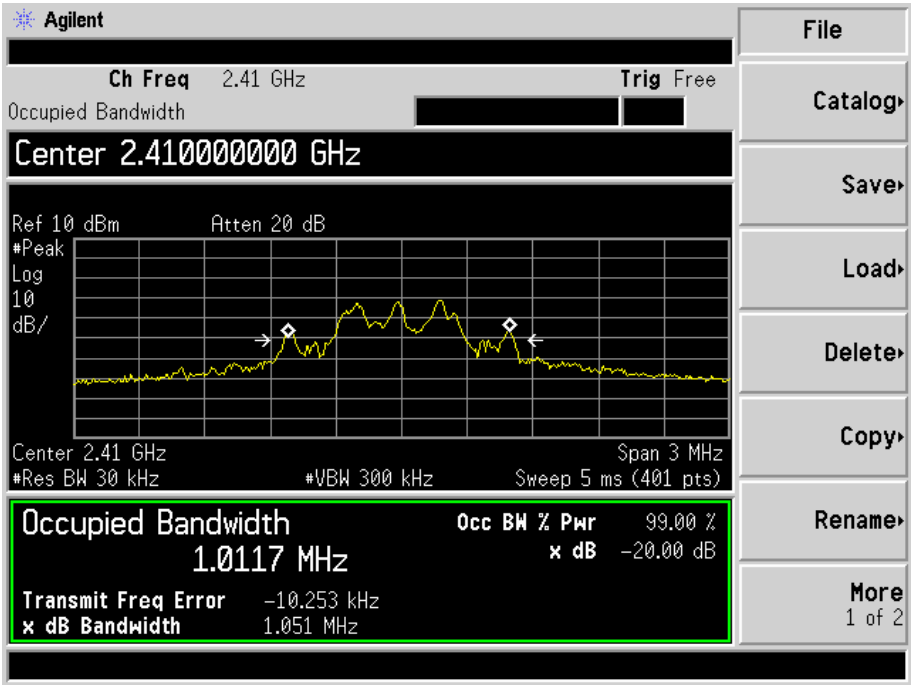
Temperature:	25 °C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

6.5 Summary of Test Results/Plots

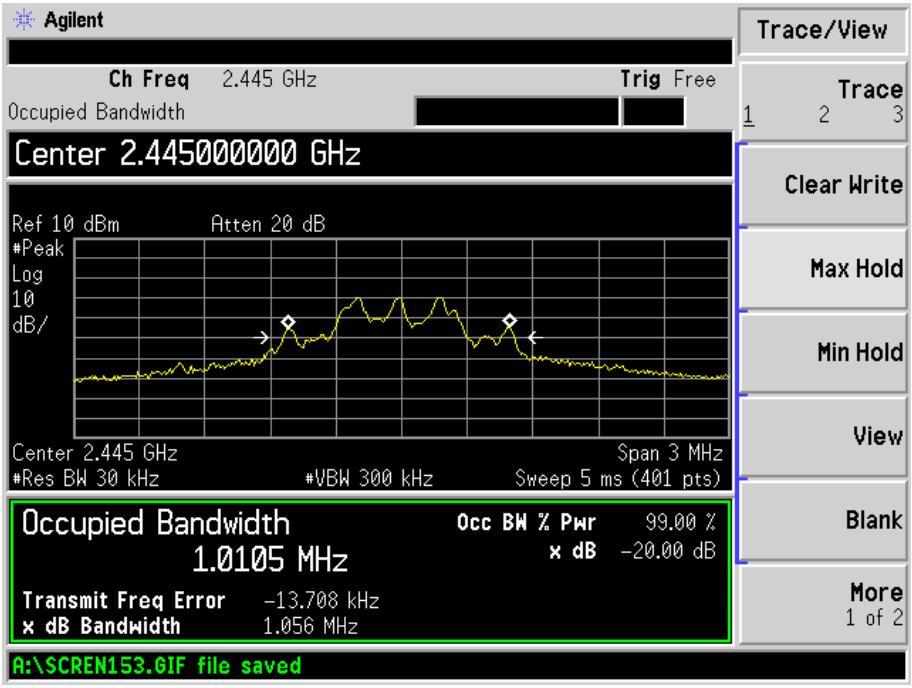
Channel	Frequency MHz	20dB Bandwidth kHz	99% Bandwidth kHz
Low Channel	2410	1051	1011.7
Middle Channel	2445	1056	1010.5
High Channel	2480	1054	1005.0

Please refer to the following test plots

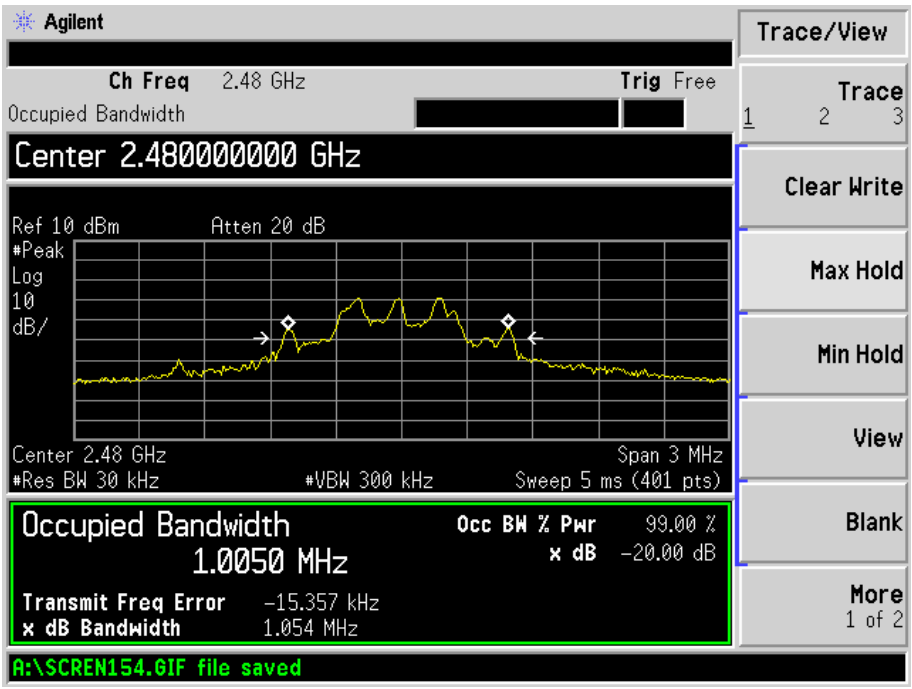
Low Channel:



Middle Channel:



High Channel:



******* END OF REPORT *******