

FCC Part 15 Subpart C §15.231

Test Report

Equipment Under Test	Remote Keyless Entry Transmitter
Model Name	SYEC3TX1804
Applicant	SEOYON ELECTRONICS CO., LTD.
FCC ID	NYOSYEC3TX1804
Manufacturer	SEOYON ELECTRONICS CO., LTD.
Date of Test(s)	2017. 10. 10 ~ 2017. 10. 16
Date of Issue	2017. 10. 27

In the configuration tested, the EUT complied with the standards specified above.

Issue to	Issue by
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Revision history

Revision	Date of issue	Description	Revised by
--	Oct 27, 2017	Initial	--

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1. Attestation of test results

1.1. Details of applicant & Manufacturer

Applicant : SEOYON ELECTRONICS CO., LTD.
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1.2. Summary of test results

The EUT has been tested according to the following specifications;

Section in FCC part 15	Description	Result
§15.203	Antenna Requirement	C
§15.209 §15.231(b)	Radiated spurious emissions, Field Strength of Fundamental	C
§15.231(c)	Bandwidth Measurement	C
§15.231(a)	Transmission Time	C

The sample was tested according to the following specification:

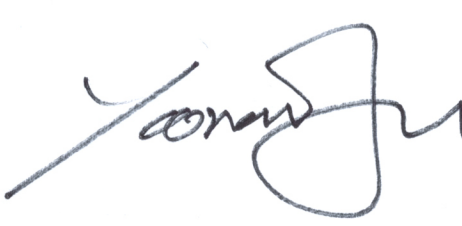
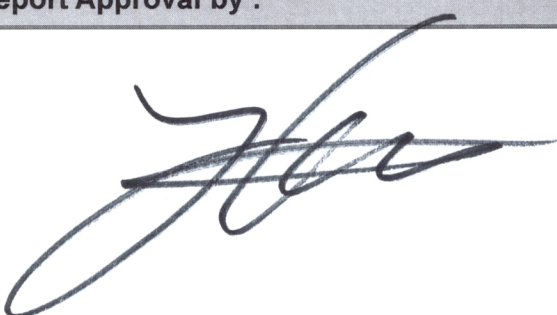
FCC Parts 15.209, 15.231; ANSI C63.10:2013

TEST SITE REGISTRATION NUMBER: **FCC(KR0151)**

※ **Abbreviation**

- C Complied
- N/A Not applicable
- F Fail

Approval Signatories

Test and Report Completed by :	Report Approval by :
	
Nanju Yoo Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

2. EUT Description

Kind of product	Remote Keyless Entry Transmitter
Model Name	SYEC3TX1804
FCC ID	NYOSYEC3TX1804
Power supply	DC 3 V
Frequency range	433.92 MHz (Only TX)
Modulation technique	FSK
Number of channels	1
Antenna gain / Type	-26.97 dB i (Max.) / PCB Antenna
Test Site Registration Number	FCC(KR0151)

2.1. Declarations by the manufacturer

None

2.2. Details of modification

None

3. Measurement equipment.

Equipment	Manufacturer	Model	Serial number	Calibration Interval	Calibration due.
Test Receiver	R&S	ESVS30	829673/015	1 year	2017-12-09
Signal Generator	R&S	SMA100A	102188	1 year	2017-12-09
Spectrum Analyzer	R&S	FSV-40	100832	1 year	2018-05-30
Horn Antenna	R&S	HF906	100236	2 year	2019-04-25
TRILOG Supper Broadband test Antenna	SCHWARZBECK	VULB 9161SE	9161-4159	2 year	2018-06-14
Power Amplifier	MITEQ	AM-1431	1497315	1 year	2018-05-30
Power Amplifier	MITEQ	AFS43-01002600	1374382	1 year	2017-11-03
Controller	INNCO	CO2000	co200/064/6961003/L	N/A	N/A
Antenna Master	INNCO	MA4000	MA4000/038/6961003/L	N/A	N/A
Loop Antenna	ETS LINDGREN	6502	00118166	2 year	2018-02-23
TWO LINE-V-NETWORK	R&S	ESH3-Z5	100296	1 year	2017-12-09
Amplifier	SONOMA INSTRUMENT	310N	185428	1 year	2017-12-09
Power Amplifier	TESTEK	TK-PA6S	140009	1 year	2017-12-08
Low Noise Amplifier	TESTEK	TK-PA18H	170013-L	1 year	2018-06-02

※ Remark;
Support equipment

Description	Manufacturer	Model	Serial number
-	-	-	-

4. ANTENNA REQUIREMENT

4.1. Antenna Regulation

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.

4.2. Result

-Complied

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

5. FIELD STRENGTH OF FUNDAMENTAL

5.1. Limit

According to § 15.109(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Measurement Distance (Meters)	Field Strength ($\mu V/m$)
0.009–0.490	300	2400/F(kHz)
0.490–1.705	30	24000/F(kHz)
1.705–30.0	30	30
30 - 88	3	100
88 – 216	3	150
216 – 960	3	200
Above 960	3	500

** 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..

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 ($\mu V/m$)	Field Strength of spurious emissions ($\mu V/m$)
40.66-40.70	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750**	125 to 375**
174 - 260	3,750	375
260 - 470	3,750 to 12,500**	375 to 1,250**
Above 470	12,500	1,250

** linear interpolations

5.2. Test result

Ambient temperature: 22°C

Relative humidity: 46% R.H.

Frequency (MHz)	Reading (dBμV)	Detector mode	Antenna Pol.	Correction Value (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
433.92	96.1	Peak	H	-12.0	84.1	100.80	16.73
	94.7	Quasi-peak	H	-12.0	82.7	100.80	18.13

※ Remark

1. Correction Value = Antenna Factor + Cable Loss - Amp gain

2. Actual = Reading + Correction Value

3. To obtain the average limit at the test frequency the values given in the table of FCC part 15.231(b) have to be linear interpolated and then converted to dBμV/m. The limit at 260 MHz is 3750 μV/m and at 470MHz it is 12500 μV/m. Limit at 433.92 MHz is calculated as shown in ANSI C63.10 Section 7.6.2:

$$\text{Limit } [\mu\text{V/m}] = \text{Limlower} + \Delta F [(\text{Limupper} - \text{Limlower}) / (f_{\text{upper}} - f_{\text{lower}})]$$

$$\text{where } \Delta F = f_c - f_{\text{lower}} = 433.92 - 260 = 173.92$$

$$\text{Limit} = 3750 + 173.92 * [(12500 - 3750) / (470 - 260)]$$

$$= 3750 + 173.92 * [8750 / 210]$$

$$= 10996.7 \mu\text{V/m}$$

$$\text{dB}\mu\text{V/m} = 20 * \log (\mu\text{V/m})$$

$$= 20 * \log (10996.7)$$

$$\text{Average Limit at 433.92 MHz} = 80.8 \text{ dB}\mu\text{V/m}$$

4. If the average limit is specified for the EUT, the peak limit is 20 dB above the average limit as specified in FCC 15.35 (b)

6. Radiated spurious emissions

6.1 Test procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10:2013. In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately.

6.2 Test procedures for radiated spurious emissions

1. The EUT is placed on a turntable, which is 0.8 m (Below 1 GHz)/ 1.5 m (Above 1 GHz) above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

※ **Remark;**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for Peak detection (PK) at frequency below 30 MHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

6.3 Test result

Ambient temperature: 22°C
Relative humidity: 46% R.H.

Emission levels are not reported much lower than the limits by over 20 dB. All reading values are peak values. To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

6.3.1 Test result for below 30 MHz

Operation mode : TX

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	C.L (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

6.3.2 Test result for 30 MHz to 1 000 MHz

Operation mode : TX

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	ANT+CL-AMP (dB)		Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
157.69	30.3	Peak	V	-10.3		20.0	43.5	23.5
867.77	44.9	Peak	H	-3.3		41.6	46.0	4.4

※ Remark

1. Correction factors = Antenna Factor + Cable Loss - Amp gain
2. Actual = Reading + Correction factors
3. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

6.3.3 Test result for above 1 000 MHz

Operation mode : TX

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1735.50	51.20	Peak	H	27.32	40.30	38.22	74.00	35.78
1735.70	44.44	Average	H	27.32	40.30	31.46	54.00	22.54
2169.25	50.80	Peak	H	27.32	39.89	38.23	74.00	35.77
2169.60	44.67	Average	H	27.32	39.89	32.10	54.00	21.90
2603.18	52.83	Peak	H	28.09	38.99	41.93	74.00	32.07
2603.53	47.15	Average	H	28.09	38.99	36.25	54.00	17.75
3037.21	52.67	Peak	H	29.79	38.01	44.45	74.00	29.55
3037.41	47.74	Average	H	29.79	38.01	39.52	54.00	14.48
3471.61	49.90	Peak	H	30.62	37.03	43.49	74.00	30.51
3471.33	43.18	Average	H	30.62	37.03	36.77	54.00	17.23
Above 4 000.00	-	-	-	-	-	-	-	-

※ **Remark**

1. Correction factors = Antenna Factor + Cable Loss - Amp gain
2. Actual = Reading + Correction factors
3. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

7. Bandwidth Measurement

7.1. Test procedure

1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=10 kHz, VBW=30 kHz and Span= 500 kHz.
3. The bandwidth of fundamental frequency was measured and recorded.

7.2. Limit

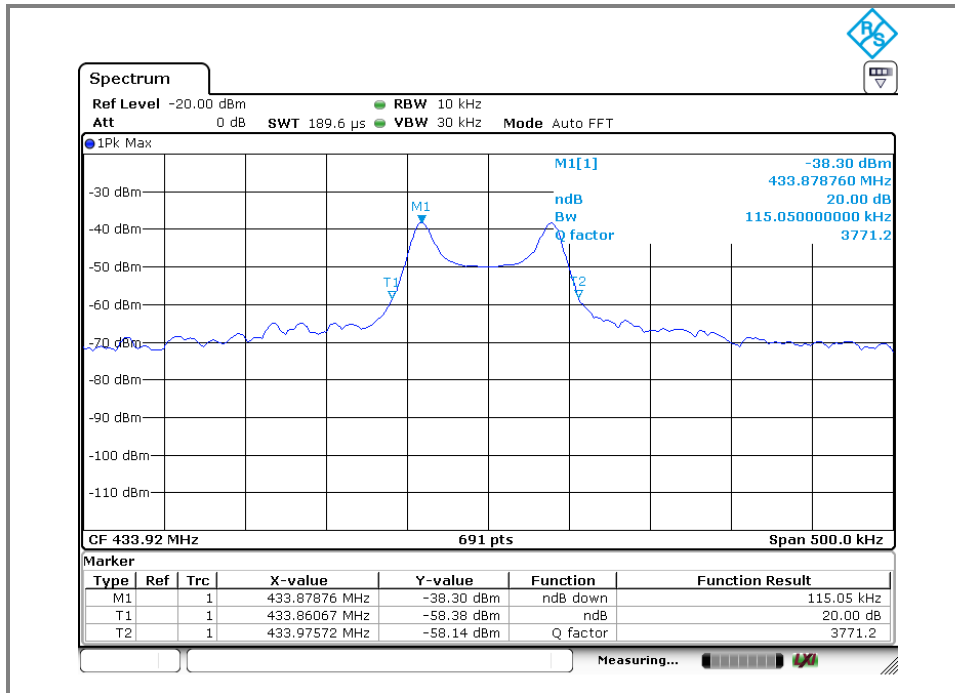
The bandwidth of the emission shall be no wider than 0.25 % of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the point 20 dB down from the modulated carrier.

7.3. Test results

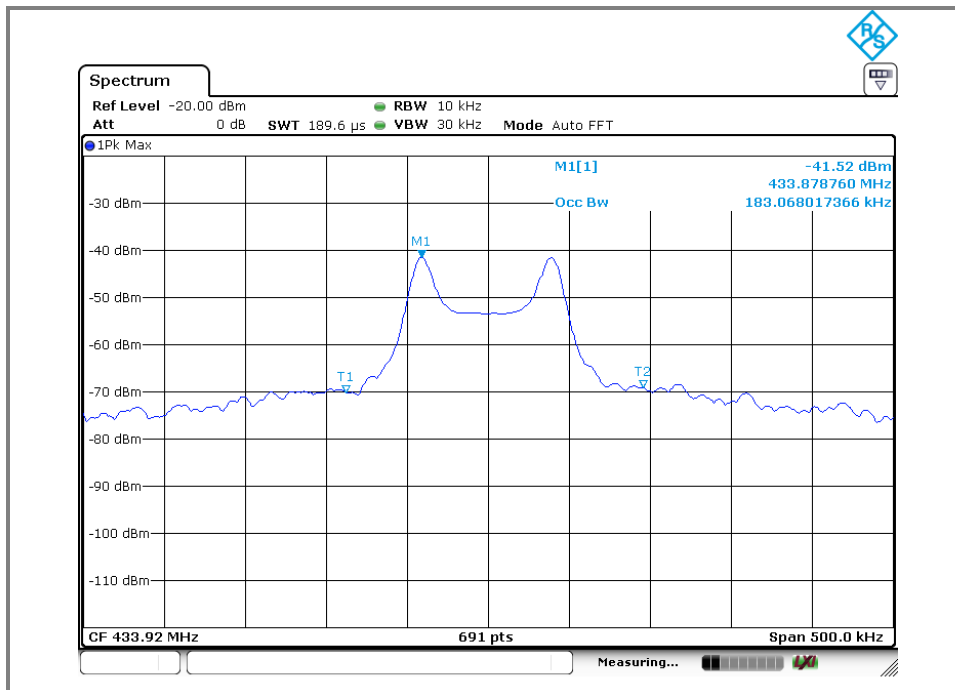
Ambient temperature: 24 °C
Relative humidity: 49% R.H.

Frequency(MHz)	20 dB bandwidth (kHz)	99% bandwidth(kHz)	Limit(kHz)
433.92	115.05	183.07	1 084.80

A. 20 dB bandwidth



B. 99 % bandwidth



8. Transmission Time

8.1. Test procedure

1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=1 000 kHz, VBW=3 000 kHz, Span=0 Hz.
3. The bandwidth of fundamental frequency was measured and recorded.

8.2. Limit

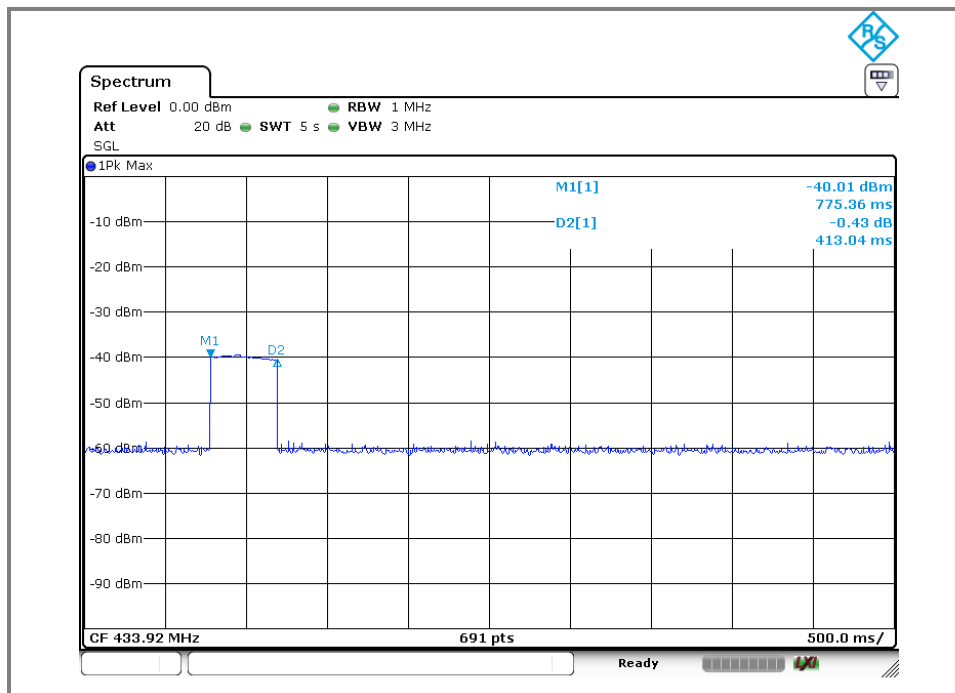
A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

8.3. Test results

Ambient temperature: 24 °C
Relative humidity: 49% R.H.

Frequency(MHz)	Transmission Time(s)	Limit(s)
433.92	0.413 04	5

A. Transmission Time



9. RF EXPOSURE EVALUATION

9.1 RF Exposure Compliance Requirement

9.1.1 Standard Requirement

According to KDB447498D01 General RF Exposure Guidance v06

4.3.1. Standalone SAR test exclusion considerations

Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

9.1.2 Limits

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances \leq 50 mm are determined by:

$$\left[\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} \right] \cdot \sqrt{f(\text{GHz})} \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where } f(\text{GHz}) \text{ is the RF channel transmit frequency in GHz}$$

Power and distance are rounded to the nearest mW and mm before calculation

The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is \leq 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is $<$ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

9.1.3 EUT RF Exposure

Output power considerations :

Worst case output power transmitter : 84.1 dB μ V/m @ 3 m = -11.13 dBm = 0.077 mW eirp

According to the formula. calculate the test result:

$$\left[\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} \right] \cdot \sqrt{f(\text{GHz})}$$

General RF Exposure = (0.077 mW / 5 mm) \times $\sqrt{0.43392 \text{ GHz}}$ = 0.010①;

SAR requirement:

S= 3.0 ② ;

①<②.

So the SAR report is not required.