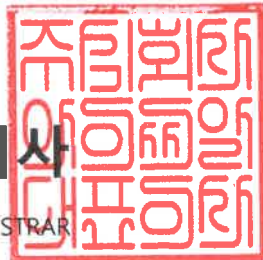




# 시험 성적서 TEST REPORT

페이지(page) : ( 1 ) / ( 총(Total) 23 )

성적서 번호 Report No.		ICRT-TR-E222976-0A	
신청자 Client	기관명 Name	CanTops Co., Ltd.	
	주소 Address	A 1002-1008, Digital Empire BLDG, 16, Deogyong-daero 1556beon-gil, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16690, South Korea	
시험대상품목 Sample description		RFID Reader	
모델명 Type designation		CTS-RFID-LM24	
정격 Ratings		DC 24 V	
시험장소 Place of test		<input checked="" type="checkbox"/> 고정시험실(Permanent Testing Lab) <input type="checkbox"/> 현장시험(On Site Testing) 주소지(Address): 112, Hwanggeum3-ro 7beon-gil, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea	
시험기간 Date of test		2022. 11. 16	
시험방법/항목 Test Method/Item		FCC CFR 47 Part 15, Subpart B / Other Class B digital devices & peripherals	
시험결과 Test Results		Refer to summary of test results	
확인 Affirmation	작성자 Tested by	기술책임자 Technical Manager	
	성명 Name	이수호 (서명) Lee, Suho (Signature)	성명 Name    박명철 (서명) Park, Myeongcheol (Signature)
<input type="checkbox"/> 위 성적서는 고객이 제공한 시료에 대한 시험결과입니다. This is certified that the above mentioned products have been tested for the sample.			
<input type="checkbox"/> 위 성적서는 KS Q ISO/IEC 17025 및 한국인정기구(KOLAS)인정과 관련이 없습니다. The above test report is not related to accreditation by KS Q ISO/IEC 17025 and Korea Laboratory Accreditation scheme.			
<input type="checkbox"/> 위 성적서는 주식회사 아이씨알의 승인 없이는 일부 복제에 대해 금지됩니다. The test report is prohibited for some reproduction without the approval of the ICR.			
<p>2022. 11. 17</p> <p><b>주식회사 아이씨알 대표이사</b></p> <p>The head of INTERNATIONAL CERTIFICATION REGISTRAR</p> 			

본 성적서의 진위 확인은 G4B 혹은 ICR 홈페이지에서 가능합니다.  
The authenticity of the test report can be checked on the G4B or ICR website.

경기도 김포시 양촌읍 황금 3로 7번길 112 / Tel: 02-6351-9001 ~ 6



**Contents**

- 1. Applicant Information.....3
  - 1.1 Applicant .....3
  - 1.2 Manufacture.....3
- 2. Laboratory.....3
  - 2.1 Information.....3
- 3. Revision History .....3
- 4. List of EUT and Accessory .....4
  - 4.1 Used equipment.....4
  - 4.2 Test Configuration .....4
  - 4.3 Cable List.....4
  - 4.4 Mode of Operating during the test .....5
  - 4.5 EUT Modifications .....5
  - 4.6 Family Model Name .....5
- 5. Summary of test result .....6
  - 5.1 Test Summary .....6
- 6. Test Description .....7
  - 6.1 Facility .....7
  - 6.2 Test Procedure .....7
- 7. EMISSION .....9
  - 7.1 Radiated emission.....9
  - 7.2 Conducted emission.....13
- Attachment I.....16



## 1. Applicant Information

### 1.1 Applicant

**Applicant** : CanTops Co., Ltd.  
**Address** : A 1002-1008, Digital Empire BLDG, 16, Deogyong-daero 1556beon-gil, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16690, South Korea

### 1.2 Manufacture

**Applicant** : CanTops Co., Ltd.  
**Address** : A 1002-1008, Digital Empire BLDG, 16, Deogyong-daero 1556beon-gil, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16690, South Korea

## 2. Laboratory

### 2.1 Information

**Laboratory** : ICR Co., Ltd  
**Address** : 112, Hwanggeum3-ro 7beon-gil, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea  
**Telephone No.** : +82-2-6351-9001  
**Facsimile No.** : +82-2-6351-9007  
  
**KOLAS No.** : KT652  
**RRA No.** : KR0165

## 3. Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
ICRT-TR-E222976-0A	2022. 11. 17	First issue.	-

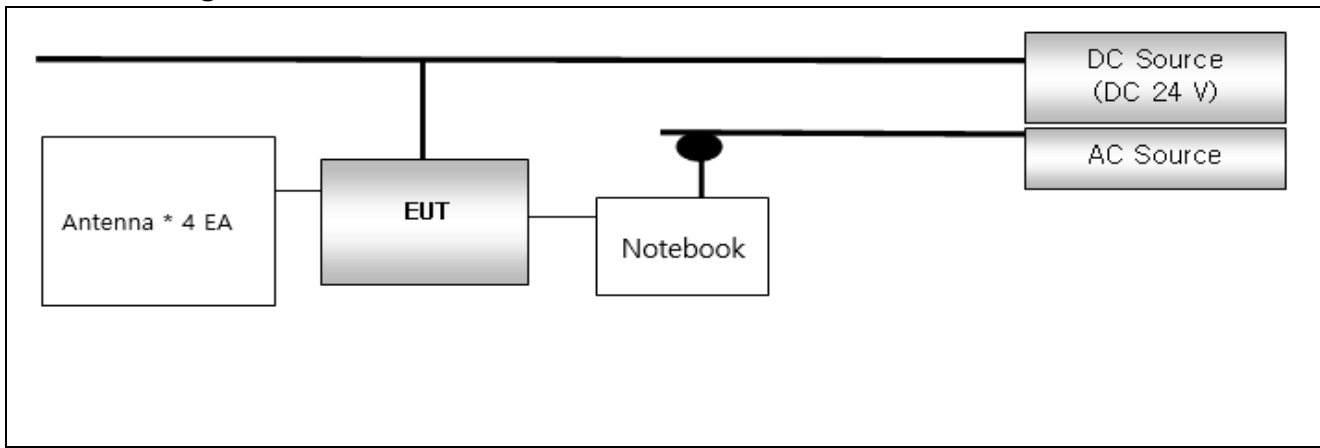


## 4. List of EUT and Accessory

### 4.1 Used equipment

Description	Model	Manufacturer	Remark
RFID Reader	CTS-RFID-LM24	CanTops Co., Ltd.	EUT
Antenna	CTS-STBA-EC-1-0400	CanTops Co., Ltd.	EUT
Antenna	CTS-RFID-AC01-0400	CanTops Co., Ltd.	EUT
Antenna	CTS-RFID-AO01-0400	CanTops Co., Ltd.	EUT
Antenna	CTS-RFID-AB01-0400	CanTops Co., Ltd.	EUT
Notebook	E520 1143-A89	LENOVO	AE
Notebook Adapter	PA-1650-16	LENOVO	AE

### 4.2 Test Configuration



——— : Signal line    ——— : Power line    △ : GROUND    ● : Adapter

### 4.3 Cable List

Equipment	Port	Equipment	Port	Length (m)	Shielded
EUT	DC IN	DC SOURCE	DC OUT	1.2	Unshielded
	LAN	Notebook	LAN	3.0	Unshielded
	ANT IN	Antenna * (4 EA)	-	2.0	Unshielded



#### 4.4 Mode of Operating during the test

[MODE 1] : EUT is connected as shown in the layout diagram and tested in the Ping test state.

#### 4.5 EUT Modifications

- None.

#### 4.6 Family Model Name

No.	Family model name	Differential point	Comments
1	CTS-RIFD-LM21	Derivatived model name is added due to the difference in antenna ports. - CTS-RFID-LM24 : Antenna 4 ports. - CTS-RIFD-LM21 : Antenna 1 ports.	-



## 5. Summary of test result

### 5.1 Test Summary

Standard	Test items	Applied	Results
FCC Part 15.109 Class B	Radiated emission	<input checked="" type="checkbox"/>	Pass
FCC Part 15.107	Conducted emission	<input type="checkbox"/>	N/A <sup>1</sup>

\* The data in this test report are traceable to the national or international standards.

**Frequency range to be scanned:**

0.15 MHz to 30 MHz as Conducted measurement

5<sup>th</sup> harmonic of the highest frequency or 40 GHz, whichever is lower as Radiated measurement

**Bandwidth:**

Measured by the CISPR quasi-peak function Bandwidth is 9 kHz in the frequency 0.15 MHz ~ 30 MHz and 120 kHz in the frequency 30 MHz ~ 1 000 MHz.

Measured by the CISPR Peak function Bandwidth is 1 MHz in the frequency 1 GHz ~ 40 GHz.

The EUT is powered by a vehicle battery, and the conduction disturbance test is excluded.

- N/A<sup>1</sup>: This test is not performed because the EUT receives DC-input power.
- Maximum operating frequency: 25 MHz



## 6. Test Description

### 6.1 Facility

All the testing facilities are periodically serviced as a daily check for equipment and cables systems, an every 6 months facility check for the facilities and a monthly check and annual calibration for testing equipment according to ISO/IEC 17025. All the testing facilities are used as the same specifications shown below. There are descriptions both for radiated disturbance measurement and conducted disturbance measurement conformed by ANSI C 63.4-2014.

### 6.2 Test Procedure

#### 6.2.1 Radiated Disturbance Measurements – Below 1 GHz

- Test site is met the requirements of ANSI C 63.4-2014 and the distance between the EUT and the antenna is adjusted 3 m/10 m.
- The turntable can be rotated 360 degrees.
- The antenna can be adjusted between 1 m and 4 m in height above the ground.
- The EUT is placed on the non-conducting table with 0.8 m height on the turntable.
- Measurements are carried out using a EMI test receiver with peak detectors (100 kHz bandwidth) and an EMI receiver with quasi-peak detectors(120 kHz bandwidth).
- Refer to the list of test equipment used for the test.
- Trilog antenna are used as Broadband antenna.
- The Trilog antenna is used in the frequency range of 30 ~ 1 000MHz, the Horn antenna is used in the frequency range of 1 GHz ~ 18 GHz.
- A variable attenuator is used for verifying amplifier's linearity.
- Rotating the turntable and adjusting the height of the antenna are carried out by control buttons on the console.
- Refer to "Brief Information"(page 4-5) about details of the EUT and configuration of the cables.
- Measurement is carried out by a ICR operator as manual operation.
- searching for some of High disturbance frequency points than the other points with the following settings;  
bandwidth 100 kHz, frequency range 10 MHz between 30 MHz and 300 MHz and frequency range 50 MHz between 300 MHz and 1 GHz.
- searching the worst direction with the maximum level of the disturbance wave in rotating the turntable 360 degrees at each searched frequency point.
- setting the height of the antenna with the maximum level of the disturbance wave from 1 m ~ 4 m.
- reading the disturbance level by the EMI receiver with quasi-peak detectors (120 kHz bandwidth) according to ANSI C 63.4-2014.
- measuring to vertical and horizontal polarization.
- calculating the measurement result with the following formula or equation:  
[Measurement result= measured value + Antenna factor + Cable loss - (Amp.)]

#### 6.2.2 Radiated Disturbance Measurements – Above 1 GHz

- Test site is met the requirements of ANSI C 63.4-2014 and the distance between the EUT and the antenna is adjusted 3 m.
- The turntable can be rotated 360 degrees.
- The antenna can be adjusted between 1 m in height above the ground.
- The EUT is placed on the non-conducting table with 1 m height on the turntable.
- Measurements are carried out using a EMI test receiver with peak detectors (1 MHz bandwidth) and an EMI receiver with peak and average detectors(1 MHz bandwidth).
- Refer to the list of test equipment used for the test.
- HORN ANTENNA are used as WIDEBAND ANTENNA.
- The HORN ANTENNA is used in the frequency range of 1 GHz ~ 18 GHz.
- A variable attenuator is used for verifying amplifier's linearity.
- Rotating the turntable and adjusting the height of the antenna are carried out by control buttons on the console.
- Refer to "Brief Information"(page 4-5) about details of the EUT and configuration of the cables.
  
- Measurement is carried out by a ICR operator as manual operation.
- searching the worst direction with the maximum level of the disturbance wave in rotating the turntable 360 degrees at each searched frequency point.– setting the height of the antenna with the



- maximum level of the disturbance wave from 1 m
- reading the disturbance level by the EMI receiver with peak and average detectors (1 MHz bandwidth) according to ANSI C 63.4-2014.
- measuring to vertical and horizontal polarization.
- calculating the measurement result with the following formula or equation:  
[Measurement result= measured value + Antenna factor + Cable loss - (Amp.)]

### 6.2.3 Conducted Disturbance Measurements

- The measurement is carried out on an open site with horizontal and metallic ground plane.
- An AMN(Artificial Mains Network) with a nominal impedance (50 Ω/50 μH) as defined in ANSI C 63.4-2014., shall be utilized.
- The AMN is grounded on a horizontal metal ground plane.
- Measurement is carried out using an EMI receiver with quasi-peak detectors and average detector. (Refer to the List of test equipment used for the test.)
- The shortest distance between the EUT and the AMN is 0.8 m.
- The EUT is placed on the non-conducting table with 0.8 m height.
- A remote switch is used for changing phases between Line (L) and Neutral (N).
- Refer to "Brief Information"(page 4-5) about details of the EUT and configuration of the cables.
- Measurement is carried out as manual operation.
- detecting the maximized emission level using the maxhold function after setting the spectrum analyzer bandwidth 1 kHz and the frequency range from 150 kHz ~ 1 MHz, 1 MHz ~ 5 MHz and 5 MHz ~ 30 MHz.
- searching the maximum frequency point of the disturbance wave in each frequency range.
- reading the disturbance level of quasi-peak, average and Line (L) and Neutral (N) in 9 kHz bandwidth by the EMI receiver.
- calculating the measurement result with the following formula or equation.  
(Result = Reading + Corr)  
(Margin = Limit - Result)





## 7. EMISSION

### 7.1 Radiated emission

**Definition:**

The test assesses the ability of ancillary equipment to limit their internal noise from being radiated from the enclosure.

Test method	:	FCC Part 15.109, Class B
Test Date	:	2022. 11. 16
Temperature, Humidity	:	24.5 °C ~ 25.1 °C, 46.2 % R.H. ~ 47.3 % R.H.
Measurement Frequency range	:	30 MHz ~ 1 GHz
Measurement Distance	:	3 m
Measurement RBW	:	120 kHz
Test mode	:	MODE 1 (refer to 4.4)
<i>Ut</i>	:	DC 24 V
Result	:	Pass

**A sample calculation:**

- Corr (correction factor) = Ant. Factor + Cable loss – (Amp.)
- Emission Level = meter reading + Corr
- Sample calculation ; Below 1 GHz (Quasi-Peak)  
At Frequency : 156.003 MHz Result = Reading + Corr = 63.17 dB(μV/m) + (-27.3) dB = 35.87 dB(μV/m)
- Measurement Data kept in ICR



**Limits of below 1 GHz - CLASS A**

Frequency Range (MHz)	Field strength ( $\mu\text{V/m}$ )	Distance (m)
30 ~ 88	90	10
88 ~ 216	150	
216 ~ 960	210	
Above 960	300	

**Limits of below 1 GHz - CLASS B**

Frequency Range (MHz)	Field strength ( $\mu\text{V/m}$ )	Distance (m)
30 ~ 88	100	3
88 ~ 216	150	
216 ~ 960	200	
Above 960	500	

**Used equipments:**

Used	Equipment	Model name	Manufacturer	Serial No.	Next Cal.
<input checked="" type="checkbox"/>	EMI Test Receiver	ESR26	R&S	101462	2023. 04. 13
<input checked="" type="checkbox"/>	TRILOG BROAD BAND ANTENNA	VULB 9162	SCHWARZBECK	120	2022. 12. 15
<input checked="" type="checkbox"/>	RF Pre Amplifier	SCU 08	R&S	100745	2023. 04. 13
<input checked="" type="checkbox"/>	HUMIDITY/TEMP. DATA RECORDER	MHT-381SD	LUTRON	AI.63107	2023. 02. 07

**Test Software:**

Used	Description	Model name	Manufacturer	Version.
<input checked="" type="checkbox"/>	EMI Test Software	EMC32	R & S	10.01.00

**Measurement Data:**

- Refer to the Next page.

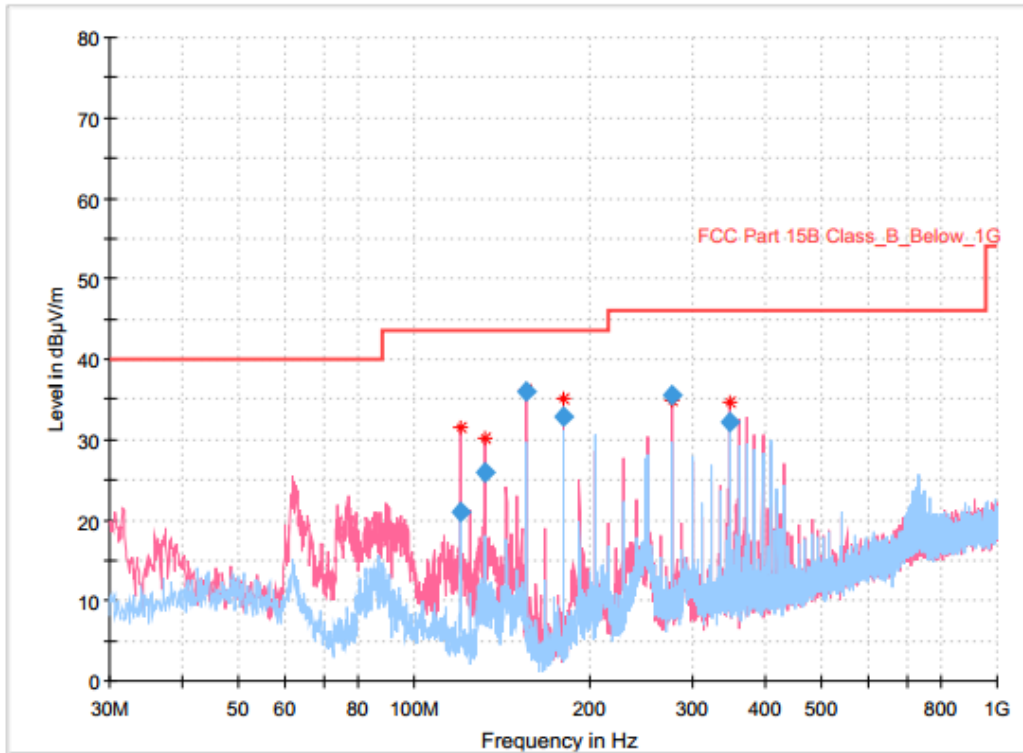


**DATA - Model : CTS-RFID-LM24**

# Test Report

## Common Information

Test Description: 2022-3002  
 Operating Conditions: ICR 3 m Chamber  
 Operator Name: LEE S H  
 Comment: RE



## Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
119.919	20.95	43.50	22.55	1000.0	120.000	100.0	V	134.0	-26.3
131.947	25.89	43.50	17.61	1000.0	120.000	200.0	V	174.0	-27.4
156.003	35.87	43.50	7.63	1000.0	120.000	100.0	V	148.0	-27.3
179.962	32.91	43.50	10.59	1000.0	120.000	100.0	V	121.0	-26.3
275.992	35.51	46.00	10.49	1000.0	120.000	200.0	V	200.0	-21.6
347.966	32.10	46.00	13.90	1000.0	120.000	100.0	V	294.0	-19.0

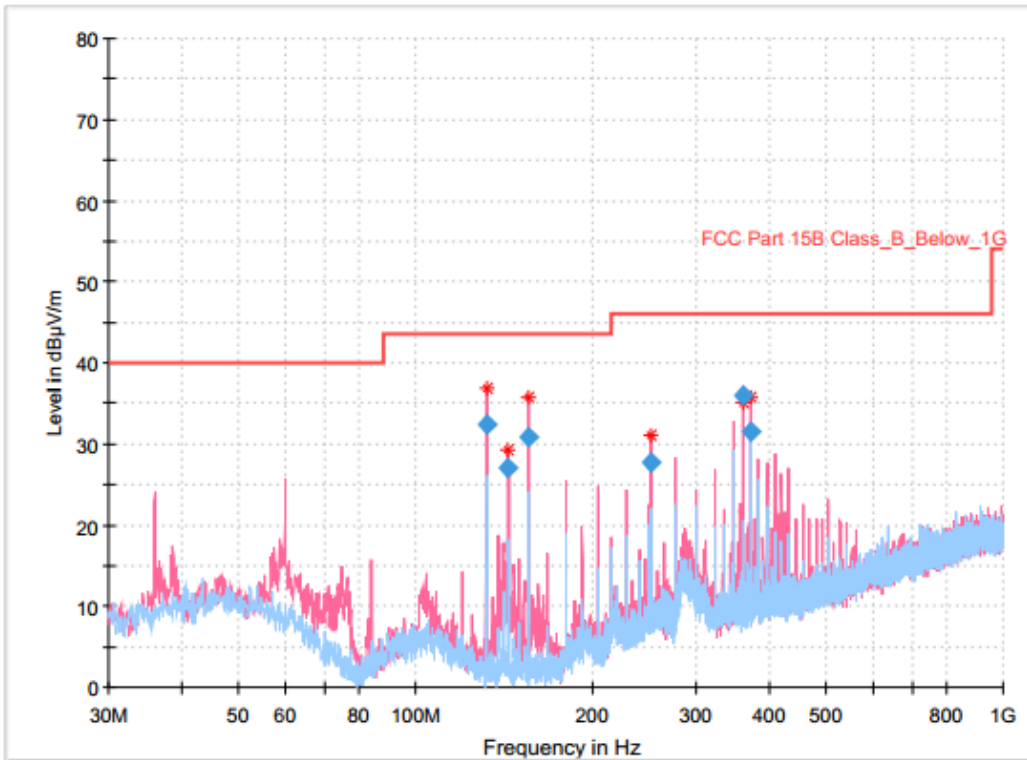


**DATA - Model : CTS-RIFD-LM21**

# Test Report

## Common Information

Test Description: 2022-3002  
 Operating Conditions: ICR 3 m Chamber  
 Operator Name: LEE S H  
 Comment: RE



## Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
131.947	32.34	43.50	11.16	1000.0	120.000	99.9	V	168.0	-27.4
143.975	27.13	43.50	16.37	1000.0	120.000	99.9	V	236.0	-27.8
156.003	30.73	43.50	12.77	1000.0	120.000	99.9	V	250.0	-27.3
252.033	27.78	46.00	18.22	1000.0	120.000	99.9	V	86.0	-22.0
359.994	36.05	46.00	9.95	1000.0	120.000	99.9	V	209.0	-19.6
372.022	31.57	46.00	14.43	1000.0	120.000	99.9	V	209.0	-18.8



## 7.2 Conducted emission

### **Definition:**

The test assesses the ability of the EUT to limit its internal noise from being present on the AC mains Power and Signal Line In / Output ports.

Test method	:	FCC Part 15.107
Test Date	:	-
Temperature, Humidity	:	-
Measurement Frequency range and RBW	:	150 kHz ~ 30 MHz
Test mode	:	-
<i>Ut</i>	:	-
Result		N/A

### **A sample calculation:**

- Corr (correction factor) = LISN Insertion loss + Cable loss

- Emission Level = meter reading + Corr

- Sample calculation;

- At Frequency:      MHz Result = Reading + Corr =      dB(μV) +      dB =      dB(μV)

(  Quasi-peak,  CISPR-Average)

- Measurement Data kept in ICR



**Limits for conducted emissions from the AC mains ports of class A equipment.**

Applicable to AC mains power port		
Frequency Range (MHz)	Quasi-Peak [dB(μV)]	CISPR-Average [dB(μV)]
0.15 ~ 0.5	79	66
0.5 ~ 30	73	60

**Limits for conducted emissions from the AC mains ports of class B equipment.**

Applicable to AC mains power port		
Frequency Range (MHz)	Quasi-Peak [dB(μV)]	CISPR-Average [dB(μV)]
0.15 ~ 0.5	66 ~ 56*	56 ~ 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

\* Decreases with the logarithm of the frequency

**Used equipments:**

Used	Equipment	Model no.	Makers	Serial no.	Next Cal.
<input type="checkbox"/>	EMI Test Receiver	ESR3	R&S	102119	2023. 04. 13
<input type="checkbox"/>	LISN(main)	ENV216	R&S	102194	2023. 04. 14
<input type="checkbox"/>	LISN(sub)	ENV216	R&S	102193	2023. 04. 14
<input type="checkbox"/>	LISN	NNLK 8130	SCHWARZBECK	05184	2023. 08. 11
<input type="checkbox"/>	LISN	NNLK 8121	SCHWARZBECK	8121-668	2022. 12. 07
<input type="checkbox"/>	HUMIDITY/TEMP. DATA RECORDER	MHT-381SD	LUTRON	AI.63101	2023. 02. 07

**Test Software:**

Used	Description	Model name	Manufacturer	Version.
<input type="checkbox"/>	EMI Test Software	EMC32	R & S	10.01.02

**Measurement Data:**

- Refer to the Next page.



**DATA**

**N/A**



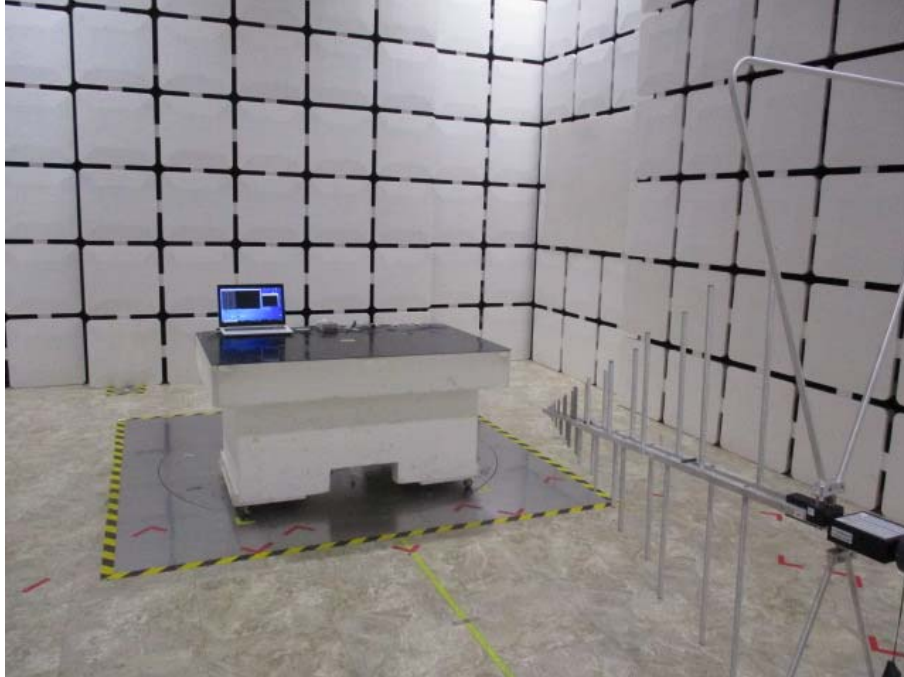
## Attachment I

### PHOTOGRAPHS

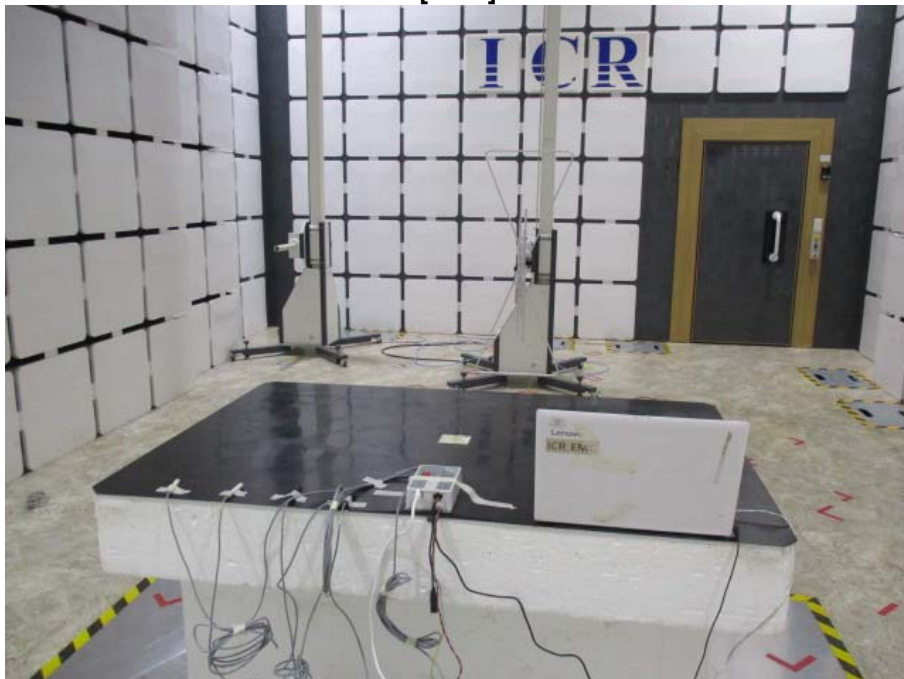


## Radiated emission (Model : CTS-RFID-LM24)

[Front]



[Rear]



## Radiated emission (Model : CTS-RIFD-LM21)

[Front]



[Rear]





**Conducted emission**

---

**[Front]**

**N/A**

---

**[Rear]**

**N/A**

## EUT (CTS-RFID-LM24)

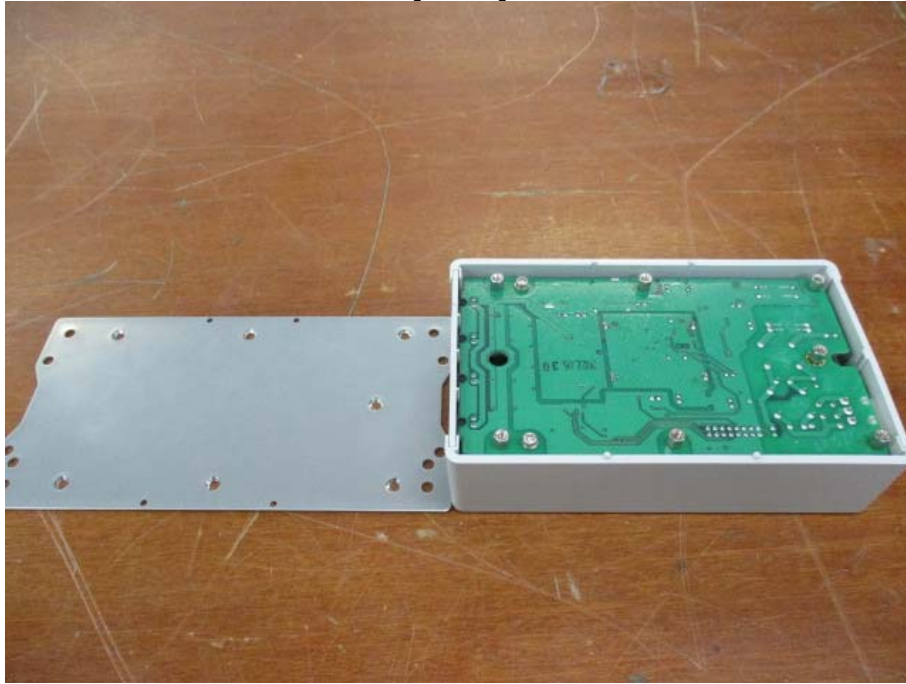
[Front]



[Rear]



[Inside]



## EUT (CTS-RIFD-LM21)

[Front]



[Rear]



[Inside]



- END -