EMC TEST REPORT

Project No.	**LBE20151667**	**Revision No.**	None
FCC ID	**A3LS22E200NY**		
Applicant	**Name of organization**	Samsung Electronics Co., Ltd.	
	Address	Samsung Electronics America QA Lab 19 Chapin Rd. Building D Pine Brook NJ 07058	
	Date of application	March 06, 2015	
EUT Equipment Under Test	**Type of device**	Class B personal computers and peripherals	
	Equipment authorization	☐ Declaration of Conformity ☒ Certification ☐ Verification	
	Kind of product	LCD Monitor	
	Model No.	*S22E20*** (The character "*" may be 0-9, A-Z or blank, it means different color)	
		Variant Model No.	None
	Manufacturer	Tianjin Samsung Electronics Co., LTD. Weisi Rd. Micro-Electronic Industrial Park,Jingang Rd. Xiqing Dist, Tianjin,300385 China No.20 Jiangtai Road, the West Zone of TEDA ,Tianjin, People's Republic of China	
Applied Standards		FCC Part 15, Subpart B class B	
		ANSI C63.4-2009	
Test period		March 13, 2015~ March 17, 2015	
Issue date		March 18, 2015	

Test result : **Complied**

The equipment under test has found to be compliant with the applied standards.
(Refer to the attached test result for more detail.)

Tested by : Yanan Li	**Reviewed by :** Zhongyuan Gao

The test results in this report only apply to the tested sample. This report must not be reproduced, except in full, without written permission from CSQAL

SAMSUNG

TSEC Wei 4 Road, Microelectronics Industrial Park, Jingang High way, Tianjin, China
Tel: 86 22 23961234, Fax: 86 22 23961234-5214

According to Sec. 2.1077, 47 CFR of the FCC Rules.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Equipment EUT Type	Class B personal computers and peripherals
Kind of product	LCD Monitor
Trade Name	Samsung Electronics
Model	***S22E20*****
Applied Rules	FCC Part 15, Subpart B Class B
	ANSI C63.4-2009
Manufacturer	Tianjin Samsung Electronics Co., LTD. Weisi Rd. Micro-Electronic Industrial Park, Jingang Rd. Xiqing Dist, Tianjin,300385 China

We hereby *declare tha*t the equipment bearing the trade name and model number specified above was tested conforming to the applicable FCC Rules under the most accurate measurement standards possible, and that all the necessary steps have been taken and are in force to assure that production units of the same equipment will continue to comply with the Commission's requirements.

U.S. RESPONSIBLE PARTY	Samsung Electronics America QA Lab 19 Chapin Rd. Building D Pine Brook NJ 07058
CONTACT PERSON	Mr. Chan-ho Youn, Manager E-Mail : jjano.youn@samsung.com Tel : 1-973-808-6362 Fax : 1-973-808-6361

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Table of contents

1. Summary of test results
1.1 Emission

2. General Information
2.1 Test facility

3. Test configuration
3.1 Test Peripherals
3.2 EUT operating mode
3.3 Details of Sampling
3.4 Used cable description
3.5 EUT Description
3.6 Description of the EUT exercising method
3.7 Measurement uncertainty

4. Result of individual tests
4.1 Conducted disturbance
4.2 Radiated disturbance

Appendix – EUT photography

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1. Summary of test results

The EUT has been tested according to the following specifications:

Applied	Test type	Applied standard	Result	Remarks
☒	Conducted Disturbance	FCC Part 15 Subpart B ANSI C63.4-2009	Complied	Meets Class B Limit
☒	Radiated Disturbance		Complied	Meets Class B Limit

- Note：These results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations.

2. General Information

2.1 Test facility

The following firm has submitted the information required by Section 2.948 of the FCC Rules for measuring devices subject to Certification under Parts 15 & 18. The FCC takes no responsibility regarding the capability of this firm for performing the required measurements. Accordingly, this firm should not advertise or otherwise imply FCC approval of CSQAL.
CHINA SAMSUNG QUALITY ASSURANCE LABORATORY is LOCATED ON Block D, 17 - 19, Wei 4 Road, Microelectronics Industrial Park, Jingang Highway, Tianjin China.
Registration Number: 745769
E-mail Address: zhongyuan.gao@samsung.com
Phone Number:86-22-2396-1234-5211
All testing are performed in Semi-anechoic chambers conforming to the site attenuation Characteristics defined by ANSI C63.4, CISPR 22, 16-1 and 16-2 and Shielded rooms.
CSQAL is operated as testing laboratory in accordance with the requirements of ISO/IEC 17025:2005.

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3. Test Setup configuration

3.1 Test Peripherals

The peripherals which were interconnected to the EUT during the test are as follows:

Item	Model No.	Serial No.	Manufacturer	Note
LCD Monitor	LS22E20	-	Samsung	EUT
PC	DM-V200-PA15	ZLPZ9WAZ600123A	Samsung	-
Printer	ML-2545/XAA	Z6FJBACB600011N	Samsung	-
USB Keyboard	SK-8185	OY526K	Dell	-
USB Mouse	SNJ-B138	Z164146	Dell	-

3.2 EUT operating mode(s)

To achieve compliance applied standard specification, the following mode(s) were made during compliance testing:

Operating Mode 1	VGA IN

3.3 Details of Sampling

Customer selected, single unit.

3.4 Cable description

The type(s) of cables which were connected to the ports (of the EUT) are as follows:

No	Connect Cable	Length [m]	Ferrite core [Y/N]	Remark
1	VGA in	1.5	Y	To PC
2	POWER	1.8	N	FOR EUT

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3.5 EUT Description

The following features describe EUT represented by this report:
Test Voltage:110V 60Hz
Model Name：LS22E20
Clock frequency: 148.5MHz
Panel information:
BOM code : BN07-01399A Model code : LTM215HT05
Manufacturer : SDC

Model Name		S22E20
Panel	Size	21.5 Inches (54 cm)
	Display area	476.64 mm (H) x 268.11 mm (V) 18.8 Inches (H) x 10.6 Inches (V)
	Pixel Pitch	0.24825 mm (H) x 0.24825 mm (V) 0.009774 Inches (H) x 0.009774 Inches (V)
Power Supply		This product uses 100 to 240V. Refer to the label at the back of the product as the standard voltage can vary in different countries.
Dimensions (W x H x D) / Weight	Without Stand	504.3 x 301.9 x 77.6 mm 19.9 x 11.9 x 3.1 Inches
	With Stand	504.3 x 385.35 x 185.0 mm / 3.5 kg 19.9 x 15.2 x 7.3 Inches / 7.7 lbs
Environmental considerations	Operating	Temperature : 50 °F – 104 °F (10 °C – 40 °C) Humidity : 10% – 80%, non-condensing
	Storage	Temperature : -4 °F – 113 °F (-20 °C – 45 °C) Humidity : 5% – 95%, non-condensing

Model Name	Synchronization		Resolution	
	Horizontal Frequency	Vertical Frequency	Optimum Resolution	Maximum Resolution
S22E20	30 – 81 kHz	56 – 75 Hz	1920 x 1080 @ 60 Hz	1920 x 1080 @ 60 Hz

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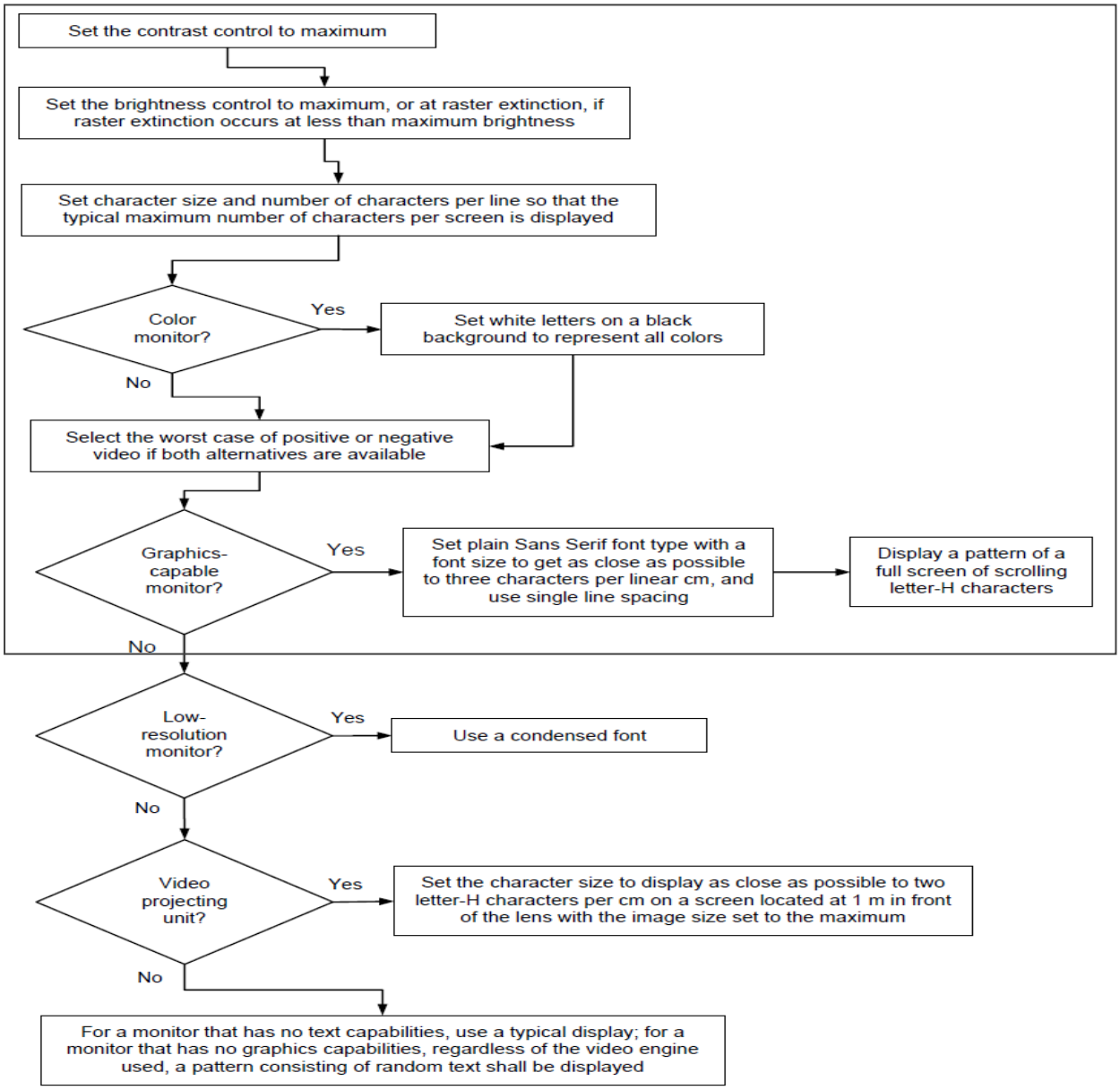
3.6 Description of the EUT exercising method

The EUT exercise program used during EMI testing was CSQAL standardized test program for MS Windows. The program repetitively sends a screen of H – Character to the display. Connect video output of computer on EUT's VGA port, and scrolled H – character continuously on EUT's screen.
The EUT system includes a monitor, the operational conditions shown as follows, within the selected area.



Notes: 1. Set the brightness control to maximum

2. Set the contrast control to maximum

3. Display a pattern of a full screen of scrolling letter-H characters with a font size to get as close as possible to three characters per linear cm and use single line spacing

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3.7 Measurement uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus: (According to CISPR 16-4 and UKAS Lab 34.)

Test type			**Measurement uncertainty (C.L. 95 %, k = 2)**
Disturbance voltage at the mains terminals			3.0 dB
Radiated Disturbance	Horizontal	30 MHz - 1 GHz	4.4 dB
	Vertical	30 MHz - 1 GHz	4.4 dB
	Horizontal	1GHz - 6 GHz	3.7 dB
	Vertical	1GHz - 6 GHz	3.7 dB

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4. Results of individual test

4.1 Conducted disturbance

Both conducted lines are measured in Quasi-Peak and Average mode, including the worst-case data points for each tested configuration.
The EUT measured in accordance with the methods described in standards.

Limits for conducted disturbance at the mains ports of class B ITE

Frequency range Limits MHz	Limits dB(µV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

Note 1: 1 µV is regarded as 0 dB.
Note 2: The limits shall decreases linearly with the logarithm of the frequency in the range 150 – 500 kHz.
Note 3: If the average limit is met in the measurement with quasi-peak detector, the measurement with average detector is unnecessary.
Note 4: The lower limit shall apply at the transition frequency.

If the reading on the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 seconds at each measurement frequency, the highest reading shall be recorded, with the exception of any brief isolated high reading (which shall be ignored).

4.1.1 Test instrumentation

Test instrumentation used in the Conducted disturbance test was as follows:

Test instrumentation	Model name	Manufacturer	Serial or Firmware (No./Ver.)	Calibration	
				Date	Interval (Month)
Test Software	EP5CE	TOYO	V 4.7.10	N/A	N/A
Measuring receiver	ESCI	R&S	101027	2015.03.02	12
Artificial mains network	ENV216	R&S	101123	2014.08.18	12
Artificial mains network	ENV216	R&S	101059	2014.08.18	12

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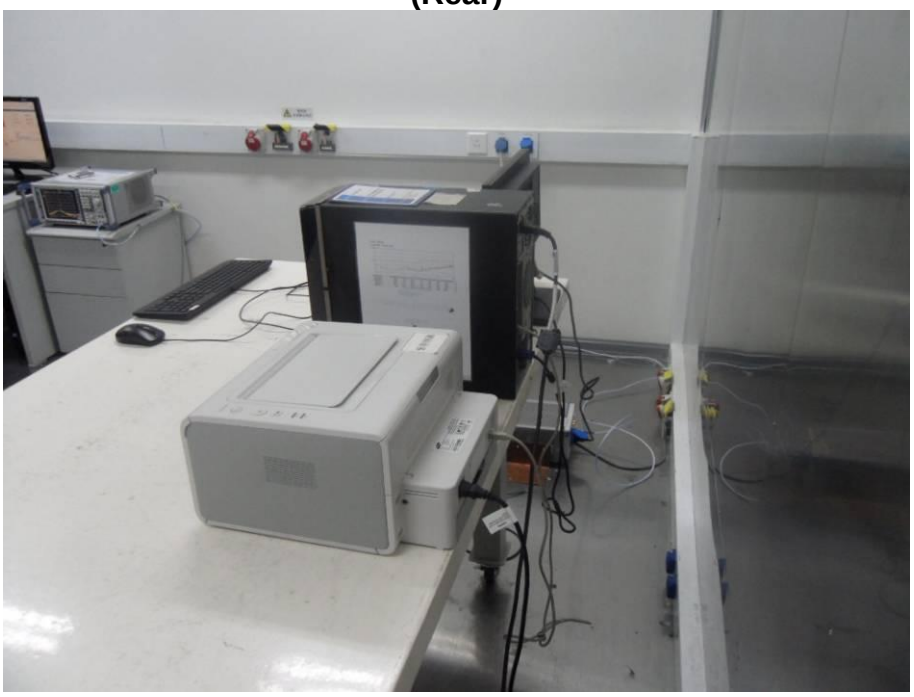
4.1.2 Photograph of the test Configuration

(Front)

(Rear)



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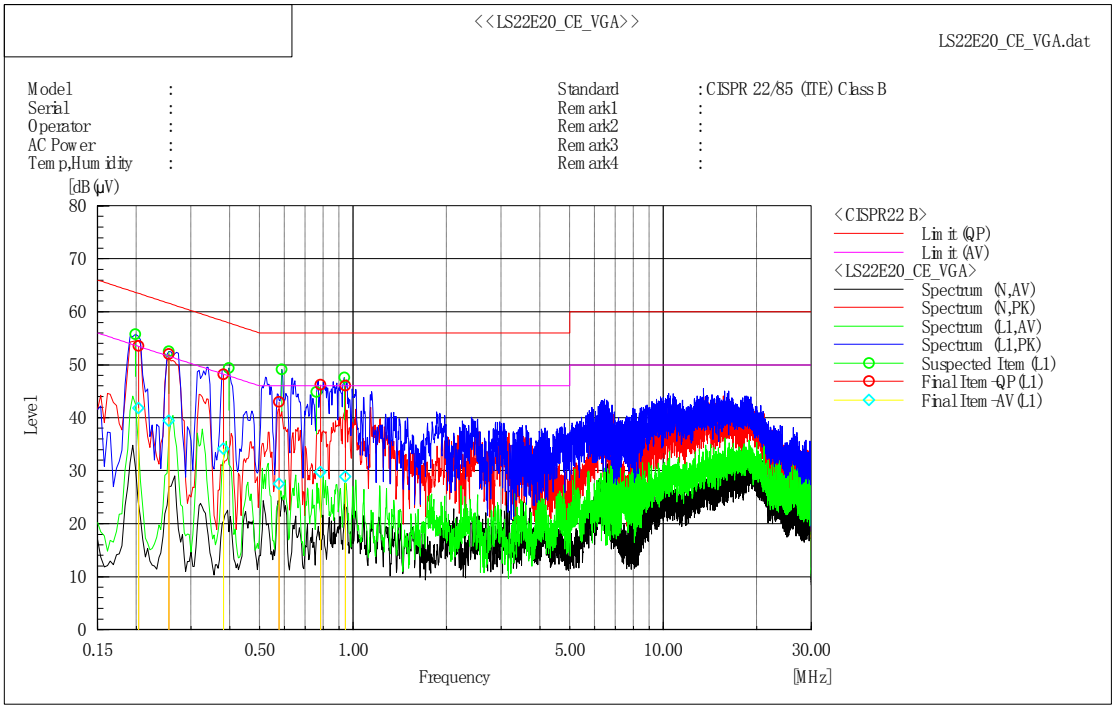
4.1.3 Test results

Test date	2015.03.13		**Test engineer**		Yanan Li	
Climate condition	**Ambient temperature**	20±1℃	**Relative humidity**	36±1%	**Atmospheric pressure**	101±0 kPa
Test place	Shielded Room #2					

4.1.4 Test data

■ Operating Mode: VGA IN

Set the brightness control to maximum, Set the contrast control to maximum
Scan three resolutions (800*600@60Hz, 1024*768@60Hz, 1920*1080@60Hz), then choose the worst one (1920*1080@60Hz) for final evaluation.



Final Result

--- L1 Phase ---

No.	Frequency [MHz]	Reading QP [dB(μV)]	Reading AV [dB(μV)]	c.f [dB]	Result QP [dB(μV)]	Result AV [dB(μV)]	Limit QP [dB(μV)]	Limit AV [dB(μV)]	Margin QP [dB]	Margin AV [dB]	Remark [dB]
1	0.25488	42.0	29.4	10.0	52.0	39.4	61.6	51.6	9.6	12.2	
2	0.78454	36.2	19.7	10.0	46.2	29.7	56.0	46.0	9.8	16.3	
3	0.94347	36.2	19.0	9.9	46.1	28.9	56.0	46.0	9.9	17.1	
4	0.20352	43.5	31.8	10.0	53.5	41.8	63.5	53.5	10.0	11.7	
5	0.38219	38.1	24.1	10.0	48.1	34.1	58.2	48.2	10.1	14.1	
6	0.57707	33.0	17.5	10.0	43.0	27.5	56.0	46.0	13.0	18.5	

Note) Level (Quasi-Peak and/or Average) = Meter Reading (Quasi-Peak and/or Average) + Factor (LISN Insertion Loss + Cable Loss)

Margin = Limit – Level (Quasi-Peak and/or Average)

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4.2 Radiated disturbance

Of those disturbances above (*L* - 20dB), where *L* is the limit level in logarithmic units, record at least the disturbance levels and the frequencies of the six highest disturbances.
The following data lists the significant emission frequencies, measured levels, correction factors (for antenna and cables), orientation of table, polarization and height of antenna, the corrected reading, the limit, and the amount of margin. All measurements were taken utilizing quasi-peak detection unless stated otherwise.
Measurements were performed at an antenna to EUT distance of 3 meters and elevated between 1 and 4 meters. Both vertical and horizontal antenna polarizations were measured.
Above 1GHz, peak detector function mode was used with resolution bandwidth of 1 MHz and a video bandwidth of 1 MHz. If the peak measured value complies with the average limit, it is unnecessary to perform an average measurement.

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency range Limits MHz	Quasi-peak Limits (microvolts/meter)
	Class B
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500
Note 1: The lower limit shall apply at the transition frequency. Note 2: Additional provisions may be required for cases where interference occurs. Note 3: 1 µV/m is regarded as 0 dB.	

Measurements above 1GHz were performed at an antenna to EUT distance of 3 meters and elevated 1 to 4 meters in FAC. Both vertical and horizontal antenna polarizations were measured.

The test is performed in a semi-anechoic chamber, use of absorbing material to cover part of the metal ground plane，the dimension of the absorbing material is: 3 x 3 x 0.3 m (W x D x H)

Limits for radiated disturbance of ITE at a measuring distance of 3 m

Frequency range Limits MHz	Class A		Class B	
	Peak dB(µV/m)	Average dB(µV/m)	Peak dB(µV/m)	Average dB(µV/m)
1000 to 3000	76	56	70	50
3000 to 6000	80	60	74	54
Note 1: The lower limit shall apply at the transition frequency.				

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4.2.1 Test instrumentation

Test instrumentation used in the Radiated disturbance was as follows:

30MHz~1GHz

Test instrumentation	Model name	Manufacturer	Serial or Firmware (No./Ver.)	Calibration	
				Date	Interval (Month)
Test Software	EP5/RE	TOYO	V 4.7.10	N/A	N/A
Bi-con Antenna	CBL6112D	TESEQ	30998	2013.04.03	24
EMI Receiver	ESCI	R&S	101026	2015.03.02	12
AMPLIFIER	310N	SONOMA	300911	2014.07.05	12
Ant Mast	MA4000	INN CO	-	N/A	N/A
Mast Controller	CO2000	INN CO	-	N/A	N/A
RF Selector	NS4900N	TOYO	-	N/A	N/A

1GHz-2GHz

Test instrumentation	Model name	Manufacturer	Serial or Firmware (No./Ver.)	Calibration	
				Date	Interval (Month)
Test Software	EP5/RE	TOYO	V 4.7.10	N/A	N/A
Broad-Band Horn Antenna	BBHA9120B	Schwarzbeck	520	2014.02.19	24
EMI Receiver	ESU26	R&S	100243	2015.03.02	12
AMPLIFIER	AMF-4D-00500800-18-13P	TOYO	0934	2014.07.05	12
Ant Mast	AUDIX	AUDIX	-	N/A	N/A

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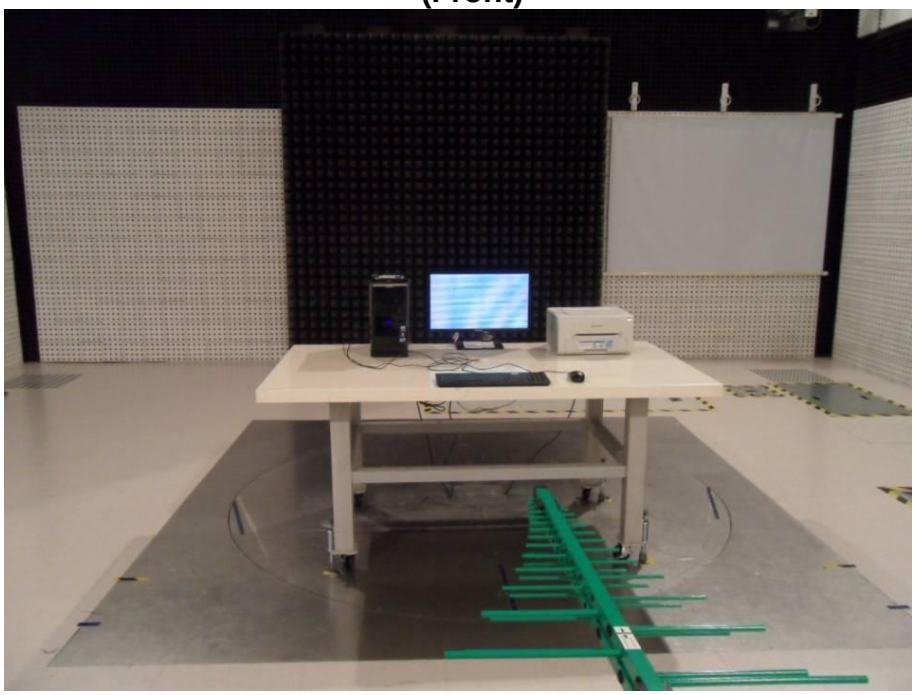
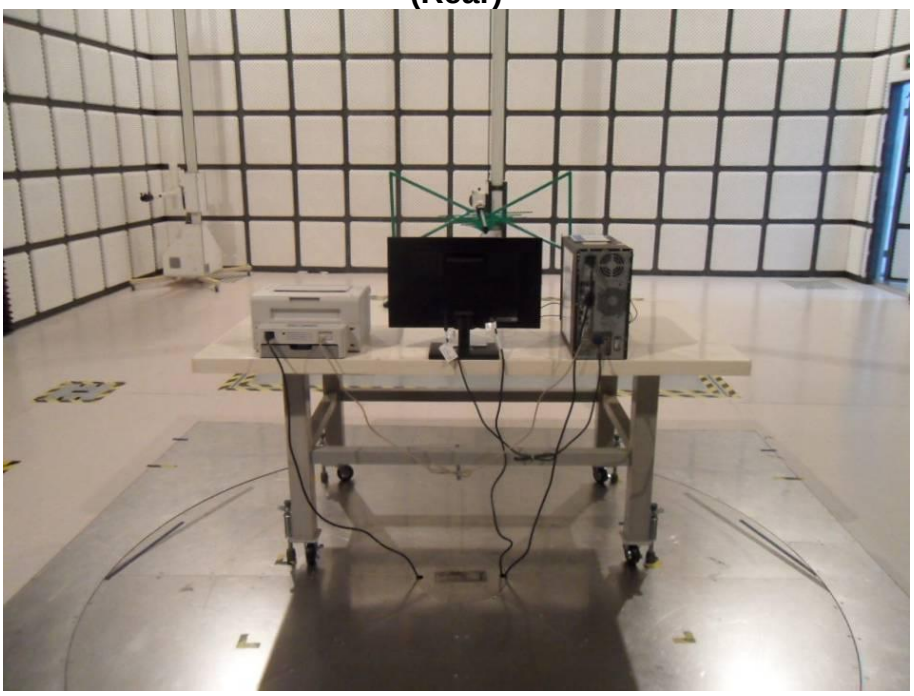
4.2.2 Photograph of the test Configuration

30MHz~1GHz

(Front)



(Rear)



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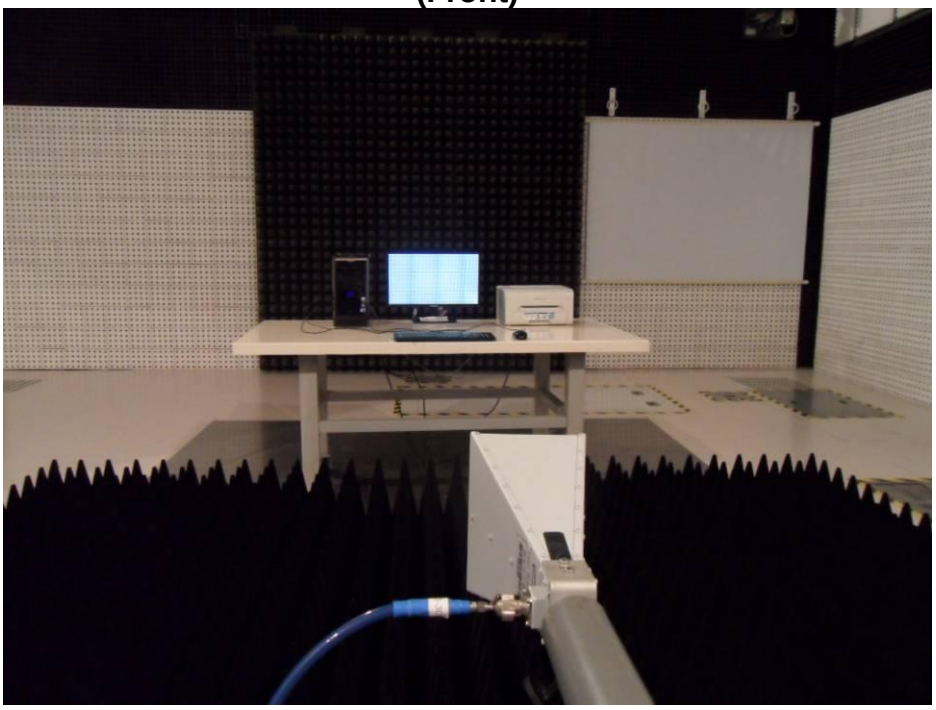
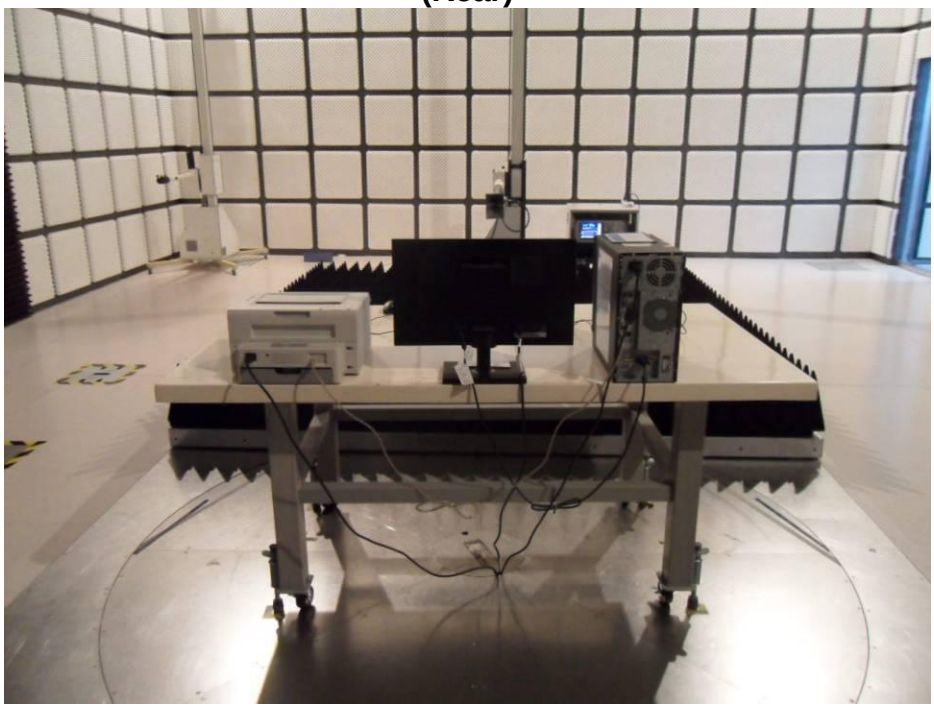
1GHz-2GHz

(Front)



(Rear)



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4.2.3 Test results

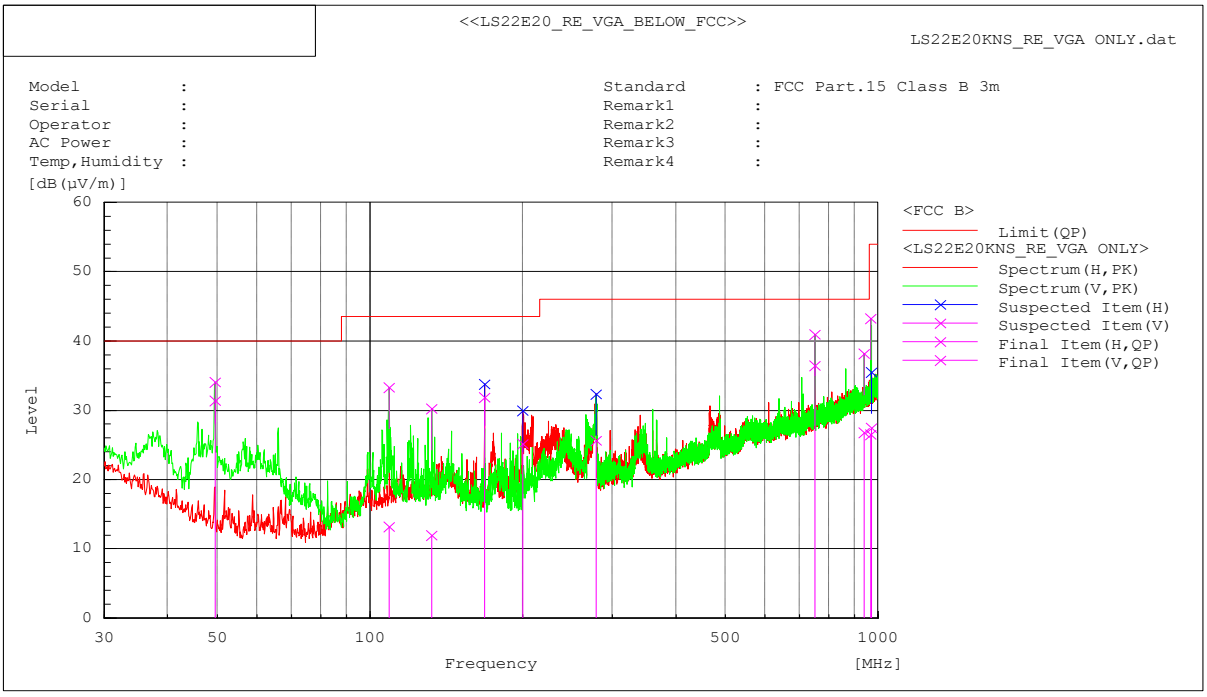
30MHz~1GHz

Test date	2015.03.14		**Test engineer**		Yanan Li	
Climate condition	**Ambient temperature**	20±1℃	**Relative humidity**	36±0%	**Atmospheric pressure**	101±0 kPa
Test place	3m Semi-Anechoic Chamber					

■ Operating Mode: VGA IN Display

Set the brightness control to maximum, Set the contrast control to maximum

Scan three resolutions (800*600@60Hz, 1024*768@60Hz, 1920*1080@60Hz), then choose the worst one (1920*1080@60Hz) for final evaluation.



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(µV)]	c.f [dB(1/m)]	Result QP [dB(µV/m)]	Limit QP [dB(µV/m)]	Margin QP [dB]	Height [cm]	Angle [°]	Remark
1	49.521	V	47.0	-15.6	31.4	40.0	8.6	101.0	33.4	
2	750.104	V	35.4	1.1	36.5	46.0	9.5	101.0	350.0	
3	167.983	H	44.4	-12.5	31.9	43.5	11.6	198.0	331.1	
4	199.750	H	37.9	-12.7	25.2	43.5	18.3	101.0	3.0	
5	937.677	V	22.9	3.9	26.8	46.0	19.2	201.0	2.9	
6	279.048	H	34.1	-8.5	25.6	46.0	20.4	101.0	105.2	
7	969.324	H	22.7	4.8	27.5	54.0	26.5	230.0	0.3	
8	968.839	V	21.8	4.8	26.6	54.0	27.4	200.0	306.2	
9	109.176	V	24.8	-11.6	13.2	43.5	30.3	101.0	25.9	
10	132.335	V	22.9	-10.9	12.0	43.5	31.5	301.0	6.3	

Note) Receiving antenna polarization : Horizontal and/or Vertical

Test Distance : 3m, Antenna Height : 1 to 4 meters

Result (Quasi-Peak) = Reading QP + C.F (Antenna Factor + Cable Loss - Amp. Gain)

Margin QP (Quasi-Peak) = Limit – Level QP

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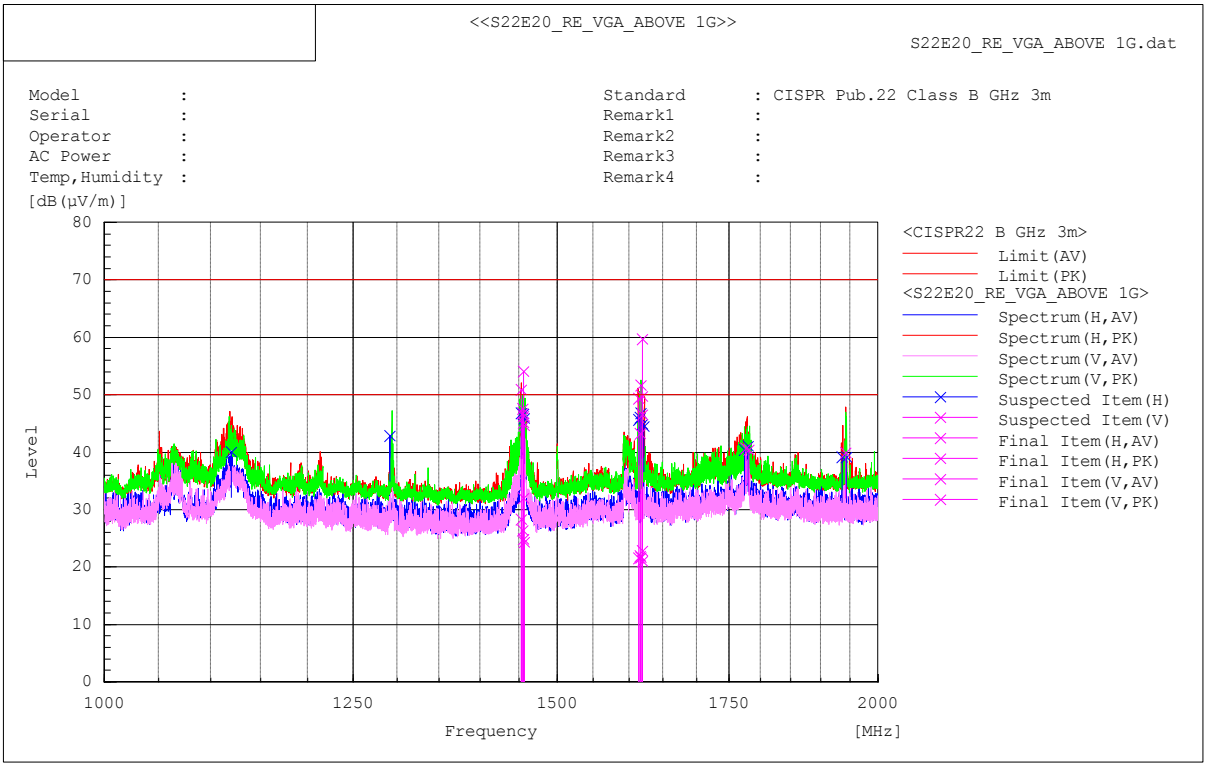
1GHz-2GHz

Test date	2015.03.17		**Test engineer**		Yanan Li	
Climate condition	**Ambient temperature**	20±1℃	**Relative humidity**	36＋1%	**Atmospheric pressure**	101±0kPa
Test place	3m Semi-Anechoic Chamber					

■ Operating Mode: VGA IN Display

Set the brightness control to maximum, Set the contrast control to maximum
Scan three resolutions (800*600@60Hz, 1024*768@60Hz, 1920*1080@60Hz), then choose the worst one (1920*1080@60Hz) for final evaluation.



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 [°]	Remark
1	1619.123	V	38.6	75.4	-15.7	22.9	59.7	50.0	70.0	27.1	10.3	142.0	210.2	
2	1617.250	H	37.3	67.4	-15.7	21.6	51.7	50.0	70.0	28.4	18.3	100.0	60.3	
3	1454.750	V	43.8	64.9	-17.3	26.5	47.6	50.0	70.0	23.5	22.4	100.0	162.8	
4	1452.750	H	45.6	68.2	-17.3	28.3	50.9	50.0	70.0	21.7	19.1	100.0	128.4	
5	1455.500	H	42.1	62.5	-17.3	24.8	45.2	50.0	70.0	25.2	24.8	100.0	165.7	
6	1456.000	V	49.3	71.3	-17.3	32.0	54.0	50.0	70.0	18.0	16.0	100.0	153.6	
7	1616.250	H	37.6	59.0	-15.7	21.9	43.3	50.0	70.0	28.1	26.7	100.0	156.6	
8	1456.750	H	41.7	61.9	-17.3	24.4	44.6	50.0	70.0	25.6	25.4	100.0	165.3	
9	1614.250	H	37.3	65.1	-15.7	21.6	49.4	50.0	70.0	28.4	20.6	302.0	33.6	
10	1618.875	H	36.7	62.3	-15.7	21.0	46.6	50.0	70.0	29.0	23.4	302.0	96.4	

Note) Receiving antenna polarization : Horizontal, Vertical

Test Distance : 3m, Antenna Height : 1 to 4 meters

Result (Average) = Reading AV + C.F (Antenna Factor + Cable Loss - Amp. Gain)

Margin AV (Average) = Limit – Result AV

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Appendix A – EUT photography

(Front)

(Rear)

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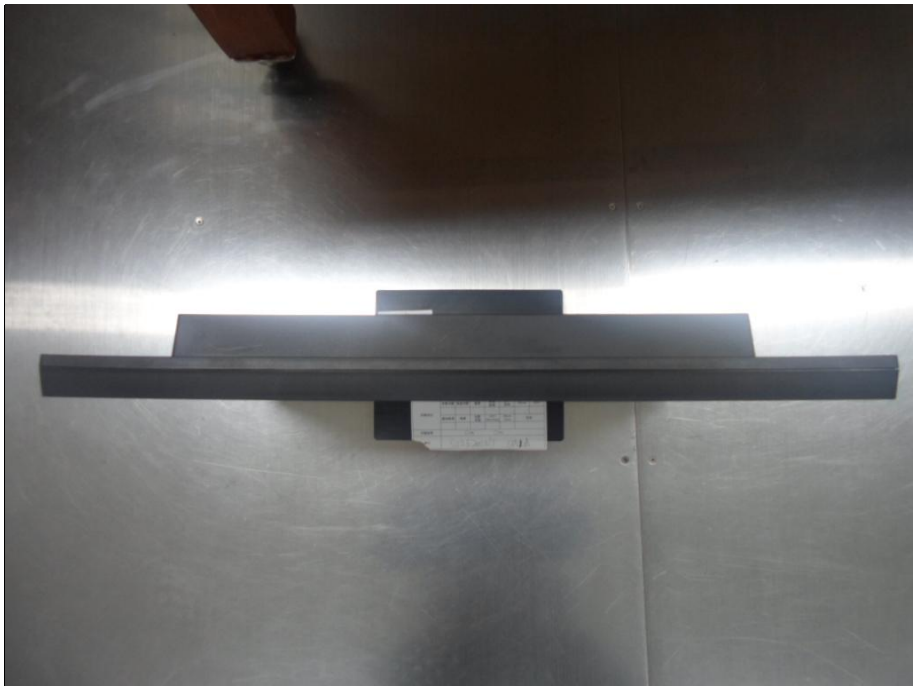
(Up)



(Down)

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(Left)

(Right)

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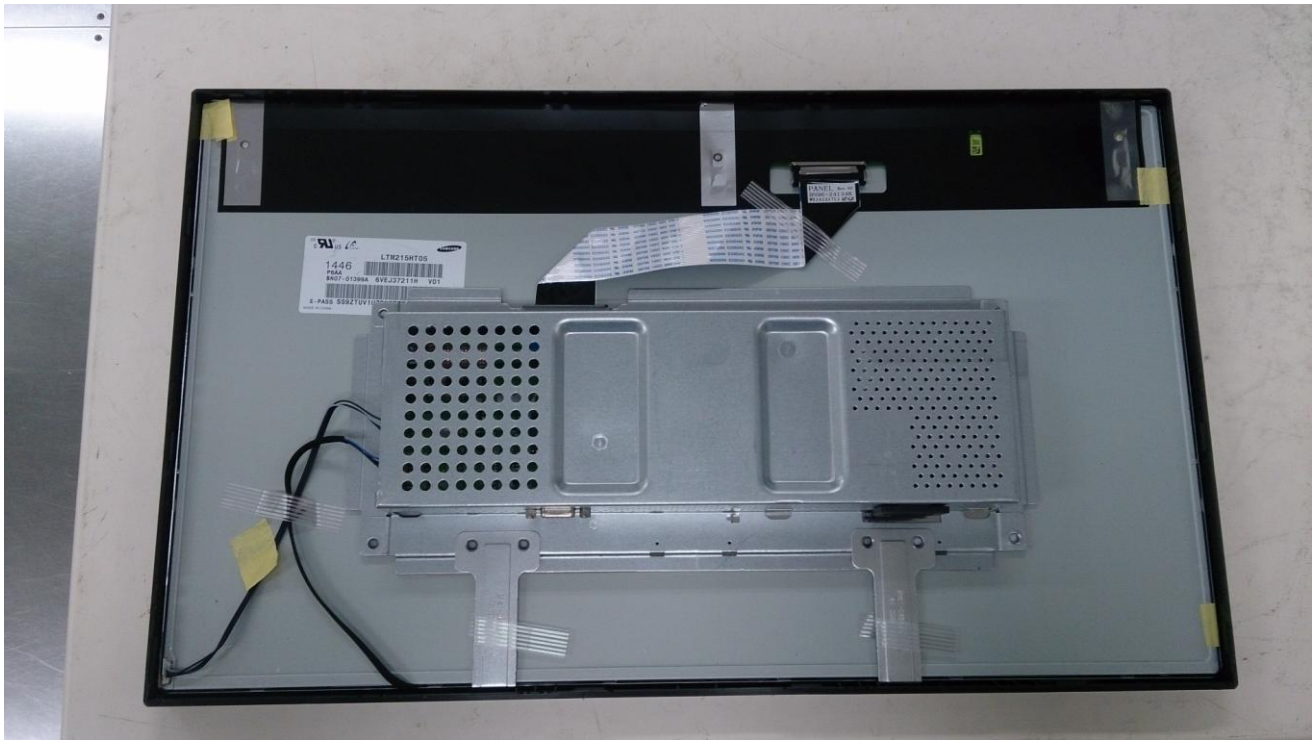
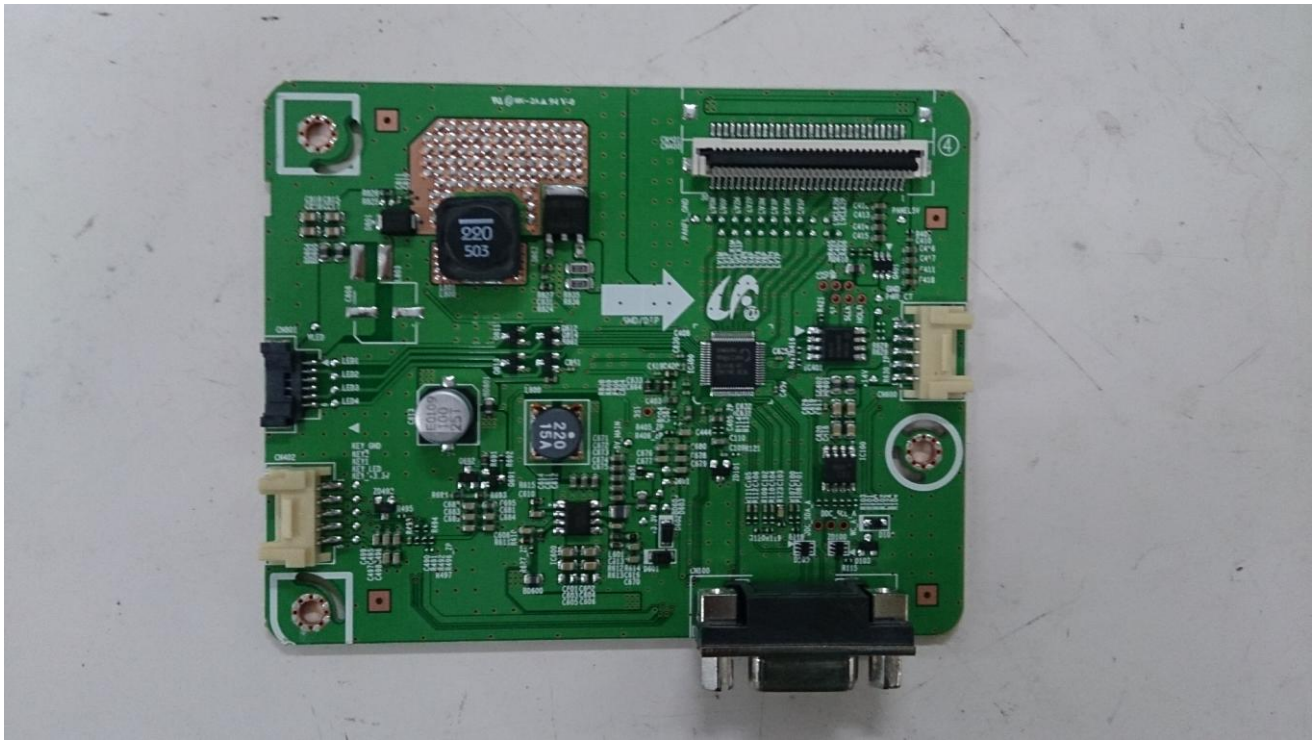
(Panel)



(Main Board)



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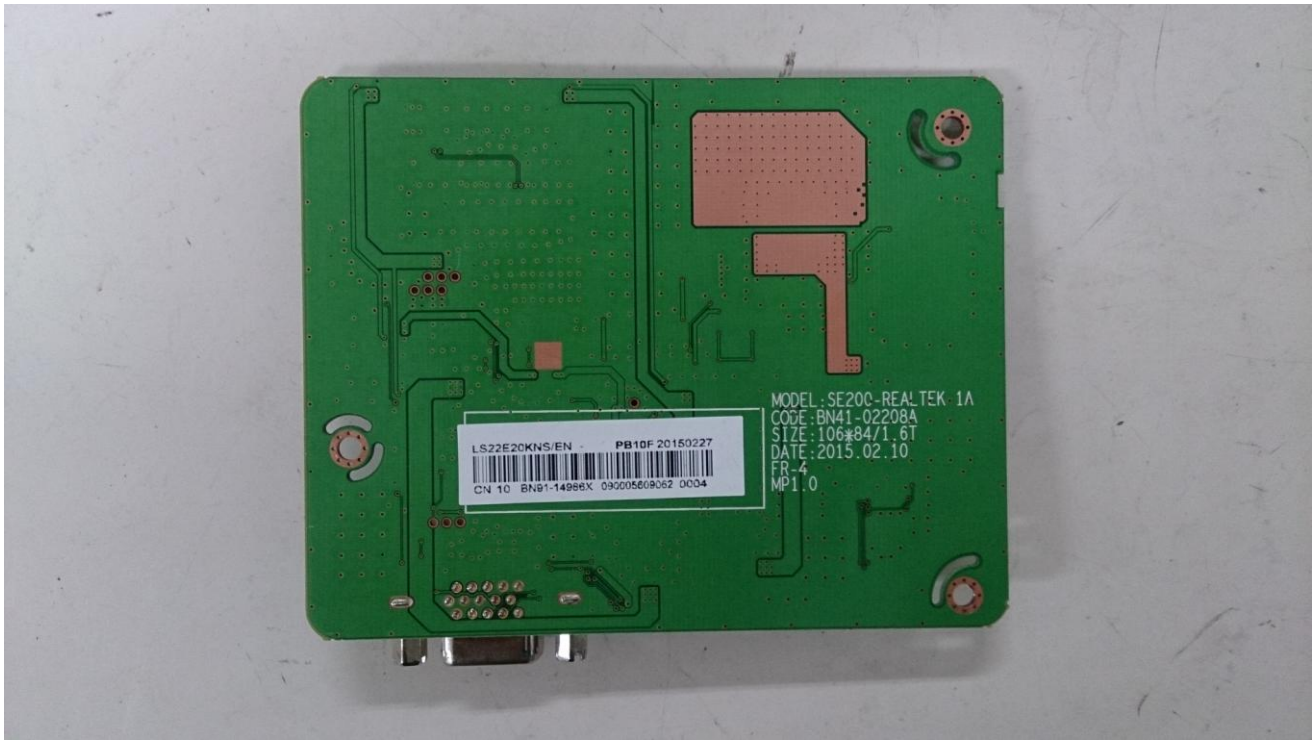
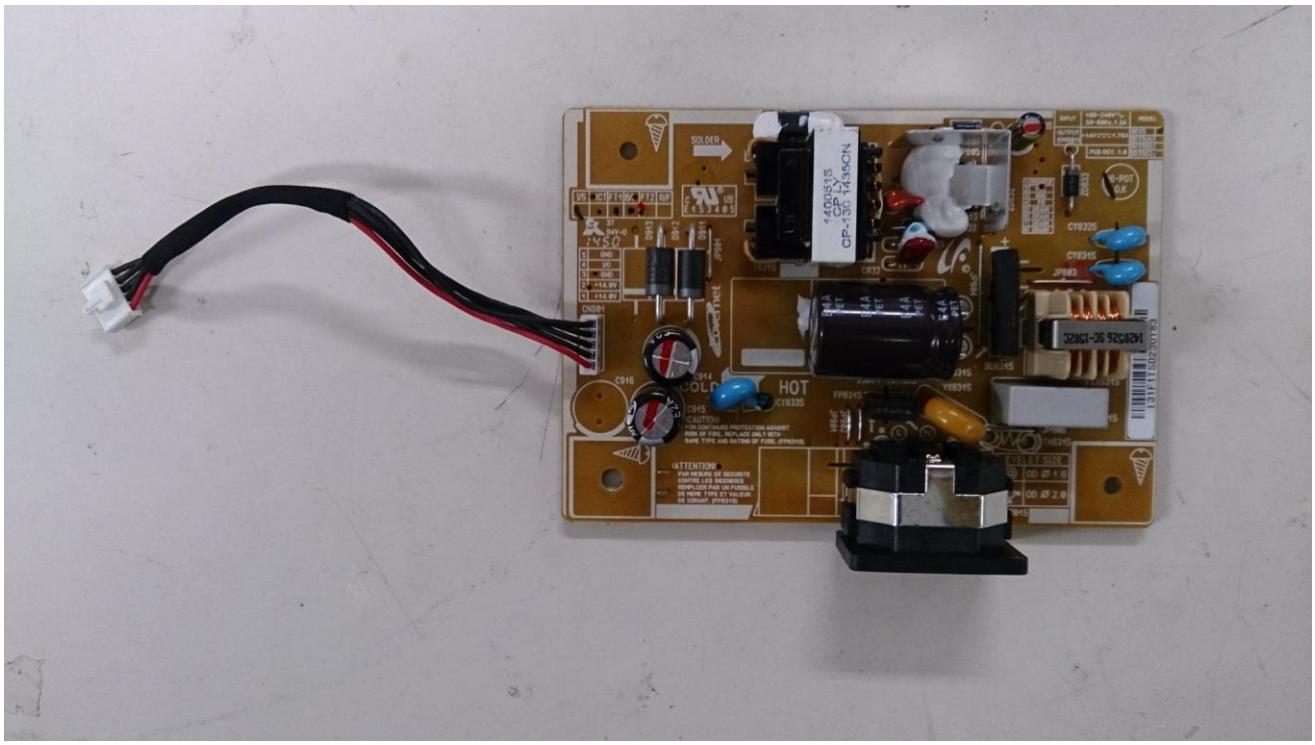
(MAIN Board)



(Power Board)



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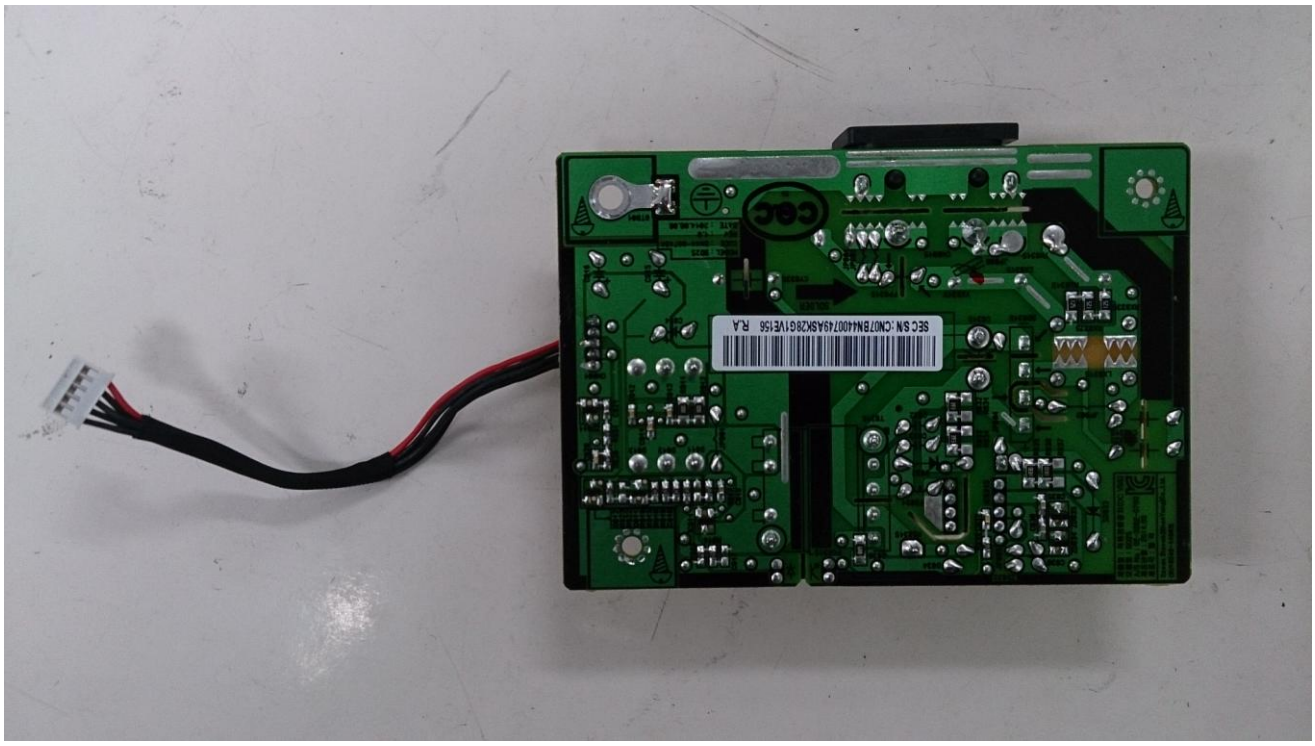
(Power Board)



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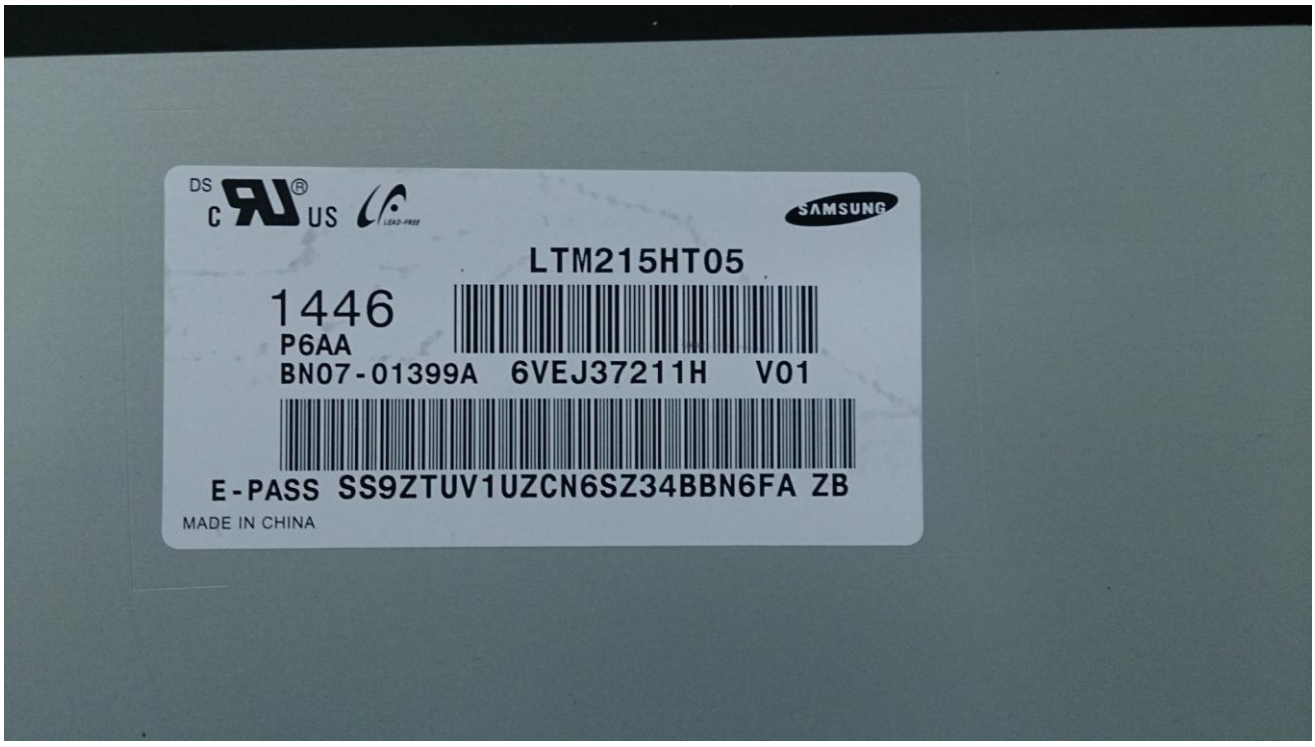

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