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	:	FM Transmitter
MODEL/Serial No.	:	F4me / NONE
FCC ID	:	X8OF4ME
APPLICANT	:	CNAPS A203 Techno Park Korea Polytechnic 2 colleges, 34-1, Gusan-dong, Bupyeong-gu, Incheon, Korea Attn. : Rio. Lee / Junior System Engineer
MANUFACTURER	:	UBIMATE 363-7 Songnae-dong, Sosa-gu, Bucheon-si, Gyeonggi-do, Korea
FCC CLASSIFICATION	:	DXX: Low Power Communication Device Transmitter
RULE PART(S)	:	FCC Title 47, Part 15 Subpart C
FCC PROCEDURE	:	ANSI C63.4-2003
TEST RESULT	:	The above-mentioned device has been tested and passed.
TEST REPORT No.	:	ETLE100209.05
DATES OF TEST	:	March 08, 2010 to March 10, 2010
REPORT ISSUE DATE	:	March 22, 2010
TEST LABORATORY	:	ETL Inc. (FCC Registration Number : KR0022)

This FM Transmitter, Model F4me has been tested in accordance with the measurement procedures specified in ANSI C63.4-2003 at the ETL Test Laboratory and has been shown to be complied with the electromagnetic radiated emission limits specified in FCC Rule Part15 Subpart C section15.239.
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.

Hyung Seok, Lee / Chief Engineer

ETL Inc.
#371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, 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	**: CNAPS**
Address	**: A203 Techno Park Korea Polytechnic 2 colleges, 34-1, Gusan-dong, Bupyeong-gu, Incheon, Korea**
Attention	**: Rio. Lee / Junior System Engineer**

- **EUT Type :** FM Transmitter
- **Model Number :** F4me
- **S/N :** NONE
- **Freq. Range :** 107.30 MHz - 107.90 MHz
- **FCC Rule Part(s) :** FCC Part 15 Subpart C Section 15.239
- **Test Procedure :** ANSI C63.4-2003
- **FCC Classification :** DXX: Low Power Communication Device Transmitter
- **Dates of Tests :** March 08, 2010 to March 10, 2010
- **Place of Tests :** ETL Inc. Testing Lab.
  Radiated Emission test;
  #499-1, Sagot-ri, Seosin-myeon, Hwaseong-si, Gyeonggi-do,
  445-882, Korea

  Conducted Emission test;
  ETL Inc. Testing Lab.
  371-51, Gasan-dong, Geumcheon-gu, Seoul, 153-803, Korea
- **Test Report No. :** ETLE100209.05

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1. INTRODUCTION

The measurement test for radiated and conducted emission test was 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 FCC Rules according to the ANSI C63.4-2003 and registered to the Federal Communications Commission (FCC Registration Number : KR0022).

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 CNAPS Model: F4me

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2. PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the CNAPS FM Transmitter. Model: F4me.
This is FM transmitter. It's power 3.7 V from battery pack of Cellular phone.
FM transmitter is designed to operate on frequency in the 107.30 MHz ~ 107.90 MHz.
The amplified RF is transmitted pattern antenna.

2.2 General Specification

- Modulation: FM Stereo
- Transfer Type: FM (F3E)
- Oscillation method: PLL
- Operating Frequency: 107.3 MHz, 107.5 MHz, 107.9 MHz
- RF power: less than 68 dBμV/m@3m(peak), 48 dBμV/m@3m(AV)
- Power Supply: Li-Ion 3.7 V Rechargeable Battery of Cellular phone

[Table of total tuning range]

No.	Freq. [MHz]
1	107.3
2	107.5
3	107.9

2.3 RF Output Frequency Range (107.30 MHz – 107.90 MHz)

FM transmitter is designed to operate verify maximum tuning range on frequency in the 107.30 MHz ~ 107.90 MHz from manufacturer's. Operating Frequency is 107.3 MHz, 107.5 MHz and 107.9 MHz.

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3. DESCRIPTION OF TESTS

3.1 Conducted Emission Measurement

Conducted emissions measurements were made in accordance with section § 13 in ANSI C63.4-2003 "measurement of intentional radiators" The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω / 50 uH 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 0,4 m 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 the worst-case emission test setup can be seen in Appendix B.

3.1.1 Limitation

(1) According to §15.207 Conducted limits

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the conducted limit is the following:

Frequency [MHz]	Quasi Peak [dB(uV)]	Average [dB(uV)]
0.15 - 0.5	66 - 56	56 - 46
0.5 - 5.0	56	46
5.0 - 30.0	60	50

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3.2 Radiated Emission Measurement

Radiated emission measurements were made in accordance with § 13 in ANSI C63.4-2003 "Measurement of Intentional radiators" The measurements were performed over the frequency range of 30 MHz to 40 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 "Peak, Quasi-peak, Average" within a bandwidth of 120 kHz and above 1GHz is 1 MHz.

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 1000 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 laced 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 maximum emission for the frequency and were placed on top of a 0,8 m high nonmetallic 1m 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.

Varying the mode of operating frequencies of the EUT maximized each emission. 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 (20 dB/decade) as per section 15.31(f).

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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3.2.1 Radiated Emission Limits

(1) According to §15.239(b) out-of-band radiated emissions

This test was performed to measure radiated emissions on frequencies outside of the specified 200 kHz band and also to verify the EUT full compliance with § 15.209, as following:

Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequencies [MHz]	Field Strength [μV/m]	Measurement Distance [m]
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

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(2) According to §15.239(b) Field strength of emissions

According to § 15.239(b), the field strength of emissions from intentional radiators operated under these frequency bands shall not exceed the following:

Frequencies [MHz]	15.239 Field Strength of Fundamental Limits [dB(uV/m)]@3 m
88 - 108	48 (Average)
	68 (Peak)

(3) According to §15.239(a) Occupied Bandwidth Measurement

Emissions from the intentional radiator shall be confined within a band 200 kHz wide centered on the operating frequency. The 200 kHz band shall lie wholly within the frequency range of 107.30 MHz - 107.90 MHz.

Position the EUT as shown in the radiated emission measurement and set it to any one measured frequency within its operating range and make sure the measuring instrument is operated in its linear range. Set both RBW and VBW of the spectrum analyzer to 10 kHz and 100 kHz respectively with a convenient frequency span including 200 kHz bandwidth of the emission.

The Measurements were performed at one channels: middle (107.50 MHz). The spectrum trace data around transmitter fundamental frequency was obtained with the spectrum analyzer in “Max Hold” mode. The bandwidth value was determined between two points 20 dB down from the center frequency. The measured results are less than 200 kHz. The measured spectrum of the signal is shown in Figure 1. From the plot we see that in the worst case, the bandwidth is 103.50 kHz at 107.50 MHz.

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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

The EUT was tested on the design frequency of the device. In the case of EUTs that can operate on more than one frequency, unless otherwise specified in the individual tests, measurements shall be made with the EUT set to a frequency or frequencies as provided in Table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
Less than 1 MHz	1	1 near middle
1 MHz to 10 MHz	2	1 near top, 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle, and 1, near bottom

The EUT was power 3.7 V from battery pack(Cellular phone's battery). FM transmitter is designed to operate on frequency in the 107.30 MHz ~ 107.90 MHz. (The test is only 107.50 MHz. Because frequency range over which device operates is less than 1 MHz)

Operating Mode	The worst operating condition *
- Frequency tuning 107.30 MHz	X
- Frequency tuning 107.50 MHz	◎
- Frequency tuning 107.90 MHz	X

* ◎ : Middle channel investigated during the test.

4.3 Support Equipment Used

Description	Model Name	Serial No.	Manufacturer
Cellular phone	SCH-W560	R95Q955744	Samsung Electronics / Korea

4.4 Type of Cables Used

Device from	Device to	Type of I/O port	Length[m]	Type of shield
EUT	Cellular phone	20 pin Connector	-	-

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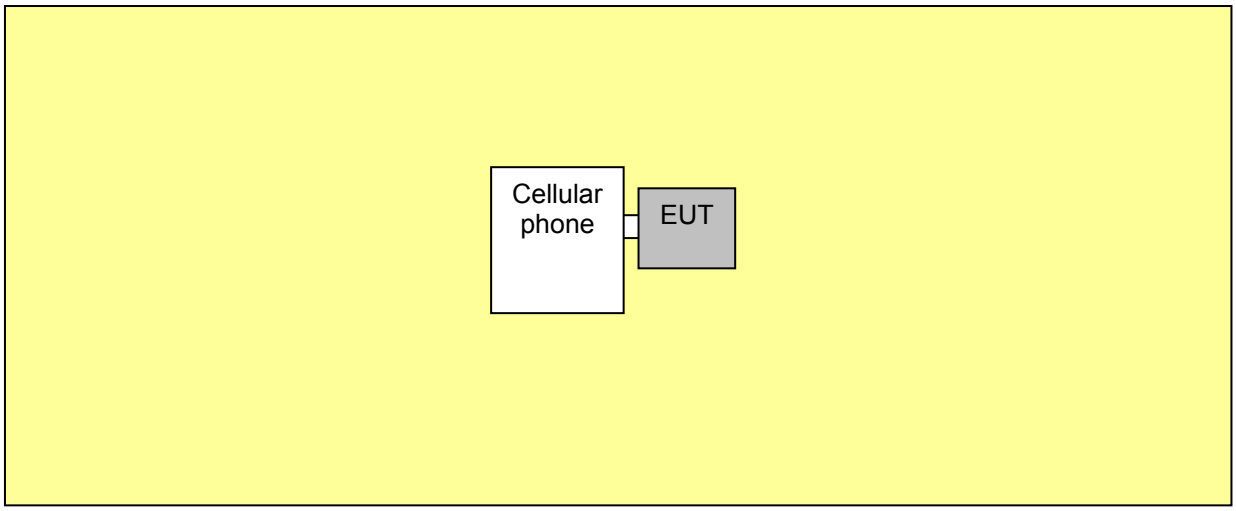
4.5 The setup drawing(s)



_____ : Data Line

▬▬▬▬▬ : AC Power Line

▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪ : DC Power Line

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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 Parts	Measurement Required	Result
15.207	Conducted Emission	-
15.209(a)	Spurious Emissions	Passed
15.239(b)	Radiated Emissions of Field Strength	Passed
15.239(c)	Out-of-band Radiated Emissions	Passed
15.239(a)	Occupied Bandwidth Measurement	Passed

The data collected shows that the **CNAPS / FM Transmitter / F4me** complied with technical requirements of the Part 15.239 of the FCC Rules.

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

EUT	FM Transmitter / F4me (S/N: N/A)
Limit apply to	N/A
Test Date	N/A
Operating Condition	N/A
Result	N/A

NOTES: This test was not applied. Because, EUT is devices which only employ battery (Cellular phone's battery) power for operation.

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5.3 Radiated Emissions of Field Strength

EUT	FM Transmitter / F4me (S/N: N/A)
Limit apply to	FCC Part15.239(a)
Test Date	March 08, 2010
Operating Condition	RF transmit with frequency tuned mode
Result	Passed by 3.50 dB

The following table shows the highest levels of radiated emissions on both polarization of horizontal and vertical.
Detector mode: Peak mode
Measurement distance: 3 m

Frequency [MHz]	Reading [dB(μV)]	Polarization (*H/**V)	Ant. Factor [dB]	Cable Loss [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
107.50	38.08	V	9.80	2.42	50.30	68.00	17.70

Detector mode: Average mode
Measurement distance: 3 m

Frequency [MHz]	Reading [dB(μV)]	Polarization (*H/**V)	Ant. Factor [dB]	Cable Loss [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
107.50	32.28	V	9.80	2.42	44.50	48.00	3.50

NOTES:

1. *** H : Horizontal polarization, ** V : Vertical polarization**
2. **Result = Reading + Antenna factor + Cable loss**
3. **Margin value = Limit - Result**
4. **Measurement was performed at three frequencies as bottom, middle and top of the operating frequency range.**
5. **The EUT was tested in all the three orthogonal planes and the worst-case emission was vertical axes.**

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5.4 Out-of-band Radiated Emissions

EUT	FM Transmitter / F4me (S/N: N/A)
Limit apply to	FCC Part15.239(c),15.209(a)
Test Date	March 22, 2010
Operating Condition	RF transmit with frequency tuned mode
Result	Passed

Radiated Emission Test Data

The following table shows the highest levels of radiated emissions on both polarization of horizontal and vertical.
(The test is 107.50 MHz. Because frequency range over which device operates is less than 1 MHz)
Detector mode: CISPR Quasi-Peak mode (6 dB Bandwidth: 120 kHz)
Measurement Distance: 3 m

Frequency [MHz]	Reading [dB(μV)]	Polarization (*H/**V)	Ant. Factor [dB]	Cable Loss [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
34.77	17.98	V	9.27	1.45	28.70	40.00	11.30
38.86	18.05	V	9.57	1.48	29.10	40.00	10.90
57.95	20.29	V	9.17	1.74	31.20	40.00	8.80
322.47	16.21	H	13.57	4.62	34.40	46.00	11.60
429.98	15.79	H	15.91	5.60	37.30	46.00	8.70
537.52	10.11	H	18.57	6.42	35.10	46.00	10.90

NOTES :

1. *** H : Horizontal polarization , ** V : Vertical polarization**
2. **Result = Reading + Antenna factor + Cable loss**
3. **Margin value = Limit - Result**
4. **The EUT was tested in all the three orthogonal planes and the worst case of emissions was vertical axes.**

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5.5 Occupied Bandwidth Measurement

EUT	FM Transmitter / F4me (S/N: N/A)
Limit apply to	FCC Part15.239(a)
Test Date	March 22, 2010
Operating Condition	The RF transmitting signal is FM modulation signal typical audio file of supplied from cellular phone.
Result	Passed

Measurement Data

Center Frequency [MHz]	Measured occupied bandwidth [kHz]	Limit [kHz]	Result
107.50	103.50	200	Pass

NOTES:

1. **Please see the measured bandwidth plot in next page.**
2. **The occupied bandwidth shall be no wider than 200 kHz of the center frequency of the equipment operating within 107.30 MHz to 107.90 MHz. The bandwidth is determined at the points 20 dB down from the modulated carrier.**
3. **Spectrum analyzer settings**
   Resolution bandwidth: 10 kHz
   Video bandwidth: 30 kHz
   Frequency span: 200 kHz

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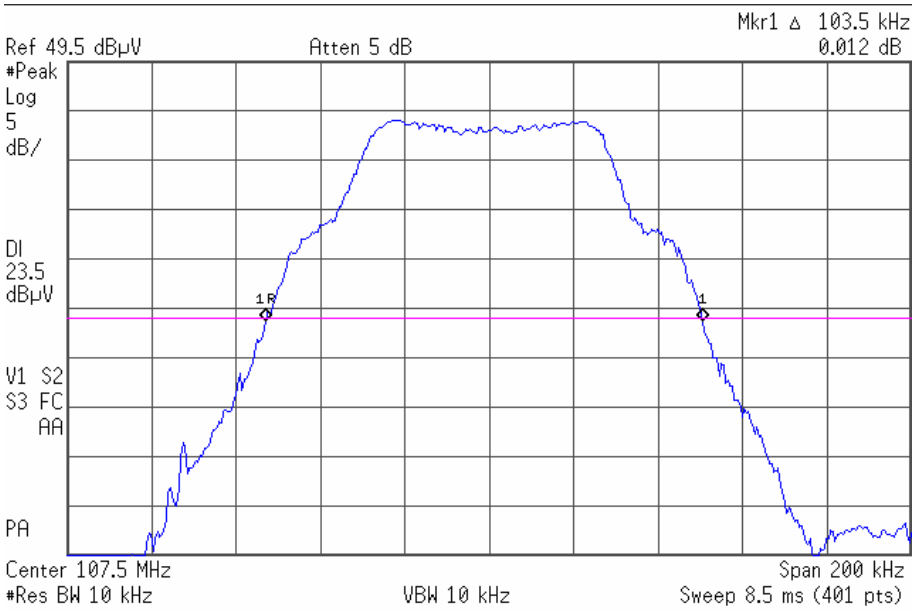
5. TEST RESULTS

[107.50 MHz]



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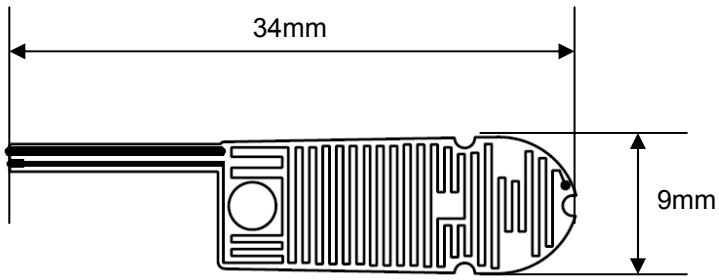
6. ANTENNA REQUIREMENT

(1) According to §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.



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7. 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

$dB(\mu V) = 20 \log_{10} (uV)$: Equation

Example : @ 429.98 MHz

Limit = 46.00 dB(㎶/m)

Reading = 15.79 dB(㎶)

Antenna Factor + Cable Loss = 15.91+ 5.60 = 21.51 dB

Total = 37.30 dB(㎶/m)

Margin = 46.00 – 37.30 = 8.70 dB

= 8.70 dB below Limit

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8. List of test equipments used for measurements

Test Equipment		Model	Mfg.	Serial No.	Cal. Due Date
☒	EMI TEST Receiver	ESVS10	R & S	835165/001	10.04.02
☐	EMI TEST Receiver	ESPI3	R & S	100478	10.09.18
☒	LogBicon Antenna	VULB9165	Schwarzbeck	2023	11.09.08
☒	Spectrum Analyzer	E7405A	Agilent	US41160290	10.09.18
☒	Spectrum Analyzer	R3132	Advantest	110401685	10.04.03
☒	Turn-Table	MFT-120S	Max-Full Antenna Corp	-	N/A
☒	Antenna Master	MFA-440E	Max-Full Antenna Corp	-	N/A

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