Electromagnetic Emission

F C C M E A S U R E M E N T R E P O R T

CERTIFICATION OF COMPLIANCE

FCC Part 15 Certification Measurement

PRODUCT	:	Power Supply
MODEL/TYPE NO	:	ZM600-HP
FCC ID	:	SAOZM600-HP
APPLICANT	:	ZALMAN TECH CO., LTD. #1007, Daeryung Techno Town III, 448 Gasan-dong, Gumchun-gu, Seoul, 153-803, Korea Attn.: Lee, Sang-Ju / Assistant manager
MANUFACTURER	:	SPI Electronics Co., Ltd. No.22, Jianguo E., Taoyuan City Taiwan, R.O.C
FCC CLASSIFICATION	:	Internal power supply used with Class B personal computers
FCC RULE PART(S)	:	FCC Part 15 Subpart B
FCC PROCEDURE	:	Certification
TEST REPORT No.	:	ETLE061226.590
DATES OF TEST	:	December 27, 2006
REPORT ISSUE DATE	:	December 28, 2006
TEST LABORATORY	:	ETL Inc. (FCC Registration Number : 95422)

This Power Supply, Model ZM600-HP has been tested in accordance with the measurement procedures specified in ANSI C63.4-2003 at the ETL EMC Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart B:
I attest to the accuracy of data. All measurement herein was performed by me or was made under my supervision and is 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.

Chon Sik, Kim / Chief Engineer

ETL Inc.
#584 Sangwhal-ri, Ganam-myeon, Yoju-gun, Gyeonggi-do, 469-885, Korea
Tel : 82-2-858-0786 Fax : 82-2-858-0788

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FCC MEASUREMENT 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)*

General Information

Applicant Name : ZALMAN TECH CO., LTD.

Address : #1007, Daeryung Techno Town III, 448 Gasan-dong, Gumchun-gu, Seoul, 153-803, Korea

Attention : Lee, Sang-Ju / Assistant manager

- **EUT Type :** Power Supply
- **Model Number :** ZM600-HP
- **FCC ID :** SAOZM600-HP
- **S/N :** N/A
- **FCC Rule Part(s) :** FCC Part 15 Subpart B
- **Test Procedure :** ANSI C63.4-2003
- **FCC Classification :** Internal power supply used with Class B personal computers
- **Dates of Tests :** December 27, 2006
- **Place of Tests :** ETL Inc. Testing Lab. (FCC Registration Number : 95422)

  Radiated Emission test;
  #584, Sangwhal-ri, Ganam-myeon, Yoju-gun,
  Gyeonggi-do, 469-885, Korea

  Conducted Emission test;
  ETL Inc. Testing Lab. (FCC Registration Number : 95422)
  371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea
- **Test Report No. :** ETLE061226.590

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1. INTRODUCTION

The measurement test for radiated and conducted emission test were conducted at the ETL Inc. The site is constructed in conformance with the requirements of the ANSI C63.4-2003 and CISPR Publication 16. The ETL has site descriptions on file with the FCC for 3 m and 10 m 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 : 95422).

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 9 kHz to 40 GHz (ANSI C63.4-2003) was used in determining radiated and conducted emissions from the ZALMAN TECH CO., LTD., Model: ZM600-HP.

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2. PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the ZALMAN TECH CO., LTD., Model: ZM600-HP.

2.2 General Specification

AC Input Range	Voltage	100VAC ~ 240VAC ±10%										
	Frequency	47Hz~63Hz										
AC Input Range (Rated)	115VAC	10A										
	230VAC	5A										
PFC Type	Active PFC											
Power Factor	99% Maximum											
Inrush Current Limit (@ Cold start at 25℃)	115VAC	60A										
	230VAC	100A										
Efficiency	84% Maximum @230VAC, Full & Typical Load											
DC Output Voltage Regulations	Vout	Regulation Range				At Full Load						
	+3.3VDC	±5%	+3.14V	~	+3.47V							
	+5VDC	±5%	+4.75V	~	+5.25V							
	+12V1DC	±5%	+11.4V	~	+12.6V							
	+12V2DC	±5%	+11.4V	~	+12.6V							
	+12V3DC	±5%	+11.4V	~	+12.6V							
	+12V4DC	±5%	+11.4V	~	+12.6V							
	-12VDC	±10%	-10.8V	~	-13.0V							
	+5VSB	±5%	+4.75V	~	+5.25V							
DC Output Ripple & Noise	Vout	Specification				At Full Load						
	+3.3VDC	100mV										
	+5VDC	100mV										
	+12V1DC	200mV										
	+12V2DC	200mV										
	+12V3DC	200mV										
	+12V4DC	200mV										
	-12VDC	200mV										
	+5VSB	100mV										

DC OUTPUT					
ZM600-HP					
Vout	Output Load Rating			Combined Power	
	Imin	Imax	Ipeak		
+3.3V	0.8A	24A		155W	600W
+5V	0.3A	24A			
+12V1	0A	16A		504W	
+12V2	0A	16A			
+12V3	1A	16A			
+12V4	1A	16A			
-12V	0.0A	0.5A		18.5W	
+5VSB	0.0A	2.5A	3.5A		

Protection
Over-voltage Protection (OVP)
Over-current Protection (OCP)
Under-voltage Protection (UVP)
Short-circuit Protection(SCP)
Over-temperature Protection (OTP)

Ambient Temperature	
Operation	0℃ ~ +50℃
Stored	-20℃ ~ +80℃
Ambient Humidity	
Operation	5 %RH ~ 95 %RH
Stored	5 %RH ~ 95 %RH
Dimensions	
150mm(L) * 165mm(W) * 86mm(H)	

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3. DESCRIPTION OF TESTS

3.1 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section 11, "Measurement of Information Technology Equipment" of ANSI C63.4-2003. The measurements were performed over the frequency range of 0,15 MHz to 30 MHz using a 50 Ω / 50uH LISN as the input transducer to a Spectrum Analyzer or a Test Receiver. The measurements were made with the detector set for "Peak" amplitude within a bandwidth of 9 kHz or for "quasi-peak" within a bandwidth of 9 kHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1 m x 1,5 m x 0,8 m wooden table which is placed 40 cm away from the vertical wall and 1,5 m away from the side wall of the chamber room. Two LISN are bonded to the shielded room. The EUT is powered from the LISN and the support equipment is powered from the other LISN. Power to the LISNs are filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1,2 cm. 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 LISN. Non-inductive bundling to a 1 m length shortened all interconnecting cables more than 1 m. 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 EMI Test Receiver to determine the frequency producing the maximum emission from the EUT. The frequency producing the maximum level was reexamined using to set Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0,15 MHz to 30 MHz. The bandwidth of the spectrum analyzer was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission.

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

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3.2 Radiated Emission Measurement

Radiated emission measurements were made in accordance with section 11, "Measurement of Information Technology Equipment" of ANSI C63.4-2003. The measurements were 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 measurements were made with the detector set for "Quasi-peak" within a bandwidth of 120 kHz.

Preliminary measurements were made at 3 m using broadband antennas, and spectrum analyzer to determine the frequency producing the maximum emission in shielded room. Appropriate precaution was taken to ensure that all emission from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth and height with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 MHz to 1 000 MHz using Log-Bicon antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used. Final measurements were made open site at 3 m. The test equipment was placed on a wooden turn-table. 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 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 1MHz depending on the frequency of type of signal. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0,8 m high nonmetallic 1 m x 1,5 m table. The EUT, support 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 m to 4 m 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 support equipment and changing the polarity of the antenna, whichever determined the worst-case emission.

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

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4. TEST CONDITION

4.1 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 and which tends to maximize its emission level in a typical application.

4.2 EUT operation

Worst operating condition : Normal operating mode(EMC test program)

4.3 Support Equipment Used

Description	Model Name	Serial No.	Manufacturer	FCC ID
EUT	**ZM600-HP**	**NONE**	**SPI Electronics Co., Ltd.**	SAOZM600-HP
Computer	NONE	NONE	NONE	-
LCD Monitor	ELM-150B	NONE	Erae Electronics Industry Co., Ltd.	-
Keyboard	ACK-260A	909251875	PC BANK	-
Mouse	SWW-23	NONE	A4 TECH	-
USB Mouse	M-UV83	HCA42606661	Suzhou Logitech Electronics Co., Ltd.	-

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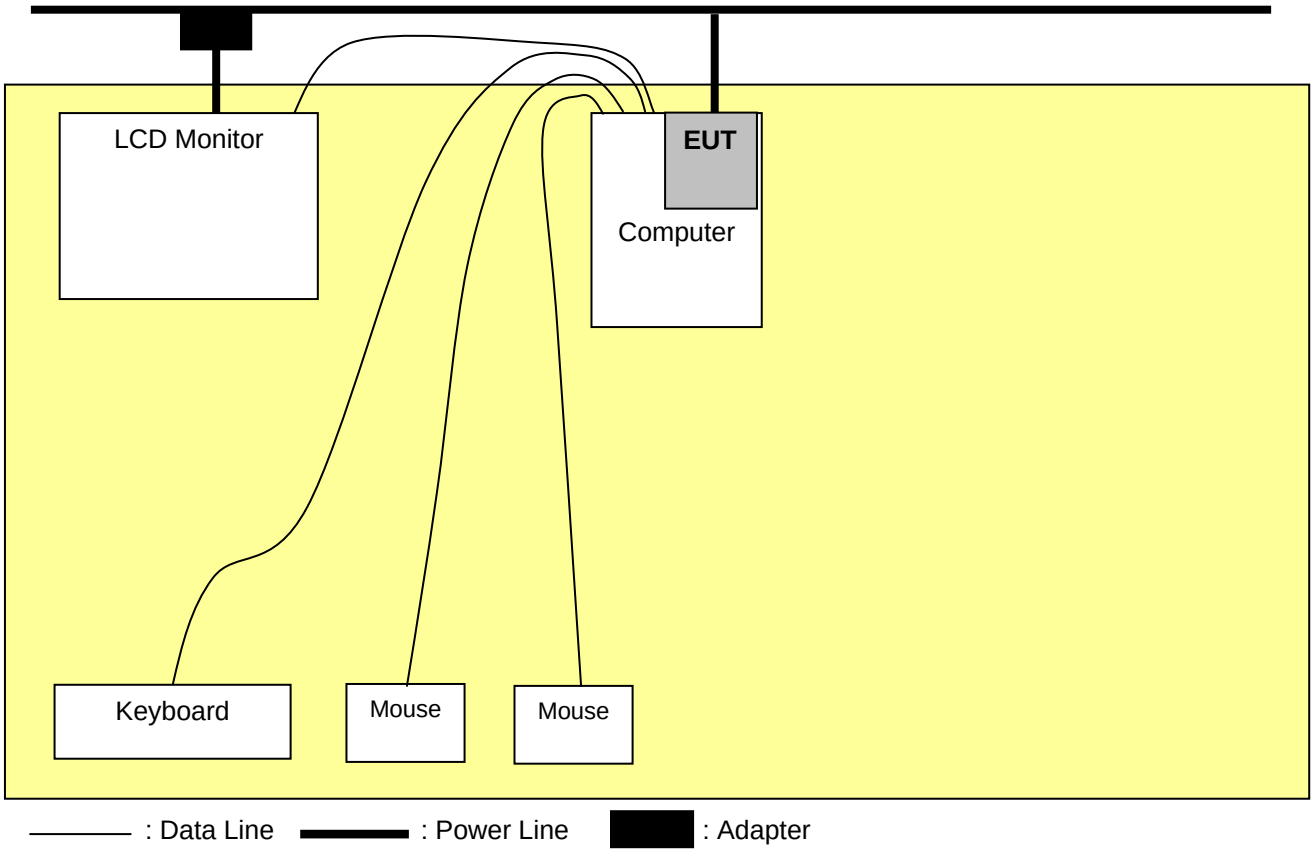
4.4 The setup drawing(s)



4.5 Type of Cables Used

Device from	Device to	Type of Cable	Length(m)	Type of shield
Computer	Keyboard	PS/2	1,2	Shielded
Computer	Mouse	PS/2	1,2	Shielded
Computer	USB Mouse	USB	1,2	Shielded
Computer	LCD Monitor	VIDEO	1,5	Shielded
EUT	Power Socket	INLET	1,5	Unshielded
LCD Monitor	Adapter	DC In	1,5	Shielded

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5. TEST RESULTS

5.1 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	Measurement Required	Result
15.107	Conducted Emission Measurement	**Passed by 12,0 dB**
15.109	Radiated Emission Measurement	**Passed by 19,1 dB**

The data collected shows that the **ZALMAN TECH CO., LTD. / Power Supply / ZM600-HP** complied with technical requirements of above rules part 15.107 and 15.109 Class B Limits.

The equipment is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

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5.2 Conducted Emissions Measurement

EUT	Power Supply / ZM600-HP (SN :N/A)
Limit apply to	FCC Part 15. 107 Class B
Test Date	December 27, 2006
Operating Condition	Normal operating mode
Result	Passed by 12,0 dB

Conducted Emission Test Data

The following table shows the highest levels of conducted emissions on both polarizations of hot and neutral line.
Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth : 9 kHz)

Frequency [MHz]	Result [dBμV]		Phase (*H/**N)	Limit [dBμV]		Margin [dB]	
	Quasi-peak	Average		Quasi-peak	Average	Quasi-peak	Average
0,166	52,8	38,0	H	65,1	55,1	12,3	17,1
0,172	47,5	42,9	N	64,9	54,9	17,4	12,0
0,218	45,8	34,6	N	62,9	52,9	17,1	18,3
0,603	38,7	33,7	N	56,0	46,0	17,3	12,3
0,981	37,5	32,1	N	56,0	46,0	18,5	13,9
1,317	36,1	31,0	N	56,0	46,0	19,9	15,0
7,660	29,0	22,3	H	60,0	50,0	31,0	27,7
10,279	34,6	27,3	N	60,0	50,0	25,4	22,7
10,876	37,3	31,3	N	60,0	50,0	22,7	18,1

NOTES: **1. * H: HOT Line , **N: Neutral Line**
2. Margin value = Limit – Result
3. Measurement were performed at the AC Power Inlet in the frequency band of 150 kHz ~ 30 MHz according to the FCC Part 15 and CISPR 22 Class B.
4. If the reading Quasi-peak value is below the average limit, do not test average mode.

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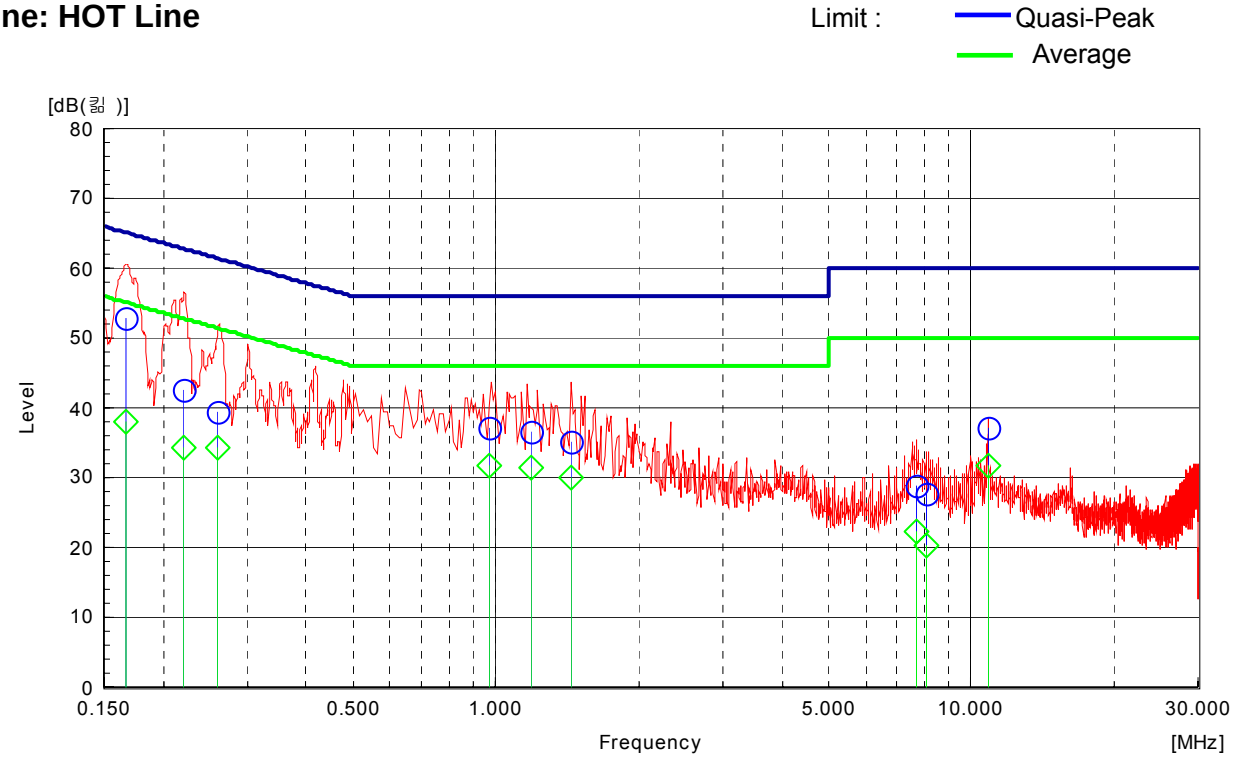
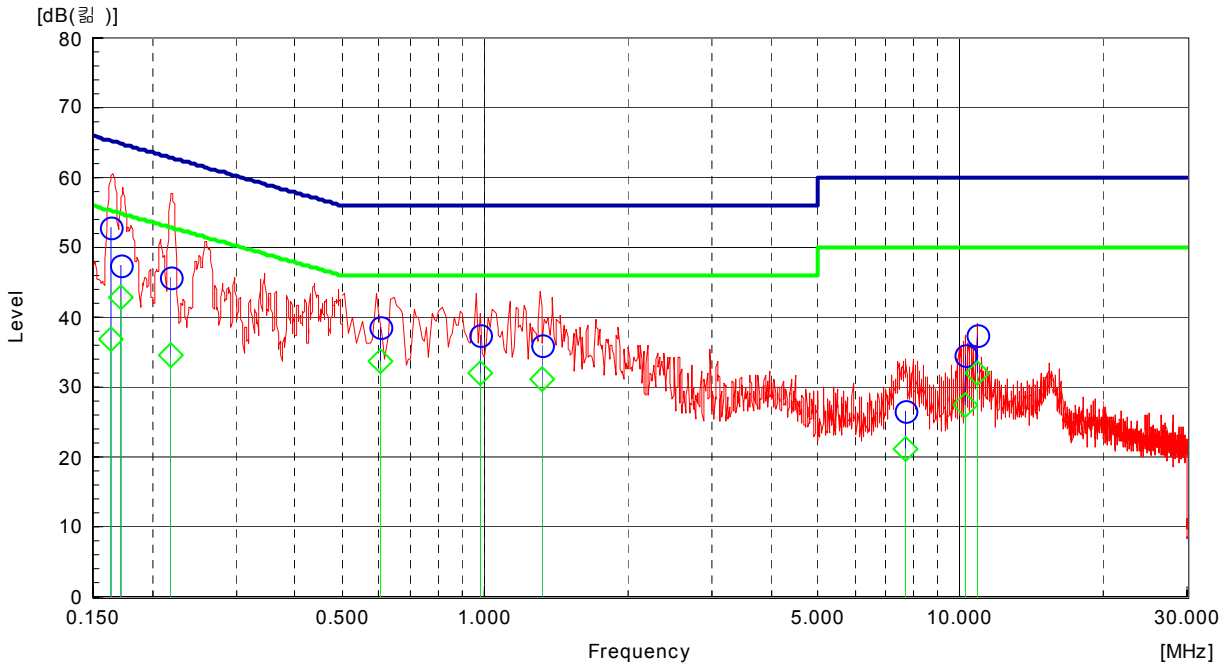
Line: HOT Line



Line: Neutral Line



Quasi-peak Average

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5.3. Radiated Emissions Measurement

EUT	Power Supply / ZM600-HP (SN :N/A)
Limit apply to	FCC Part 15. 109 Class B
Test Date	December 27, 2006
Operating Condition	Normal operating mode
Result	Passed by 19,1 dB

Radiated Emission Test Data

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.
Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 120 kHz)

Frequency [MHz]	Reading [dBμV]	Polarization (*H/**V)	Ant. Factor [dB/m]	Cable Loss [dBμV]	Emission Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
38,77	6,05	V	11,52	1,73	19,30	40,0	20,70
54,97	4,08	V	11,72	2,10	17,90	40,0	22,10
78,60	9,94	V	8,07	2,29	20,30	40,0	19,70
82,65	7,81	V	7,90	2,49	18,20	40,0	21,80
132,60	9,07	V	12,04	3,29	24,40	43,5	19,10
144,07	4,42	V	12,62	3,46	20,50	43,5	23,00
250,72	4,46	H	10,88	4,86	20,20	46,0	25,80

NOTES : **1. * H : Horizontal polarization , ** V : Vertical polarization**
2. Result = Reading + Antenna factor + Cable loss
3. Margin value = Limit - Result
4. The measurement was performed for the frequency range 30 MHz ~ 1 000 MHz according to the FCC Part 15. 109 Class B.

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6. SAMPLE CALCULATION

Sample Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor.
The basic equation with a sample calculation is as follows:

FS = RA + AF + CF

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor

$dB(\mu V) = 20 \log_{10} (\mu V)$
$dB\mu V$ = dBm + 107

Example : @ 132,60 MHz

Class B Limit = 43,5 dB μV/m

Reading = 9,07 dB μV

Antenna Factor + Cable Loss = 12,04 + 3,29 = 15,33 dB μV/m

Total = 24,40 dB μV/m

Margin = 43,5 – 24,4 = 19,1 dB

= 19,1 dB below Limit

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7. List of test equipments used for measurements

Test Equipment		Model	Mfg.	Serial No.	Cal. Due Date
☒	EMI TEST Receiver	ESVS 10	R & S	835165/001	07-04-25
☒	EMI TEST Receiver	ESPI3	R & S	100478	07-10-17
☒	LISN	3816-2	EMCO	1002	07-10-17
☒	LISN	3825/2	EMCO	9208-1995	07-04-06
☒	LogBicon Antenna	VULB9160	Schwarz Beck	3082	07-08-11
☒	Turn-Table	DETT-03	Daeil EMC	-	N/A
☒	Antenna Master	DEAM-03	Daeil EMC	-	N/A

End of Test Report

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