

Test Report No. 7191153026-EEC16/02

dated 19 Jul 2017



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FORMAL REPORT ON TESTING IN ACCORDANCE WITH 47 CFR FCC Parts 15B & C OF A **SMART LOCK** [Model : GTX000 Series] [FCC ID : 2Afp6-EGT10L]

TEST FACILITY

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Electrical & Electronics Centre (EEC), Product Services,
No. 1 Science Park Drive, Singapore 118221

FCC REG. NO.

994109 (Test Firm Registration Number)
SG0002 (Designation Number)

IND. CANADA REG. NO.

2932I-1 (3m and 10m Semi-Anechoic Chamber, Science Park)

PREPARED FOR

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QUOTATION NUMBER

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LA-2007-0380-A LA-2007-0384-G
LA-2007-0381-F LA-2007-0385-E
LA-2007-0382-B LA-2007-0386-C
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TEST SUMMARY

The product was tested in accordance with the customer's specifications.

Test Results Summary

Test Standard	Description	Pass / Fail
47 CFR FCC Part 15		
15.107(a), 15.207	Conducted Emissions	Not Applicable *See Note 6
15.109(a), 15.205, 15.209, 15.225(d)	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass
15.225(a)	Radiated Emissions (Fundamental) (applicable if EUT's carrier is in 13.553 -13.567MHz)	Pass
15.225(b)	Radiated Emissions (Fundamental) (applicable if EUT's carrier is in 13.410 -13.553MHz or / and 13.567- 13.710MHz)	Not Applicable *See Note 1
15.225(c)	Radiated Emissions (Fundamental) (applicable if EUT's carrier is in 13.110 -13.410MHz or / and 13.710- 14.010MHz)	Not Applicable *See Note 1
15.225(e)	Frequency Stability Versus Temperature	Pass
15.225(e)	Frequency Stability Versus Input Voltage	Pass



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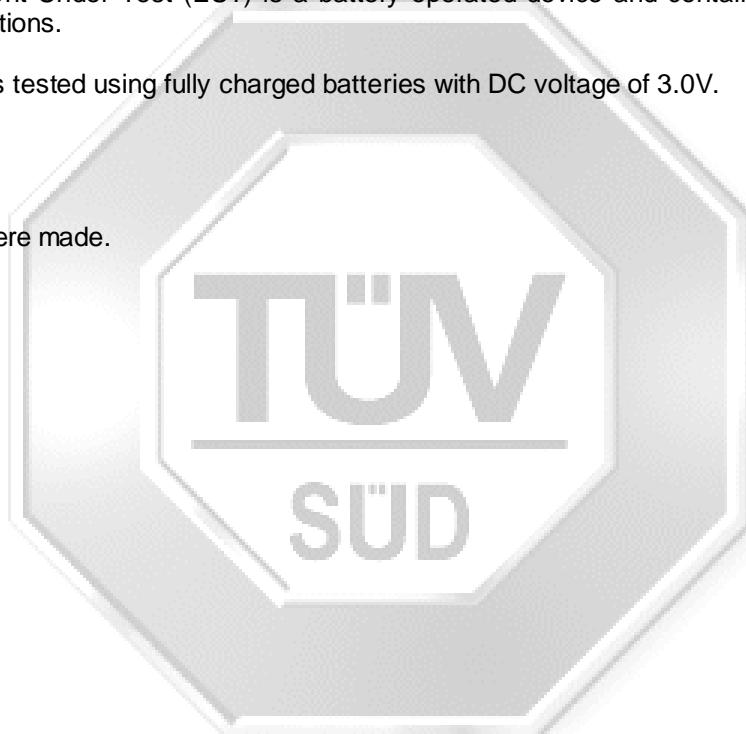
TEST SUMMARY

Notes

1. The Equipment Under Test (EUT) was configured to operate in the test mode at 13.56MHz.
2. The measurements in section 15.225(e) were done based on conducted measurements.
3. The EUT is a Class B device when in non-transmitting state and meets the 47 CFR FCC Part15B Class B requirements.
4. All test measurement procedures are according to ANSI C63.4: 2014 and ANSI C63.10: 2013.
5. The Equipment Under Test (EUT) is a battery operated device and contains no provision for public utility connections.
6. The EUT was tested using fully charged batteries with DC voltage of 3.0V.

Modifications

No modifications were made.





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PRODUCT DESCRIPTION

Description	: The Equipment Under Test (EUT) is a Smart Lock .
Applicant	: JSB Tech Pte Ltd 100 Pasir Panjang Road #06-02, 100 Pasir Panjang Singapore 118518
Manufacturer	: JSB Tech Pte Ltd 100 Pasir Panjang Road #06-02, 100 Pasir Panjang Singapore 118518
Factory (ies)	: JSB Tech Pte Ltd 100 Pasir Panjang Road #06-02, 100 Pasir Panjang Singapore 118518
Model Number	: GTX000 Series
FCC ID	: 2AFP6-EGT10L
Serial Number	: Nil
Microprocessor	: Texas Instruments CC2541
Operating / Transmitting Frequency	: 2402MHz (lower channel) to 2480MHz (upper channel) 79 (<i>total number of channels</i>) channels
Clock / Oscillator Frequency	: 3 crystals are used in the product: <ul style="list-style-type: none">• 32MHz and 32.768kHz crystal are used for Microcontroller.• 27.12MHz crystal is used for NFC transceiver.
Modulation	: Bluetooth Low Energy <ul style="list-style-type: none">• Gaussian Frequency Shift Keying (GFSK)
	Near Field Communication <ul style="list-style-type: none">• Amplitude Shift Keying (ASK)
Antenna Gain	: Bluetooth Low Energy <ul style="list-style-type: none">• -4.3 dBi
	Near Field Communication <ul style="list-style-type: none">• -1.2 dBi
Port / Connectors	: Refer to manufacturer's user manual / operating manual
Rated Input Power	: 3Vdc
Accessories	: Nil.



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SUPPORTING EQUIPMENT DESCRIPTION

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
Logitech USB AC/DC Power Adapter	M/N: AD8318C S/N: Nil FCC ID: Nil	1.00m standard USB cable





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EUT OPERATING CONDITIONS

47 CFR FCC Part 15

1. Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)
2. Radiated Emissions (Fundamental)
3. Frequency Stability Versus Temperature
4. Frequency Stability Versus Input Voltage

The EUT was exercised by operating in maximum continuous transmission in test mode, i.e transmitting at 13.56MHz continuously.





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RADIATED EMISSION TEST

47 CFR FCC Part 15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.090	-	0.110	16.42
0.495	-	0.505	16.69475
2.1735	-	2.1905	16.80425
4.125	-	4.128	25.5
4.17725	-	4.17775	37.5
4.20725	-	4.20775	73
6.215	-	6.218	74.8
6.26775	-	6.26825	108
6.31175	-	6.31225	123
8.291	-	8.294	149.9
8.362	-	8.366	156.52475
8.37625	-	8.38675	156.7
8.41425	-	8.41475	162.0125
12.29	-	12.293	167.72
12.51975	-	12.52025	240
12.57675	-	12.57725	322
13.36	-	13.41	
			Above 38.6

47 CFR FCC Parts 15.109(a), 15.209 and 15.225(d) Radiated Emission Limits

Frequency Range (MHz)	Quasi-Peak Limit Values (dBμV/m)
0.009 - 0.490	20 log [2400 / F (kHz)] @ 300m
0.490 - 1.705	20 log [24000 / F (kHz)] @ 30m
1.705 - 30.0	30.0 @ 30m
30 - 88	40.0 @ 3m
88 - 216	43.5 @ 3m
216 - 960	46.0 @ 3m
Above 960	54.0* @ 3m

* For frequency bands 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.

47 CFR FCC Parts 15.109(a), 15.209 and 15.225(d) Radiated Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver – ESI1	ESI40	100010	11 Oct 2017
Schaffner Bilog Antenna –(30MHz-2GHz) BL4	CBL6112B	2593	18 Jan 2018
Com-Power Preamplifier (1MHz-1GHz)	PAM-103	441096	30 Sep 2017
EMCO Loop Ant (ext)_red_00134413	6502	134413	28 Oct 2017



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RADIATED EMISSION TEST

47 CFR FCC Parts 15.109(a), 15.209 and 15.225(d) Radiated Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table for measurement up to 1GHz. For measurement above 1GHz, 1.5m height table was used.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

47 CFR FCC Parts 15.109(a), 15.209 and 5.225(d) Radiated Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude and equipment arrangement produces such emissions.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point in the range of 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.
6. The frequency range covered was from the lowest radio frequency signal generated from the EUT, without going below 9kHz to 10th harmonics of the EUT fundamental frequency, using the loop antenna for frequency below 30MHz, Bi-log antenna for frequencies from 30MHz up to 1GHz, and the Horn antenna above 1GHz.

Sample Calculation Example

At 300 MHz

Q-P limit = 46.0 dB μ V/m

Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB

Q-P reading obtained directly from EMI Receiver = 40.0 dB μ V/m
(Calibrated level including antenna factors & cable losses)

Therefore, Q-P margin = 46.0 - 40.0 = 6.0

i.e. 6.0 dB below Q-P limit



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RADIATED EMISSION TEST

47 CFR FCC Parts 15.109(a), 15.205, 15.209 and 15.225(d) Radiated Emission Results

Test Input Power	3Vdc	Temperature	24°C
Test Distance	3m (9kHz – 1GHz)	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz) *See Note 4

Freq (MHz)	Peak Value (dB μ V/m)	Peak Limit (dB μ V/m)	Peak Margin (dB) *See Note 2	AV Value (dB μ V/m) *See Note 2	AV Limit (dB μ V/m)	AV Margin (dB) *See Note 3	Height (cm)	Azimuth (Degrees)
0.0110	-10.9	46.8	57.7	--	26.8	37.7	120	48
0.0180	-15.7	42.5	58.2	--	22.5	38.2	120	115
0.0250	-16.8	39.6	56.4	--	19.6	36.4	120	103
0.0290	-18.6	38.4	57.0	--	18.4	37.0	120	122
0.0340	-19.4	37.0	56.4	--	17.0	36.4	120	96
0.0380	-19.8	36.0	55.8	--	16.0	35.8	120	262

Spurious Emissions ranging from 9kHz – 30MHz *See Note 4

Frequency (MHz)	Q-P Value (dB μ V/m)	Q-P Limit (dB μ V/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)
1.3560	46.1	66.1	20.0	120	254
1.8580	48.2	70.0	21.8	120	247
2.2940	45.5	70.0	24.5	120	114
2.6290	45.8	70.0	24.2	120	267
2.8300	41.5	70.0	28.5	120	201
3.1310	39.1	70.0	30.9	120	321

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dB μ V/m)	Q-P Limit (dB μ V/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)
40.2990	2.4	40.0	37.6	294	354	V
67.8220	26.0	40.0	14.0	240	271	V
111.4350	18.8	43.5	24.7	240	284	V
203.4000	30.2	43.5	13.3	101	287	V
257.6350	35.5	46.0	10.5	122	14	H
433.9430	20.0	46.0	26.0	240	237	H



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RADIATED EMISSION TEST

Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. As the measured peak shows compliance to the average limit, as such no average measurement was required.
3. The average margin indicates the margin of the measured peak value below the average limit.
4. The measurement was done at 3m. The measured results were extrapolated to the specified test limits as specified in § 15.209 (a) based on 40dB/decade.
5. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
6. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
7. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:

<u>9kHz - 150kHz</u>	
RBW: 100Hz	VBW: 300Hz
<u>150kHz - 30MHz</u>	
RBW: 10kHz	VBW: 30kHz
<u>30MHz - 1GHz</u>	
RBW: 120kHz	VBW: 1MHz
<u>>1GHz</u>	
RBW: 1MHz	VBW: 3MHz
8. The upper frequency of radiated emission investigations was according to requirements stated in Section 15.33(a) for intentional radiators & Section 15.33(b) for unintentional radiators.
9. The channel in the table refers to the transmit channel of the EUT.
10. Radiated Emissions Measurement Uncertainty
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 9kHz – 25GHz is $\pm 4.0\text{dB}$.



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RADIATED EMISSION (FUNDAMENTAL) TEST

47 CFR FCC Parts 15.225(a), 15.225(b) and 15.225(c) Radiated Emission (Fundamental) Limits

Fundamental Frequency (MHz)	Field Strength of Fundamental Limit Values @ 30m (dB μ V/m)
13.553 - 13.567	84.0
13.410 - 13.553	50.5
13.567 - 13.710	50.5
13.110 - 13.410	40.5
13.710 - 14.010	40.5

47 CFR FCC Parts 15.225(a), 15.225(b) and 15.225(c) Radiated Emission (Fundamental) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
R&S Test Receiver – ESI1	ESI40	100010	11 Oct 2017
EMCO Loop Ant (ext)_red_00134413	6502	134413	28 Oct 2017





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RADIATED EMISSION (FUNDAMENTAL) TEST

47 CFR FCC Parts 15.225(a), 15.225(b) and 15.225(c) Radiated Emission (Fundamental) Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table for measurement up to 1GHz. For measurement above 1GHz, 1.5m height table was used.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

47 CFR FCC Parts 15.225(a), 15.225(b) and 15.225(c) Radiated Emission (Fundamental) Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the fundamental frequency from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude and equipment arrangement produces such emissions.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point that above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.

Sample Calculation Example

At 300 MHz

Q-P limit = 46.0 dB μ V/m

Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB

Q-P reading obtained directly from EMI Receiver = 40.0 dB μ V/m
(Calibrated level including antenna factors & cable losses)

Therefore, Q-P margin = 46.0 - 40.0 = 6.0

i.e. 6.0 dB below Q-P limit



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RADIATED EMISSION (FUNDAMENTAL) TEST

47 CFR FCC Part 15.225(a / b / c) Radiated Emission (Fundamental) Results

Test Input Power	3Vdc	Temperature	24°C
Test Distance	3m *See Note 2	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

Frequency (MHz)	Q-P Value (dB μ V/m)	Q-P Limit (dB μ V/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)
13.5830	36.6	84.0	47.4	100	300

Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured, using the average and peak detectors, are reported. All other emissions were relatively insignificant.
2. A closer test distance of 3m was used for the measurement instead of 30m as the fundamental (carrier) electric field strength of the EUT at the 3m distance shows compliance to the limit of 30m test distance.
3. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
4. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:

150kHz - 30MHz

RBW: 10kHz VBW: 30kHz

30MHz - 1GHz

RBW: 120kHz VBW: 1MHz

>1GHz

RBW: 1MHz VBW: 3MHz

5. Radiated Emissions (Fundamental) Measurement Uncertainty

All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 9kHz – 25GHz is $\pm 4.0\text{dB}$.



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FREQUENCY STABILITY VERSUS TEMPERATURE TEST

47 CFR FCC Part 15.225(e) Frequency Stability Versus Temperature Limits

The EUT shows compliance to the requirements of this section, which states that the frequency tolerance of the carrier frequency shall be $\pm 0.01\%$ for a temperature variation of -20°C to +50°C at normal supply voltage.

47 CFR FCC Part 15.225(e) Frequency Stability Versus Temperature Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Universal Counter	53132A	3736A06236	05 Apr 2018
Agilent DC Power Supply	E3620A	MY40000448	Output Monitor
Cincinnati Sub-Zero Products, INC. Temperature & Humidity Chamber	ZH-8-1-1-H/AC	ZF9722653	29 Nov 2017

47 CFR FCC Part 15.225(e) Frequency Stability Versus Temperature Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo. The EUT was placed in an environmental temperature chamber with a nominal supply voltage. For the battery operated EUT, a power supply was used.
2. The RF antenna connector of the EUT was connected to the frequency counter via a low-loss coaxial cable.

47 CFR FCC Part 15.225(e) Frequency Stability Versus Temperature Test Method

1. The EUT was switched off and the environmental temperature was set to the highest temperature, i.e, +50°C.
2. Upon reaching the highest set temperature with 30 minutes of stabilisation period, the EUT was switched on and configured to operate in the test mode with transmitting frequency at 13.56MHz.
3. The EUT's transmitting frequency was then measured at start up, and two, five and ten minutes after start up with the frequency counter set to capture the transmitting frequency. For each measurement, the signal capturing was continuous until no further changes were observed. Four measurements were made in total.
4. The EUT was switched off. The environmental chamber temperature was lowered by 10 °C and was allowed the temperature inside the chamber to stabilize.
5. The EUT was turned on and the step 3 was repeated.
6. The steps 3 and 4 were repeated until the lowest temperature was reached, i.e, -20 °C.



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FREQUENCY STABILITY VERSUS TEMPERATURE TEST

47 CFR FCC Part 15.225(e) Frequency Stability Versus Temperature Results

Test Input Power	3Vdc	Temperature	See table below
		Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

Channel Frequency (MHz)	Temperature (°C)	± 0.01% Carrier Tolerance (Hz)	Measured Tolerance (Hz)	Measurement with respects to Start Up Time (Mins)
13.5600	50.0	±1356.0000	-0.6095	0
		±1356.0000	-0.6133	2
		±1356.0000	-0.6136	5
		±1356.0000	-0.6124	10
	40.0	±1356.0000	-0.5926	0
		±1356.0000	-0.6016	2
		±1356.0000	-0.6060	5
		±1356.0000	-0.6077	10
	30.0	±1356.0000	-0.5093	0
		±1356.0000	-0.5314	2
		±1356.0000	-0.5877	5
		±1356.0000	-0.5992	10
	20.0	±1356.0000	-0.5428	0
		±1356.0000	-0.5920	2
		±1356.0000	-0.6002	5
		±1356.0000	-0.7437	10
	10.0	±1356.0000	-0.5264	0
		±1356.0000	-0.5302	2
		±1356.0000	-0.5357	5
		±1356.0000	-0.5378	10
	0.0	±1356.0000	-0.5130	0
		±1356.0000	-0.5142	2
		±1356.0000	-0.5172	5
		±1356.0000	-0.5182	10
	-10.0	±1356.0000	-0.5236	0
		±1356.0000	-0.5158	2
		±1356.0000	-0.5139	5
		±1356.0000	-0.5136	10
	-20.0	±1356.0000	-0.5293	0
		±1356.0000	-0.5293	2
		±1356.0000	-0.5296	5
		±1356.0000	-0.5295	10



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FREQUENCY STABILITY VERSUS INPUT VOLTAGE TEST

47 CFR FCC Part 15.225(e) Frequency Stability Versus Input Voltage Limits

The EUT shows compliance to the requirements of this section, which states that the frequency tolerance of the carrier frequency shall be $\pm 0.01\%$ for variation of a primary voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C. For a battery operated equipment, the equipment tests shall be performed using a new battery.

47 CFR FCC Part 15.225(e) Frequency Stability Versus Input Voltage Test Instrumentation

Instrument	Model	S/No	Cal Due Date
HP Universal Counter	53132A	3736A06236	05 Apr 2018
Agilent DC Power Supply	E3620A	MY40000448	Output Monitor
Cincinnati Sub-Zero Products, INC. Temperature & Humidity Chamber	ZH-8-1-1-H/AC	ZF9722653	29 Nov 2017

47 CFR FCC Part 15.225(e) Frequency Stability Versus Input Voltage Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo. The EUT was placed in an environmental temperature chamber with a nominal supply voltage. For the battery operated EUT, the EUT was supplied using a variable power supply.
2. The RF antenna connector of the EUT was connected to the frequency counter via a low-loss coaxial cable.

47 CFR FCC Part 15.225(e) Frequency Stability Versus Input Voltage Test Method

1. The EUT was switched off and the environmental temperature was set to 20°C.
2. Upon reaching the set temperature with 30 minutes of stabilisation period, the EUT was switched on and configured to operate in the test mode with transmitting frequency at 13.56MHz.
3. The EUT's transmitting frequency was then measured with the frequency counter. The signal capturing was continuous until no further changes were observed. Four measurements were made in total.
4. Repeat steps 1 to 3 with the supply voltage set to 85% and 115% of the nominal voltage supply respectively.



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FREQUENCY STABILITY VERSUS INPUT VOLTAGE TEST

47 CFR FCC Part 15.225(e) Frequency Stability Versus Input Voltage Results

Test Input Power	See table below	Temperature	20°C
		Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

Channel Frequency (MHz)	Test Input Power (Vdc)	±0.01% Carrier Tolerance (Hz)	Measured Tolerance (Hz)
13.5600	3.0Vdc (<i>nominal voltage</i>)	±1356.0000	-0.5428
	2.55Vdc (85% of <i>nominal voltage</i>)	±1356.0000	-0.5850
	3.45Vdc (115% of <i>nominal voltage</i>)	±1356.0000	-0.5659



Test Report No. 7191153026-EEC16/02
dated 19 Jul 2017



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