Electromagnetic Emission

FCC MEASUREMENT REPORT

CERTIFICATION
OF
FCC PART15 Subpart B COMPLIANCE

PRODUCT	:	LCD Tablet Monitor
MODEL/TYPE NO	:	AHALTM-222W
FCC ID	:	UHAAHALTM-222W
TRADE NAME	:	AHA (주)아하정보통신 AHA Information & Communication
APPLICANT	:	AHA I&C Co., Ltd. 918-38, Whagok1-Dong, Kang Seo-Gu, Seoul, 157-011, South Korea.
FCC CLASSIFICATION	:	JBP : Part 15 Class B Computer Device Peripheral
FCC RULE PART(S)	:	FCC Part 15 Subpart B Class B
FCC PROCEDURE	:	Certification
DATES OF TEST	:	March 13, 2008
TEST REPORT No.	:	BWS-08-EF-0012
TEST LAB.	:	BWS TECH Inc. (Registration No. : 553281)

This LCD Tablet Monitor has been tested in accordance with the measurement procedures specified in ANSI C63.4-2003 at the BWS TECH/EMC Test Laboratory and has been shown to be complied with the electromagnetic emission limits specified in FCC Rule Part15 Subpart B Section15.107 and 15.109
I attest to the accuracy of data. All measurement herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

March. 15, 2008
(Date)

Nam, Tae-Hyun
Chief Engineer
Laboratory Division

BWS TECH Inc.
www.bws.co.kr
611-1, Maesan-ri, Mohyeon-myeon, Yongin-si, Gyeonggi-do 449-853, Korea
TEL: +82 31 333 5997 FAX: +82 31 333 0017

TABLE OF CONTENTS

FCC TEST REPORT

Scope – *Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC).*

1. General Information

Applicant Name	: AHA I&C Co., Ltd.
Applicant Address	: 918-38, Whagok1-Dong, Kang Seo-Gu, Seoul, 157-011, South Korea.
Manufacturer Name	: AHA I&C Co., Ltd.
Manufacturer Address	: 918-38, Whagok1-Dong, Kang Seo-Gu, Seoul, 157-011, South Korea.
Contact Person	: Doo-Young, Moom
Phone/Fax	: Phone : +82-2-2666-0012 / Fax : +82-2-2666-3456

- **EUT Type** : LCD Tablet Monitor
- **Model Number** : AHALTM-222W
- **FCC Identifier** : UHAAHALTM-222W
- **S/N :** : Prototype
- **FCC Rule Part(s)** : Part 15 Subpart B Class B
- **Test Procedure** : ANSI C63.4-2003
- **Date of Tests** : March 13, 2008
- **Place of Tests** : BWS TECH Inc.
  EMC Testing Lab (FCC Registration Number : 553281)
  611-1, Maesan-ri, Mohyeon-myeon, Yongin-si, Gyeonggi-do
  449-853, Korea

  TEL: +82 31 333 5997 FAX: +82 31 333 0017
- **Test Report No.** : BWS-08-EF-0012

2. Description of Test Facility

The measurement for radiated emission test were practiced at the open area test site of BWS TECH Inc. Measurement for conducted emission test were practiced at the semi EMC Anechoic Chamber test site of BWS TECH Inc. facility located at ***611-1, Maesan-ri, Mohyeon-myeon, Yongin-si, Gyeonggi-do 449-853, Korea***. The site is constructed in conformance with the requirements of the ANSI C63.4-2003 and CISPR Publication 16. The BWS TECH measurement facility has been filed to the Commission with the FCC for 3 and 10 meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-2003 and registered to the Federal Communications Commission(Registration Number : 553281).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-2003) was used in determining radiated and conducted emissions from the AHA I&C Co., Ltd. LCD Tablet Monitor Model : AHALTM-222W.

3. Product Information

3.1 Equipment Description

Specification

Panel	Size	22-inch(55.88cm) diagonal
	Panel Type	TFT Active Matrix
	Pixel Pitch	0.282×0.282 mm
	Viewing Angle	160° (Right/Lef/UP/DOWN)
	Contrast Ratio	1,000 : 1 contrast ratio
	Brightness	300cd/m2 brightness
	Response Time	5msec
	Color Filter	RGB vertical stripe
Synchronization	Horizontal	30~80 KHz
	Vertical	56~77 Hz
Video Bandwidth		165 MHz
Resolution	Max	1680×1050@60Hz
	Optima	1680×1050@60Hz
Colors		16.7M Colors
Display Area		473.76mm X 296.1mm
PC Input Signal	Sync	H/V separate(TTL)
	Video	15 pin mini D-sub (RGB analog)
		DVI-D(optional)
Speaker	Max. Output	3W (Left 3W + Right 3W)(optional)
Special features		Pen-input Screen
Display screen		Anti-Scratch Protective Glasses
PLUG & PLAY		VESA DDC Compatible
Power Source		DC 12V, 5A
Power Consumption		50 Watt
Dimension-W x H x D		523(W) x 420(H) x 159 mm(with stand)
		523(W) x 367(H) x 66 mm(without stand)
Weight-net/gross		6.5Kg / 8.7 Kg
Power Saving		EPA, VESA DPMS, NUTEK Compliant
Operating Temperature		10~40°C /50~104°F
Tablet	Technology	Electromagnetic/Handwriting Tablet
	Resolution	660 DPI
	Pressure Sensitivity	512 levels
	Accuracy	+0.5mm (+0.02")
	Max. Reading Height	8mm
	Data Report Rate	125 reports/ per second
	Data Interface	USB Port
	OS support	Window 98 / Me / 2000 / XP
	Power Voltage	+ 5 Voltage
	Power Consumed	0.03A (0.15 Watts)
	Battery Life	2,000 hours

3.2 Variations covered by this report

Model Difference : N/A.

3.3 Additional Information Related to Testing

Test results apply only to the particular sample tested and functionality described in this test report.
This report may be reproduced in full. Partial reproduction may only be made with the written permission of the BWS TECH Inc.

4. Description of Tests

4.1 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section 11, "Measurement of Information Technology Equipment" of ANSI C63.4-2003. The measurement were performed over the frequency range of 0.15MHz to 30MHz using a 50Ω/50uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak" amplitude within an bandwidth of 10KHz or for "quasi-peak" within a bandwidth of 9KHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1m x 1.5m x 0.8m wooden table which is placed 40cm away from the vertical wall and 1.5m away from the side wall of the chamber room. Two LISNs are bonded to bottom plane of the shielded room. The EUT is powered from the FCC LISN and the support equipment is powered from the another Com-power LISN. Power to the LISNs is filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1.2cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the Com-power LISN. All interconnecting cables more than 1m were shortened by non-inductive bundling(serpentine fashion) to a 1m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the Test Receiver to determine the frequency producing the max. Emission from the EUT. The frequency producing the max. Level was reexamined using the detector function set to the CISPR Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.15 to 30MHz. The bandwidth of the Spectrum Analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was maximized by switching power lines, varying the mode of operation or resolution, clock or data exchange speed, if applicable, whichever determined the worst-case emission. Each emission reported was calibrated using self-calibrating mode.

Photographs of the worst-case emission can be seen in photographs of conducted emission test setup.

4.2 Radiated Emission Measurement

Preliminary measurements were made at indoors 3 meter semi EMC Anechoic Chamber using broadband antennas, broadband amplifier, and spectrum analyzer to determine the emission frequencies producing the maximum EME.

Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 1000MHz using bilog antenna and above 1000MHz, linearly polarized double ridge horn antennas were used. Above 1GHz, linearly polarized double ridge horn antennas were used. The measurements were performed with three frequencies which were selected as bottom, middle and top frequency in the operating band. Emission level from the EUT with various configurations were examined on the spectrum analyzer connected with the RF amplifier and plotted graphically.

Final measurements were made outdoors open site at 3-meter test range using bilog antenna. The output from the antenna was connected, via a pre-selector or a preamplifier, to the input of the EMI Measuring Receiver and Spectrum analyzer(for above 1GHz). The detector function was set to the quasi-peak or peak mode as appropriate. The measurement bandwidth on the Field strength receiver was set to at least 120kHz (1MHz for measurement above 1GHz), with all post-detector filtering no less than 10 times the measurement bandwidth. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

Each frequency found during preliminary measurement was examined and investigated as the same set up and configuration which produced the maximum emission The EUT, support equipment and interconnecting cables were configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1m x 1.5 meter table. The turntable containing the system was rotated and 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 operating frequencies of the EUT. The system was tested in all the three orthogonal planes and changing the polarity of the antenna. The worst case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor(20dB/decade) as per section 15.31(f).

Photographs of the worst-case emission test setup can be seen in Appendix 1.

5. Test Condition

5.1 Test Configuration

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the EUT and the supported equipments were installed to meet FCC requirement and operated in a manner which tends to maximize its emission level in a typical application.

Radiated Emission Test

Preliminary radiated emission tests were performed using the procedure in ANSI C63.4/2003 Clause 8.3 to determine the worst operating condition. Final radiated emission tests were conducted at 3 meter open field test site.

5.2 EUT operation

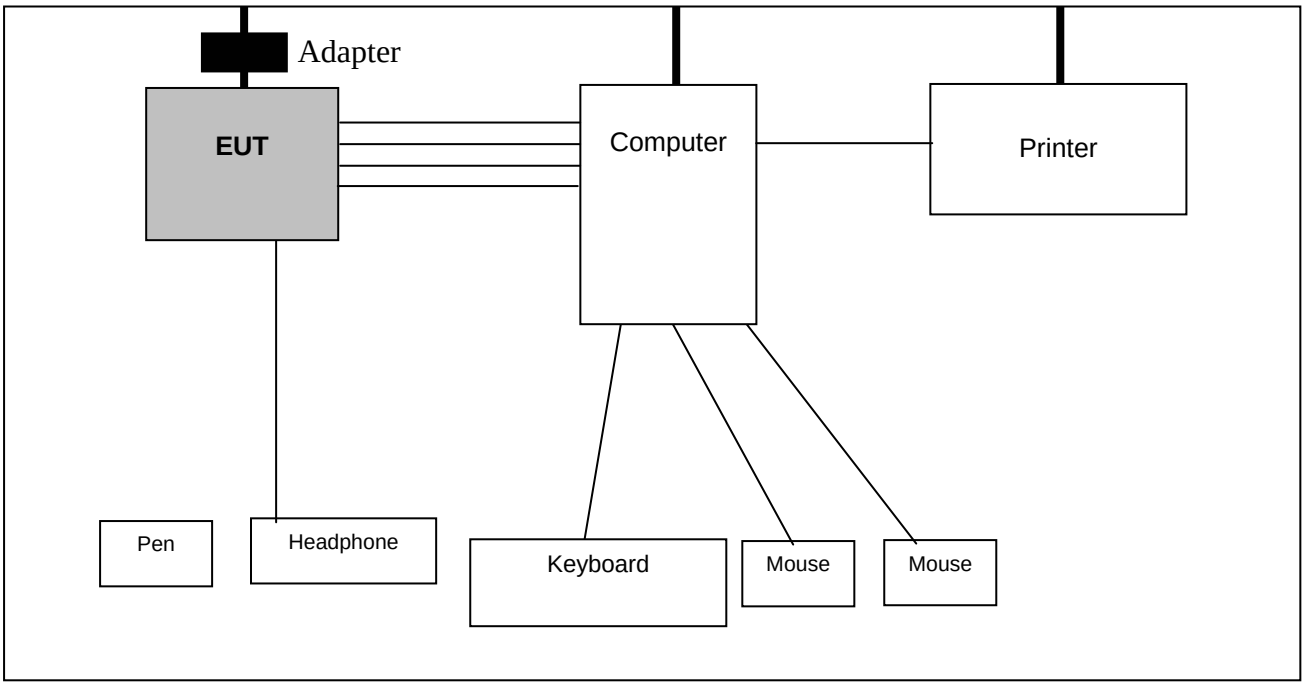
EUT was tested according to the following operation modes provided by the specifications given by the manufacturer, and reported the worst emissions.

Operation Modes	Worst Case Mode
Checked the operating condition by observing Tablet sense Mode and PC Mode	☒

Note : Brightness and Contrast was adjusted as maximum level.

5.3 Test System layout on EUT and peripherals

Interface cable _____ Power cable ▬▬▬



5.4 Peripherals / Support Equipment Used

Following peripheral devices and interface cables were connected during the measurement:

Type of Peripheral Equipment Used:

Description	Model Name	Serial No.	Manufacturer	FCC ID
EUT	AHALTM-222W	prototype	AHA I&C Co., Ltd.	UHAAHALTM-222W
Computer	d530CMT	CNG416075J	HP	N/A
Printer	MJC-650G	H3AH703638	SAMSUNG	N/A
Keyboard	RT2300	7668200800660	Microsoft	N/A
Mouse	SMOP5000WX	06090061375	SAMSUNG	N/A
Mouse	SMOP5000WX	06090060246	SAMSUNG	N/A
VGA CARD	7300GT Super AGP DDR3 128MB	TA31LF107003845	-	N/A
Headphone	MDR-V150	-	SONY	N/A
Pen	-	-	-	N/A

Type of Cables Used:

Device from	Device to	Type of Cable	Length(m)	Type of shield
Computer	Printer	PARALLEL	1.9	Shielded
Computer	Keyboard	PS/2	2.1	Unshielded
Computer	Mouse	PS/2	1.8	Unshielded
Computer	Mouse	SERIAL	1.5	Unshielded
Computer	Power Socket	Inlet	1.5	Unshielded
EUT	Computer	DVI	2.0	Shielded
EUT	Computer	Video	1.5	Shielded
EUT	Computer	LINE IN	1.5	Unshielded
EUT	Headphone	LINE OUT	2.0	Unshielded
EUT	Computer	USB	1.8	Shielded
EUT	Adapter	Inlet	1.5	Shielded

6. TEST RESULTS

6.1 Summary of Test Results

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum emission of the EUT are reported.

FCC Rule Parts	Measurement Required	Result
15.107(a)	Conducted Emission	Passed by –7.51 dB
15.109(a)	Radiated Emissions	Passed by –3.37 dB

The data collected shows that the AHA I&C Co., Ltd. LCD Tablet Monitor models : AHALTM-222W and family models comply with technical requirements of the Part 15.107 and 15.109 of the FCC Rules.

Note : Modification to EUT

The device tested has been made some modification to improve EMI status during a preliminary measurement and applied to the final measurement. The following EMI suppression device(s) was added and/or modified during testing.

1. Apply to gasket (refer to appendix 7. Internal photos of EUT)
2. Apply to conductivity tape (refer to appendix 7. Internal photos of EUT)
3. Reinforce a ground (refer to appendix 7. Internal photos of EUT)
4. Added ferrite core (refer to appendix 7. Internal photos of EUT)
5. Added ferrite core (refer to appendix 7. Internal photos of EUT)
6. Added ferrite core (refer to appendix 7. Internal photos of EUT)
7. Apply to gasket (refer to appendix 7. Internal photos of EUT)

6.2 Conducted Emissions

EUT	: LCD Tablet Monitor AHALTM-222W
Limit apply to	: FCC Part15 Subpart B Class B Section 15.107(a)
Test Date	: March 13, 2008
Operating Condition	: Checked the operating condition by observing Tablet sense Mode and PC Mode
Environment Condition	: Humidity Level : 37 %RH, Temperature : 21 ℃
Result	: Passed by -7.51dB (AV)

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Tabulated Conducted Emission Test Data

Detector Mode ; CISPR Quasi Peak mode (6dB Bandwidth : 9kHz).

Test data sheets follow : **Tablet sense Mode**

Freq [MHz]	Correcton		Phase [H/N]	Quasi-Peak Mode				Average Mode			
	AMN	C.L		Limit	Reading	Emission Level	Margin	Limit	Reading	Emission Level	Margin
				[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]
0.158	0.06	0.03	N	65.90	54.06	54.15	-11.75	55.90	30.00	30.09	-25.81
0.194	0.06	0.03	N	64.90	52.39	52.48	-12.42	54.90	40.31	40.40	-14.50
0.262	0.07	0.16	N	62.90	46.19	46.42	-16.48	52.90	39.92	40.15	-12.75
0.390	0.08	0.24	H	59.10	43.89	44.21	-14.89	49.10	41.27	41.59	-7.51
0.450	0.07	0.28	N	57.40	44.30	44.65	-12.75	47.40	38.50	38.85	-8.55
0.518	0.07	0.30	N	56.00	41.11	41.48	-14.52	46.00			
0.774	0.08	0.30	N		40.07	40.45	-15.55				
1.034	0.04	0.40	N		39.42	39.86	-16.14				
11.630	0.04	1.12	N	60.00	34.22	35.38	-24.62	50.00			
19.550	0.05	1.35	H		37.28	38.68	-21.32				
20.518	0.06	1.38	H		38.09	39.53	-20.47				

NOTES :

1. H : Hot Line , N :Neutral Line
2. Emission Level = Reading + Correction Factor
3. Margin = Emission Level – Limit
4. Measurement uncertainty estimated at ±1.38 dB.
   The measurement uncertainty is given with a confidence of 95.45 % with the coverage factor, k=2.

Tested by ***Jin, Dong-su***

Test data sheets follow : **PC Mode**

Freq [MHz]	Correcton		Phase [H/N]	Quasi-Peak Mode				Average Mode			
	AMN	C.L		Limit	Reading	Emission Level	Margin	Limit	Reading	Emission Level	Margin
				[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]
0.150	0.06	0.03	N	66.00	39.63	39.72	-26.28	56.00			
0.202	0.07	0.10	N	64.60	38.64	38.81	-25.79	54.60			
0.302	0.08	0.22	N	61.70	28.83	29.13	-32.57	51.70			
0.406	0.08	0.26	H	58.70	22.58	22.92	-35.78	48.70			
0.506	0.07	0.30	H	56.00	25.02	25.39	-30.61	46.00			
0.914	0.05	0.35	H		30.37	30.77	-25.23				
4.246	0.03	0.79	N		31.51	32.33	-23.67				
15.514	0.07	1.22	H	60.00	40.57	41.86	-18.14	50.00			
20.778	0.06	1.40	H		36.65	38.11	-21.89				
29.174	0.25	1.64	H		36.34	38.23	-21.77				

NOTES :

5. H : Hot Line , N :Neutral Line
6. Emission Level = Reading + Correction Factor
7. Margin = Emission Level – Limit
8. Measurement uncertainty estimated at ±1.38 dB.
   The measurement uncertainty is given with a confidence of 95.45 % with the coverage factor, k=2.

Tested by ***Jin, Dong-su***

6.3 Radiated Emissions

EUT : LCD Tablet Monitor AHALTM-222W
Limit apply to : FCC Part15 Subpart B Class B Section 15.109(a)
Test Date : March 13, 2008
Operating Condition : Checked the operating condition by observing Tablet sense Mode
Environment Condition : Humidity Level : 42 %RH, Temperature : 8 ℃
Result : Passed by -3.37dB

Radiated Emission Test Data

The following table shows the highest levels of radiated emissions on both polarization of horizontal and vertical.

Detector mode : CISPR Quasi-Peak mode (6dB Bandwidth : 120 kHz)
Measurement Distance : 3 meters

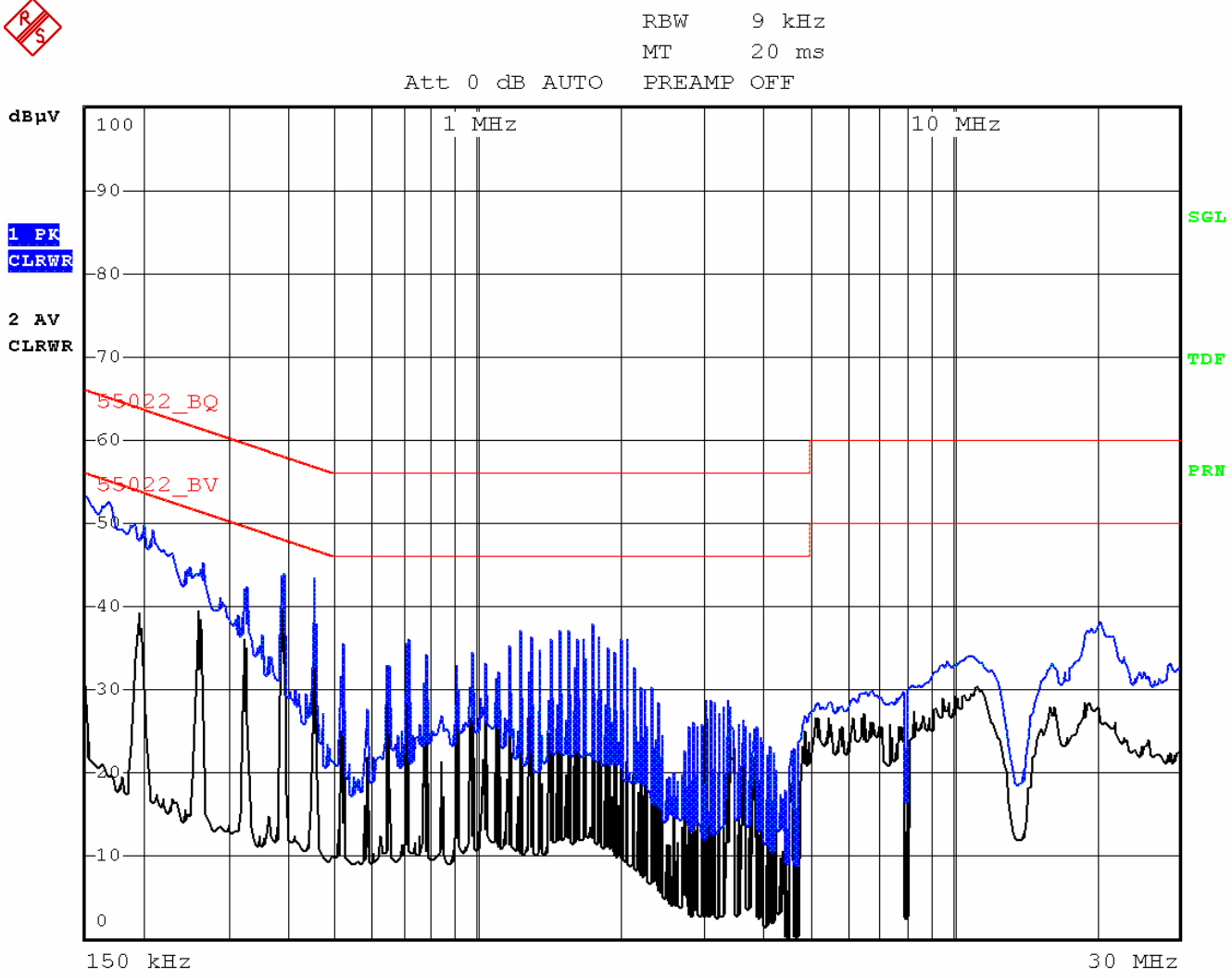
Frequency [MHz]	Reading [dBμV]	Polarization [*H/**V]	Ant.Factor [dB]	Cable Loss [dB]	Limit [dBμV/m]	Emission Level [dBμV/m]	Margin [dB]
47.09	20.04	V	12.27	1.55	40.00	33.86	-6.14
69.71	17.94	V	10.64	1.84	40.00	30.42	-9.58
86.83	24.53	V	8.73	2.04	40.00	35.30	-4.70
139.40	19.17	V	12.92	2.59	43.50	34.68	-8.82
206.78	25.81	V	10.20	3.20	43.50	39.21	-4.29
233.23	15.65	H	10.88	3.39	46.00	29.92	-16.08
297.10	19.32	H	13.31	3.86	46.00	36.50	-9.50
620.56	16.38	V	20.09	5.70	46.00	42.17	-3.83
628.19	16.73	H	20.16	5.74	46.00	42.63	-3.37
697.84	13.78	H	20.92	6.14	46.00	40.84	-5.16
767.78	12.12	H	22.36	6.58	46.00	41.06	-4.94
827.06	8.74	V	22.81	6.83	46.00	38.39	-7.61

NOTES :

1. * H : Horizontal polarization , ** V : Vertical polarization
2. Emission Level = Reading + Antenna factor + Cable loss
3. Margin value = Emission Level - Limit
4. All other emissions not reported were more than 25dB below the permitted limit.
5. Measurement uncertainty estimated at ±1.38 dB.
   The measurement uncertainty is given with a confidence of 95.45 % with the coverage factor, k=2.

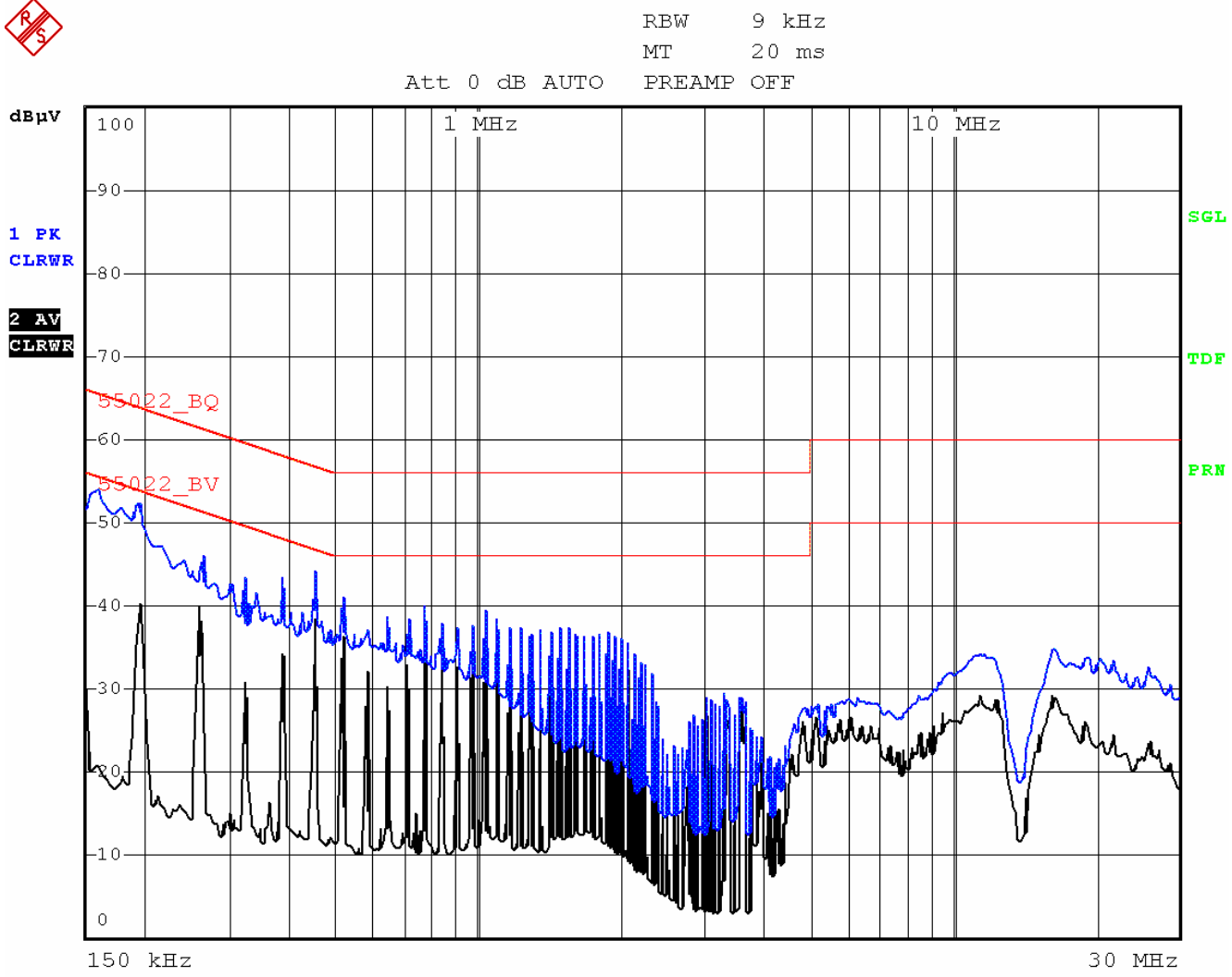
Tested by ***Jin, Dong-su***

Plots of Conducted Emission Test (Tablet sense Mode)



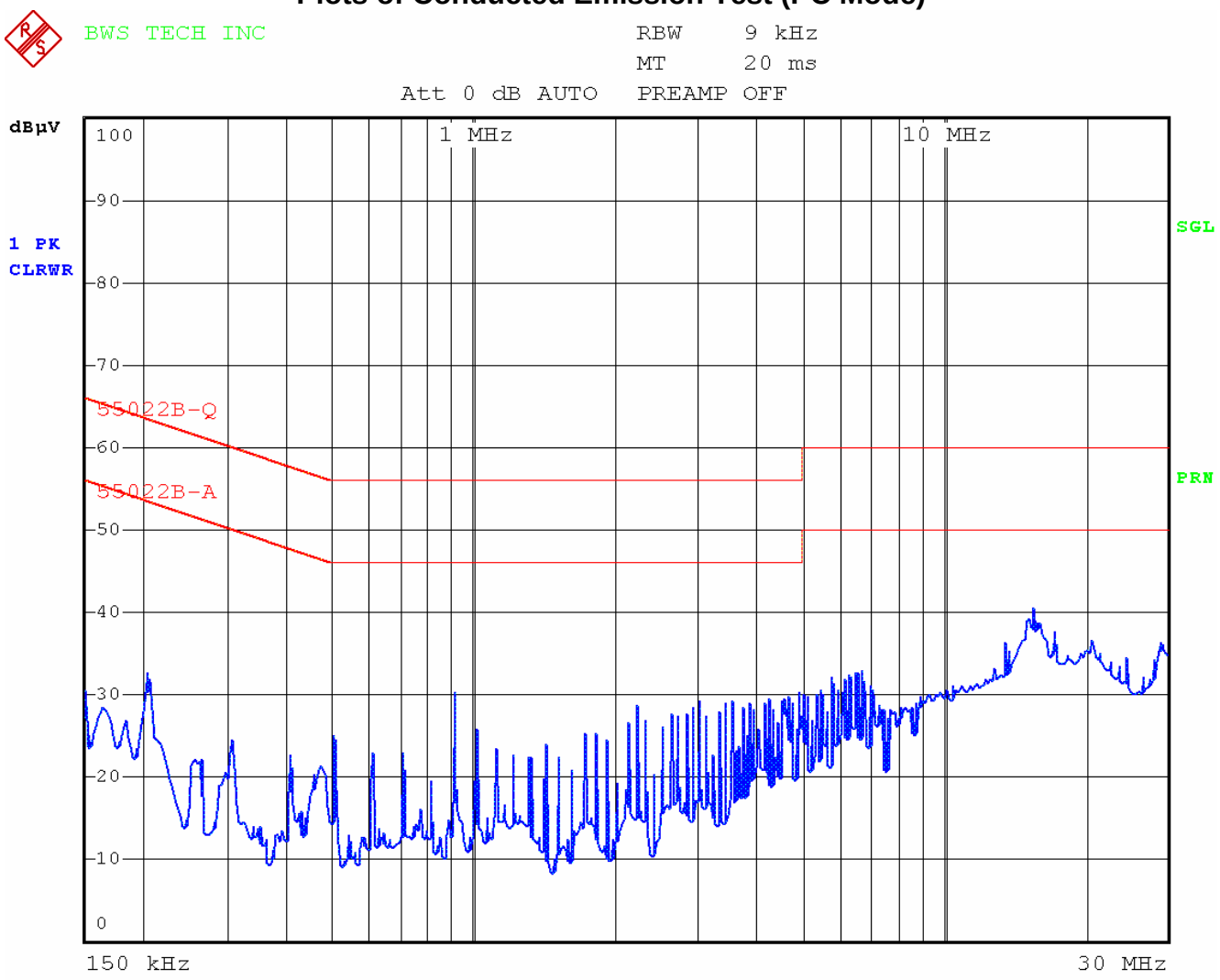
Test Mode: HOT
Model Name: AHALTM-222W
Classification: FCC Part 15 Subpart B Class B

Plots of Conducted Emission Test (Tablet sense Mode)



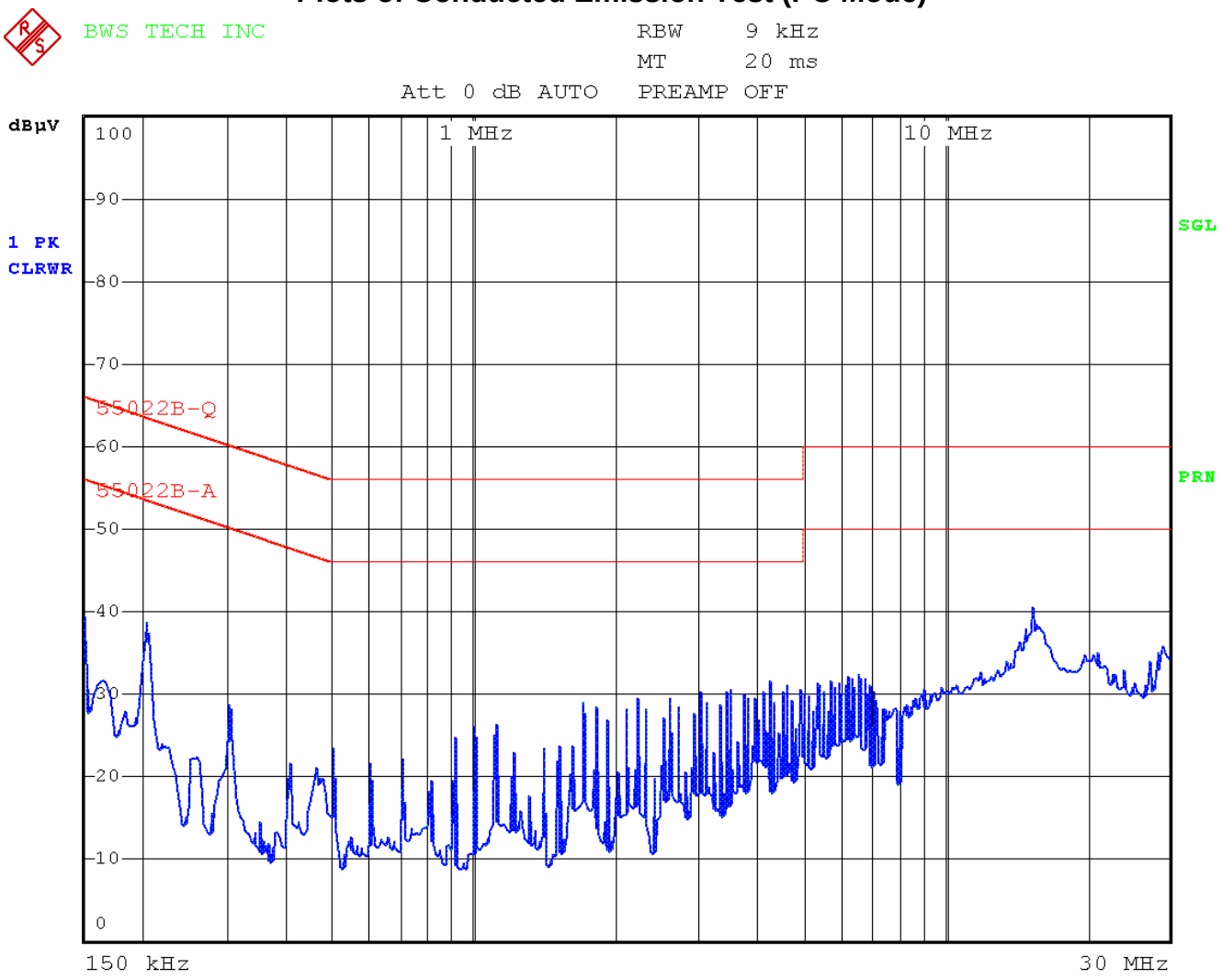
Test Mode: NEUTRAL
Model Name: AHALTM-222W
Classification: FCC Part 15 Subpart B Class B

Plots of Conducted Emission Test (PC Mode)



Test Mode: HOT
Model Name: AHALTM-222W
Classification: FCC Part 15 Subpart B Class B

Plots of Conducted Emission Test (PC Mode)



Test Mode: HOT
Model Name: AHALTM-222W
Classification: FCC Part 15 Subpart B Class B

7. Sample Calculation and Other Information

7.1 Sample Calculations

$$dB\mu V = 20 \log 10 (\mu V/m)$$

$$\mu V = 10^{(dB\mu V/20)}$$

EX. 1.
@ 0.390 MHz Class B limit(Average-peak) = 49.10 dBμV

Reading = 41.27 dBμV (calibrated level)
AMN factor + Cable Loss = 0.32 dB
Total = 41.59 dBμV/m
Margin = 41.59 – 49.10 = -7.51
7.51 dB ; below limit

EX. 2.

@ 628.19 MHz Class B limit = 46.00 dBμV/m

Reading = 16.73dBμV(calibrated level)
Antenna factor + Cable Loss = 25.90 dB
Total = 42.63 dBμV/m
$10^{(43.12/20)}$ = μV/m
Margin = 42.63 – 46.00 = -3.37 dB
3.37 dB ; below limit

8. TEST EQUIPMENTS LIST

The listing below denotes the test equipments utilized for the test(s).

Equipment Type	Model	Manufacture	Serial No	Cal Due Date	Use
TEST RECEIVER	ESPI	ROHDE & SCHWARZ	100063	11. 19. 2008	☒
Conducted Cable	N/A	N/A	N/A	N/A	☒
LISN	FCC-LISN-50-50-2-02	FCC	03074	11. 02. 2008	☒
LISN	NSLK 8127	SCHWARZBECK MESS-ELEKTRONIK	8127-414	01. 03. 2009	☒
Bilog Antenna	VULB 9160	SCHWARZBECK	9160-3122	01. 24. 2010	☒
Open Site Cable	OSC-30	N/A	BWS-01	N/A	☒
Antenna Mast	JAC-3	DAIL EMC	N/A	N/A	☒
Antenna Turntable Controller	JAC-2	JAEMC	N/A	N/A	☒
EMI RECEIVER	ESVN30	ROHDE & SCHWARZ	832854/010	07. 13. 2008	☒