

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No. : OT-18D-RWD-019

AGR No : A188A-427

Applicant : Milestone AV Technologies LLC

Address : 3100 North Detroit Street Warsaw, Indiana 46582, United States

Manufacturer : Shimwoo Electronics co.,LTD

Address : 5F, Yongjin Bldg, 402-1, Yangjae2-Dong, Seocho-gu, Seoul, Korea

Type of Equipment : Single Frequency Remote Control

FCC ID. : 2AREN-12501

IC Certification No. : 24449-12501

Model Name : RF REMOTE CONTROL

Serial number : N/A

Total page of Report : 19 pages (including this page)

Date of Incoming : November 07, 2018

Date of issue : December 12, 2018

SUMMARY

The equipment complies with the regulation; **FCC Part 15 Subpart C Section 15.231.**

IC RSS-Gen Issue 5 April 2018 and RSS-210 Issue 9, August 2016

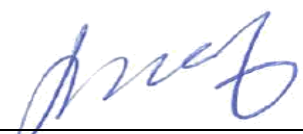
This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by:


Ki-Hong, Nam / Chief Engineer
ONETECH Corp.

Approved by:


Keun-Young, Choi / Vice President
ONETECH Corp.

CONTENTS

PAGE

1. VERIFICATION OF COMPLIANCE	4
2. TEST SUMMARY	5
2.1 TEST ITEMS AND RESULTS	5
2.2 MODEL DIFFERENCES.....	5
2.3 RELATED SUBMITTAL(S) / GRANT(S)	5
2.4 PURPOSE OF THE TEST	5
2.5 TEST METHODOLOGY.....	5
2.6 TEST FACILITY.....	5
3. GENERAL INFORMATION	6
3.1 PRODUCT DESCRIPTION.....	6
3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT.....	6
4. EUT MODIFICATIONS	6
5. SYSTEM TEST CONFIGURATION	7
5.1 JUSTIFICATION.....	7
5.2 PERIPHERAL EQUIPMENT	7
5.3 MODE OF OPERATION DURING THE TEST	7
5.4. EUT MODIFICATIONS	7
5.5 CONFIGURATION OF TEST SYSTEM.....	7
5.6 ANTENNA REQUIREMENT	7
6. PRELIMINARY TEST	8
6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....	8
6.2 GENERAL RADIATED EMISSIONS TESTS	8
7. FINAL RESULT OF MEASURMENT	9
7.1 TEST DATA	9
7.1.1 <i>Field Strength of the Carrier Test</i>	9
7.1.2 <i>Maximum Modulation Percentage (MMP)</i>	10
7.1.3 <i>Transmitter Transmission Duration</i>	12
7.1.4 <i>Spurious Emission Test</i>	13
7.1.5 <i>Bandwidth of the operating frequency</i>	16
8. FIELD STRENGTH CALCULATION	18

9. LIST OF TEST EQUIPMENT19

1. VERIFICATION OF COMPLIANCE

APPLICANT : Milestone AV Technologies LLC
 ADDRESS : 3100 North Detroit Street Warsaw, Indiana 46582, United States
 CONTACT PERSON : Ronald Knutson / Design Engineer
 TELEPHONE NO : 574-372-1382
 FCC ID : 2AREN-12501
 IC Certification No : 24449-12501
 MODEL NAME : RF REMOTE CONTROL
 BRAND NAME : -
 SERIAL NUMBER : N/A
 DATE : December 12, 2018

EQUIPMENT CLASS	DDX – Low Power Communications Transmitter
KIND OF EQUIPMENT	Single Frequency Remote Control
THIS REPORT CONCERNS	ORIGINAL GRANT
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	PRE-PRODUCTION
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	CERTIFICATION
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.231, IC RSS-Gen Issue 5 April 2018 and RSS-210 Issue 9, August 2016
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	None
FINAL TEST WAS CONDUCTED ON	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC&IC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION		TEST ITEMS	RESULTS
FCC	IC		
15.203	-	Antenna Requirement	PASS
15.209(a) 15.231(b)	RSS-210, Issue 9, Table A1	Radiated emission, Spurious Emission and Field Strength of Fundamental	PASS
15.231(c)	RSS-210, Issue 9, A1.3 RSS-GEN Issue 5, 6.7	Bandwidth Measurement	PASS
15.231(a)	RSS-210, Issue 9, A1,1(a)	Transmission Time	PASS
15.207(a)	RSS-GEN, 8.8	Conducted Emissions	N/A (See Note)

Note: This test is not performed because the EUT is operated by DC battery.

2.2 Model Differences

-. None

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.231, IC RSS-Gen Issue 5 April 2018 and RSS-210 Issue 9, August 2016

2.5 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.10: 2013 a distance of 3 meters from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The Milestone AV Technologies LLC, Model: RF REMOTE CONTROL (referred to as the EUT in this report) is a Single Frequency Remote Control. The product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Single Frequency Remote Control
RF FREQUENCY	433.92 MHz
MODULATION	ASK
LIST OF EACH OSC. OR CRY. FREQ.(FREQ.>=1 MHz)	4 MHz, 433.92 MHz
ANTENNA TYPE	Inserted into the main board (Pattern Antenna)
TRANSMISSION TIME	Not longer than 5 s
RATED SUPPLY VOLTAGE	AAA x 2, 1.5 V x 2 Battery
NUMBER OF LAYERS	Double side layer

3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC&IC
Main Board	Shimwoo Electronics co.,LTD	S-467G 387 Rev.01	N/A

5.2 Peripheral equipment

-. None

5.3 Mode of operation during the test

To get a maximum radiated emission from the EUT, the button on the EUT was continuously pressed to transmit the signal. To activate continuous transmission, place a small plastic block between rubber band and the push button on the EUT. To get a maximum emission levels from the EUT, the EUT was moved throughout the X, Y, and Z axis and the worst case is "X" axis.

5.4. EUT MODIFICATIONS

-. None

5.5 Configuration of Test System

Line Conducted Test: It is not need to test this requirement, because the EUT shall be operated by DC battery.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

Occupied Bandwidth Measurement:

This measurement is performed with the antenna located close enough to give a full-scale deflection of the modulated carrier on the spectrum analyzer. The plot is taken at 20 kHz/division frequency span, 10 kHz resolution bandwidth and 10 dB/division logarithmic display from the spectrum analyzer.

5.6 Antenna Requirement

According to section 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.

Antenna Construction:

The antenna of the EUT is a pattern antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
It is not need to test this requirement, because the power of the EUT is supplied from a DC battery.	

6.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

7. FINAL RESULT OF MEASUREMENT

7.1 Test Data

7.1.1 Field Strength of the Carrier Test

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

Humidity Level : 42 %R.H. Temperature: 24 °C
 Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.231(b)
 Type of Test : INTENTIONAL RADIATOR
 Result : PASSED

EUT : Single Frequency Remote Control Date: November 01, 2018 ~ November 07, 2018
 Operating Condition : TX mode
 Distance : 3 Meter

Radiated Emissions			Ant	Correction Factors				Total	FCC&IC	
Carrier Freq. (MHz)	Reading (dBμV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Amp Gain	Average Level Factor	Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
433.92	75.30	Average	H	16.40	4.80	33.10	-19.54	43.86	80.83	36.97
	66.20	Average	V					34.76	80.83	46.07

* Remark: To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

“H”: Horizontal Polarization, “V”: Vertical Polarization



Tested by: Tae-Ho, Kim / Senior Manager


7.1.2 Maximum Modulation Percentage (MMP)

In order to determine possible Maximum Modulation Percentage from the EUT, we measured the duty cycle according to the clause H4.(j) in ANSI C63.10: 2013

The pulse train from the EUT was consisting of long and short pulse. The measured values are as follows.

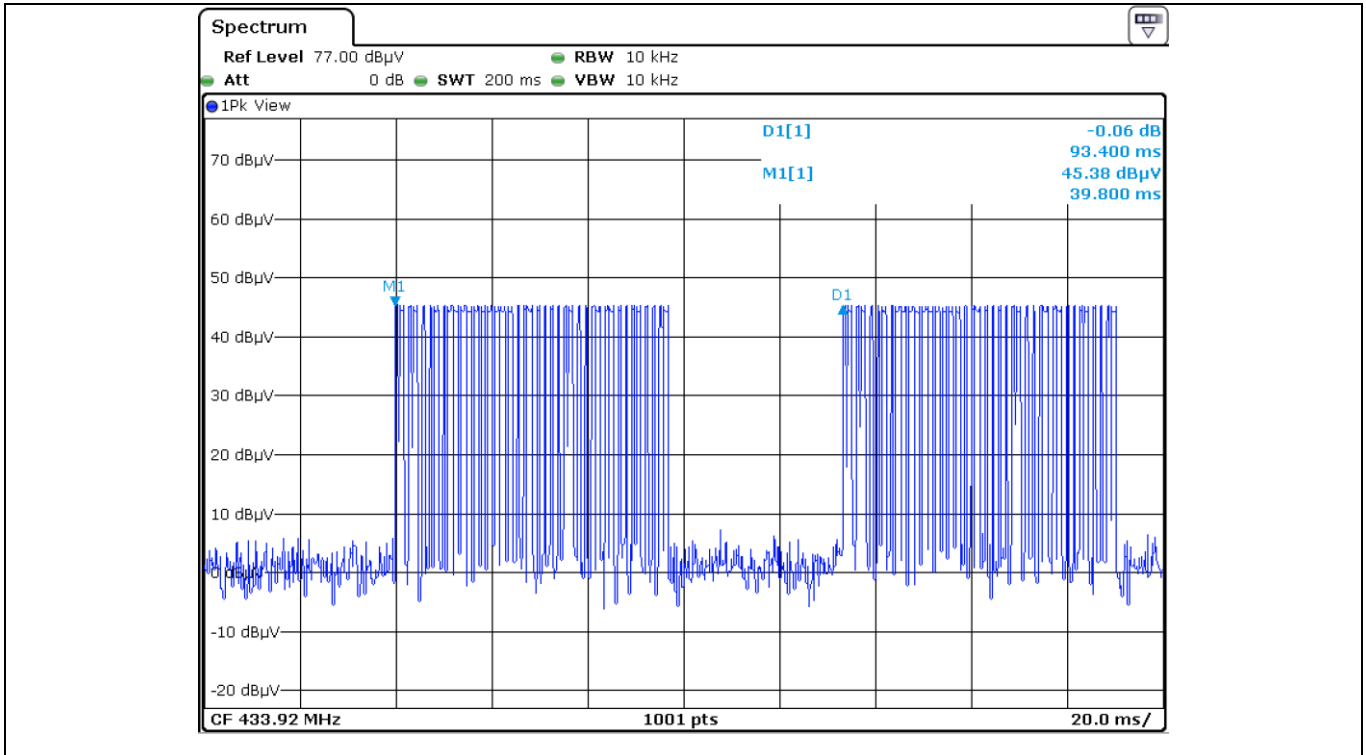
Pulse	Total sum of Pulse	Pulse Width
0.34 ms	31	93.4
Duty Cycle	$(0.34 \times 31) / 100 = 0.1054$	
Maximum Modulation Percentage(MMP)	Duty Cycle x 100 % = 10.54 %	
Average Level Factor	-19.54 dB	

Remark: Please refer to Photo Data for MMP.

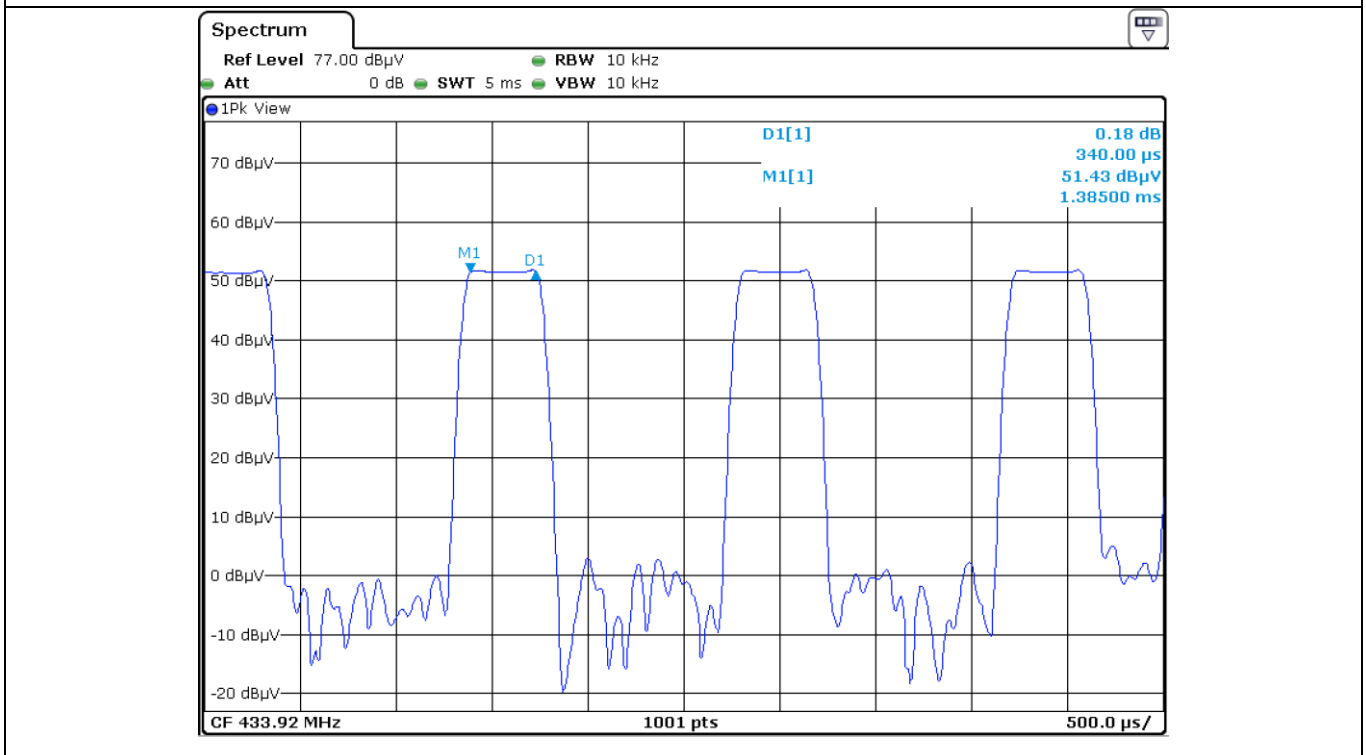


Tested by: Tae-Ho, Kim / Senior Manager

Photo Data for MMP



Pulse width



Shot Pulse

7.1.3 Transmitter Transmission Duration

Humidity Level : 42 %R.H.

Temperature: 24 °C

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.231 (a)

Type of Test : INTENTIONAL RADIATOR

EUT : Single Frequency Remote Control

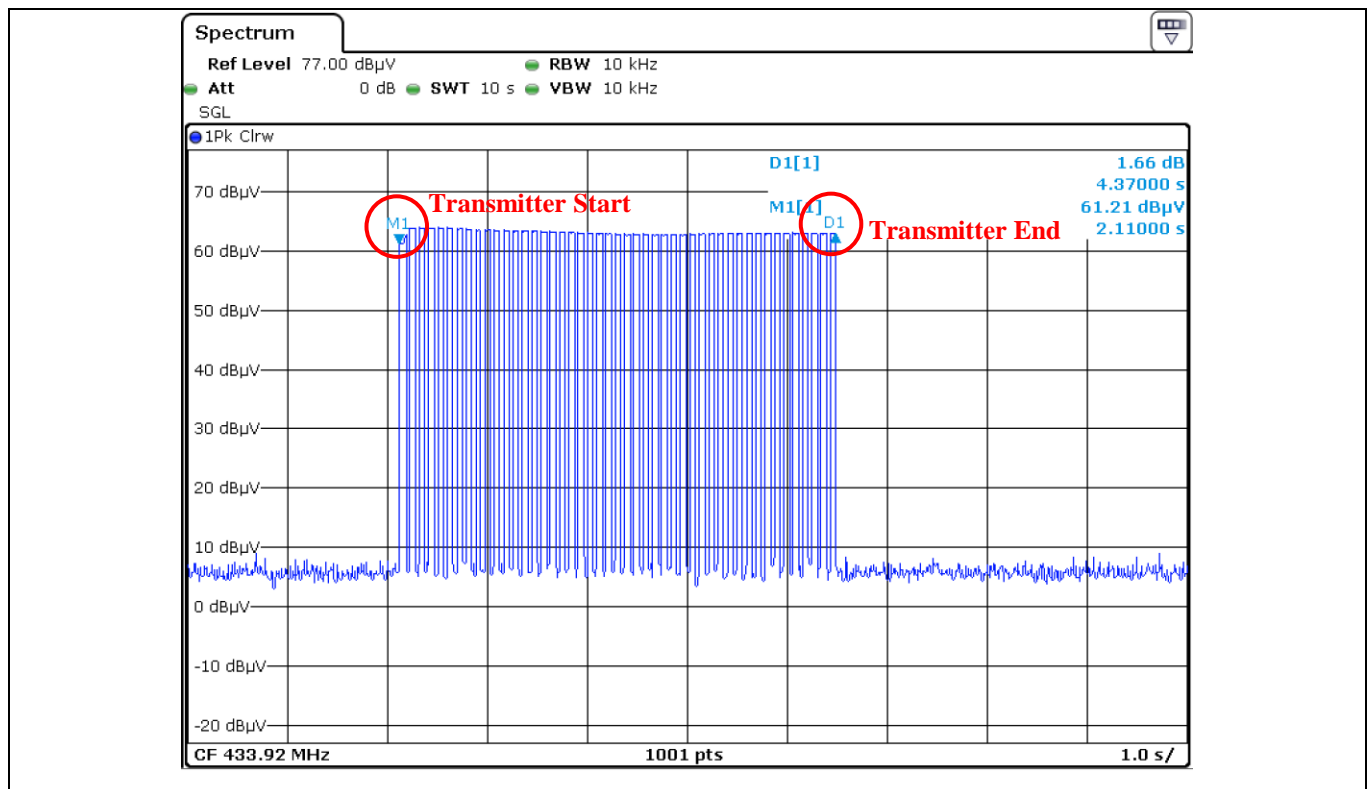
Date: November 01, 2018 ~ November 07, 2018

Operating Condition : Switch on the EUT was continuously pushed

Manually Activated Duration (s)	Limit (s)	Margin (s)	Result
4.37	5.00	0.63	Pass



Tested by: Tae-Ho, Kim / Senior Manager




7.1.4 Spurious Emission Test

7.1.4.1 Spurious Radiated Emission Below 30 MHz

Humidity Level : 42 %R.H. Temperature: 24 °C
 Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.231(b)
 Type of Test : INTENTIONAL RADIATOR
 Frequency range : 9 kHz ~ 30 MHz
 Result : PASSED

EUT : Single Frequency Remote Control Date: November 01, 2018 ~ November 07, 2018
 Operating Condition : TX mode
 Distance : 3 Meter

Radiated Emissions			Ant	Correction Factors				Total	FCC	
Carrier Freq. (MHz)	Amplitude (dBμV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Amp Gain	Average Level Factor	Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.										


 Tested by: Tae-Ho, Kim / Senior Manager

7.1.4.2 Spurious Radiated Emission 30 MHz ~ 1 000 MHz

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


Humidity Level : 42 %R.H. Temperature: 24 °C
 Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.231(b)
 Type of Test : INTENTIONAL RADIATOR
 Frequency range : 30 MHz ~ 1 000 MHz
 Result : PASSED

EUT : Single Frequency Remote Control Date: November 01, 2018 ~ November 07, 2018
 Operating Condition : TX mode
 Distance : 3 Meter

Radiated Emissions			Ant	Correction Factors				Total	FCC&IC	
Carrier Freq. (MHz)	Reading (dBμV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Amp Gain	Average Level Factor	Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
867.84	48.40	quasi-peak	H	21.80	6.90	32.60	-19.54	24.96	60.83	35.87
	36.20	quasi-peak	V					12.76	60.83	48.07

*Remark: To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

“H”: Horizontal Polarization, “V”: Vertical Polarization


 Tested by: Tae-Ho, Kim / Senior Manager

7.1.4.3 Spurious Radiated Emission above 1 GHz

Humidity Level : 42 %R.H.

Temperature: 24 °C

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.231(b)

Type of Test : INTENTIONAL RADIATOR

Frequency range : 1 000 MHz ~ 4 400 MHz

Result : PASSED


EUT : Single Frequency Remote Control

Date: November 01, 2018 ~ November 07, 2018

Operating Condition : TX mode

Distance : 3 Meter

Radiated Emissions			Ant	Correction Factors				Total	FCC&IC	
Carrier Freq. (MHz)	Amplitude (dBμV)	Detector Mode	Pol.	Antenna (dB/m)	Cable (dB)	Amp Gain	Average Level Factor	Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 735.68	45.72	Average	H	25.30	6.20	42.70	-19.54	14.98	60.83	45.85
	47.20	Average	V					16.46	60.83	44.37
2 169.60	39.51	Average	H	26.10	7.10	43.00	-19.54	10.17	60.83	50.66
	42.54	Average	V					13.20	60.83	47.63


Tested by: Tae-Ho, Kim / Senior Manager

7.1.5 Bandwidth of the operating frequency

Humidity Level : 42 %R.H.

Temperature: 24 °C

Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.231(b)

Type of Test : INTENTIONAL RADIATOR

Result : PASSED

EUT : Single Frequency Remote Control

Date: November 01, 2018 ~ November 07, 2018


Operating Condition : TX mode

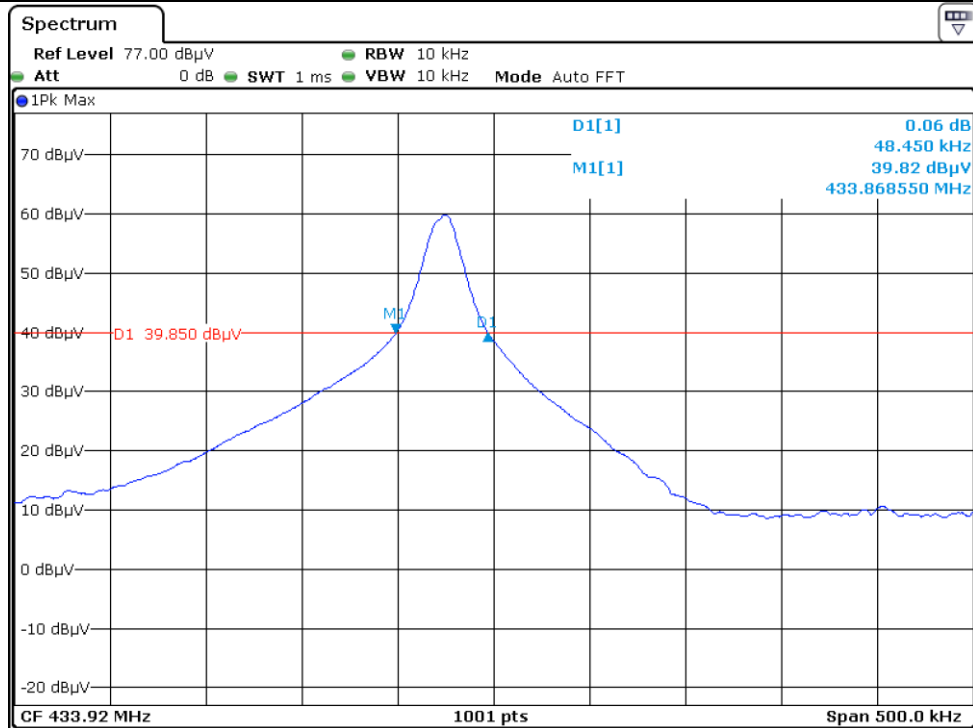
Minimum Resolution Bandwidth: 10 kHz

Carrier Freq. (MHz)	20dB Bandwidth (kHz)	99% Occupied Bandwidth (kHz)	Limit (kHz)
433.92	48.45	98.90	1 084.80

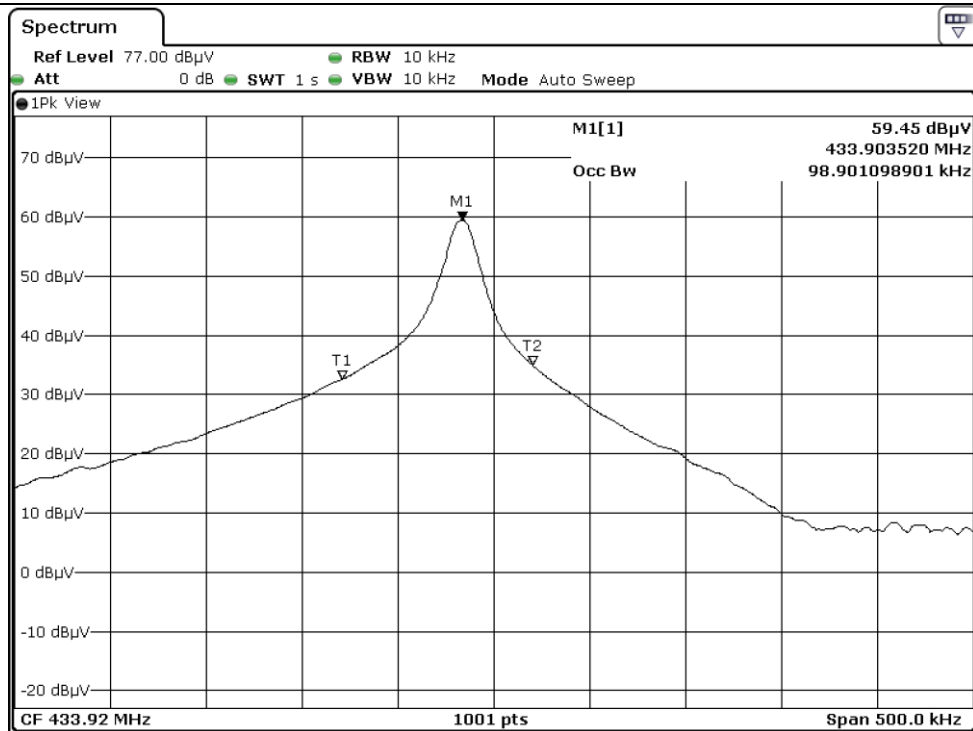
 $\text{Limit} = 0.25 \% * f(\text{MHz}) = 0.25 \% * 433.92 \text{ MHz} = 1\,084.80 \text{ kHz}$

Remark: Please refer to Photo Data for bandwidth for test data.


 Tested by: Tae-Ho, Kim / Senior Manager



20dB Bandwidth



99% Occupied Bandwidth

8. FIELD STRENGTH CALCULATION

Meter readings are compared to the specification limit correcting for antenna and cable losses

+	Meter reading	(dB μ V)
+	Cable Loss	(dB)
+	Antenna Factor	(dB/m)
-	Amplifier Gain	(dB)
=	Corrected Reading	(dB μ V/m)
	Specification Limit	(dBuV/m)
-	Corrected Reading	(dBuV/m)
=	dB Relative to Limit	(\pm dB)

9. LIST OF TEST EQUIPMENT

No.	EQUIPMENTS	MFR.	MODEL	SER. NO.	LAST CAL	DUE CAL	USE
1.	Signal Analyzer	R/S	FSV40	101009	MAR/18	12MONTH	
2.	Test Receiver	R/S	ESU	100261	MAR/18	12MONTH	■
3.	Amplifier	Schwarzbeck	BBV9718	310	MAR/18	12MONTH	■
4.	TRILOG Broadband Antenna	Schwarzbeck	VULB9163	9163-419	AUG/18	24MONTH	■
5.	Controller	Innco System	CO2000	619/27030611/L	N/A	N/A	■
6.	Turn Table	Innco System	DT3000	930611	N/A	N/A	■
7.	Antenna Master	Innco System	MA4000-EP	3320611	N/A	N/A	■
8.	Antenna Master	Innco System	MA4000-EP	3350611	N/A	N/A	
9.	Pre-Amplifier	Sonoma Instrument	310N	312544	MAR/18	12MONTH	■
10.	Horn Antenna	Schwarzbeck	BBHA9120D	BBHA9120D295	AUG/17	24MONTH	■
11.	Loop Antenna	Schwarzbeck	FMZB 1513	1513-235	MAY/18	24MONTH	■