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EMC TEST REPORT For FCC



Test Report No. : CTK-2014-00195
Date of Issue : 2014-03-05
Kind of Product : Digital Set Top Box
Basic Model/Type No. : SX021ANM
Variant Model/Type No. : SX021ANC
Applicant : Samsung Electronics Co., Ltd.
Applicant Address : 129, Samsung-ro, YeongTong-Gu, Suwon-Si, Gyeonggi-Do, Korea, 443-742
Manufacturer : Samsung Electronics Co., Ltd.
Manufacturer Address : 129, Samsung-ro, YeongTong-Gu, Suwon-Si, Gyeonggi-Do, Korea, 443-742
Contact Person : Gi Won Lee / Senior Engineer
Telephone : +82-31-277-2637
Received Date : 2014-02-18
Test Data : Start : 2014-02-18 End : 2014-02-24
Test Results : ☒ **In Compliance** ☐ **Not in Compliance**

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

CTK Co., Ltd. is accredited by Korea Laboratory Accreditation Scheme (KOLAS) which signed the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA) for the above test item(s) and test method(s).

Tested by

Reviewed by

Eun-Won LEE
EMC Test Engineer
Date: 2014-03-05

Young-Kug Song
EMC Technical Manager
Date: 2014-03-05



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REPORT REVISION HISTORY

Date	Revision	Page No
2014-03-05	Issued (CTK-2014-00195)	All

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1.0 General Product Description

No.	ITEM	APPLICATION
1	Kind of Product	Digital Set Top Box
2	Basic Model/Type No.	SX021ANM
3	Variant Model/Type No.	SX021ANC
4	Front End Moudle / Manufacturer	DNQF13450KB / SEMCO
5	System	Open Cable
6	Antenna input	75 Ω coaxial cable
7	Dimensions (mm)	240 x 204.7 x 60mm
8	Mobility	☒ Table-top ☐ Floor-standing ☐ Built-in ☐ Portable
9	Maximum Clock Frequency	928 MHz
10	Electrical Ratings	Input: AC 100 V – AC 220 V, 50 Hz / 60 Hz
		Output: -
11	Test Voltage / Frequency	Voltage: AC 120 V
		Frequency: 60 Hz

1.1 Model Differences

- SX021ANM is Basic model.
- SX021ANM and SX021ANC are identical to each other only except for model designations at requests of a buyer.

1.2 Device Modifications

The following modifications were necessary for compliance:

Not applicable

1.3 EUT Configuration(s)

See Appendix A for individual test set-up configuration(s). The following peripheral devices and/or interface cables were connected during the measurement:

☒ Peripheral Devices

Device	Model No.	Serial No.	Manufacturer
AC/DC ADAPTER	DSP-3612A	CN07GL4400103ADC07F1K5011	Dongyang E&P Inc.
LED TV	UN22ES5003	ZV8R33FD301120F	Samsung Electronics Co., Ltd.
USB Drive	MemoRive slim	-	BMK Technology Co., Ltd.

☒ Cable Description

No.	From		To		Type of Cable		
	Device	I/O Port	Device	I/O Port	Length (m)	Shielded or Unshielded	Ferrite Core [Y/N]
1	EUT	USB	USB Drive	-	-	-	-
2		ETHERNET	Notebook (Outside of test site)	ETHERNET	10.0	S	N
3		HDMI OUT	LED TV	HDMI	1.8	S	Y
4		CABLE OUT	LED TV	Antenna IN	1.8	S	N
5		SD VIDEO OUT	LED TV	VIDEO IN	1.8	U	N
6		AUDIO OUT	LED TV	AUDIO IN	1.8	U	N
7		eSATA	CABLE	-	1.5	S	N
8		HDMI IN	CABLE	-	1.8	S	Y
9		DIGITAL AUDIO OUT	CABLE	-	1.2	U	N
10		CABLE IN	Digital signal transmitter (Outside of test site)	CABLE OUT	10.0	S	N
11		DC IN	AC/DC ADAPTER	DC OUT	1.8	U	Y
12	AC/DC ADAPTER	AC POWER	AC MAIN	-	1.8	U	N
13	LED TV	AC POWER	AC MAIN	-	1.8	U	Y

* Shielded or Unshielded : Unshielded=U, Shielded=S

1.4 Test Software

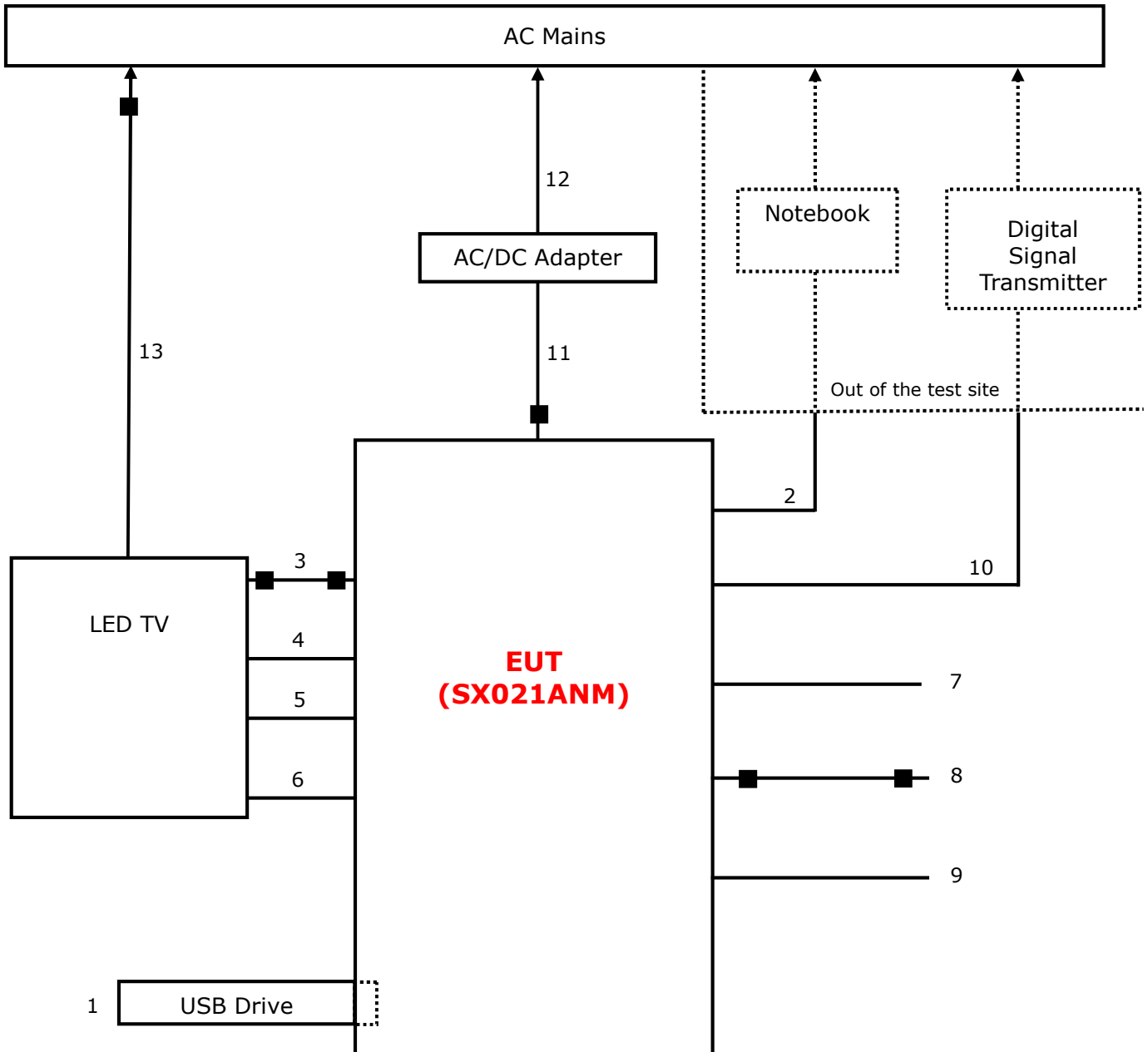
- ☐ EMC Test V 1.0
☐ Display Test Patterns - V1.5
☐ Ping.exe
☒ Not applicable

1.5 EUT Operating Mode(s)

Equipment under test was operated during the measurement under the following conditions:

☒ Digital signal receiving mode

1.6 Configuration





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1.7 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.

1.8 Test Facility

The measurement facility is located at (Ho-dong) 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

1.9 Measurement Procedure

Preliminary AC power line conducted emissions tests were performed shielded room. To find worst mode, several typical mode and typical cable position were tested. Final AC power line conducted emissions test was performed shielded room. (location is same as Preliminary test)
Based on the preliminary tests of the EUT, final test was proceeded worst case test mode and cable configuration.

Preliminary radiated emissions test were performed Semi-Anechoic Chamber or anechoic chamber (Distance of antenna and EUT was 3 m). To find worst mode, several typical mode and typical cable position were tested and peak level and frequency were recorded.

Final radiated emissions test was performed Semi-Anechoic Chamber.
Based on the preliminary tests of the EUT, final test was proceeded worst case test mode and cable configuration.

* Measurement procedures was In accordance with ANSI C63.4-2009 7.3.3, 7.3.4, 8.3.1.1, 8.3.1.2, 8.3.2.1, 8.3.2.2

1.10 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Registration Number	Logo
USA	FCC	FCC Part 15 & 18 EMI (Electromagnetic Interference / Emission)	805871	
JAPAN	VCCI	VCCI V-3 EMI (Electromagnetic Interference / Emission)	C-986 T-1843 R-3627 G-387	
KOREA	MSIP	EMI (Electromagnetic Interference / Emission) EMS (Electromagnetic Susceptibility / Immunity)	KR0025	

1.11 Measurement Uncertainty

Compliance of the product is based on the measured value.

However, the measurement uncertainty is included for information purposes.

The measurement uncertainties given below are based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95 %.

Measurement Type	Frequency Range	Expanded Uncertainty
Conducted Emission	150 kHz to 30 MHz	2.66 dB (C.L.: Approx. 95 %, $k=2$)
Radiated Emission	30 MHz to 1000 MHz	3.66 dB (C.L.: Approx. 95 %, $k=2$)
Radiated Emission	1 GHz Above	4.16 dB (C.L.: Approx. 95 %, $k=2$)



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2.0 EMC Test Regulations/Standards

The tests were performed according to following regulations:

Applied standard	Title	Applied	Test Result
FCC Part 15 Subpart B ☐ Class A ☒ Class B (Cable system terminal device)	Conducted Voltage Emissions	☒	☒ MET ☐ NOT MET
	Radiated Electric Field Emissions	☒	☒ MET ☐ NOT MET
	Antenna-Conducted Power	☒	☒ MET ☐ NOT MET
	Output and Spurious Conducted Level	☒	☒ MET ☐ NOT MET
	Antenna Transfer Switch	☐	☐ MET ☐ NOT MET



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3.0 Results of Individual Test

3.1 Conducted Voltage Emissions of Mains ports

Test Date

2014-02-20

Test Location

Shielded Room

Test Equipment

Name of Equipment	Model No.	Manufacturer	Serial No.	Due Date	Applied
EMI Test Receiver	ESCI7	Rohde & Schwarz	100816	2014-12-06	☒
LISN	ENV216	Rohde & Schwarz	101235	2014-08-02	☒
LISN	ENV216	Rohde & Schwarz	101236	2014-08-02	☒
EMI Test Receiver	ESR7	Rohde & Schwarz	101088	2014-08-02	☐
LISN	ENV216	Rohde & Schwarz	101151	2014-11-08	☐
LISN	ESH3-Z5	Rohde & Schwarz	100207	2014-11-08	☐
EMI Test Receiver	ESCI3	Rohde & Schwarz	100032	2015-02-04	☐
LISN	ENV216	Rohde & Schwarz	101150	2015-02-04	☐
LISN	3825/2	EMCO	9607-2575	2014-07-12	☐

Test Software

ESCI7 : EMC32 Ver. 8.50.0

ESR7, ESCI3 : EMC32 Ver. 8.53.0

Frequency Range of Measurement

150 kHz to 30 MHz

Instrument Setting

IF Band Width: 9 kHz

Climate Condition

Temperature: (23 ± 1) °C

Relative Humidity: (45 ± 1) %

Atmospheric Pressure: 100 kPa

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.



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Test Result

The requirements are: ☒ MET ☐ NOT MET

Frequency (MHz)	Measured Data (dBμV)	Margin (dB)	Remark
0.181 500	58.3	6.2	Quasi-peak

The Result is calculated by using the following formula;

- * Result = Limit – Margin (Result included the correction factor)
- * Correction factor = Cable Loss + Insertion loss of LISN



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Test Data

[Line: L1]

Test

1 / 2

Test Report

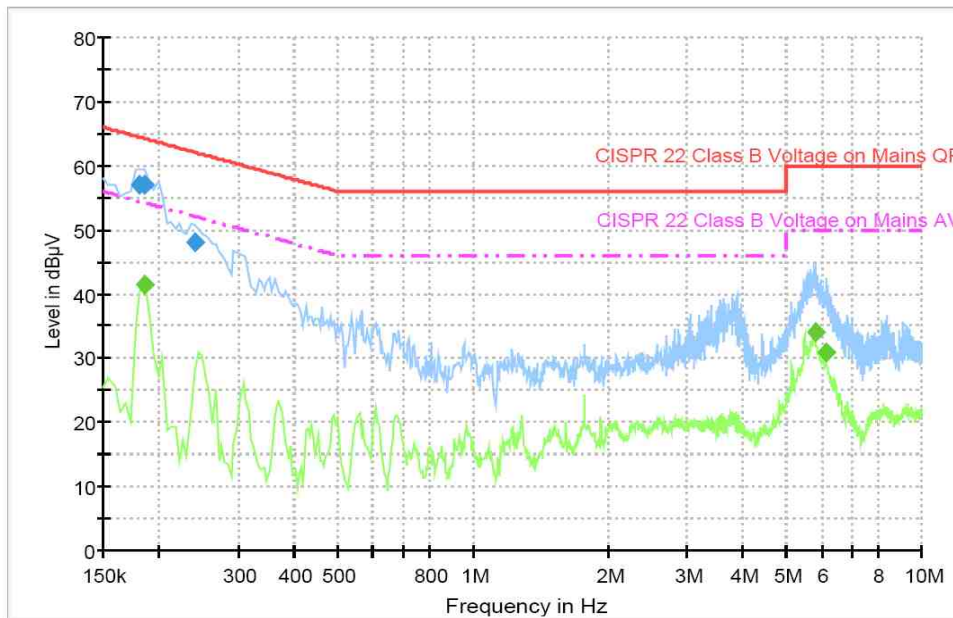
Common Information

Test Model Name: SX021ANM
Test Mode: Digital signal receiving mode
Manufacturer: SAMSUNG
Tester: LEE EUN-WON

Hardware Setup: EMI conducted Voltage with ENV216_FO(101235) - [EMI conducted]

Subrange 1
Frequency Range: 150 kHz - 30 MHz
Receiver: ESCI 7 [ESCI 7]
@ GPIB0 (ADR 20), SN 100816/007, FW 4.42
Signal Path: ESCI 7-ENV216 FO(101235)
FW 1.0
Correction Table: 3CE Cable Loss
ENV216 FO(101235)
LISN: Correction Table (Line 0): ENV216_FO_N(101235)
Correction Table (Line 1): ENV216_FO_L1(101235)

3CE_CISPR 22 Class B_L1



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10:06:33



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Test

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Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.181500	57.1	1000.0	9.000	On	L1	10.0	7.3	64.4
0.186000	57.0	1000.0	9.000	On	L1	10.0	7.2	64.2
0.240000	47.9	1000.0	9.000	On	L1	9.9	14.2	62.1

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.186000	41.4	1000.0	9.000	On	L1	10.0	12.8	54.2
5.797500	33.9	1000.0	9.000	On	L1	9.7	16.1	50.0
6.121500	30.9	1000.0	9.000	On	L1	9.6	19.1	50.0

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[Line : Neutral]

Test

1 / 2

Test Report

Common Information

Test Model Name: SX021ANM
Test Mode: Digital signal receiving mode
Manufacturer: SAMSUNG
Tester: LEE EUN-WON

Hardware Setup: EMI conducted Voltage with ENV216_FO(101235) - [EMI conducted]

Subrange 1

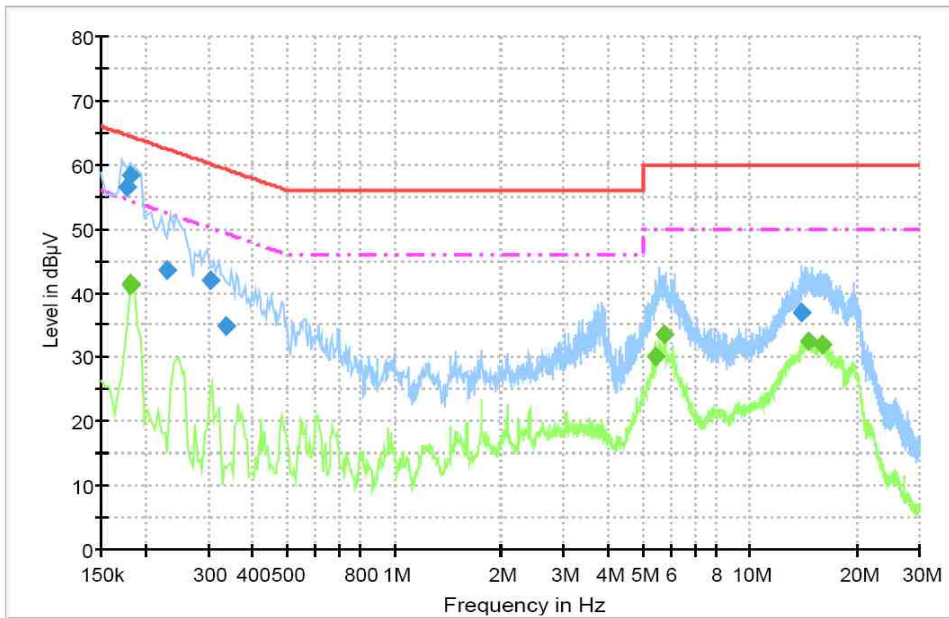
Frequency Range: 150 kHz - 30 MHz

Receiver: ESCI 7 [ESCI 7]
@ GPIB0 (ADR 20), SN 100816/007, FW 4.42

Signal Path: ESCI 7-ENV216 FO(101235)
FW 1.0

LISN: Correction Table: 3CE Cable Loss
ENV216 FO(101235)
Correction Table (Line 0): ENV216_FO_N(101235)
Correction Table (Line 1): ENV216_FO_L1(101235)

3CE_CISPR 22 Class B_N



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Test

2 / 2

Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.177000	56.4	1000.0	9.000	On	N	10.0	8.2	64.6
0.181500	58.3	1000.0	9.000	On	N	10.0	6.2	64.4
0.231000	43.5	1000.0	9.000	On	N	9.9	19.0	62.4
0.303000	42.0	1000.0	9.000	On	N	10.0	18.1	60.2
0.339000	34.8	1000.0	9.000	On	N	10.1	24.4	59.2
13.996500	37.1	1000.0	9.000	On	N	9.9	22.9	60.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.181500	41.4	1000.0	9.000	On	N	10.0	13.0	54.4
0.181500	41.2	1000.0	9.000	On	N	10.0	13.3	54.4
5.428500	30.2	1000.0	9.000	On	N	9.7	19.8	50.0
5.739000	33.4	1000.0	9.000	On	N	9.7	16.6	50.0
14.532000	32.4	1000.0	9.000	On	N	9.9	17.6	50.0
16.066500	32.1	1000.0	9.000	On	N	9.9	17.9	50.0

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3.2 Radiated Electric Field Emissions (Below 1 GHz)

Test Date

2014-02-18

Test Location

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

Test Equipment

Name of Equipment	Model No.	Manufacturer	Serial No.	Due Date	Applied
EMI Test Receiver	ESCI7	Rohde & Schwarz	100814	2014-12-06	☒
Trilog Broadband Antenna	VULB 9161 SE	SCHWARZBECK	9161-4133	2014-06-11	☒
6dB Attenuator	DNF	Rohde & Schwarz	272.4110.50	2014-11-12	☒
Amplifier	310	Sonoma Instrument Co.	291721	2015-02-06	☒

Test Software

TOYO EMI software Ver. 5.1.0

Frequency Range of Measurement

30 MHz to 1 GHz

Instrument Setting

IF Band Width: 120 kHz

Climate Condition

Temperature: (20 ± 1) °C
Relative Humidity: (39 ± 1) %
Atmospheric Pressure: 100 kPa

Test Procedures

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity. The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.



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Test Result

The requirements are: ☒ MET ☐ NOT MET

Frequency (MHz)	Measured Data (dB μ V/m)	Margin (dB)	Remark
162.041	38.6	4.9	Quasi-peak

The Result is calculated by using the following formula;

* Result = Reading + Correction factor

* Correction factor = Antenna Factor + Cable Loss + 6 dB attenuator – Amp Gain



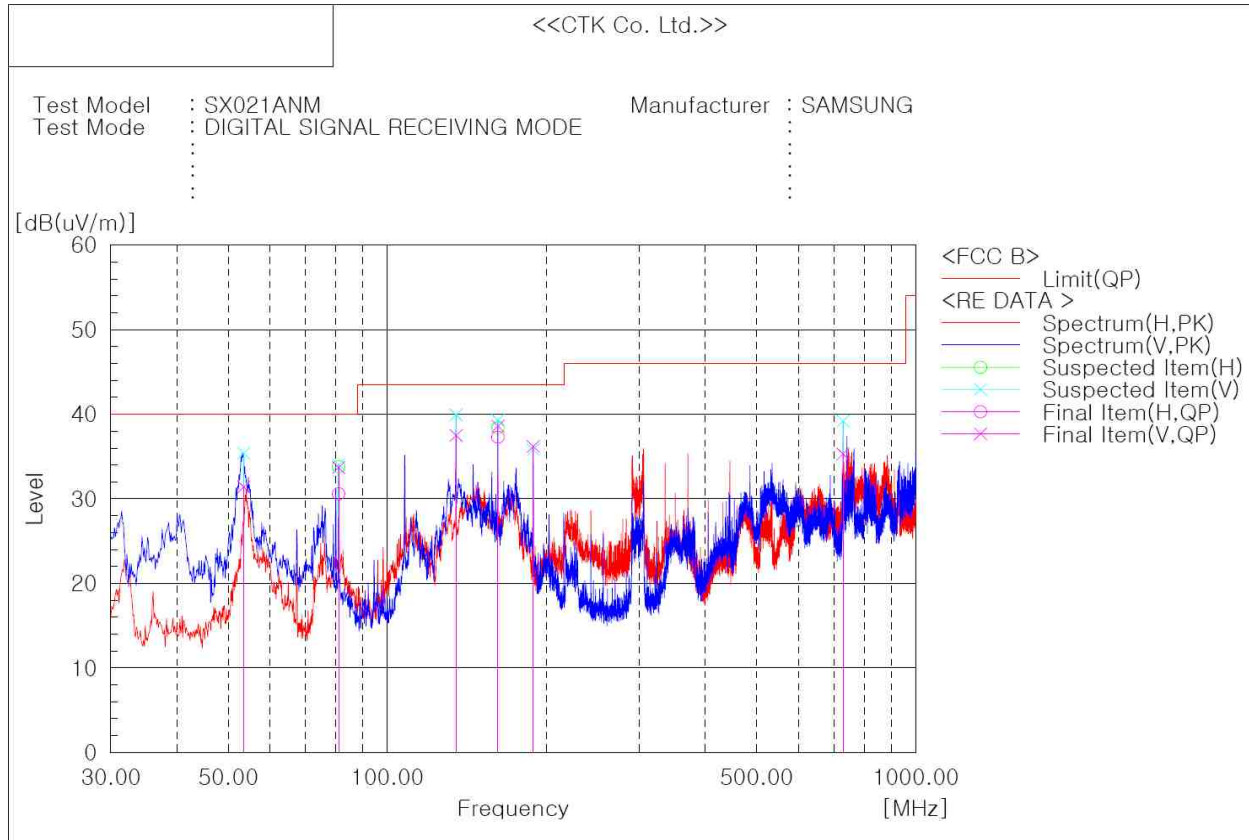
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Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	53.523	V	44.9	-13.5	31.4	40.0	8.6	100.0	290.0
2	80.925	V	49.2	-15.5	33.7	40.0	6.3	100.0	0.0
3	80.925	H	46.1	-15.5	30.6	40.0	9.4	207.0	0.0
4	135.003	V	46.7	-9.2	37.5	43.5	6.0	100.0	0.0
5	162.041	V	44.7	-6.1	38.6	43.5	4.9	100.0	0.0
6	162.041	H	43.4	-6.1	37.3	43.5	6.2	309.0	219.0
7	188.959	V	47.0	-10.8	36.2	43.5	7.3	100.0	0.0
8	729.128	V	35.6	-0.3	35.3	46.0	10.7	100.0	0.0



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3.3 Radiated Electric Field Emissions (Above 1 GHz)

Test Date

2014-02-24

Test Location

3 m SAC

Test Equipment

Name of Equipment	Model No.	Manufacturer	Serial No.	Due Date	Applied
EMI Test Receiver	ESU40	Rohde & Schwarz	100336	2014-06-27	☒
Double Ridged Guide Antenna	3115	ETS-Lindgren	78895	2015-02-28	☒
Preamplifier	8449B	Agilent Technologies	3008A02307	2014-11-08	☒
Band Reject Filter	WRGV 2400/2403-2375/2305-50/10G	Wainwright Instruments GmbH	2	2014-09-09	☒

Test Software

TOYO EMI software Ver. 5.1.0

Frequency Range of Measurement

1 GHz to 5 GHz

Instrument Setting

IF Band Width: 1 MHz

Climate Condition

Temperature: (20 ± 1) °C

Relative Humidity: (44 ± 1) %

Atmospheric Pressure: 100 kPa

Test Procedures

The height of the measuring antenna was varied between 1 to 4 m and the table was rotated a full revolution in order to obtain maximum values of the electric field intensity. The measurement was made in both the vertical and horizontal polarization, and the maximum value is presented in the report.

If the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.



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Test Result

The requirements are: ☒ MET ☐ NOT MET

Frequency (MHz)	Measured Data (dBμV/m)	Margin (dB)	Remark
1 857.920	36.7	17.3	Average

The Result is calculated by using the following formula;

- * Result = Reading + Correction factor
- * Correction factor = Antenna Factor + Cable Loss- Amp Gain



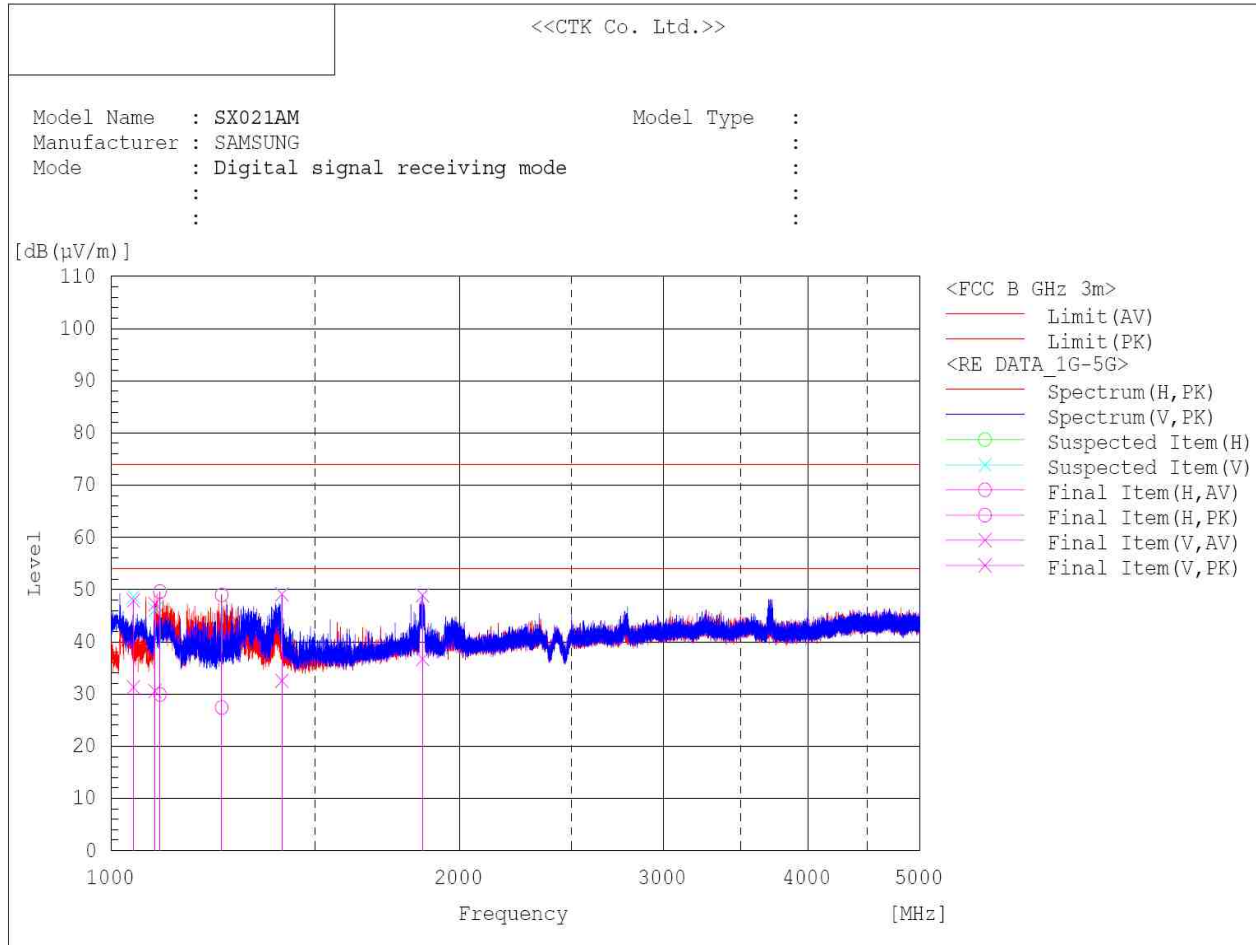
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Test Data



Final Result

No.	Frequency [MHz]	(P)	Reading AV [dB (μV)]	Reading PK [dB (μV)]	c.f [dB (1/m)]	Result AV [dB (μV/m)]	Result PK [dB (μV/m)]	Limit AV [dB (μV/m)]	Limit PK [dB (μV/m)]	Margin AV [dB]	Margin PK [dB]	Height [cm]	Angle [°]
1	1044.800	V	35.2	51.8	-3.9	31.3	47.9	54.0	74.0	22.7	26.1	100.0	220.0
2	1090.400	V	34.2	50.8	-3.6	30.6	47.2	54.0	74.0	23.4	26.8	100.0	200.0
3	1101.440	H	33.4	53.1	-3.5	29.9	49.6	54.0	74.0	24.1	24.4	100.0	217.0
4	1245.760	H	29.6	51.2	-2.2	27.4	49.0	54.0	74.0	26.6	25.0	100.0	217.0
5	1404.000	V	33.5	50.1	-1.0	32.5	49.1	54.0	74.0	21.5	24.9	100.0	239.0
6	1857.920	V	34.0	46.2	2.7	36.7	48.9	54.0	74.0	17.3	25.1	100.0	220.0



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3.4 Antenna-Conducted Power

Test Date

2014-02-24

Test Location

Shielded Room

Test Equipment

Name of Equipment	Model No.	Manufacturer	Serial No.	Due Date	Applied
EMI Test Receiver	ESU40	Rohde & Schwarz	100336	2014-06-27	☒

Frequency Range of Measurement

☒ 30 MHz to 1 GHz

☒ 1 GHz to 5 GHz

Instrument Settings

☒ IF Band Width: 120 kHz

☒ IF Band Width: 1 MHz

Climate Condition

Temperature: (22 ± 1) °C

Relative Humidity: (45 ± 1) %

Atmospheric Pressure: 100 kPa

Test Procedures

Antenna-conducted power measurements are performed with the EUT antenna terminals connected directly to a spectrum analyzer, if the antenna impedance matches the impedance of the measuring instrument. Otherwise, use an impedance-matching network to connect the measuring instrument to the antenna terminals of the EUT. Losses in decibels in any impedance matching network used are added to the measured value in dB μ V.

With the EUT tuned to one of the number of frequencies, measure both the frequency and voltage present at the antenna input terminals over the frequency range specified in the individual equipment requirements. Repeat this measurement with the EUT tuned to another frequency until the number of frequencies have been successively measured.

Power available from the EUT antenna terminals is the ratio of V^2/R , where V is the loss-corrected voltage measured at the antenna terminals, and R is the impedance of the measuring instrument.

Test Result

The requirements are: ☒ MET ☐ NOT MET

Test Data

No values due to local oscillator higher than 20 dB below the limits was measured during the disturbance voltage at the antenna terminals.

Emissions 20 dB's below the limit were not necessarily recorded.



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3.5 Output and Spurious Conducted Level

Test Date

2014-02-24

Test Location

Shielded Room

Test Equipment

Name of Equipment	Model No.	Manufacturer	Serial No.	Due Date	Applied
EMI Test Receiver	ESU40	Rohde & Schwarz	100336	2014-06-27	☒

Frequency Range of Measurement

30 MHz to 1 GHz

Instrument Settings

IF Band Width: 120 kHz

Climate Condition

Temperature: (22 ± 1) °C

Relative Humidity: (45 ± 1) %

Atmospheric Pressure: 100 kPa

Test Procedures

The Output signal level is the maximum voltage level present at the output terminals of the EUT on a particular frequency during normal use of the device.

Measurements were made by direct connection to the spectrum analyzer and EUT with proper impedance matching.

The Cable was supported between the EUT and the measuring instrument in a straight horizontal line so it had at least 75 cm clearance from any conducting surface.

The EUT was provided with a typical signal consistent with normal operation. For each channel on which the device operates and in each mode in which the device operates, the video carrier level, audio carrier level and the spurious emissions over the frequency range was measured and recorded.

Test Result

The requirements are: ☒ MET ☐ NOT MET



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Test Data

[Output Signal Test Data]

Test Channel	Frequency [MHz]	Reading [dB μ V]	Cable Loss [dB]	Limits [dB μ V]	Result [dB μ V]	Margin [dB]
3	56.75	58.80	0.6	62.56	59.40	3.16
	61.25	71.60	0.6	75.56	72.20	3.36
	65.75	58.60	0.6	62.56	59.20	3.36
4	62.75	58.80	0.6	62.56	59.40	3.16
	67.25	71.30	0.6	75.56	71.90	3.66
	71.25	58.10	0.6	62.56	58.70	3.86

[Output Terminal Conducted Spurious Test data]

Test Channel	Frequency [MHz]	Reading [dB μ V]	Correction Factor [dB]	Limits [dB μ V]	Result [dB μ V]	Margin [dB]
3	No emission were detected at a level greater than 20 dB below limit					
4						



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3.6 Antenna Transfer Switch

Test Date

Not Applicable

Test Location

Shielded Room

Test Equipment

Name of Equipment	Model No.	Manufacturer	Serial No.	Due Date	Applied
EMI Test Receiver	ESU40	Rohde & Schwarz	100336	2014-06-27	☐

Frequency Range of Measurement

30 MHz to 1 GHz

Instrument Settings

IF Band Width: 120 kHz

Climate Condition

Temperature:

Relative Humidity:

Atmospheric Pressure:

Test Procedures

The isolation of a cable TV antenna transfer switch shall be measured on the following frequencies: 54, 100, 150, 200, 250, 300, 350, 400, 450, 500 and 550 MHz.

If the device or switch is equipped with more than two antenna input ports or terminals, repeat the following procedure until isolation for each pair of input ports has been measured.

The cable TV antenna transfer switch isolation, expressed in decibels, is the difference between the level of a signal going into the port that is used for cable TV input to the switch and the level of the same signal coming out of an antenna input port of the transfer switch.

Be sure to compare emission levels of the same frequency.

The signal levels are expressed in decibel units.

Test Result

The requirements are: ☐ MET ☐ NOT MET

Test Data



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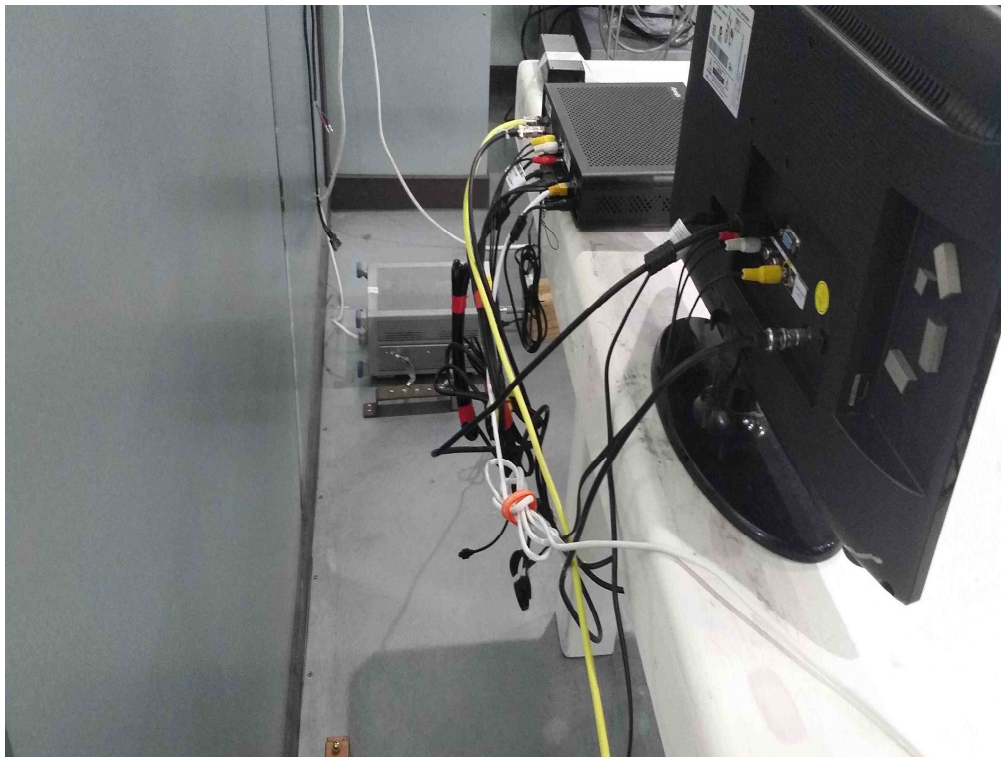
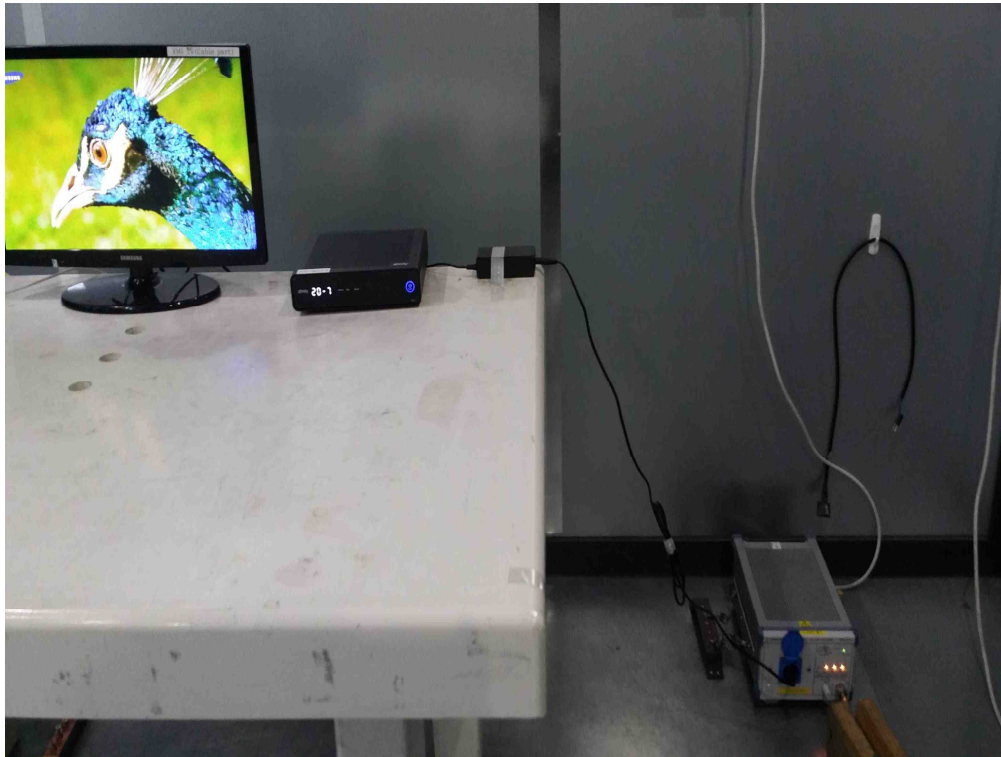
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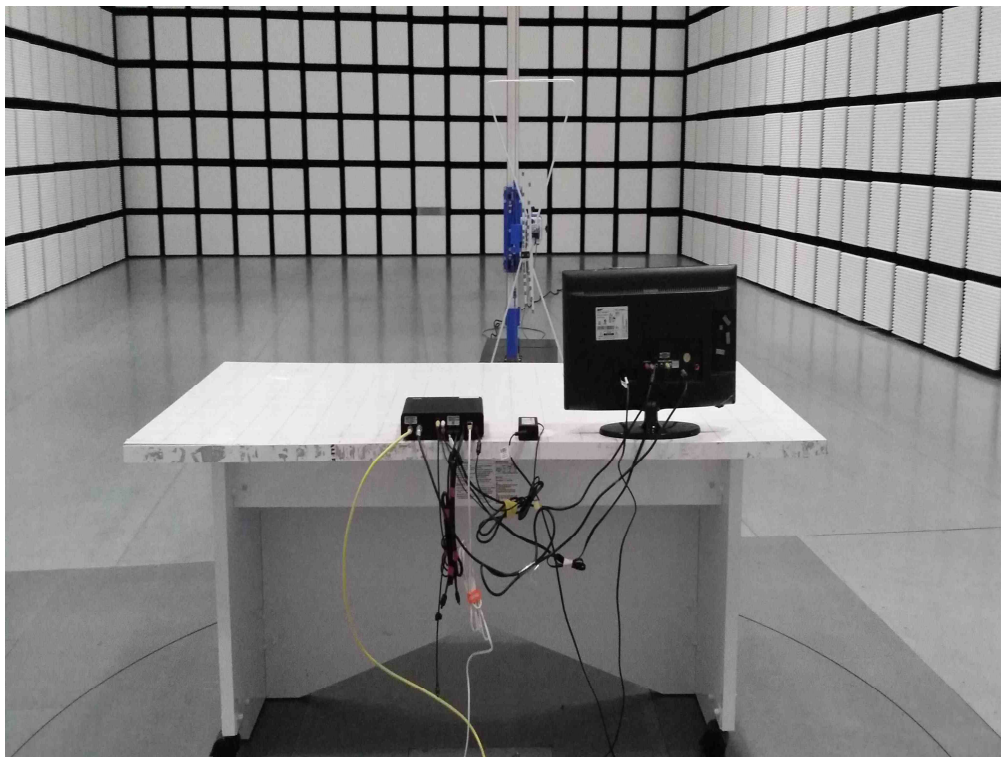
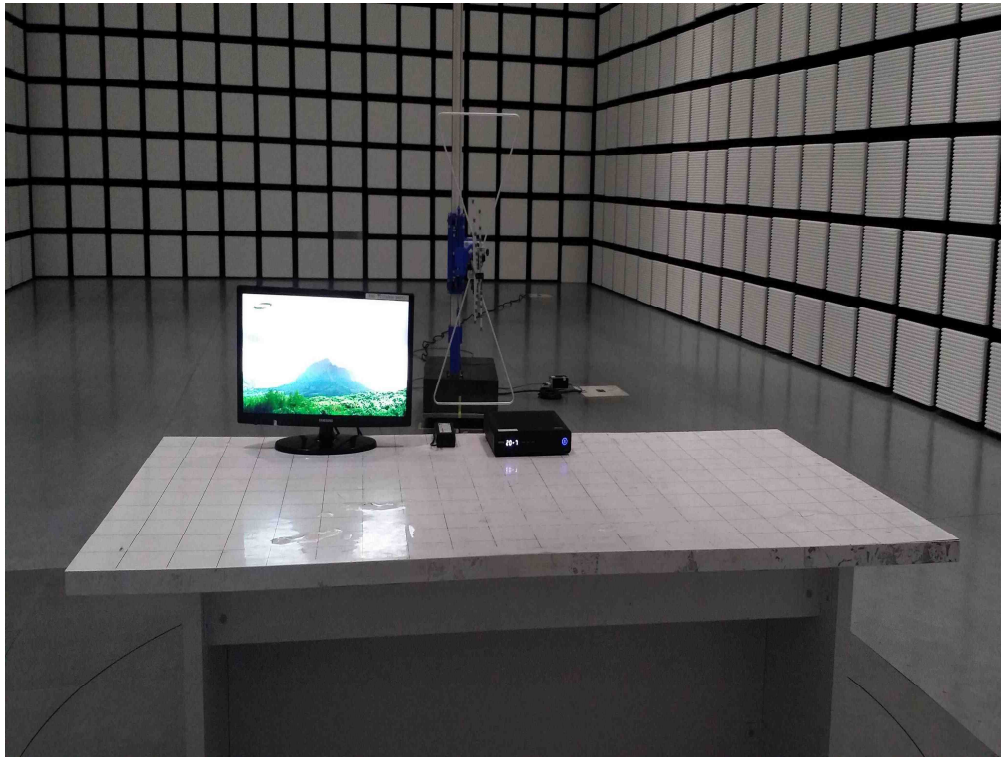


APPENDIX A - Test Setup Photos and Configuration

Conducted Voltage Emissions of Mains Ports



Radiated Electric Field Emissions (Below 1 GHz)



Radiated Electric Field Emissions (Above 1 GHz)





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Antenna-Conducted Power





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Output and Spurious Conducted Level





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Antenna Transfer Switch

Not Applicable



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APPENDIX B – EUT Photographs

EUT External Photographs





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