

TEST REPORT

Applicant Name & : NINGBO LINSHENG ELECTRIC CO.,LTD
Address : Xiao Dong Industrial Park,Yuyao City,Zhejiang China 315409

Sample Description

Product : REMOTE CONTROL
FCC ID : 2AL50-WELL
Model No. : LTR02
Electrical Rating : DC 3V
Frequency : 433.92MHz

Date Received : 01 April 2017
Date Test Conducted : 01 April 2017 – 15 May 2017
Test standards : 47 CFR PART 15 Subpart C: 2015 section 15.231

Test Result : Pass

Conclusion : The submitted samples complied with the above rules/standards.

Remark : TRF No.: FCC part 15.231-a Effective date: 01 July 2016

*****End of Page*****

Prepared and Checked By:

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18 May 2017 *Date*

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Report No.: 170401141GZU-001
Issued: 2017-5-18

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1.0 Summary of Test

TEST	TEST REQUIREMENT	TEST METHOD	RESULT
Radiated Emission	FCC PART 15 section 15.231(b)	ANSI C 63.10: Clause 6.4, 6.5 and 6.6	PASS
Occupied Bandwidth	FCC PART 15 section 15.231(c)	ANSI C 63.10: Clause 6.9	PASS
Dwell Time	FCC PART 15 section 15.231(a)	FCC PART 15: Section 15.231(a)	PASS
Remark: N/A: not applicable. Refer to the relative section for the details. EUT: In this whole report EUT means Equipment Under Test. Tx: In this whole report Tx (or tx) means Transmitter. Rx: In this whole report Rx (or rx) means Receiver. RF: In this whole report RF means Radio Frequency. ANSI C63.10: the detail version is ANSI C63.10:2013 in the whole report.			



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2.0 General Description

2.1 Product Description

Operating Frequency	433.92 MHz
Type of Modulation:	ASK modulated by internal signal
Antenna Type	Integral
Antenna gain:	-2 dBi
Function:	Wireless control with 433.92 MHz as carrier.
Power Supply:	DC 3 V for remote control
Power cord:	Power by battery



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2.3 Test Methodology

Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans and final tests were performed in the semi-anechoic chamber to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise.

2.4 Test Facility

All of the tests are performed at:

Intertek Testing Services Shenzhen Ltd. Guangzhou Branch

Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD Guangzhou, China.

This test facility and site measurement data have been fully placed on file with the FCC, test firm registration number is 549654.

3.0 System Test Configuration

3.1 Justification

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, it was powered by DC 4.5V supply.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

Number of fundamental frequencies to be tested in EUT transmit band

Frequency range in which device operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

Frequency range of radiated emission measurements

Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

Remark: Test frequency is 433.92MHz.



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3.2 EUT Exercising Software

N/A

3.3 Special Accessories

No special accessories used.

3.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Occupied Bandwidth	2.3%
2	Spurious Emission (TX)-Radiated	4.7 dB (25 MHz-1 GHz)
		4.8 dB (1 GHz-18 GHz)
3	Time	1.2%

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

Uncertainty and Compliance – Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

3.5 Equipment Modification

Any modifications installed previous to testing by NINGBO LINSHENG ELECTRIC CO.,LTD
Will be incorporated in each production model sold / leased in the United States

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch.

3.6 Support Equipment List and Description

This product was tested as an independent unit. It operated in continues transmit mode.

4.0 Measurement Results

4.1 Antenna Requirement:

Standard requirement

15.203 requirement:

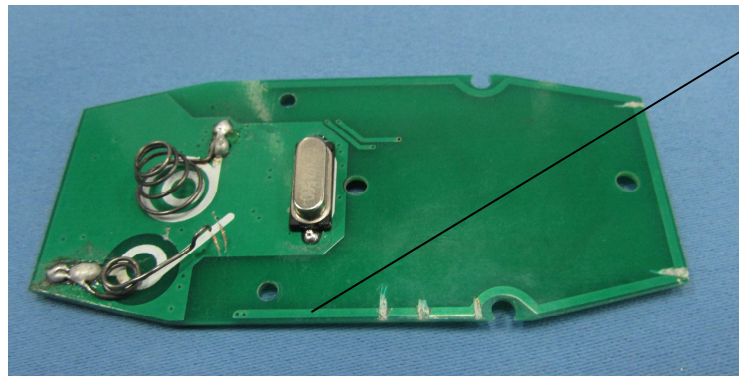
For intentional device. According to 15.203. an intentional radiator shall be designed to
Ensure that no antenna other than that furnished by the responsible party shall be used with
the device.

EUT Antenna

FCC ID: 2AL5O-WELL

TRF No.: FCC part 15.231-a

The antenna is an integral antenna and no consideration of replacement. The best case gain of the antenna is 0 dBi.



Antenna

4.2 Radiated Emissions

Test Requirement:	FCC Part 15 C section 15.231(b)
Test Method:	ANSI C63.10: Clause 6.4, 6.5 and 6.6
Measurement Distance:	3 m (Semi-Anechoic Chamber)
Test Status:	Test the transmitter in continuous transmitting mode.
Test site:	Measurement Distance: 3m (Semi-Anechoic Chamber)
Limit:	The field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

Fundamental Frequency MHz	Field Strength of Fundamental (dB μ V/m @ 3 m)	Field Strength of Harmonics and Spurious Emissions (dB μ V/m @ 3 m)
40.66 to 40.70	67.04	47.04
70 to 130	61.94	41.94
130 to 174	61.94 to 71.48**	41.94 to 51.48**
174 to 260	71.48	51.48
260 to 470	71.48 to 81.94**	51.48 to 61.94**
Above 470	81.94	61.94

** 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, μ V/m at 3 meters = $56.81818(F) - 6136.3636$; for the band 260-470 MHz, μ V/m at 3 meters = $41.6667(F) - 7083.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

The fundamental frequency of the EUT is 433.92 MHz

The limit for average or QP field strength dB μ V/m for the fundamental emission= 80.8 dB μ V/m

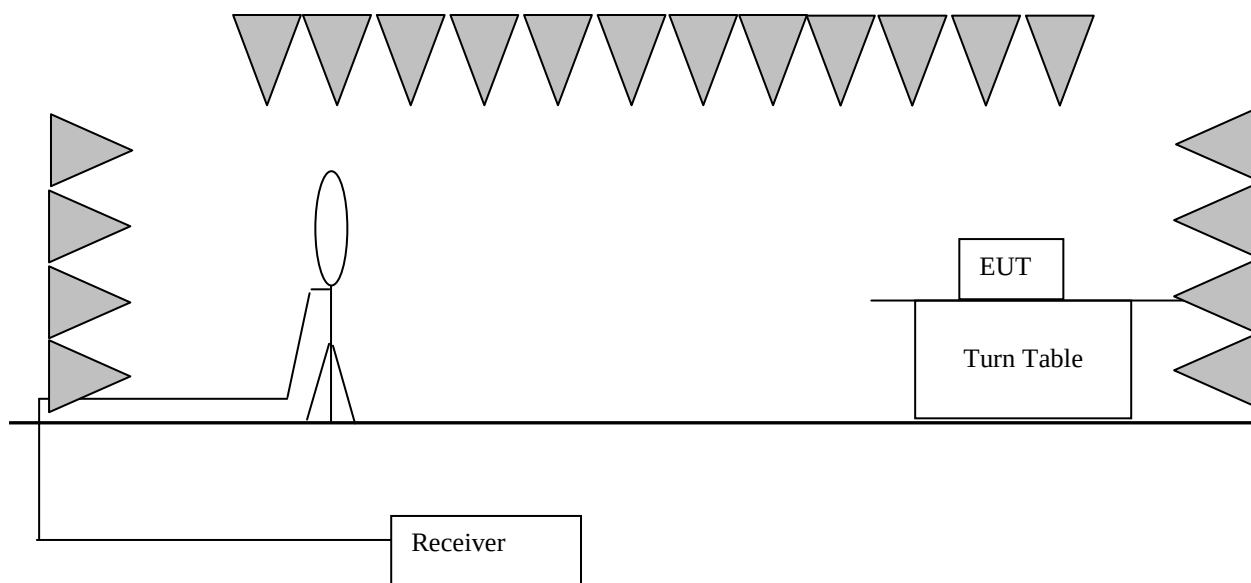
No fundamental is allowed in the restricted bands.

The limit for average field strength dB μ V/m for the spurious emission=60.8 dB μ V/m. Spurious Emissions do not fall in the restricted bands must be less than 60.8 dB μ V/m or limits shown in Section 15.209, whichever limit permits a higher field strength.

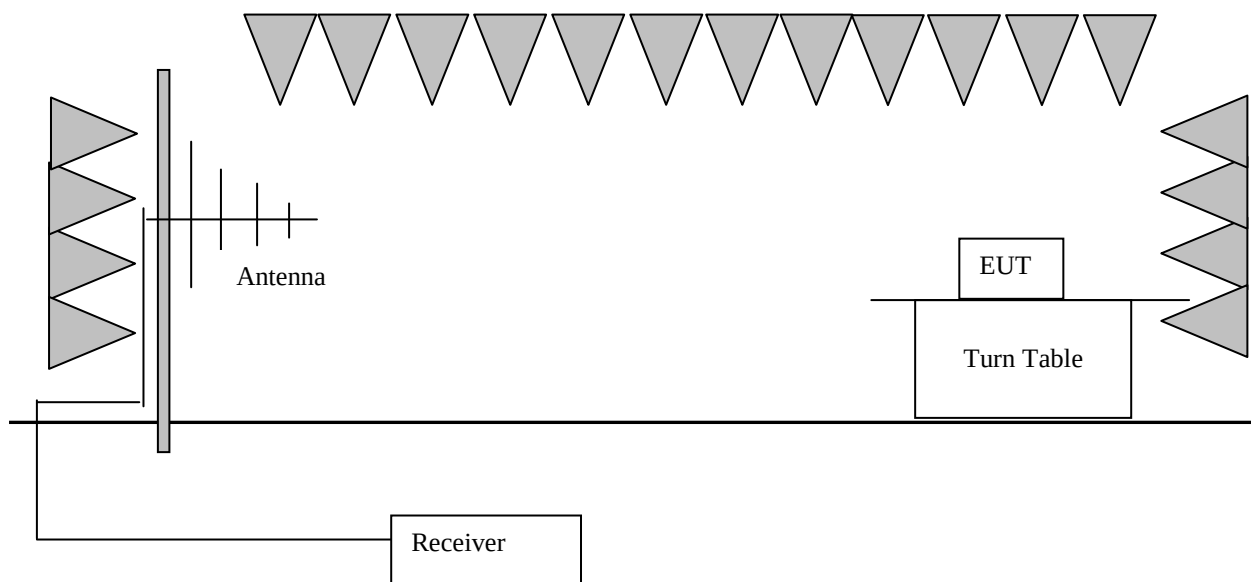
Spurious Emissions appear within the restricted bands shall not exceed the limits shown in Section 15.209.

Test Configuration:

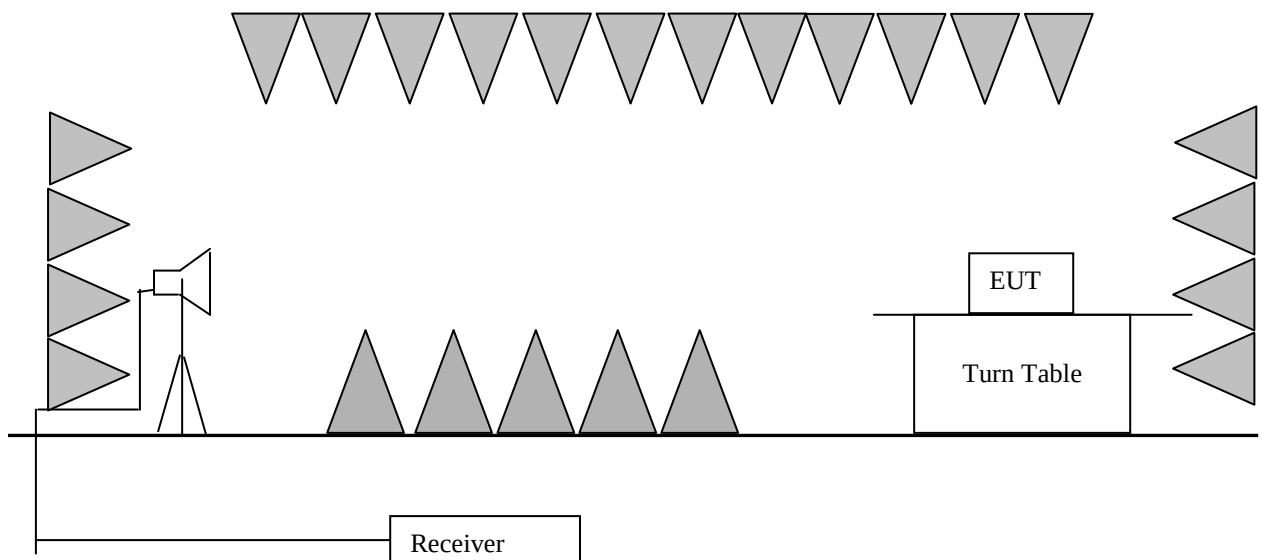
1) 9 kHz to 30 MHz emissions:



2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 40 GHz emissions:



Test Procedure:

1) 9 kHz to 30 MHz emissions:

For testing performed with the loop antenna. The centre of the loop was positioned 1 m above the ground and positioned with its plane vertical at the special distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.

2) 30 MHz to 1 GHz emissions:

For testing performed with the bi-log type antenna. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

3) 1 GHz to 40 GHz emissions:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2010 was used to perform radiated emission test above 1 GHz.

For testing performed with the horn antenna. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

Detector: For Peak and Quasi-Peak value:
RBW = 1 MHz for $f \geq 1$ GHz,

200 Hz for 9 kHz to 150 kHz
9 kHz for 150 kHz to 30 MHz
120 kHz for 30 MHz to 1GHz
VBW $\geq$ RBW
Sweep = auto
Detector function = peak for $f \geq 1$ GHz, QP for $f < 1$ GHz
Trace = max hold
For AV value:
Average = Peak value + $20\log$ (Duty cycle)

The average correction factor is computed by analyzing the on time in 100ms over one complete pulse train. Analysis of the remote transmitter on time in one complete pulse train, therefore the average value of fundamental frequency is: Average = Peak value + $20\log$ (Duty cycle), where the duty factor is calculated from following formula:

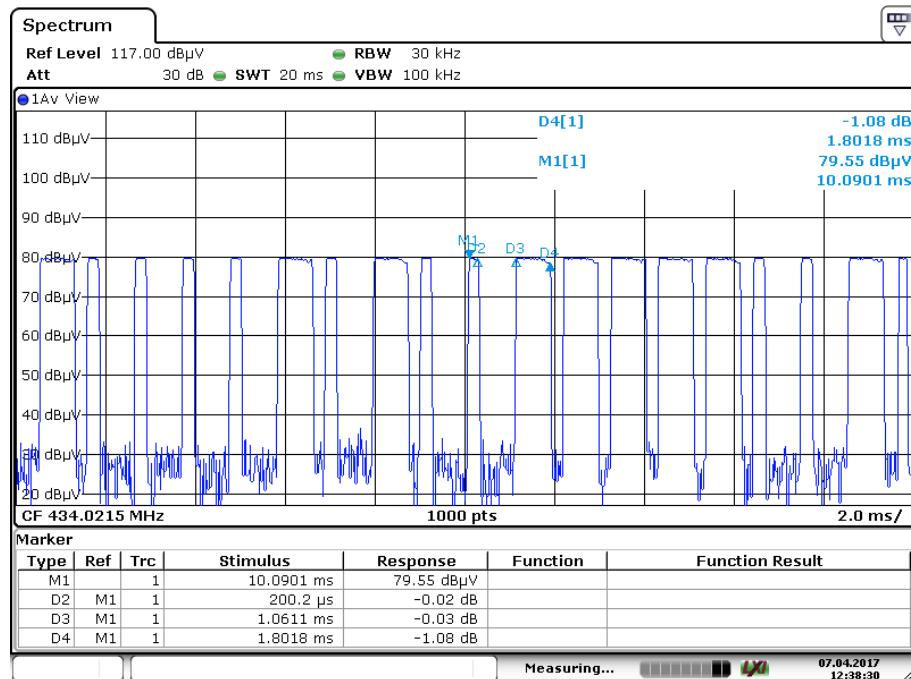
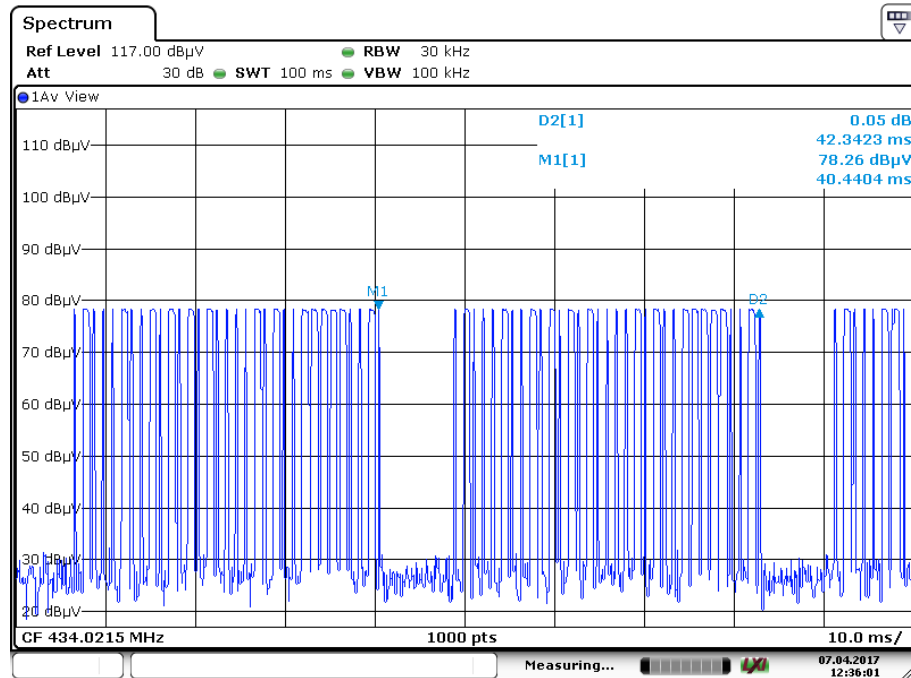
The duration of one cycle =40.44ms

Effective period of the cycle =(0.2x20+0.74x14) ms=14.36 ms

DC =14.36/40.44=0.3550 or 35.5%

Therefore, the averaging factor is found by $20\log 0.3550=-8.99$

Please refer to below plots for more details. The worst case found on the “B H” Key



1) Fundamental emission:

Antenna polarization: Horizontal:

Frequency (MHz)	Read Level (dBuV)	Correction Factor (dB)	Level (dBuV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Remark
433.92	34.29	18.30	52.59	100.80	-48.21	Peak
433.92	52.59	-8.99	43.60	80.80	-37.20	Average

Antenna polarization: Vertical

Frequency (MHz)	Read Level (dBuV)	Correction Factor (dB)	Level (dBuV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Remark
433.92	32.13	18.30	50.43	100.80	-50.37	Peak
433.92	50.43	-8.99	41.44	80.80	-39.36	Average

2) other emissions:

The receiver was scanned from the lowest frequency generated within the EUT to 5 GHz.

The field strength is calculated by adding the Antenna Factor, Cable Factor & Peramplifier.

The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Correct Factor

Correct Factor = Antenna Factor + Cable Factor – Peramplifier Factor.

The following test results were performed on the EUT.

Since the peak emission level is lower than the average limit, the average emission level does not need to show.

Test the EUT in transmitting mode:

9 kHz~30 MHz Field Strength of Unwanted Emissions. Peak and Average or Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

Horizontal

Frequency (MHz)	Read Level (dBuV)	Correction Factor (dB)	Level (dBuV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Remark
868.08	37.49	25.20	62.69	80.80	-18.11	Peak
868.08	62.69	-8.99	53.70	60.80	-7.10	AV
1301.87	71.11	-13.20	57.91	74.00	-16.09	Peak
1301.87	57.91	-8.99	48.92	54.00	-5.08	AV
1735.60	58.83	-10.30	48.53	60.80	-12.27	Peak
2170.62	70.17	-7.70	62.47	80.80	-18.33	Peak
2170.62	62.47	-8.99	53.48	60.80	-7.32	AV

Vertical

Frequency (MHz)	Read Level (dBuV)	Correction Factor (dB)	Level (dBuV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Remark
868.08	29.35	25.20	54.55	80.80	-26.25	Peak
868.08	54.55	-8.99	45.56	60.80	-15.24	AV
1301.87	75.35	-13.20	62.15	74.00	-11.85	Peak
1301.87	62.15	-8.99	53.16	54.00	-0.84	AV
1735.78	65.76	-10.30	55.46	60.80	-5.34	Peak
2170.60	69.03	-7.70	61.33	80.80	-19.47	Peak
2170.60	61.33	-8.99	52.34	60.80	-8.46	AV

Remark:

According to 15.35 (b) When average radiated emission measurements are specified in the regulations, including emission measurements below 1000 MHz, there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

4.3 Occupied Bandwidth

Test Requirement: FCC Part 15 C section 15.231 (c)
 Test Method: ANSI C63.10: Clause 6.9
 Test Status: Test in transmitting mode at lowest and highest channel.
 Requirements: 15.231 (c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.25% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.
 Method of measurement: The useful radiated emission from the EUT was detected by the spectrum analyzer with peak detector. Record the 20 dB bandwidth of the carrier.

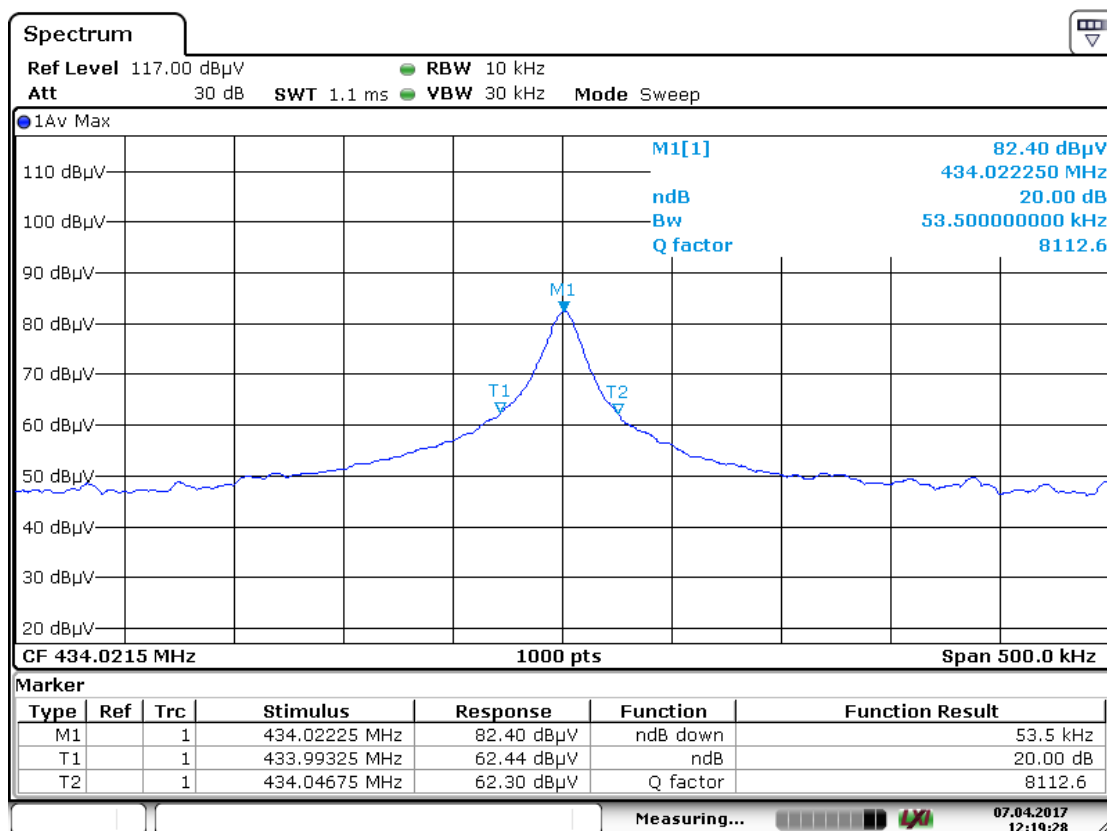
Test result:

Test Channel	bandwidth	Limit
433.92MHz	53.5 kHz	1.08 MHz

Remark:

The bandwidth limit is $433.92 \times 0.0025 = 1.08 \text{ MHz}$

Test plot:



4.4 Dwell Time:

Test Requirement: FCC Part 15 C section 15.231(a)

Test Method: FCC Part 15 C section 15.231(a)

Test Status: Test in transmitting mode.

Requirements:

1. Regulation 15.231 (a) The provisions of this Section are restricted to periodic operation within the band 40.66 40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this Section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Radio control of toys is not permitted. Continuous transmissions, such as voice or video, and data transmissions are not permitted. The prohibition against data transmissions does not preclude the use of recognition codes. Those codes are used to identify the sensor that is activated or to identify the particular component as being part of the system.

Result:

The EUT is a remote switch without audio or video transmitted.

The EUT meets the requirements of this section.

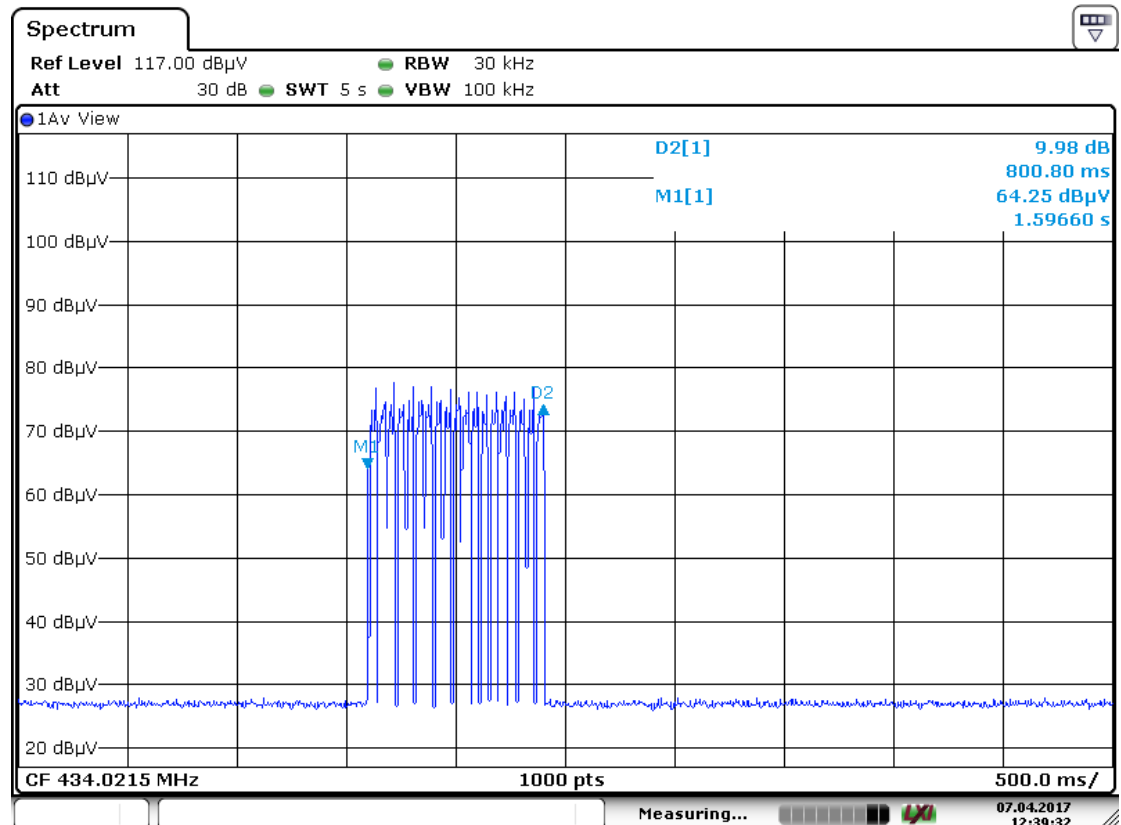
2. Regulation 15.231 (a1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

Result:

Carrier Frequency	Shutdown Time	Limit
433.92MHz	1.596s	≤5s

Result polt as follows:

Channel:



3. Regulation 15.231 (a2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

Result:

The EUT does not have automatic transmission.

4. Regulation 15.231 (a3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.

Result:

The EUT does not employ periodic transmission.



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5. Regulation 15.231 (a4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

Result:

This section is not applicable to the EUT.

4.5 Conducted Emission Test

Test result: Not applicable



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5.0 Test Equipment List

Equipment No.	Equipment	Model	Manufacturer	Cal. Due date (YYYY-MM-DD)	Calibration Interval
EM030-04	3m Semi-Anechoic Chamber	9×6×6 m ³	ETS• LINDGRE N	2018/5/9	1Y
EM031-02	EMI Test Receiver (9 kHz~7 GHz)	R&S ESR7	R&S	2017/6/7	1Y
EM031-03	Signal and Spectrum Analyzer (10 Hz~40 GHz)	R&S FSV40	R&S	2017/6/3	1Y
EM011-04	Loop antenna (9 kHz-30 MHz)	HFH2-Z2	R&S	2017/6/6	1Y
EM061-03	TRILOG Super Broadband test Antenna (30 MHz-1.5 GHz) (TX)	VULB 9161	SCHWARZBECK	2017/6/6	1Y
EM033-01	TRILOG Super Broadband test Antenna(30 MHz-3 GHz) (RX)	VULB 9163	SCHWARZBECK	2017/9/2	1Y
EM033-02	Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX)	R&S HF907	R&S	2017/6/6	1Y
EM033-03	High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX)	R&S SCU-26	R&S	2018/4/1	1Y
EM033-04	High Frequency Antenna & preamplifier (26 GHz-40 GHz)	R&S SCU-40	R&S	2018/4/1	1Y
EM031-02-01	Coaxial cable(9 kHz-1 GHz)	N/A	R&S	2017/5/30	1Y
EM033-02-02	Coaxial cable(1 GHz-18 GHz)	N/A	R&S	2017/5/30	1Y
EM033-04-02	Coaxial cable(18 GHz~40 GHz)	N/A	R&S	2018/4/1	1Y
EM031-01	Signal Generator (9 kHz~6 GHz)	SMB100A	R&S	2017/6/11	1Y
SZ180-10	Signal Generator (10MHz-40GHz)	68369B	Wiltron	2017/5/23	1Y
EM040-01	Band Reject/Notch Filter	WRHFV	Wainwright	N/A	1Y
EM040-02	Band Reject/Notch Filter	WRCGV	Wainwright	N/A	1Y
EM040-03	Band Reject/Notch Filter	WRCGV	Wainwright	N/A	1Y
EM022-03	2.45 GHz Filter	BRM50702	Micro-Tronics	2018/5/9	1Y
SA016-16	Programmable Temperature & Humidity Test Chamber	MHU-800LJ	TERCHY	2017/10/26	1Y
SA012-74	Digital Multimeter	FLUKE175	FLUKE	2017/10/12	1Y
EM010-01	Regulated DC Power supply	PAB-3003A	GUANHUA	N/A	1Y
SA040-22	Regulated DC Power supply	IT6721	ITECH	2017/9/22	1Y
EM084-06	Audio Analyzer	8903B	HP	2018/3/29	1Y
EM084-07	Modulation Analyzer	8901B	HP	2017/6/5	1Y