

# TLHM CO., LTD.

## TEST REPORT

**SCOPE OF WORK**

EMC TESTING—FEW

**REPORT NUMBER**

190401006GZU-001

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**TEST REPORT**

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Intertek Report No: 190401006GZU-001  
FCC ID: 2ATVH-A1-FEW

**Test standards**

**47 CFR PART 15 Subpart C:2018**

**Sample Description**

Product : Electronic lock  
Model No. : FEW  
Electrical Rating : 6Vdc from battery  
**Serial No.** : Not Labeled  
Date Received : 11 April 2019  
Date Test Conducted : 11 April 2019-16 October 2019

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## TEST REPORT

### CONTENT

<b>TEST REPORT</b> .....	<b>1</b>
<b>CONTENT</b> .....	<b>3</b>
<b>1.0 TEST RESULT SUMMARY</b> .....	<b>4</b>
<b>2.0 GENERAL DESCRIPTION</b> .....	<b>5</b>
2.1 PRODUCT DESCRIPTION .....	5
2.2 RELATED SUBMITTAL(S) GRANTS .....	5
2.3 TEST METHODOLOGY .....	5
2.4 TEST FACILITY .....	5
<b>3.0 SYSTEM TEST CONFIGURATION</b> .....	<b>6</b>
3.1 JUSTIFICATION .....	6
3.2 EUT EXERCISING SOFTWARE .....	7
3.3 SPECIAL ACCESSORIES .....	7
3.4 MEASUREMENT UNCERTAINTY .....	7
3.5 EQUIPMENT MODIFICATION .....	8
3.6 SUPPORT EQUIPMENT LIST AND DESCRIPTION .....	8
<b>4.0 RADIATED EMISSION</b> .....	<b>9</b>
<b>5.0 TEST EQUIPMENT LIST</b> .....	<b>19</b>

**TEST REPORT****1.0 TEST RESULT SUMMARY**

Test Item	Test Requirement	Test Method	Result
<b>Radiated Emission</b>	<b>FCC PART 15 C section 15.209</b>	<b>ANSI C63.10: Clause 6.4 &amp; 6.5</b>	<b>PASS</b>

## Remark:

When determining the test results, measurement uncertainty of tests has been considered.

## TEST REPORT

### 2.0 General Description

#### 2.1 Product Description

Operating Frequency 125KHz  
Type of Modulation: Load modulation  
Antenna Type Inductive loop coil antenna  
Antenna gain: 0 dBi  
Power Supply: 6Vdc  
Power cord: N/A

#### 2.2 Related Submittal(s) Grants

This is an application for certification of:  
DCD-Part 15 Low Power Transmitter below 1705kHz

Remaining portions are subject to the following procedures: N/A

#### 2.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10. Radiated emission measurement was performed in semi-anechoic chamber. 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 tests were performed at:  
Room102/104, No 203, KeZhu Road, Science City, GETDD Guangzhou, China  
Except Conducted Emissions was performed at:  
Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City,  
GETDD Guangzhou, China

A2LA Certificate Number 0078.10

Intertek Testing Services Shenzhen Ltd. Guangzhou Branch is accredited by A2LA and Listed in FCC website. FCC accredited test labs may perform both Certification testing under Parts 15 and 18 and Declaration of Conformity testing.

**TEST REPORT****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. It was powered by DC 6V.

When below 30MHz, the measurement antenna was positioned with its plane perpendicular to the ground at the specified distance. When perpendicular to the ground plane, the lowest height of the magnetic antenna was 1 m above the ground and was positioned at 3m distance from the EUT. During testing the loop antenna was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane. For each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable.

When above 30MHz, 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. 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:

Frequency range of radiated emission measurements

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

The frequency range is from 9kHz to 13GHz, since there's Bluetooth module in the product, the Bluetooth module had been certified.

## TEST REPORT

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

### 3.2 EUT Exercising Software

N/A

### 3.3 Special Accessories

N/A

### 3.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Conduction Emission (9 kHz-150 kHz)	2.51 dB
2	Conduction Emission (150 kHz-30 MHz)	2.69 dB
3	Disturbance Power (30 MHz-300 MHz)	3.21 dB
4	Radiated Emission (30 MHz-1 GHz)	4.79 dB
5	Radiated Emission (1 GHz-6 GHz)	5.02 dB
6	Radiated Emission (6 GHz-18 GHz)	5.17 dB
7	20 dB Bandwidth	2.3%

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.

Measurement uncertainty is calculated in accordance with ETSI TR 100 028-2001.

The measurement uncertainty is given with a confidence of 95%, k=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

## TEST REPORT

### 3.5 Equipment Modification

Any modifications installed previous to testing by TLHM 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 with corresponding support equipment as below:

Support Equipment: N/A

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above evaluated respectively

Pre-test mode	Description
Transmitting Mode	kept 125kHz transmitting continuously and Bluetooth on.

## TEST REPORT

### 4.0 Radiated Emission

Test Requirement: FCC PART 15 C section 15.209 (a)(f)

§ 15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

Field strength limits(below 30MHz) at 30 m and 300 m changed to 3 m by formula:

$$\text{Limit3m(dB}\mu\text{V)} = \text{Limit30m(dB}\mu\text{V)} + 40 * \log(30m/3m)$$

$$\text{Limit3m(dB}\mu\text{V)} = \text{Limit300m(dB}\mu\text{V)} + 40 * \log(300m/3m)$$

Frequency (MHz)	Field Strength (dB $\mu$ V/m @ 3m)
0.009-0.490	128-93.8
0.490-1.705	73.8-62.9
1.705-30.0	69.5
30-88	40
88-216	43.5
216-960	46
Above 960	54

(f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission

## TEST REPORT

limits in §15.109 that are applicable to the incorporated digital device.

Test Method: ANSI C63.10: Clause 6.4 and 6.5.  
Test Status: Pre-Scan has been conducted to determine the worst-case mode from all possible configuration.  
Test site: Measurement Distance: 3m (Semi-Anechoic Chamber)  
Detector: Quasi-Peak detector:  
RBW=200 Hz for 9 kHz to 150 kHz  
RBW=9 kHz for 150 kHz to 30 MHz  
RBW=120 kHz for 30 MHz to 1GHz  
Sweep = auto  
Trace = max hold  
Field Strength Calculation: The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below:  
$$FS = RA + AF + CF - AG + PD + AV$$
  
$$FS = RA + \text{Correct Factor} + AV$$
  
$$FS = \text{Field Strength in } dB\mu V/m$$
  
Where:  
RA = Receiver Amplitude (including preamplifier) in  $dB\mu V$   
AF = Antenna Factor in dB  
CF = Cable Attenuation Factor in dB  
AG = Amplifier Gain in dB  
PD = Pulse Desensitization in dB  
AV = Average Factor in  $-dB$   
Correct Factor =  $AF + CF - AG + PD$

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

$FS = RA + AF + CF - AG + PD + AV$   
Assume a receiver reading of 62.0  $dB\mu V$  is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32  $dB\mu V/m$ .

RA = 62.0  $dB\mu V$   
AF = 7.4 dB  
CF = 1.6 dB  
AG = 29.0 dB  
PD = 0 dB  
AV = -10 dB  
Correct Factor =  $7.4 + 1.6 - 29.0 + 0 = -20 dB$   
 $FS = 62 + (-20) + (-10) = 32 dB\mu V/m$

**TEST REPORT**

Section 15.205 Restricted bands of operation.

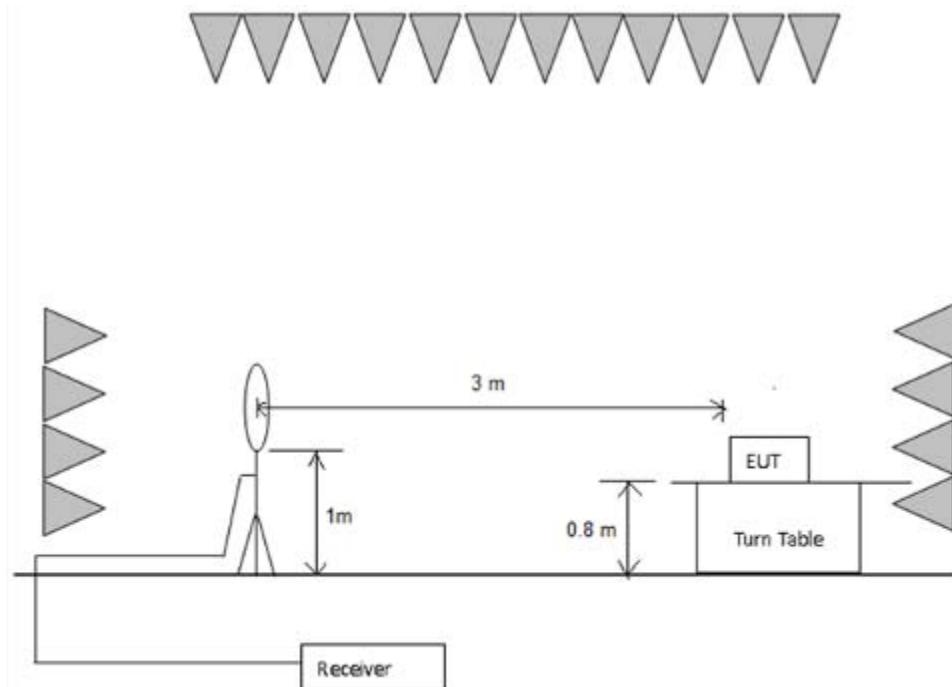
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	
13.36 - 13.41	322 - 335.4		

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in 15.209.

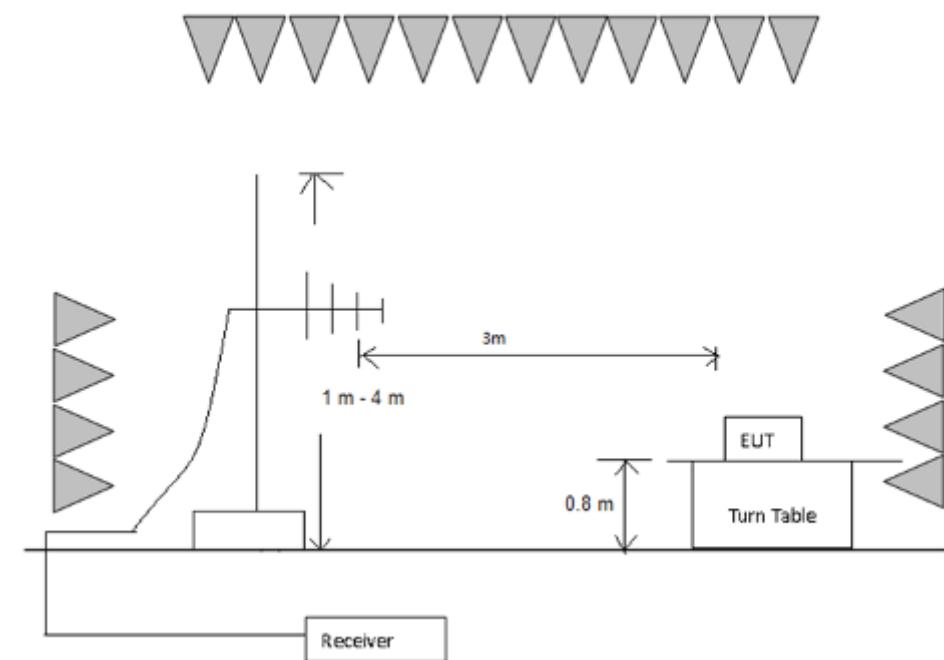
## TEST REPORT

Test Configuration:

- 1) 9 kHz to 30 MHz emissions:

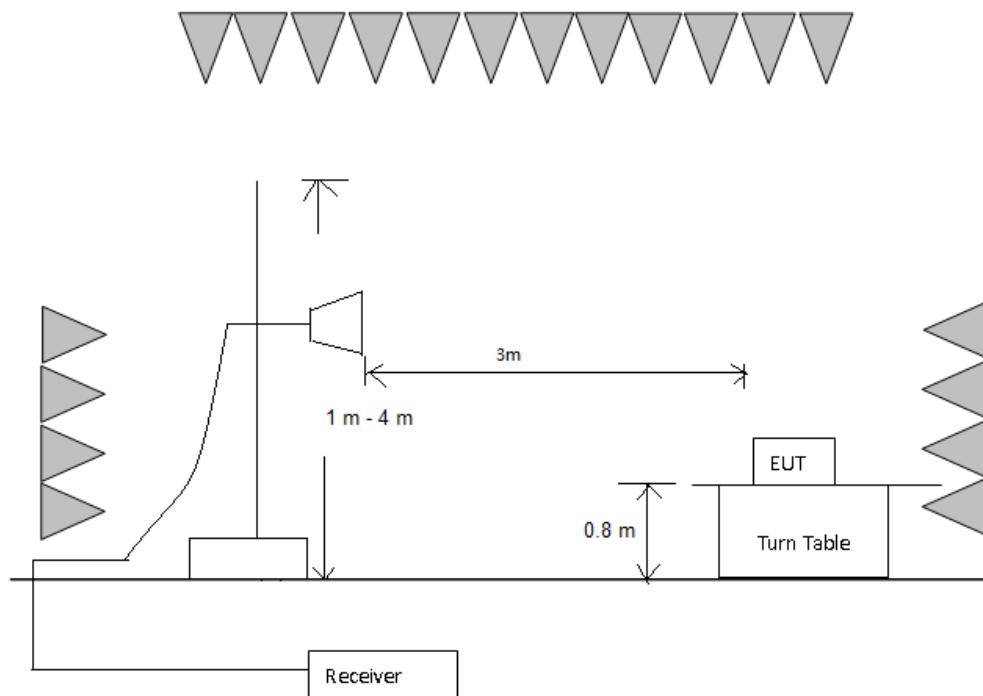


- 2) 30 MHz to 1 GHz emissions:



## TEST REPORT

### 3) 1 GHz to 40 GHz emissions:



#### Test Procedure:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2007 was used to perform radiated emission test above 1 GHz.

The receiver was scanned from 9 kHz to 25 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

#### Used Test Equipment List:

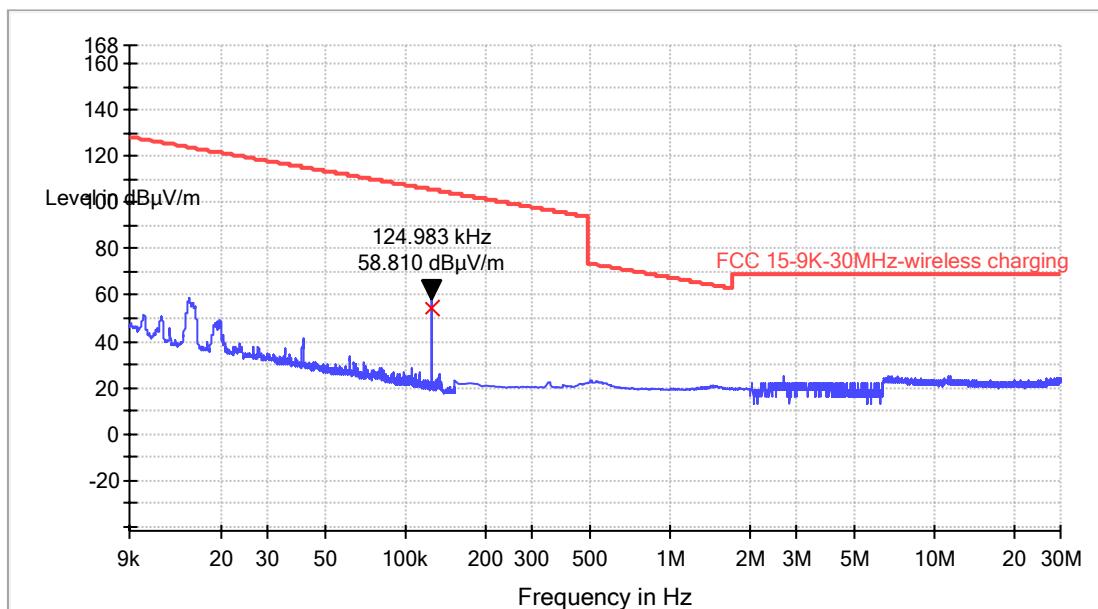
3m Semi-Anechoic Chamber, EMI Test Receiver (9 kHz~7 GHz), Signal and Spectrum Analyzer (10 Hz~40 GHz), Loop antenna (9 kHz-30 MHz). TRILOG Super Broadband test Antenna(30 MHz-3 GHz) (RX), Double-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX) and High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX). Refer to Clause 5 Test Equipment List for details.

## TEST REPORT

## Radiated Emissions (Below 30 MHz)

Operation Mode: 125kHz Tramsmitting mode and Bluetooth on

Horizontal



Operation Frequency (kHz)	Receiver Reading Level (dB $\mu$ V)	Correction factors (dB/m)	Average Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)
125	33.5	20.5	54.0	105.6

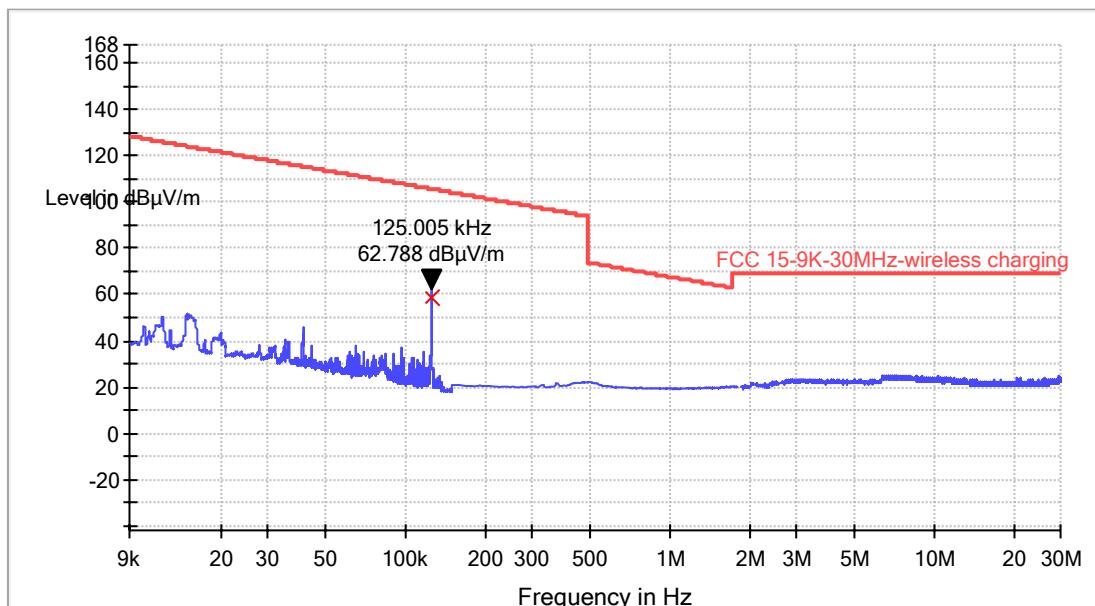
All emissions are at least 40 dB below the limits.

Remark:

1. Corr. (dB) = Antenna Factor (dB) + Cable Loss (dB)
2. Quasi Peak (dB $\mu$ V/m) = Corr. (dB) + Read Level (dB $\mu$ V)
3. Margin (dB) = Limit QPK (dB $\mu$ V/m) – Quasi Peak (dB $\mu$ V/m)

**TEST REPORT**

Vertical



Operation Frequency (kHz)	Receiver Reading Level (dB $\mu$ V)	Correction factors (dB/m)	Average Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)
125	37.9	20.7	58.6	105.6

All emissions are at least 40 dB below the limits.

Remark:

1. Corr. (dB) = Antenna Factor (dB) + Cable Loss (dB)
2. Quasi Peak (dB $\mu$ V/m) = Corr. (dB) + Read Level (dB $\mu$ V)
3. Margin (dB) = Limit QPK (dB $\mu$ V/m) – Quasi Peak (dB $\mu$ V/m)

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

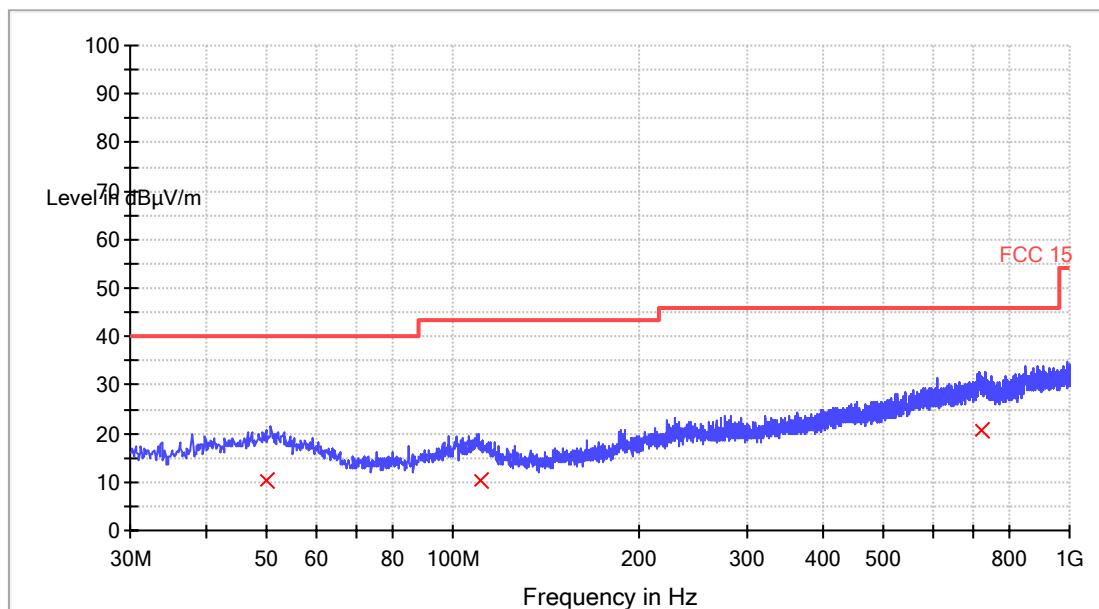
Remark:

1. Corr. (dB) = Antenna Factor (dB) + Cable Loss (dB)
2. Level (dB $\mu$ V/m) = Corr. (dB) + Read Level (dB $\mu$ V)
3. Margin (dB) = Limit (dB $\mu$ V/m) – Level (dB $\mu$ V/m)
4. Only record the date closest to limit
5. The emission is worst case on Vertical

## TEST REPORT

30 MHz~1 GHz Spurious Emissions. Quasi-Peak Measurement

Vertical:



Frequency (MHz)	QuasiPeak (dBμV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
50.000000	10.4	120.000	V	15.3	29.6	40.0
110.760000	10.5	120.000	V	13.0	33.0	43.5
717.840000	20.8	120.000	V	23.1	25.2	46.0

## QP

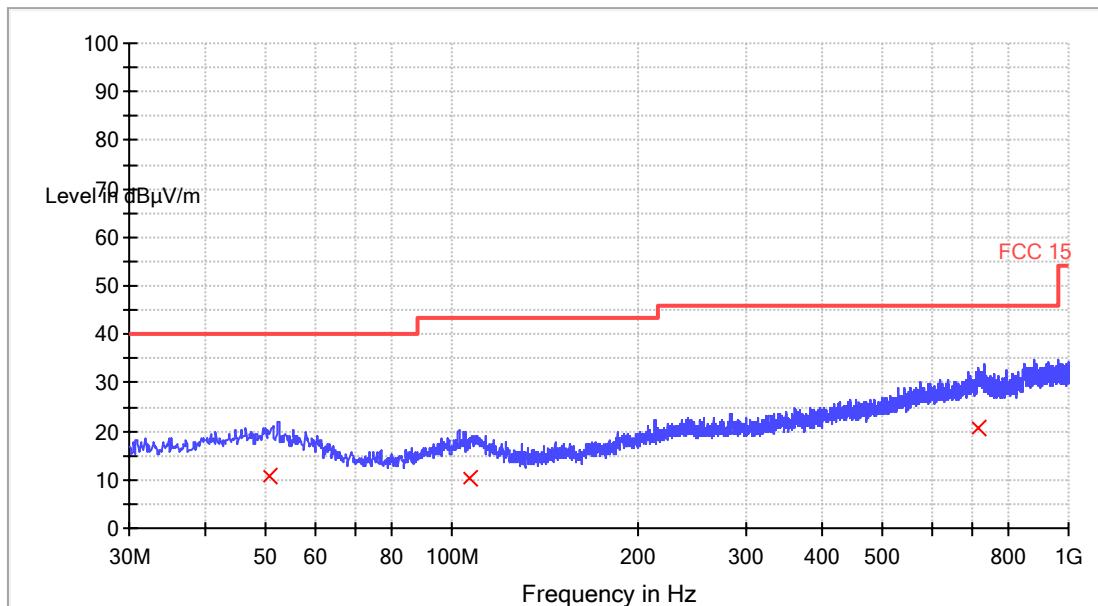
Remark:

Final Test Level = Receiver Reading + Correction Factor

Correction Factor = Antenna Factor + Cable Loss.

## TEST REPORT

Horizontal:



## QP

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Pol	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
50.720000	10.7	120.000	H	15.2	29.3	40.0
107.000000	10.5	120.000	H	13.0	33.0	43.5
712.520000	20.6	120.000	H	23.1	25.4	46.0

Remark:

Final Test Level = Receiver Reading + Correction Factor

Correction Factor = Antenna Factor + Cable Loss.

**TEST REPORT**

1~25 GHz Radiated Emissions.

**PK Measurement:**

Frequency (MHz)	PK Reading Level (dB $\mu$ V)	Correction factors (dB/m)	PK Emission Level (dB $\mu$ V/m)	PK Limit (dB $\mu$ V/m)	Antenna polarization
2875.2	30.7	-6.8	37.5	74	V
4661.6	37.8	-2.5	40.3	74	V
7924.0	57.5	8.0	49.5	74	V
3434.4	34.0	-5.3	39.3	74	H
4770.4	38.2	-2.5	40.7	74	H
7490.4	55.8	7.3	48.5	74	H

**AV Measurement:**

Frequency (MHz)	AVReading Level (dB $\mu$ V)	Correction factors (dB/m)	AV Emission Level (dB $\mu$ V/m)	AV Limit (dB $\mu$ V/m)	Antenna polarization
2875.2	-	-6.8	-	54	V
4661.6	-	-2.5	-	54	V
7924.0	-	8.0	-	54	V
3434.4	-	-5.3	-	54	H
4770.4	-	-2.5	-	54	H
7490.4	-	7.3	-	54	H

Remark: When Peak emission level was below AV limit, the AV emission level was not recorded.

**TEST REPORT**
**5.0 Test Equipment List**
**Radiated Disturbance ( 9 kHz-30 MHz )**

Equipment No.	Equipment	Model	Manufacturer	Cal. Due date (DD-MM-YYYY)	Calibration Interval
EM030-04	3m Semi-Anechoic Chamber	9×6×6 m3	ETS-LINDGREN	09/04/2020	1Y
EM031-02	EMI Test Receiver (9 kHz~7 GHz)	R&S ESR7	R&S	28/02/2020	1Y
EM011-04	Loop antenna (9 kHz-30 MHz)	HFH2-Z2	R&S	24/06/2020	1Y
EM031-02-01	Coaxial cable	/	R&S	09/04/2020	1Y
SA047-118	Digital Temperature-Humidity Recorder	RS210	YIJIE	16/7/2020	1Y
EM045-01-01	EMC32 software (RE/RS)	V10.01.00	R&S	N/A	N/A

**Radiated Disturbance ( 30 MHz-1 GHz )**

Equipment No.	Equipment	Model	Manufacturer	Cal. Due date (DD-MM-YYYY)	Calibration Interval
EM030-04	3m Semi-Anechoic Chamber	9×6×6 m3	ETS-LINDGREN	9/04/2020	1Y
EM031-02	EMI Test Receiver (9 kHz~7 GHz)	R&S ESR7	R&S	28/02/2020	1Y
EM033-01	TRILOG Super Broadband test Antenna (30 MHz-3 GHz)	VULB 9163	SCHWARZBEC K	19/09/2020	1Y
EM031-02-01	Coaxial cable	/	R&S	9/04/2020	1Y
EM036-01	Common-mode absorbing clamp	CMAD 20B	TESEQ	21/07/2020	1Y
SA047-118	Digital Temperature-Humidity Recorder	RS210	YIJIE	16/07/2020	1Y
EM045-01-01	EMC32 software (RE/RS)	V10.01.00	R&S	N/A	N/A

**Radiated Disturbance ( 1-18 GHz )**

Equipment No.	Equipment	Model	Manufacturer	Cal. Due date (DD-MM-YYYY)	Calibration Interval
EM030-04	3m Semi-Anechoic Chamber	9×6×6 m3	ETS-LINDGREN	09/04/2020	1Y
EM031-02	EMI Test Receiver (9 kHz~7 GHz)	R&S ESR7	R&S	28/02/2020	1Y
EM031-03	Signal and Spectrum Analyzer (10 Hz~40 GHz)	R&S FSV40	R&S	08/09/2020	1Y
EM033-02	Double-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)	R&S HF907	R&S	22/06/2020	1Y
EM033-02-02	Coaxial cable(1 GHz-18 GHz)	N/A	R&S	09/04/2020	1Y
EM022-03	2.45 GHz Filter	BRM 50702	Micro-Tronics	16/05/2020	1Y
SA047-118	Digital Temperature-Humidity Recorder	RS210	YIJIE	16/07/2020	1Y
EM045-01-01	EMC32 software (RE/RS)	V10.01.00	R&S	N/A	N/A

\*\*\*\*End of the test report\*\*\*\*\*