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E-RAE Testing Laboratory

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	:	SMPS
MODEL/TYPE NO	:	TNN400APF-V2
FCC ID	:	SAOTNN400APF-V2
APPLICANT	:	Zalman Tech Co., Ltd. #1007, Daeryung TechnoTown 3th, 448, Gasan-dong, Gumchun-gu, Seoul, Korea Attn. : Sang Ju, Lee **/** Assistant Manager
FCC CLASSIFICATION	:	Internal power supplies used with Class B personal computers
FCC RULE PART(S)	:	FCC Part 15 Subpart B
FCC PROCEDURE	:	Certification
TRADE NAME	:	ZALMAN
TEST REPORT No.	:	E04.0701.FCC.352N
DATES OF TEST	:	June 17~25, 2004
DATES OF ISSUE	:	June 26, 2004
TEST LABORATORY	:	ETL Inc. (FCC Registration Number : 95422) #584 Sangwhal-ri, Kanam-myon, Yoju-kun, Kyounggi-do, 469-880, Korea Tel : (031) 885-0072 Fax : (031) 885-0074

This SMPS, Model TNN400APF-V2 has been tested in accordance with the measurement procedures specified in ANSI C63.4-1992 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 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.

Yo Han, Park

Yo Han, Park / Chief Engineer

ETL Inc.

#584 Sangwhal-ri, Kanam-myon, Yoju-kun,
Kyounggi-do, 469-880, Korea

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Head Office : # 371-51 Kasan-Dong, Keumcheon-ku, Seoul, 153-023, Korea / Tel : 82-2-858-0786, Fax : 82-858-0788 E-mail : etl@etl.re.kr

EMC Lab : #584 Sangwhal-ri, Kanam-myon, Yoju-kun, Kyounggi-do, 469-885, Korea /Tel:82-31-885-0072, Fax:82-31-885-0074

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 TechnoTown 3th, 448, Gasan-dong, Gumchun-gu, Seoul, Korea

Attention : Sang Ju, Lee/ Assistant Manager

- **EUT Type :** SMPS
- **Model Number :** TNN400APF-V2
- **FCC ID :** SAOTNN400APF-V2
- **S/N :** N/A
- **FCC Rule Part(s) :** FCC Part 15 Subpart B
- **Test Procedure :** ANSI C63.4-1992
- **FCC Classification :** Internal power supplies used with Class B personal computers
- **Dates of Tests :** June 26, 2004
  ETL Inc.
  EMC Testing Lab. (FCC Registration Number : 95422)
- **Place of Tests :** 584, Sangwhal-Ri, Kanam-Myun, Yoju-Kun,
  Kyounggi-Do, Korea
  Tel : (031) 885-0072 Fax : (031) 885-0074
- **Test Report No. :** E04.0701.FCC.352N

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1. INTRODUCTION

The measurement test for radiated and conducted emission test were conducted at the open area test site of E-RAE Testing Laboratory Inc. facility located at 584, Sangwhal-ri, Ganam-myun, Youju-kun, Kyoungki-do, Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-1992 and CISPR Publication 16. The ETL has site descriptions on file 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 C63.4-1992 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 9kHz to 40GHz (ANSI C.63.4-1992) was used in determining radiated and conducted emissions from the Zalman Tech Co., Ltd. Model : TNN400APF-V2

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2. PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test(EUT) is the Zalman Tech Co., Ltd. SMPS, TNN400APF-V2.

2.2 General Specification

Form-factor		ATX/ATX12V		
POWER		440. Watt max peak 400. Watt max Continuous		
Efficiency		=75% at Full load		
Output voltage	Requla -tion	Min load(Amps)	Max load(Amps)	Peak current(Amps)
+12V1DC	±5%	1	16	18
+12V2DC	±5%	1	18	
+5VDC	±5%	0.5A	26.0A	
+3.3VDC	±5%	0.5A	27.0A	
-12VDC	±5%	0A	0.8A	
-5VDC	±10%	0A	0.3A	
+5VSB	±5%	0A	2A	2.5A

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3. DESCRIPTION OF TESTS

3.1 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with § 12.2 in ANSI C63.4-1992 "Measurement of Information Technology Equipment". The measurement were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 ? /50 uH 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 a bandwidth of 10 kHz or for "quasi-peak" within a bandwidth of 9 kHz.

- Procedure of Test

The line-conducted facility is located inside a shielded room 1 m X 1.5 m wooden table 80 cm high is placed 40 cm away from the vertical wall and 1.5 m away from the side wall of the shielded room. Ground of Two EMCO 3825/2 LISN are bonded to the reference horizontal ground. The EUT is powered from the EMCO LISN and the support equipment is powered from the other EMCO 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 EMCO LISN. Non-inductive bundling to a 1m length shortened all interconnecting cables more than 1m. 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 ESHS30 EMI Test Receiver to determine the frequency producing the max. emission from the EUT. The frequency producing the max. level was reexamined using to set Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.15 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.

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3. DESCRIPTION OF TESTS

3.2 Radiated Emission Measurement

Radiated emission measurements were in accordance with § 12.2 in ANSI C63.4-1992 "Measurement of Information Technology Equipment". 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.

- Procedure of Test

Preliminary measurements were made at 3 meter using broadband antennas, and spectrum analyzer to determined the frequency producing the max. 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 to 1000 MHz using SchwarzBeck Log-Bicon antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used. Final measurements were made open site at 10-meters. 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 1 MHz depending on the frequency of type of signal. The EUT, support 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, 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 to 4 meters and stopped at the azimuth or height producing the max. 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 following conditions and configurations were used.

4.2 EUT operation

Operating Mode	The worst operating condition
Stand-by Mode	X
Normal Operating Mode	O

O : Worst case investigated during the Test

4.3 Support Equipment Used

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

EUT – SMPS

FCC ID	: SAOTNN400APF-V2
Model Name	: TNN400APF-V2
Serial No.	: N/A
Manufacturer	: Zalman Tech Co., Ltd.
Power Supply Type	: Switching
Power Cord	: Non-Shielded, Detachable, 1.5 m
Data Cable	: 0.5 m Non-Shielded DC output Cable

Support Unit 1 – Personal computer

FCC ID	: N/A
Model Name	: N/A
Serial No.	: N/A
Manufacturer	: N/A
Power Supply Type	: Switching(EUT)
Power Cord	: Non-Shielded: 1.5 m
Data Port	: RGB IN:1, Parallel:1, RS-232:1, PS/2: 2, USB: 2, : Audio in:1, Audio out:1, MIC IN:1

Support Unit 2 – Keyboard (Chicony Electronics)

FCC ID	: N/A (DoC)
Model Name	: KB-9963
Serial No.	: B26960GBUKO13F
Manufacturer	: Chicony Electronics
Power Supply Type	: N/A
Power Cord	: N/A
Data Cable	: Shielded, 1.5m

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Support Unit 3 – Mouse (LOGITECH)

FCC ID	: DZL211029
Model Name	: M-S34
Serial No.	: LNA10212779
Manufacturer	: LOGITECH
Power Supply Type	: N/A
Power Cord	: N/A
Data Cable	: None-Shielded, 1.2m

Support Unit 5 – Serial Mouse (N/A)

FCC ID	: JKGMUS5S01
Model Name	: MUS5S
Serial No.	: N/A
Manufacturer	: N/A
Power Supply Type	: N/A
Power Cord	: N/A
Data Cable	: Shielded, 1.2m

Support Unit 6 – LCD Monitor (E-RAE)

FCC ID	: N/A
Model Name	: ELM-150B
Serial No.	: N/A
Manufacturer	: E-RAE Electronics Industry Co., Ltd.
Power Supply Type	: AC 110V~220V
Power Cord	: Non-Shield, 1.5m
Data Cable	: Shielded, 1.5m

Support Unit 7 – EAR MIC (JETECH)

FCC ID	: N/A
Model Name	: JE101
Serial No.	: N/A
Manufacturer	: JETECH
Power Supply Type	: N/A
Power Cord	: N/A
Data Cable	: Shielded, 1.5m

Support Unit 7 – PRINTER (INTERNATIONAL)

FCC ID	: N/A
Model Name	: Color cap 330
Serial No.	: 11-03098
Manufacturer	: International Inc.
Power Supply Type	: AC 110V~220V
Power Cord	: Non-Shield, 1.5m
Data Cable	: Shielded, 1.5m

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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.

Test Rule Parts	Measurement Required	Result
15.107	Conducted Emissions Measurement	**Passed by 12.10 dB**
15.109	Radiated Emissions Measurement	**Passed by 6.30 dB**

The data collected shows that the **Zalman Tech Co., Ltd. SMPS, TNN400APF-V2** complies with technical requirements of above rules part 15.107 and 15.109 Class B Limits and CISPR Publication 22.

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. TEST RESULTS

5.2 Conducted Emissions Measurement

EUT	SMPS / TNN400APF-V2 (SN : N/A)
Limit apply to	FCC Part 15. 107(CISPR Pub.22 Class B)
Test Date	June 21, 2004
Operating Condition	Normal Operating Mode
Environment Condition	Humidity Level : 39 %RH, Temperature : 26 ℃
Result	Passed by 12.10 dB

Conducted Emission Test Data

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

Detector mode: CISPR Quasi-Peak mode (6dB Bandwidth : 9 KHz)

Frequency [MHz]	Reading [dBμV]		Phase [*H/**V]	Limit [dBμV]		Margin [dB]	
	Quasi-peak	Average		Quasi-peak	Average	Quasi-peak	Average
0.167	50.59		H	65.11		14.52	
0.250	41.93		N	61.76		19.83	
0.334	39.50		H	59.35		19.85	
11.120	39.92		H	60.00		20.08	
17.000	47.90		N	60.00		12.10	
25.840	46.50		N	60.00		13.50	

NOTES :

1. *** H : HOT Line , **N : Neutral Line**
2. **Margin value = Limit – Reading**
3. **Measurement were performed at the HOST AC Power Inlet in the frequency band of 150 kHz ~ 30 MHz according to the CISPR 22 Class B**
4. **If the Reading Quasi-Peak value is bellowed the Average Limit, Do not test Average Mode.**

Test Engineer: H. S. Lee

Head Office : # 371-51 Kasan-Dong, Keumcheon-ku, Seoul, 153-023, Korea / Tel : 82-2-858-0786, Fax : 82-858-0788 E-mail : etl@etl.re.kr
EMC Lab : #584 Sangwhal-ri, Kanam-myon, Yoju-kun, Kyounggi-do, 469-885, Korea /Tel:82-31-885-0072, Fax:82-31-885-0074

5. TEST RESULTS

Line: HOT Line

ETL EMC Laboratory

Conducted Emission Test Result

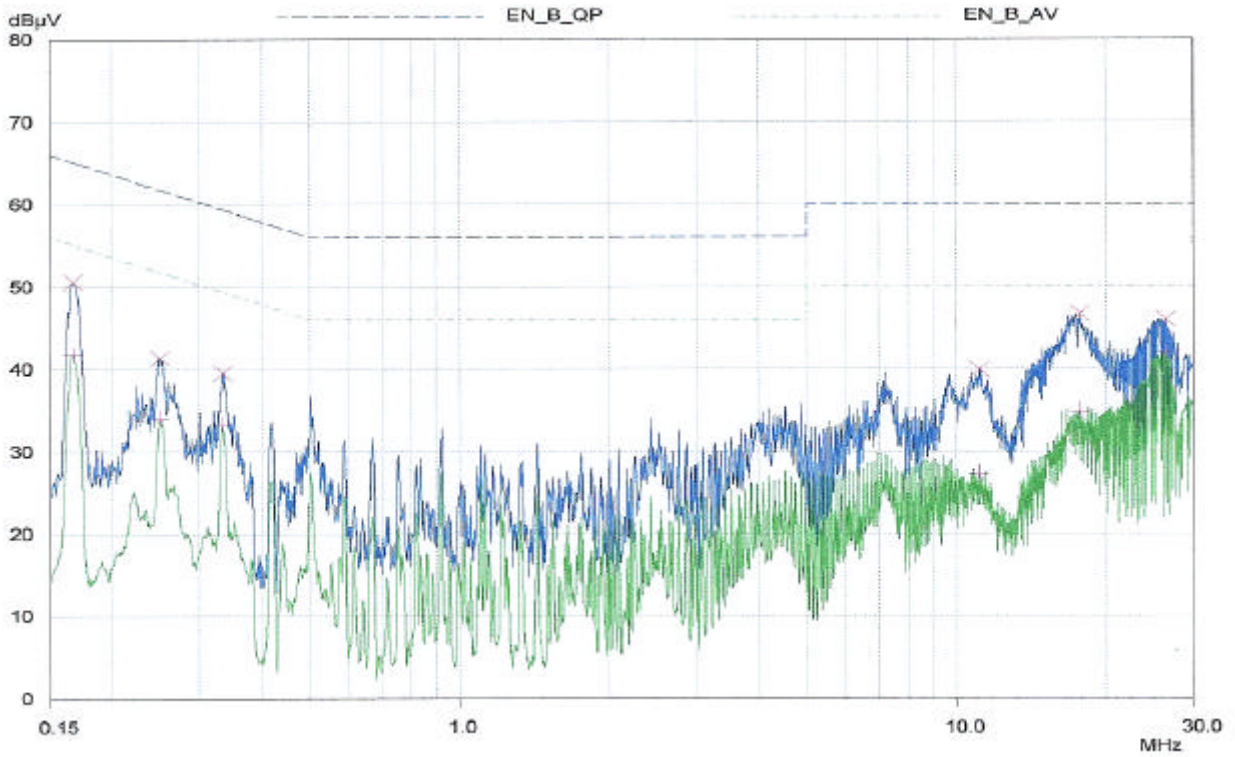
EUT: TNN400APF-V2
Manuf: Zalman
Op Cond:
Operator:
Test Spec: FCC Part 15 CLASS B
Comment: HOT

Scan Settings (3 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	1000kHz	1000Hz	10kHz	PK+AV	10msec	Auto	OFF	60dB
1000kHz	5MHz	2kHz	10kHz	PK+AV	10msec	Auto	OFF	60dB
5MHz	30MHz	5kHz	10kHz	PK+AV	10msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	1	9kHz	30MHz	Factor

Prescan Measurement:		
	Detectors:	X PK / + AV
	Meas Time:	see scan settings
	Peaks:	8
	Acc Margin:	10 dB



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5. TEST RESULTS

Line: Neutral Line

ETL EMC Laboratory

Conducted Emission Test Result

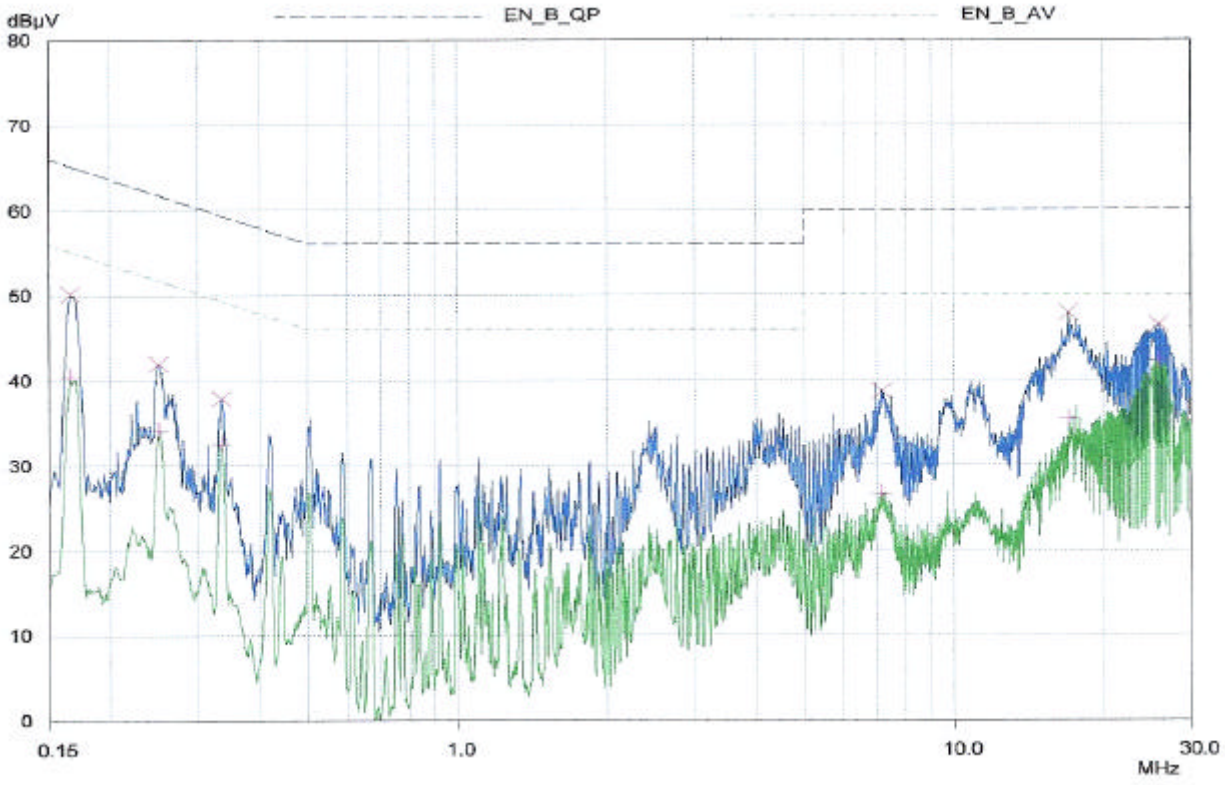
EUT:	TNN400APF-V2
Manuf:	Zalman
Op Cond:	
Operator:	
Test Spec:	FCC Part 15 CLASS B
Comment:	NEUTRAL

Scan Settings (3 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	1000kHz	1000Hz	10kHz	PK+AV	10msec	Auto	OFF	60dB
1000kHz	5MHz	2kHz	10kHz	PK+AV	10msec	Auto	OFF	60dB
5MHz	30MHz	5kHz	10kHz	PK+AV	10msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	1	9kHz	30MHz	Factor

Prescan Measurement:	Detectors:	X PK / + AV
	Meas Time:	see scan settings
	Peaks:	8
	Acc Margin:	10 dB



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5. TEST RESULTS

5.3 Radiated Emissions Measurement

EUT	SMPS / TNN400APF-V2 (SN : N/A)
Limit apply to	FCC Part 15. 109(CISPR Pub.22 Class B)
Test Date	June 21, 2004
Operating Condition	Normal Operating Mode
Environment Condition	Humidity Level : 24 %RH, Temperature : 28 ℃
Result	Passed by – 6.30 dB

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)

Frequency [MHz]	Reading [dBμV]	Polarization [*H/**V]	Ant.Factor [dB/m]	Cable Loss [dB]	Result [dBμV/m]	Limit [dBμV/m]	Margin [dB]
42.82	4.95	V	12.25	2.60	19.80	30.00	10.20
153.52	6.20	V	13.37	4.14	23.70	30.00	6.30
168.37	4.16	V	12.45	4.28	20.90	30.00	9.10
573.00	1.72	V	18.56	9.12	29.40	37.00	7.60

NOTES :

1. *** H : Horizontal polarization , ** V : Vertical polarization**
2. **Emission Level = Reading + Antenna factor + Cable loss**
3. **Margin value = Limit - Emission Level**
4. **The measurement was performed for the frequency range 30MHz ~ 1000MHz according to the CISPR 22 Class B**

Test Engineer: H. S. Lee

Head Office : # 371-51 Kasan-Dong, Keumcheon-ku, Seoul, 153-023, Korea / Tel : 82-2-858-0786, Fax : 82-858-0788 E-mail : etl@etl.re.kr
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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(μV/m) = 20 $\log_{10}$ (μV /m) : Equation 1
dBμV = dBm + 107 : Equation 2

Example 1 : @ 17.00 MHz

Class B Limit = 1000 μV = 60.00 dB μV
Reading = 47.90 dB μV
Convert to μV = 248.32 μV
Margin = 60.00 – 47.90 = 12.10 dB μV
= 12.10 dB μV below Limit

Example 2 : @ 153.52 MHz

Class B Limit = 31.63 μV = 30 dB μV
Reading = 6.20 dB μV
Antenna Factor + Cable Loss = 13.37 + 4.14 = 17.51 dB μV
Total = 23.70 dB μV
Margin = 30 – 23.70 = 6.30 dB μV
= 6.30 dB μV below Limit

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7. TEST EQUIPMENT LIST

List of Test Equipments Used for Measurements

Test Equipment		Model	Mfg.	Serial No.	Cal. Due Date
☒	Spectrum Analyzer	E7402A	H.P	US39110107	05-06-07
☒	Spectrum Analyzer	R3261A	Advantest	21720033	04-10-24
☒	Receiver	ESVS 10	R & S	835165/001	05-04-12
☒	EMI TEST Receiver	ESHS30	Rohde & Schwarz	0401901/002	05-03-29
☐	Preamplifier	HP 8347A	HP	2834A00544	05-04-12
☒	LISN	3825/2	EMCO	9006-1669	05-04-13
☒	LISN	3825/2	EMCO	9208-1995	05-01-29
☒	TriLog Antenna	VULB9160	Schwarz Beck	3082	04-07-16
☐	LogBicon	VULB9165	Schwarz Beck	2023	04-07-05
☐	Dipole Antenna	VHAP	Schwarz Beck	964	05-05-09
☐	Dipole Antenna	VHAP	Schwarz Beck	965	04-07-05
☐	Dipole Antenna	UHAP	Schwarz Beck	949	04-07-05
☐	Dipole Antenna	UHAP	Schwarz Beck	950	05-05-09
☐	Double Ridged Horn	3115	EMCO	9809-2334	05-09-20
☒	Turn-Table	DETT-03	Daeil EMC	-	N/A
☒	Antenna Master	DEAM-03	Daeil EMC	-	N/A
☐	Plotter	7440A	H.P	2725A 75722	N/A
☒	Chamber	DTEC01	DAETONG	-	N/A
☐	Impedance Matching Pad	6001.01.A	SUNNER	3252	04-10-24
☐	Thermo Hygrograph	3-3122	ISUZU	3312201	05-04-16
☐	BaroMeter	-	Regulus	-	-

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