

Certification of Compliance

CFR 47 Part 15 Subpart C


Order No. : STB13-2643
Test Report No. : W13WD-003
Applicant : Samsung SDS Co., Ltd.
Address of Applicant : 707-19, Youksam 2-dong, Kangnam-gu, Seoul, 135-918, Korea

Equipment Under Test (EUT)


Kind of Product : MiBUS OBE (BUS Management System)
Model Name : SMT-500P
FCC ID : P4YSMT-500P
Buyer Model(s) : N/A
Standards : FCC CFR Title 47 Part 15 Subpart C (15.225):2012
ANSI C63.4:2003, ANSI C63.10:2009

Date of Receipt : 27 September, 2013
Date of Test : 01 ~ 08 October, 2013
Date of Issue : 14 October, 2013

Test Result : **Positive** **Negative**



Ji Hwan Kim / Testing By Engineer



Chang Woo, Kim / General Manager

In the configuration tested, the EUT complied with the standards specified above.

Remarks :

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards.

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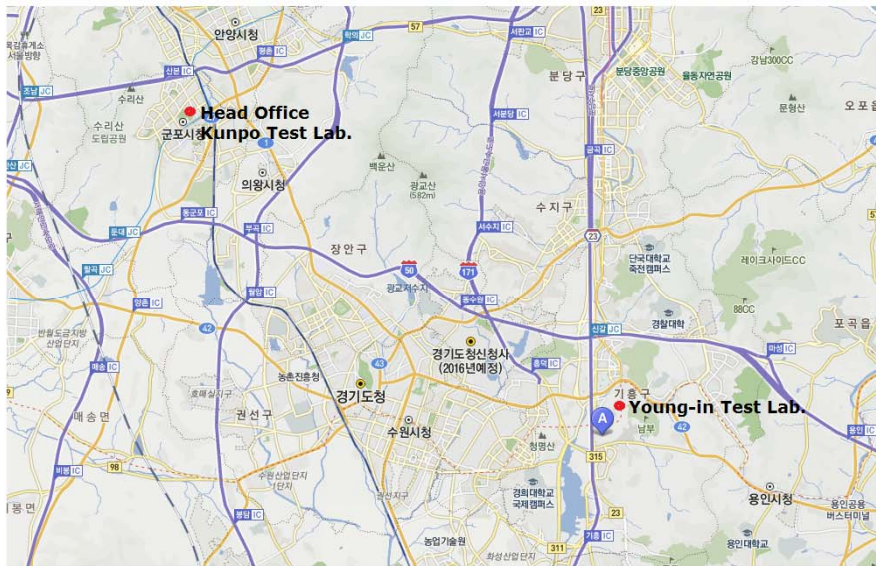
1. General Information

1.1 Information of Test Laboratory.

FCC E-Filing : Registration Number:323115

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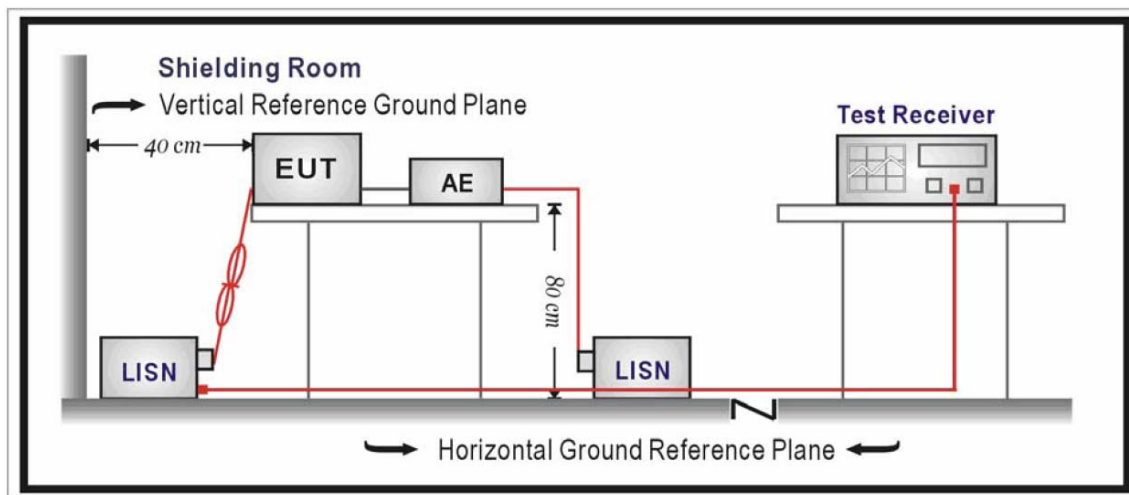
1.2 Description of Test

Conducted Emissions:

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 ohm/50 uH coupling impedance with 50ohm termination.(Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. 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 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15 MHz to 30 MHz using a receiver bandwidth of 9kHz.



Limit Of Conducted Emission:

Test Specification

: According to FCC CFR Title 47 Part 15 Subpart C Section 15.207

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

- Note : * Decrease with the logarithm of the frequency

Radiated Emissions:

The measurement was performed over the frequency range of 30 MHz to 1 GHz using antenna as the input transducer to a Spectrum analyzer or a Field Intensity Meter. The measurement was made with the detector set for "quasi-peak" within a bandwidth of 120 kHz.

Procedure of Test Preliminary measurements were made at 3 meter using bi-log antennas, and spectrum analyzer to determine the frequency producing the max. Emission in Semi-Anechoic Chamber. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turn-table azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 MHz to 1000 MHz using bi-log antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used. Final measurements were made at open site with 3-meters test distance using bi-log antenna or horn antenna. The 3 m Full Chamber have been verified in regular for its normalized site attenuation. The test equipment was placed on a wooden table. Sufficient time for the EUT, peripheral equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined by manual. The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 120 kHz or 1 MHz depending on the frequency of type of signal. The EUT, peripheral equipment and interconnecting cables were re-configured to the set-up producing the max. emission for the frequency and were placed on top of a 0.8-meter high nonmetallic 1 x 1.5 meter table. The EUT, peripheral equipment, and interconnecting cables were re-arranged and manipulated to maximize each emission. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission. Each emission was maximized by: varying the mode of operation to the EUT and/or peripheral equipment and changing the polarity of the antenna, whichever determined the worst-case emission.(The bandwidth below 1 GHz setting on the field strength meter is 120 kHz and above 1 GHz is 1 MHz.)

Radiated Emissions Test, 9 kHz to 30 MHz(Magnetic Field Test):

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions at a distance of 3 meters according to Section 15.31(f)(2).
2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table.
3. Emissions from the EUT are maximized by adjusting the orientation of the Loop antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions if applicable.
4. To obtain the final measurement data, each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector with specified bandwidth.

Limit Of Radiated Emission :

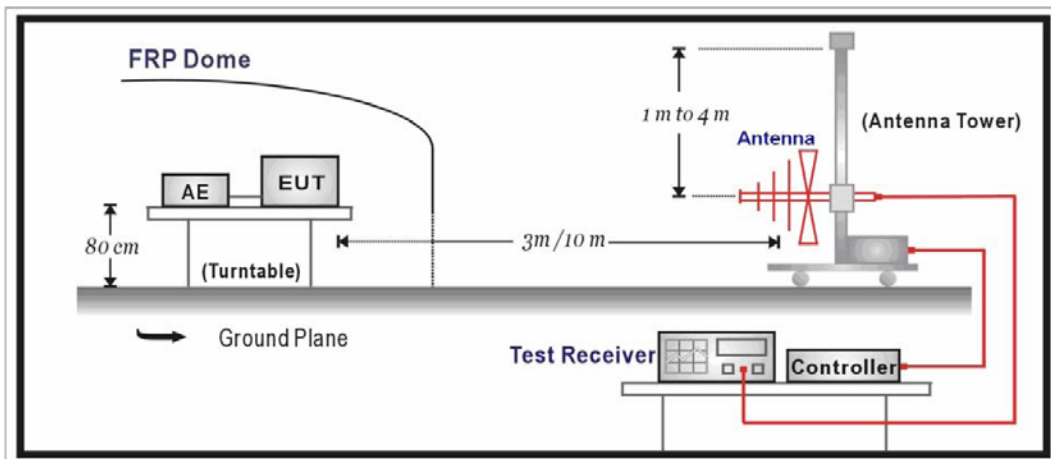
Test Specification

: According to FCC CFR Title 47 Part 15 Subpart C Section 15.209

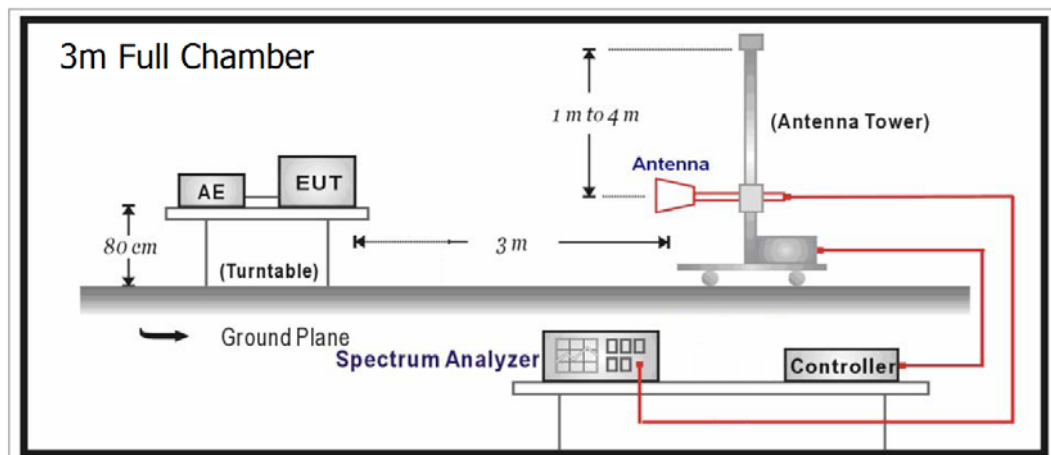
Limits		
Frequency (MHz)	uV/meter	dBuV/meter
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960	500	53.98

- Note : 1. RF Voltage(dBuV)=20log RF Voltage(uV)
- 2. In the Above Table, the tighter limit applies at the band edges.
- 3. Distance refers to the distance in meters between the measuring Instrument antenna and the closed point of any part of the device or System.

Below 1GHz Test Setup:



Above 1GHz Test Setup:



1.3 Measurement Uncertainty Calculations

Conducted Emissions

Type	Contribution	Probability Distribution	Uncertainty	Remark
B	Receiver Level	normal (k=2)	±0.0577 dB	Rlevel
	LISN			
	Attenuation : LISN-receiver	normal (k=2)	±0.0577 dB	Aatt
	Voltage Division Factor	normal (k=2)	±0.1155 dB	Ddivision
	Cable	normal (k=2)	±0.025 dB	Ccable
	Receiver			
	Input Impedance	normal (k=2)	±0.0115 dB	Iimpedance
	QP Sine-Wave Voltage Accuracy	normal (k=2)	±0.0981 dB	Aaccuracy
	QP-Pulse Amplitude Sensibility	normal (k=2)	±0.5312 dB	Ssensitivity
	QP-Pulse Frequency Response	normal (k=2)	±0.0981 dB	Rresponse
	Random Noise	normal (k=2)	±0.0346 dB	Rrandom
	Mismatch AMN to Receiver	U-Shaped	+0.4041/-0.4619 dB	CISPR Theory
A	System Repeatability	Std deviation	±0.0761 dB	Ssystem
	Cable loss	Std deviation	±0.0017 dB	C _{CL}
Combined Standard Uncertainty		normal	± 1.6439 dB	
Expanded Uncertainty U		normal (k=2)	± 3.2878 dB	(k=2, 95 %)

Radiated Emission

Type	Contribution	Probability Distribution	Uncertainty	Remark
B	Antenna			Afactor
	Factor	normal (k=2)	±0.288 dB	Iinterpolation
	Frequency interpolation			
	Height variation	rectangular	±1.155 dB	Hheight
	Direcvalupsy difference	rectangular	±0.577 dB	Ddirect
	Phase center location	rectangular	±0.025 dB	Pphase
	Cable loss	normal (k=2)	±0.025 dB	Ccable
	Receiver			
	Input Impedance	normal (k=2)	±0.012 dB	Iimpedance
	QP Sine-Wave Voltage Accuracy	normal (k=2)	±0.098 dB	Aaccuracy
	QP-Pulse Amplitude Sensibility	normal (k=2)	±0.531 dB	Ssensitivity
	QP-Pulse Frequency Response	normal (k=2)	±0.098 dB	Rresponse
	Random Noise	normal (k=2)	±0.035 dB	Rrandom
	Mismatch : AMN – receiver $ \Gamma_{\text{antenna}} = 0.33$ $ \Gamma_{\text{receiver}} = 0.33$	U-Shaped	+0.520/-0.577 dB	CISPR Theory
	Site imperfection	Triangular	±1.633 dB	Ssite
Table height	normal (k=2)	±0.058 dB	Stable	
A	System Repeatability	Std deviation	±0.039 dB	Ssystem
Combined standard Uncertainty		normal	±2.335 dB	
Expanded Uncertainty U		normal (k=2)	± 4.67 dB	(k=2, 95 %)

1.4 Manufacturer Information

Manufacturer : Samsung SDS Co., Ltd.
 Address : 707-19, Youksam2-dong, Kangnam-gu, Seoul, 135-918, Korea

1.5 General Description of EUT

Name : Samsung SDS Co., Ltd.
 Model No. : 707-19, Youksam2-dong, Kangnam-gu, Seoul, 135-918, Korea
 FCC ID : P4YSMT-500P
 Serial No. : N/A

1.6 Details of EUT

Item		Specification
RF Card (RFID)	Frequency	13.5611 MHz
	Antenna Type	PCB Printed Antenna
	Antenna Gain	3.0 dBi
Operating Voltage	DC 24.0 V	

- Note : Please refer to user`s manual.

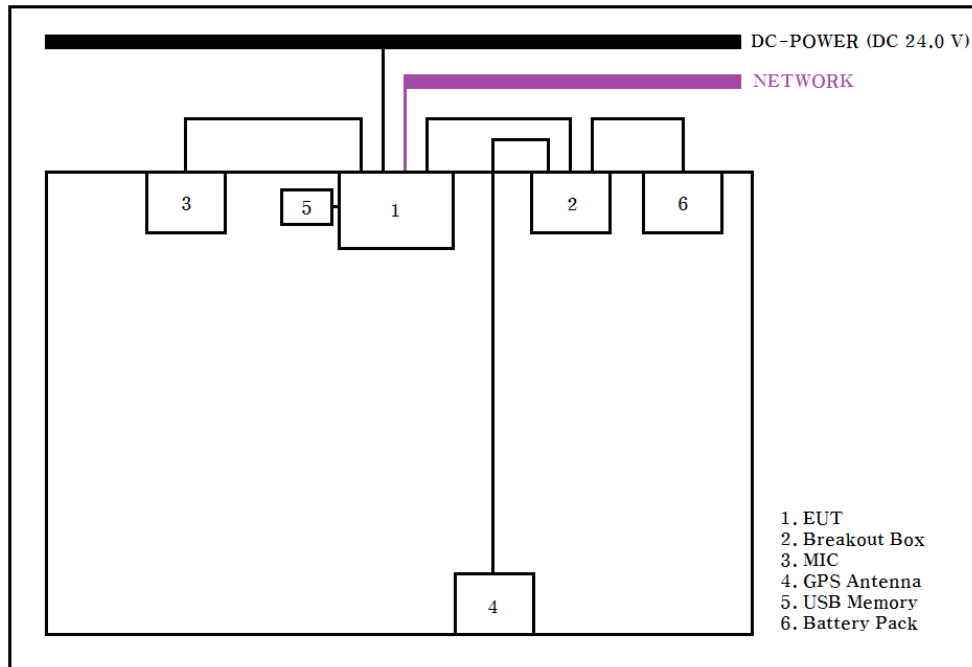
1.7 Description of Support Units

Product	Model No.	Serial No.	Manufacturer	Certification
Bus Information System	SMT-500T	N/A	Samsung SDS Co., Ltd.	EUT
Breakout Box	N/A	N/A	Samsung SDS Co., Ltd.	EUT
MIC	N/A	N/A	Samsung SDS Co., Ltd.	-
Battery Pack	N/A	N/A	Samsung SDS Co., Ltd.	EUT
GPS Antenna	KGM-610G	N/A	KND Global, Inc.	-

1.8 Cable List

Device Form		Device To		Cable Spec.	
Name	I/O Port	Name	I/O port	Length(m)	Shield
EUT	PIM (Multi Port)	Breakout Box	PIM (Multi Port)	1.2	Shielded
	USB	USB Memory	-	-	-
	MIC(RJ45)	MIC	-	1.5	Shielded
	LAN(RJ45)	NETWORK	LAN(RJ45)	-	Unshielded
Breakout Box	GPS	GPS Antenna	-	2.9	Shielded
	-	Battery Pack	POWER (2 PIN)	0.5	Unshielded
	DC-IN	DC Power Supply	DC-OUT	1.8	Unshielded

1.9 Test Set-Up Configuration



1.10 Test Methodology And Configuration

RFID (13.56 MHz) all device activating state.

1.11 Standards Applicable for Testing

Table of tests to be carried out under FCC CFR 47 Part 15 Subpart C

Test Standards	Status
FCC CFR 47 Part 15 Subpart C	A
Deviation from Standard	No Deviation

- Note : A : Indicates that the test is applicable
 N/A : Indicates that the test is not applicable

2. SUMMARY

Test Descriptions

- Conducted Emission N/A
 - The EUT uses the DC power
- 20 dB Bandwidth PASS
 - Test Result
- Radiated Emission-15.225(a) PASS
 - Radiated Emission Result
- Radiated Electric Field Emission-15.225(b)(c) PASS
 - Test result
- Radiated Electric Field Emission-15.209, 15.225(d) PASS
 - Test result
- Frequency stability-15.225(e) PASS
 - Test Result

- *Note : * The EUT power use Bus's battery. Operating voltage is DC 24 V.*

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. For battery operated equipment, the equipment tests shall be performed using a new battery.

3. Equipment Under Test Condition

3.1 20 dB Bandwidth-15.215(c)

3.1.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Cal.
Spectrum Analyzer	Aglient	E4440A	MY45304577	03/05/2014
DC Power Supply	DIGITAL	DRP-303D	5070395	01/09/2014

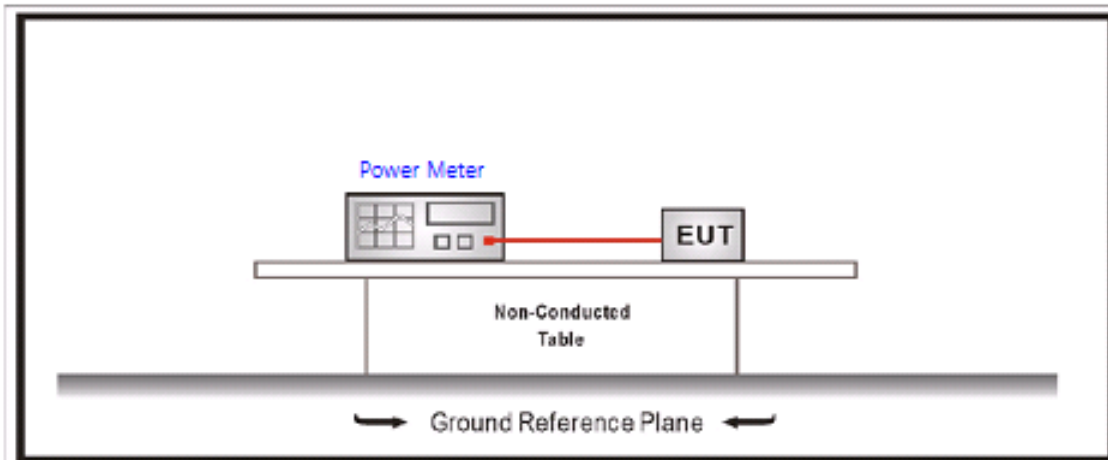
- Note : 1. The calibration interval of the above test instrument is 12 month and the calibrations are traceable to RRA, KRISS, KTL and HCT.
2. The calibration interval of horn, Loop Ant. and bi-log Ant. is 24 months

3.1.2 Limit

The upper and lower frequency of the 20 dB Bandwidth shall within 13.553 ~ 13.567 MHz

3.1.3 Test Configuration

RF Conducted Measurement:



4.1.4 Test Procedure

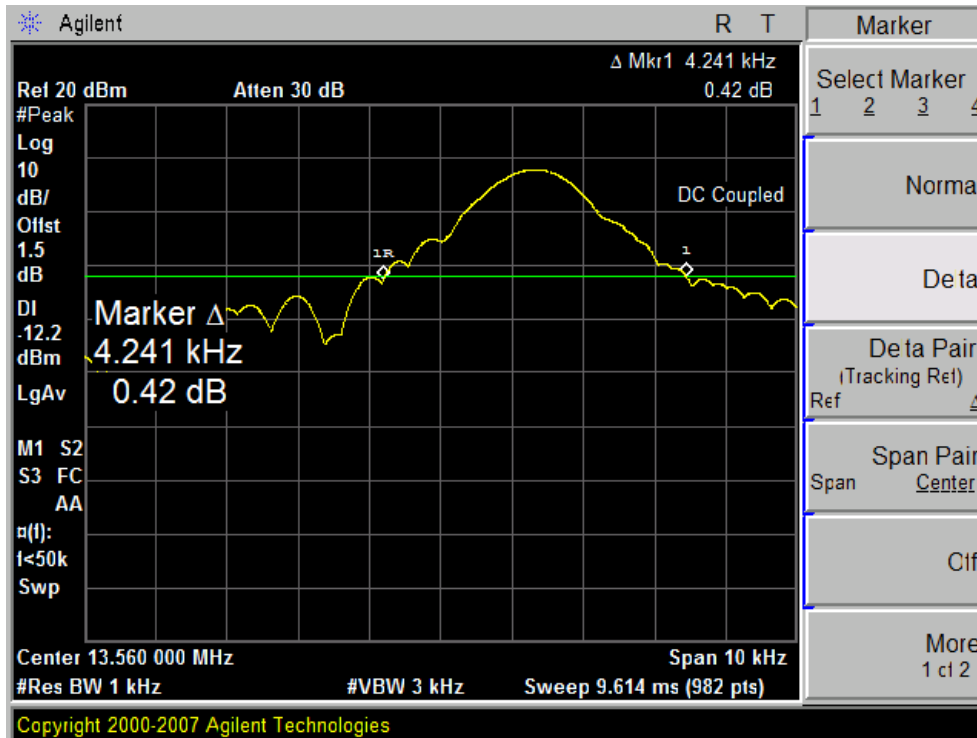
Measure the Maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

3.1.5 20 dB Bandwidth Test Result

Test Item	20 dB Bandwidth		
Test Mode	Modulated Conti-Tx	Test Data Rate	N/A
Test Channel	Channel 1 (13.5611 MHz)	Test Site	RF Shielded Room
Meas.Method	Conducted	Polarization	N/A

Channel No.	Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (kHz)	Result
1	13.5611	4.241	< 14	Pass

Channel 1. (13.5611 MHz)



3.2 Radiated Field emission-15.225

3.2.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Cal.
Bi-log Ant.	Schwarzbeck	VULB 9160	3292	04/11/2015
Loop Ant.	Rohde&Schwarz	HFH2-Z2	862077/017	10/26/2014
EMI Test Receiver	LIGNex1	ER-265	L0811B009	04/09/2014
DC Power Supply	DIGITAL	DRP-303D	5070395	01/09/2014
True RMS Multimeter	FLUKE	87-V	14990137	12/03/2013

- Note : 1. The calibration interval of the above test instrument is 12 month and the calibrations are traceable to RRA, KRISS, KTL and HCT.

2. The calibration interval of horn, Loop Ant. and bi-log Ant. is 24 months

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable loss, and subtracting the Amplifier Gain (if any) from the measured reading. For the limit is employed average value, therefore the peak value can be transferred to average value by subtracting the duty factor. The basic equation with a sample calculation is as follows:

$$\text{Peak} = \text{Reading} + \text{Corrected Factor}$$

Where

Corr. Factor = Antenna Factor + Cable loss - Amplifier Gain (if any)

3.2.2 Radiated Emission Limit

All emission form a digital device, including any network of conductors and apparatus connected thereto shall not exceed the level of field strength specified below:

FCC Part 15 Subpart C paragraph 15.225(a) Limit

Frequency (MHz)	Field Strength of Fundamental (uV/m)	Field Strength of Fundamental (dBuV/m) @30m	Field Strength of Fundamental (dBuV/m) @3m
13.553 – 13.567	15,848	83.9	123.9

FCC Part 15 Subpart C paragraph 15.225(b)(c) Limit

Frequency (MHz)	Field Strength of Fundamental (uV/m)	Field Strength of Fundamental (dBuV/m) @30m	Field Strength of Fundamental (dBuV/m) @3m
13.110 – 13.410	106	40.5	80.5
13.410 – 13.553	334	50.4	90.4
13.567 – 13.710	334	50.4	90.4
13.710 – 14.010	106	40.5	80.5

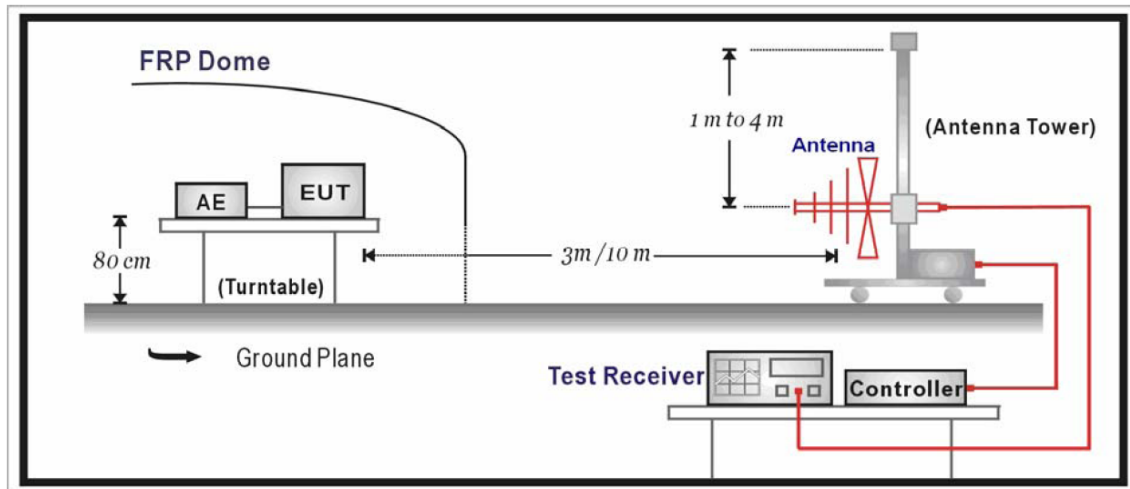
FCC Part 15 Subpart C paragraph 15.225(d) Limit

Frequency Range (MHz)	Field Strength of Fundamental (dBuV/m) @30m	Field Strength of Fundamental (dBuV/m) @3m
1.705 – 30.0	30 (at 30m)	49.5
30-88	100 (at 3m)	40.0
88-216	150 (at 3m)	43.5
216-960	200 (at 3m)	46.0
Above 960	500 (at 3m)	54.0

- Note :
1. $RF\ voltage\ (dBuV) = 20\ log\ RF\ Voltage\ (uV)$
 2. In the Above Table, the tighter limit applies at the band edges.
 3. Distance refers to the distance in meters between the measuring instrument antenna and the EUT
 4. This device used to install a wall device. The location of EUT measurements has the Y-plane(Stand).
 5. All scanning using PK detector. And the final emission level was get using QP detector for frequency range from 30 – 1000 MHz. As to 1 - 26 GHz, the final emission level got using PK and AV detector.
 6. If measurement is made at 3m distance.

3.2.3. Test Configuration

Below 1GHz Test Setup:



3.2.4. Test Procedure

The EUT was setup according to ANSI C63.10: 2009 and tested according to DTS test procedure of ANSI C63.10: 2009 for compliance to FCC 47CFR 15.247 requirements.

The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.4: 2003 on radiated measurement.

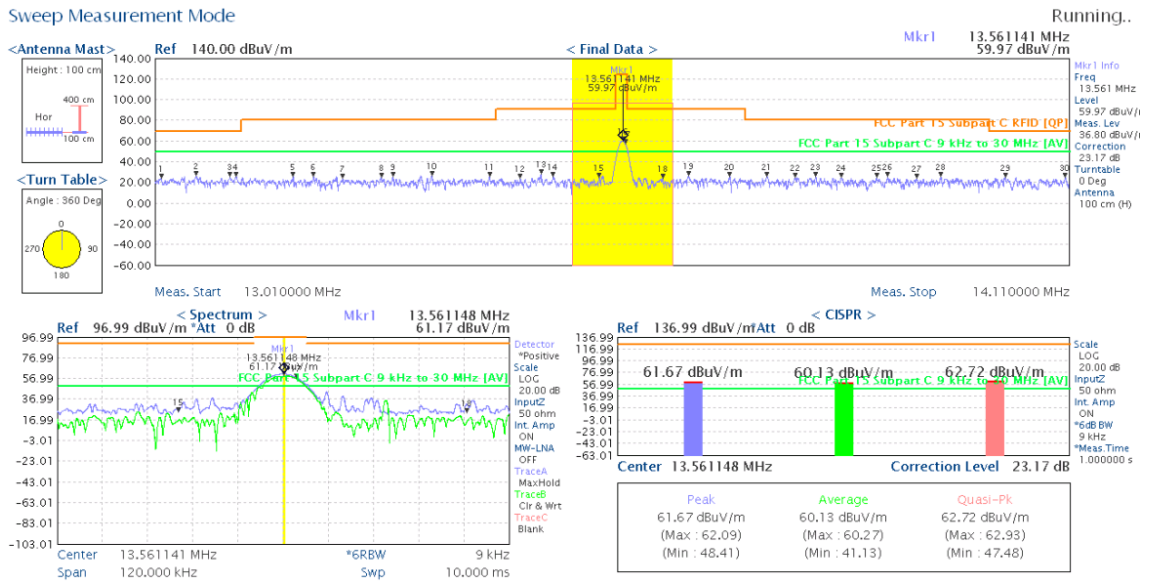
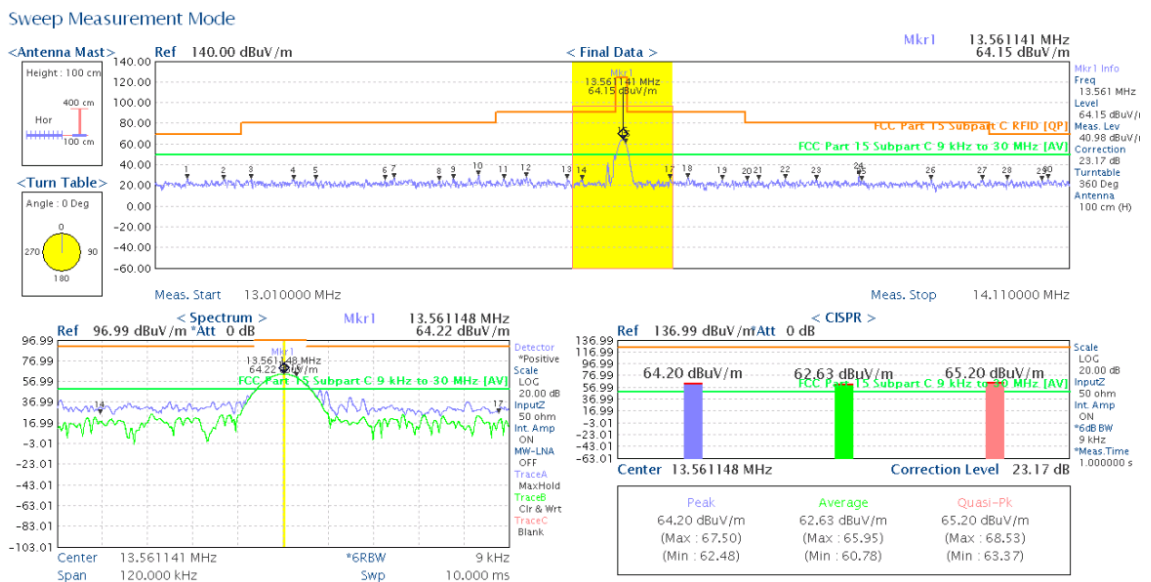
The resolution bandwidth below 1 GHz setting on the field strength meter is 120 kHz and above 1 GHz is 1 MHz. Radiated emission measurements below 1 GHz are made using broadband Bilog antenna and above 1 GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna. The frequency range from 30 MHz to 10th harmonics is checked.

3.2.5 Test Result – Radiated Field Emission-15.225(a)

Test Item	Radiated Field Emission		
Test Mode	RFID	Test Data Rate	N/A
Test Channel	Channel 1 (13.5605 MHz)	Test Site	3 m Semi-Anechoic Chamber
Meas.Method	Radiated	Polarization	Horizontal & Vertical

Horizontal

Vertical


Frequency (MHz)	Reading (dBuV/m)	Pol. (H/V)	Ant. Factor (dB/m)	Cable loss (dB)	Amp. Gain. (dB)	Limit (dBuV/m)	Total (dBuV/m)	Margin (dB)
13.5611	39.76	H	22.73	0.44	-	123.9	62.93	60.97
13.5611	45.36	V	22.73	0.44	-	123.9	68.53	55.37

- Note : 1. RF voltage (dBuV) = 20 log RF Voltage (uV)

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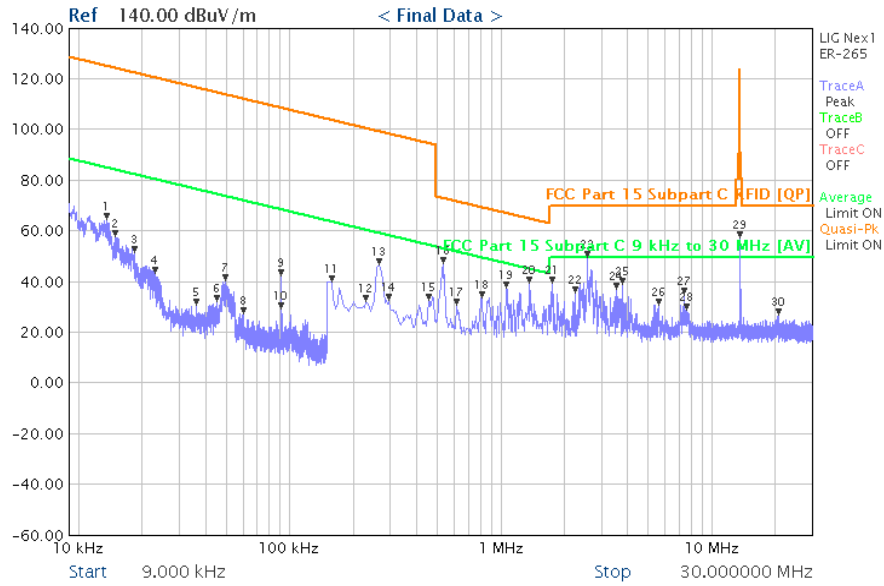
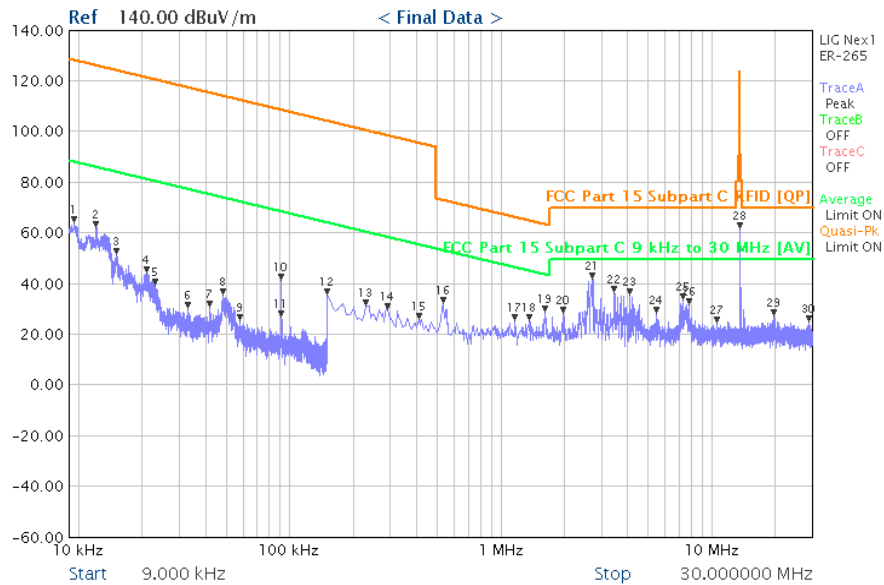
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3.2.6 Test Result – Radiated Field Emission-15.225(b)(c)

Test Item	Radiated Field Emission		
Test Mode	RFID	Test Data Rate	N/A
Test Channel	Channel 1 (13.5605 MHz)	Test Site	3 m Semi-Anechoic Chamber
Meas.Method	Radiated	Polarization	Horizontal & Vertical

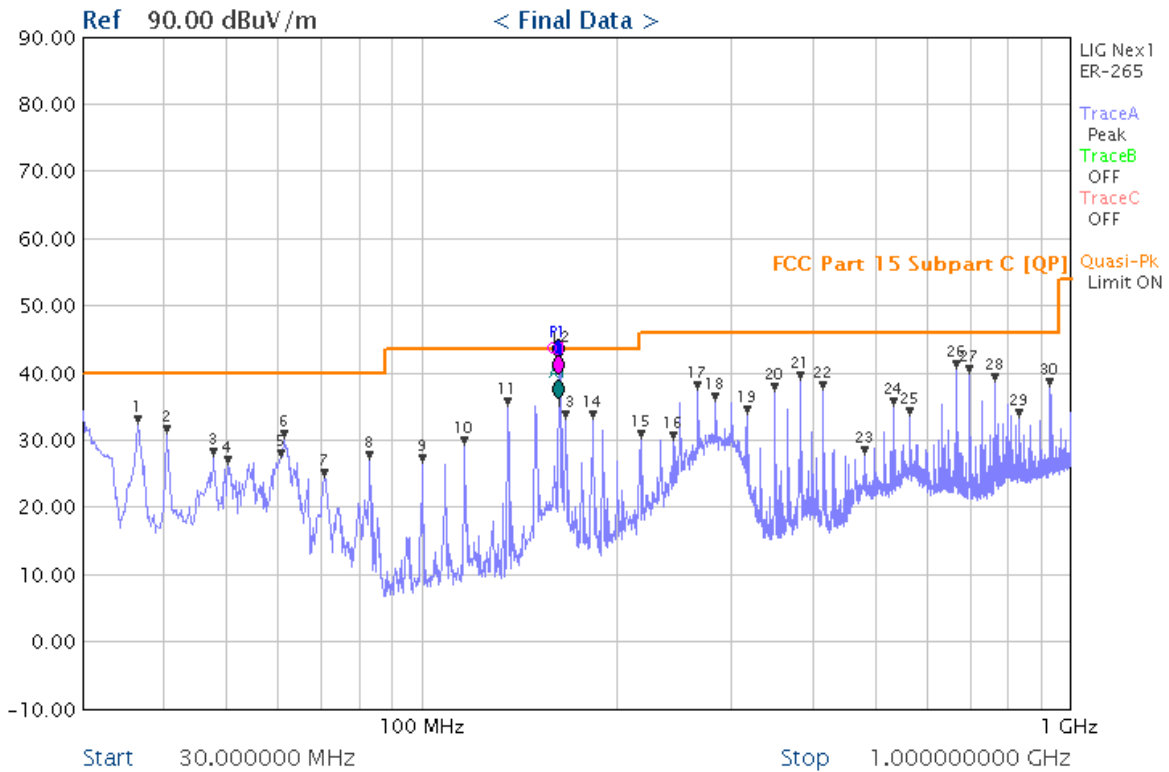
Horizontal

Vertical


Frequency (MHz)	Reading (dBuV/m)	Pol. (H/V)	Ant. Factor (dB/m)	Cable loss (dB)	Amp. Gain. (dB)	Limit (dBuV/m)	Total (dBuV/m)	Margin (dB)
-	-	-	-	-	-	-	-	-

- Note : 1. Other emissions don't exceed the level of 20 dB below the applicable Limit.

3.3 Radiated Field Emission-15.109,15.209, 15.225(d)

Test Item	Radiated Field Emission		
Test Mode	RFID	Test Data Rate	N/A
Test Channel	Channel 1 (13.5603 MHz)	Test Site	3 m Semi-Anechoic Chamber
Meas.Method	Radiated	Polarization	Horizontal & Vertical



Frequency (MHz)	Reading (dBuV/m)	Pol. (H/V)	Ant. Factor (dB/m)	Cable loss (dB)	Amp. Gain. (dB)	Limit (dBuV/m)	Total (dBuV/m)	Margin (dB)
163.46	30.58	V	8.67	1.84	-	43.50	41.09	2.41
665.34	16.51	H	20.47	3.61	-	46.00	40.59	5.41

- Note : 1. RF voltage (dBuV) = 20 log RF Voltage (uV)

3.4 Frequency Stability-15.225(e)

3.4.1 Test Instruments

Description	Manufacturer	Model No.	Serial No.	Next of Cal.
Spectrum Analyzer	Aglient	E4440A	MY45304577	03/05/2014
DC Power Supply	DIGITAL	DRP-303D	5070395	01/09/2014
Temp. & Humid Chamber	Enex Scientific	EN-TH-150	EN-101108	05/29/2014

- Note : 1. The calibration interval of the above test instrument is 12 month and the calibrations are traceable to RRA, KRISS, KTL and HCT.
2. The calibration interval of horn, Loop Ant. and bi-log Ant. is 24 months

3.4.2 Test Procedure

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. For battery operated equipment, the equipment tests shall be performed using a new battery

3.4.3 Test Results.

Table 1 : Frequency Tolerance									
Reference Frequency : 13.5611 MHz, Limit : within ± 1356.11 Hz									
Environment Temperature (degees]	Power Supplied (Vdc)	Carrier Frequency Measured with Time Elapsed							
		Start up		2 minutes		5 minutes		10 minutes	
		(Hz)	Err(Hz)	(Hz)	Err(Hz)	(Hz)	Err(Hz)	(Hz)	Err(Hz)
+50	24	13561312	212	13561312	212	13561312	212	13561312	212
+40	24	13561280	180	13561296	196	13561296	196	13561296	196
+30	24	13561280	180	13561280	180	13561280	180	13561280	180
+20	24	13561296	196	13561296	196	13561296	196	13561296	196
+10	24	13561328	228	13561312	212	13561312	212	13561312	212
0	24	13561328	228	13561328	228	13561328	228	13561328	228
-10	24	13561344	244	13561344	244	13561344	244	13561344	244
-20	24	13561344	244	13561344	244	13561344	244	13561344	244

Table 2 : Frequency Tolerance									
Reference Frequency : 13.5611 MHz, Limit : within ± 1356.11 Hz									
Power Supplied (Vdc)	Carrier Frequency Measured with Time Elapsed								
	Start up		2 minutes		5 minutes		10 minutes		
	(Hz)	Err(Hz)	(Hz)	Err(Hz)	(Hz)	Err(Hz)	(Hz)	Err(Hz)	
85 %	13561312	212	13561296	196	13561296	196	13561280	180	
100 %	13561280	180	13561280	180	13561280	180	13561280	180	
115 %	13561280	180	13561296	196	13561296	196	13561280	180	

- Note : $Err(Hz) = \text{Measured carrier frequency (MHz)} - \text{Reference Frequency (13.5611 MHz)}$

4.0 ANTENNA REQUIREMENT

4.1 Applicable Standard

According to § 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.

4.2 Applicable Construction

The antenna is permanently mounted on PCB, no consideration of replacement.

4.3 Test Result

Pass

Appendix A. The Photo of Test Setup

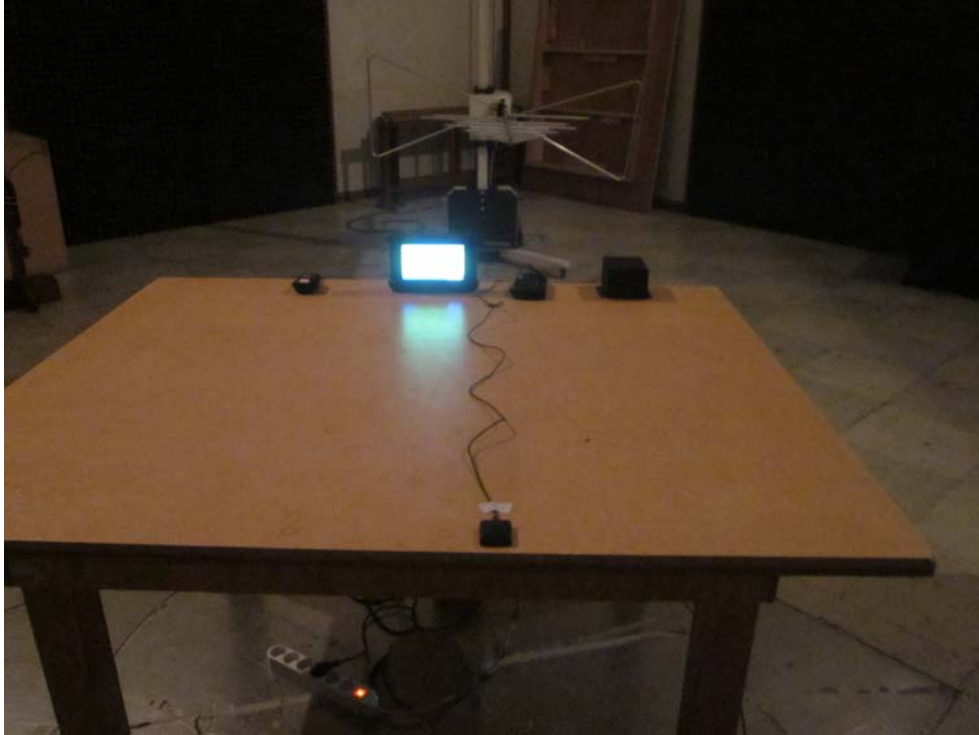
- Front View of Radiated Emission (9 kHz to 30 MHz)



- Rear View of Radiated Emission (9 kHz to 30 MHz)



- **Front View of Radiated Emission (30 MHz to 1 GHz)**



- **Rear View of Radiated Emission (30 MHz to 1 GHz)**



Appendix B. The Photo of Equipment Under Test

- Front View of EUT



- Rear View of EUT



● Inner View of EUT

