Test Report of FCC Part 15 C for FCC Certificate

On Behalf of

Max-plus CO.,LTD

Product description:	**RF remote control (8 key)**
Model No.:	**RF-01**
FCC ID:	**2AB96RF-01**
Prepared for:	**Max-plus CO.,LTD**
	PingNan industry zone,SanXiang town,ZhongShan city, GuangDong province,China
Prepared by:	**Bontek Compliance Testing Laboratory Ltd**
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Report No.:	BCT14DR097E
Issue Date:	April 18, 2014
Test Date:	April 17~ 18, 2014

Test by:	**Reviewed By:**
Lion Cai	Owen Yang

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	**Max-plus CO.,LTD**
Address of applicant:	PingNan industry zone,SanXiang town,ZhongShan city,GuangDong province,China
Manufacturer:	**Max-plus CO.,LTD**
Address of manufacturer:	PingNan industry zone,SanXiang town,ZhongShan city,GuangDong province,China

General Description of E.U.T

Items	Description
EUT Description:	RF remote control (8 key)
Trade Name:	N/A
Model No.:	RF-01
Rated Voltage	DC 12V from Battery
Frequency range	433.63MHz
Number of channels	1
Channel Separation	None
Product Class:	Part 15 Security/Remote Control Transmitter

** The test data gathered are from the production sample provided by the manufacturer.*

1.2 Test Standards

The following Declaration of Conformity report of EUT is prepared in accordance with

FCC Rules and Regulations Part 15 Subpart C Section 15.231

The objective of the manufacturer is to demonstrate compliance with the described above standards.

1.3 Test Facility

All measurement required was performed at laboratory of Shenzhen CTL Testing Technology Co., Ltd. at Floor 1-A,Baisha Technology Park,No.3011,Shahexi Road, Nanshan District, Shenzhen, China 518055.

The test facility is recognized, certified, or accredited by the following organizations:

FCC – Registration No.: 970318

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 970318, December, 2013.

2. SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The calibrated antennas used to sample the radiated field strength are mounted on a non-conductive, motorized antenna mast 3 or 10 meters from the leading edge of the turntable.

2.3 General Test Procedures

Conducted Emissions: The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 7.1 of ANSI C63.4-2003 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak detector mode.

Radiated Emissions: The EUT is a placed on as turntable, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4-2003.

2.4 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Power Line Conducted Emission	+/- 2.3 dB
Radiated Emission	+/- 3.4 dB

Uncertainty figures are valid to a confidence level of 95%.

2.5 Test Equipment List and Details

Test equipments list of Shenzhen CTL Testing Technology Co., Ltd.

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2013/07/12	2014/07/11
EMI Test Receiver	R&S	ESCI3	103710	2013/07/10	2014/07/09
EMI Test Receiver	R&S	ESPI	1164.6407.07	2013/07/10	2014/07/09
Spectrum Analyzer	Agilent	E4407B	MY45108355	2013/07/06	2014/07/05
Controller	EM Electronics	Controller EM 1000	N/A	2013/07/06	2014/07/05
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2013/07/12	2014/07/11
Horn Antenna	SCHWARZBECK	BBHA9170	1562	2013/07/12	2014/07/11
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2013/07/12	2014/07/11
LISN	R&S	ENV216	101316	2013/07/10	2014/07/09
LISN	SCHWARZBECK	NSLK8127	8127687	2013/07/10	2014/07/09
Microwave Preamplifier	HP	8349B	3155A00882	2013/07/10	2014/07/09
Amplifier	HP	8447D	3113A07663	2013/07/10	2014/07/09
Transient Limiter	Com-Power	LIT-153	532226	2013/07/10	2014/07/09

3. SUMMARY OF TEST RESULTS

Standard	Test Items	Status	Application
Part 15 Subpart C Section 15.231	Disturbance Voltage at The Mains Terminals	x	N/A, without AC power supply
	Radiation Emission	√	
	20dB Bandwidth	√	
	Duty Cycle	√	
	Transmission time	√	
	Antennal requirement	√	

√ Indicates that the test is applicable

× Indicates that the test is not applicable

4. DISTURBANCE VOLTAGE AT THE MAINS TERMINALS

4.1 Measurement Uncertainty

All test results complied with Section 15.207 requirements. Measurement Uncertainty is 2.4 dB.

4.2 Applicable Standard

Section 15.207: For a Low-power Radio-frequency Device is designed to be connected to the AC power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed below limits table.

Frequency Range (MHz)	Limits (dBuV)	
	Quasi-Peak	Average
0.150～0.500	66～56	56～46
0.500～5.000	56	46
5.000～30.00	60	50

4.3 Test Description

The EUT is excused from investigation of Disturbance Voltage at The Mains Terminals, for it is powered by a DC 12V bettary. According to the Section 15.207(d),measurement to demonstrate compliance with the limits of Disturbance Voltage at The Mains Terminals are not required to the devices which only employed bettary power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

5. RADIATED DISTURBANCES

5.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is ±3.4 dB.

5.2 Limit of Radiated Disturbances

According to 15.231(b), In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental		Field Strength of Spurious	
	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)
40.66 - 40.70	67.04	2,250	47.04	225
70 - 130	61.94	1,250	41.94	125
130 - 174	* 61.94 - 71.48	* 1,250 -3,750	* 41.94 - 51.48	* 125 - 375
174 - 260	71.48	3,750	51.48	375
260 - 470	* 71.48 - 81.94	* 3,750 - 12,500	* 51.48 - 61.94	* 375 - 1,250
above 470	81.94	12,500	61.94	1,250

** linear interpolations

Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, uV/m at 3 meters = 56.81818(F) - 6136.3636; for band 260-470 MHz, uV/m at 3 meters = 41.6667(F) - 7083.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.

5.3 EUT Setup

The radiated emission tests were performed in the in the 3-meter anechoic chamber, using the setup accordance with the ANSI C63.4-2009. The specification used was the FCC Part 15 Subpart B limits.

The EUT was placed on the center of the test table. In the frequency range below 1 GHz, Ultra-Broadband Antenna horn-antenna is used. In the frequency range above 1 GHz horn-antenna is used. Test setup refer to Section 2.4 Basic Test Setup Block Diagram of this report.

Maximum emission emitted from EUT was determined by manipulating the EUT, support equipment, interconnecting cables and varying the mode of operation and the levels in the final result of the test were recorded with the EUT running in the operating mode that maximum emission was emitted.

5.4 Test Receiver Setup

According to FCC Part 15 rule, the frequency was investigated from 30 to 4000 MHz.During the radiated emission test, the test receiver was set with the following configurations:

Test Receiver Setting for frequency range below 1000MHz:

Detector……..Peak & Quasi-Peak
IF Band Width……..100KHz
Frequency Range……30MHz to 1000MHz
Turntable Rotated……0 to 360 degrees

Test Receiver Setting for frequency range above 1000MHz:

Detector……..Peak
IF Band Width……..1MHz
Frequency Range……1000MHz to 4000MHz
Turntable Rotated……0 to 360 degrees

Antenna Position:

Height……1m to 4m
Polarity……...Horizontal and Vertical

5.5 Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

1). Configure the EUT according to ANSI C63.4:2009.

2). The EUT was placed on the top of the turntable 0.8 meter above ground.

3). The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.

4). Power on the EUT and all the supporting units.

5). The turntable was rotated by 360 degrees to determine the position of the highest radiation.

6). The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emission field strength of both horizontal and vertical polarization.

7). For each suspected emission, the antenna tower was scanned (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.

8). Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode. Then all data was recorded in the peak detection mode. Quasi-peak readings performed only when an emission was found to be marginal (within -10 dBμV of specification limits), and are distinguished with a "**QP**" in the data plots.

5.6 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude Indicated reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Transd.

Transd.= Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBμV means the emission is 7dBμV below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. –Limit

5.7 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

Average Value = Peak Value + Duty Cycle Correction Factor

5.8 Radiated Emissions Test Result

Temperature (℃) : 22~23	EUT: RF remote control (8 key)
Humidity (%RH): 50~54	M/N: RF-01
Barometric Pressure (mbar): 950~1000	Operation Condition: Transmitting

433.63MHz Tx in operation										
Maximum Frequency	Emission						Limit		Margin	
(MHz)	Position and Level									
	Polarity	m	Deg°	Transd	Peak	AV	Peak	AV/QP	(dB)	
					(dBμV/m)	(dBμV/m)	(dBμV/m)	(dBμV/m)		
47.46	H	1.4	158	15.8	22.9			40	-17.1	QP
59.1	H	1.2	177	14.6	20.8			40	-19.2	QP
103.72	H	1.6	251	17.1	22.4			43.5	-21.1	QP
433.63	H	1.3	24	22	82.6	73.38	100.82	80.82	-7.44	QP
868.08	H	1.4	136	28.8	52.9	43.68		60.82	-17.14	AV
893.3	H	1.7	85	29.1	32.5			46	-13.5	AV
1300.89	H	1.8	94	-8.61	44.6	35.38		54.00*	-18.62	AV
1734.52	H	1.3	138	-7.52	40.5	31.28		60.82	-29.54	AV
2169.95	H	---	---	---	---	---		60.82	---	
2603.94	H	---	---	---	---	---		60.82	---	
3037.93	H	---	---	---	---	---		60.82	---	
3471.92	H	---	---	---	---	---		60.82	---	
3905.91	H	---	---	---	---	---		60.82	---	
4339.91	H	---	---	---	---	---		60.82	---	

Remark：

(1) In this testing, the EUT was respectively tested in three different orientations. That is:

(1) EUT was lie vertically, and then its Antenna oriented upward
(2) EUT was lie vertically, and then its Antenna oriented downward
(3) EUT was lie flatwise, and then its Antenna oriented to the receiving antenna

When the EUT was lie flatwise, and its Antenna oriented to the receiving antenna, the worst test data was got as following table.

(2) Measuring frequencies from 30 MHz to the 10th harmonic of fundamental frequency of 433.63 MHz。

(3) Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

(4) * denotes spurious frequency which falls within the Restricted Bands specified in provision of § 15.205, then the general radiated emission limits in § 15.209 apply.

(5) Spectrum Setting : 30MHz – 1000MHz , RBW= 100KHz, VBW=100KHz, Sweep time = 200 ms. 1GHz- 8GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms

433.63MHz Tx in operation										
Maximum Frequency	Emission						Limit		Margin	
(MHz)	Position and Level									
	Polarity	m	Deg°	Transd	Peak	AV	Peak	AV/QP	(dB)	
					(dBμV/m)	(dBμV/m)	(dBμV/m)	(dBμV/m)		
47.46	V	1.2	187	15.8	25.9			40	-14.1	QP
59.1	V	1.1	269	14.6	20.4			40	-19.6	QP
103.72	V	1.5	138	17.1	21.4			43.5	-22.1	QP
433.63	V	1.5	65	22	69.3	60.08	100.82	80.82	-20.74	AV
868.08	V	1.2	155	28.8	50.1	40.88		60.82	-19.94	AV
893.3	V	1.3	238	29.1	30.6			46	-15.4	AV
1300.89	V	1.3	254	-8.61	42.37	33.15		54.00*	-20.85	AV
1734.52	V	1.4	158	-7.52	40.8	31.58		60.82	-29.24	AV
2169.95	V	---	---	---	---	---		60.82	---	
2603.94	V	---	---	---	---	---		60.82	---	
3037.93	V	---	---	---	---	---		60.82	---	
3471.92	V	---	---	---	---	---		60.82	---	
3905.91	V	---	---	---	---	---		60.82	---	
4339.91	V	---	---	---	---	---		60.82	---	

Remark：

(1) In this testing, the EUT was respectively tested in three different orientations. That is:

(1) EUT was lie vertically, and then its Antenna oriented upward
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(3) EUT was lie flatwise, and then its Antenna oriented to the receiving antenna

When the EUT was lie flatwise, and its Antenna oriented to the receiving antenna, the worst test data was got as following table.

(2) Measuring frequencies from 30 MHz to the 10th harmonic of fundamental frequency of 433.63 MHz。

(3) Data of measurement within this frequency range shown " - " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

(4) * denotes spurious frequency which falls within the Restricted Bands specified in provision of § 15.205, then the general radiated emission limits in § 15.209 apply.

(5) Spectrum Setting : 30MHz – 1000MHz , RBW= 100KHz, VBW=100KHz, Sweep time = 200 ms. 1GHz- 8GHz, RBW= 1MHz, VBW= 1MHz, Sweep time= 200 ms

6. 20dB BANDWIDTH

6.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is ±3.4 dB.

6.2 Limit of 20dB Bandwidth

In accordance with Part15.231(c), the fundamental frequency bandwidth was kept within 0.25% of the center frequency for devices operating>70MHz and <900MHz.

Fundamental Frequency (MHz)	Limit of 20dB Bandwidth (kHz)
433.63	433630x0.0025=1084.075

6.3 EUT Setup

The radiated emission tests were performed in the in the 3-meter anechoic chamber, using the setup accordance with the ANSI C63.4-2003.

The EUT was placed on the center of the nonmetal table which is 0.8 meter above a grounded turntable. The turntable can rotate 360 degrees to determine the azimuth of the maximum emission level.

Maximum emission emitted from EUT was determined by manipulating the EUT, support equipment, interconnecting cables and varying the mode of operation and the levels in the final result of the test were recorded with the EUT running in the operating mode that maximum emission was emitted.

6.4 Test Procedure

1) Turn on the transmitter, and set it to transmit the pulse train continuously.

2) Set Test Receiver into spectrum analyzer mode, Tune the spectrum analyzer to the transmitter carrier frequency, and set the spectrum analyzer resolution bandwidth(RBW) to 100kHz and video bandwidth(VBW) to 100kHz, then select Peak function to scan the channel frequency.

3) The 20dB bandwidth was measured and recorded.

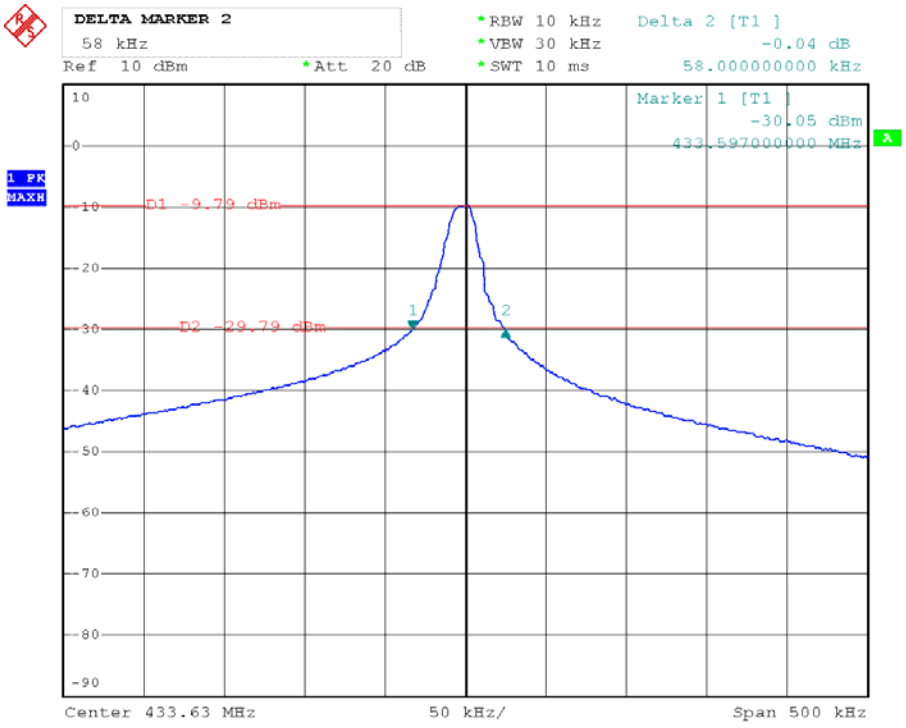
Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

6.5 Emissions within Band Edges Test Result

Temperature (℃) : 22~23	EUT: RF remote control (8 key)
Humidity (%RH): 50~54	M/N: RF-01
Barometric Pressure (mbar): 950~1000	Operation Condition: Transmitting

Test plots see following pages

Fundamental Frequency (MHz)	20dB Bandwidth (kHz)	Maximum Limit (kHz)	Pass/Fail
433.63	58	1084.075	Pass



7. Duty Cycle

7.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is ±3.4 dB.

7.2 EUT Setup

The radiated emission tests were performed in the in the 3-meter anechoic chamber, using the setup accordance with the ANSI C63.4-2009

The EUT was placed on the center of the nonmetal table which is 0.8 meter above a grounded turntable. The turntable can rotate 360 degrees to determine the azimuth of the maximum emission level.

7.3 Test Procedure

1) The EUT was placed on a turntable which is 0.8m above ground plane.

2) Set EUT operating in continuous transmitting mode

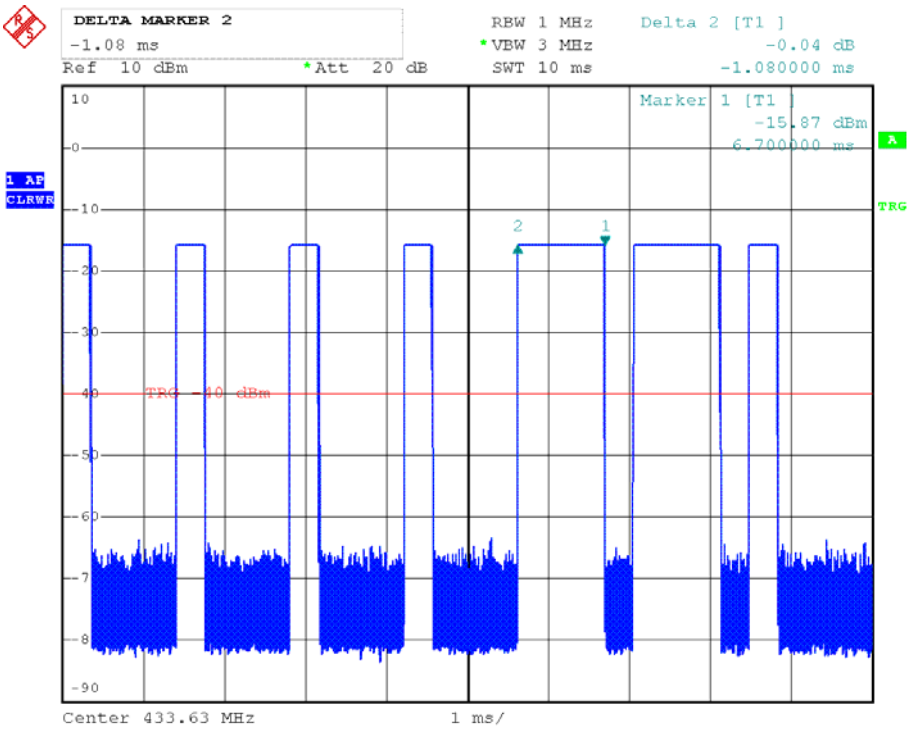
3) Set Test Receiver into spectrum analyzer mode, Tune the spectrum analyzer to the transmitter carrier frequency, and set the spectrum analyzer resolution bandwidth(RBW) to 1000kHz and video bandwidth(VBW) to 1000kHz, Span was set to 0Hz.

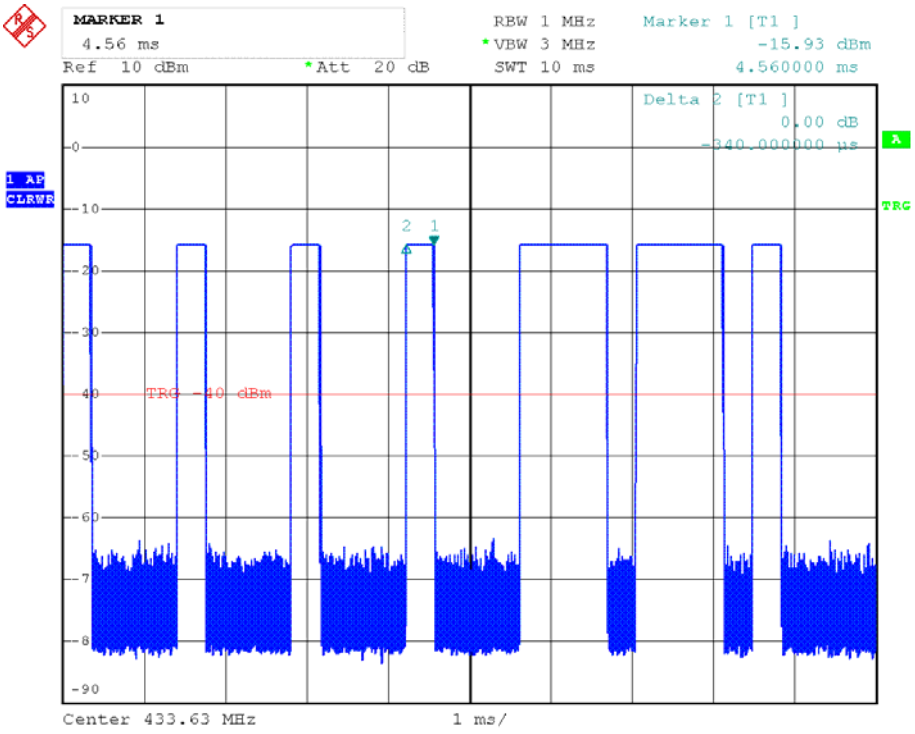
4) The Duty Cycle was measured and recorded.

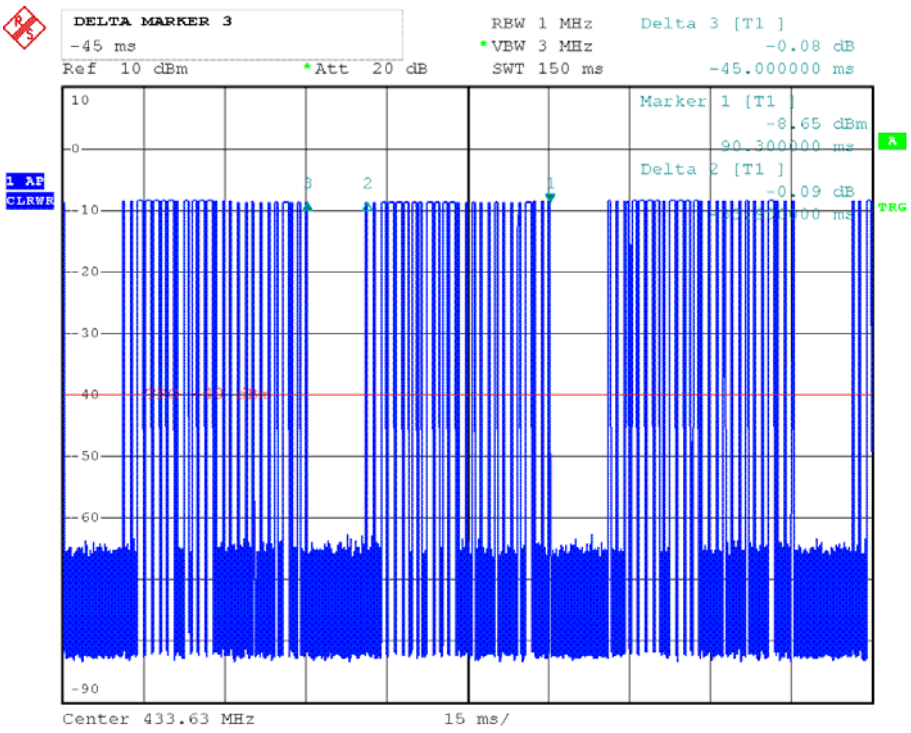
7.4 Measurement Result

Temperature (℃) : 22~23	EUT: RF remote control (8 key)
Humidity (%RH): 50~54	M/N: RF-01
Barometric Pressure (mbar): 950~1000	Operation Condition: Transmitting

The Duty Cycle= (0.34* 14+ 1.08*10)/45= 34.58%
Then the Duty Cycle Correction Factor derived from the 34.58% is: 20 Log.3458= -9.22dB
This value is used to adjust the average corrected value.


DELTA MARKER 2
-1.08 ms
RBW 1 MHz
*VBW 3 MHz
SWT 10 ms
Delta 2 [T1]
-0.04 dB
-1.080000 ms
Ref 10 dBm
*Att 20 dB
Marker 1 [T1]
-15.87 dBm
6.700000 ms
1 AP
CLRWR
A
TRG
TRG -40 dBm
Center 433.63 MHz
1 ms/


MARKER 1
4.56 ms
RBW 1 MHz
*VBW 3 MHz
SWT 10 ms
Marker 1 [T1]
-15.93 dBm
4.560000 ms
Ref 10 dBm
*Att 20 dB
Delta 2 [T1]
0.00 dB
-340.000000 µs
1 AP
CLRWR
A
TRG
TRG -40 dBm
Center 433.63 MHz
1 ms/


DELTA MARKER 3
-45 ms
RBW 1 MHz
*VBW 3 MHz
SWT 150 ms
Delta 3 [T1]
-0.08 dB
-45.000000 ms
Ref 10 dBm
*Att 20 dB
Marker 1 [T1]
-8.65 dBm
90.300000 ms
Delta 2 [T1]
-0.09 dB
1 AP
CLRWR
TRG
10
0
-10
-20
-30
-40
-50
-60
-90
Center 433.63 MHz
15 ms/

8. Transmission Time

8.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is +3.4 dB.

8.2 EUT Setup

The radiated emission tests were performed in the in the 3-meter anechoic chamber, using the setup accordance with the ANSI C63.4-2009.

The EUT was placed on the center of the nonmetal table which is 0.8 meter above a grounded turntable. The turntable can rotate 360 degrees to determine the azimuth of the maximum emission level.

8.3 Test Procedure

3) The EUT was placed on a turntable which is 0.8m above ground plane.

4) Set EUT operating in continuous transmitting mode

3) Set Test Receiver into spectrum analyzer mode, Tune the spectrum analyzer to the transmitter carrier frequency, and set the spectrum analyzer resolution bandwidth(RBW) to 1000kHz and video bandwidth(VBW) to 1000kHz, Span was set to 0Hz.

5) The Transmission time was measured and recorded.

8.4 Limit of Transmission time

In accordance with Part15.231(a)(2), A transmitter activated automatically shall cease transmission within 5 seconds after activation

Fundamental Frequency (MHz)	Limit of Transmission (S)
433.946	5

8.5 Transmission Time Test Result

Temperature (℃) : 22~23	EUT: RF remote control (8 key)
Humidity (%RH): 50~54	M/N: RF-01
Barometric Pressure (mbar): 950~1000	Operation Condition: Transmitting

Test plots see following pages

Fundamental Frequency (MHz)	Transmission time (S)	Maximum Limit (S)	Pass/Fail
433.63	2.52	5	Pass

9. ANTENNA REQUIREMENT

9.1 Standard Applicable

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. 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.

9.2 Antenna Connected Construction

The antenna connector is designed with permanent attachment and no consideration of replacement.