TÜVRheinland®

Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	**50101920 001**	**Seite 1 von 33** *Page 1 of 33*

Auftraggeber: *Client:*	**MIWA LOCK CO.,LTD.** 3-1-12, Shiba, Minato-ku, Tokyo 105-8510, JAPAN
Gegenstand der Prüfung: *Test Item:*	**Hotel Card Lock System**
Bezeichnung: *Identification:*	**ALVBP**
Serien-Nr.: *Serial No.:*	**T00063C**
Wareneingangs-Nr.: *Receipt No.:*	**A000646573**
Eingangsdatum: *Date of Receipt:*	**2017-11-06**
Zustand des Prüfgegenstandes bei Anlieferung: *Condition of Test Item at Delivery:*	**Good**
Prüfort: *Testing Location:*	**TÜV Rheinland Japan Ltd. – Global Technology Assessment Center** 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan
Prüfgrundlage: *Test Specification:*	**FCC 47 CFR Part 15, Subpart C, Section 15.225** **RSS-210 (Issue 9): 2016** **RSS-Gen (Issue 4): 2014** ANSI C63.10-2013
Prüfergebnis: *Test Result:*	**Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test item passed the test specification(s).*
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland Japan Ltd. – Global Technology Assessment Center** 4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
2017-12-13	P. Zhang / Inspector		2017-12-13	A. Abe / Reviewer	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges / *Other Aspects:*

This test report covers aspects related to 13.56MHz RFID function of the EUT (**E**quipment **U**nder **T**est) only. It contains one Bluetooth Low Energy module (model ZS, manufacturer Murata Manufacturing Co., Ltd). The BLE module was already tested and certified as per FCC and ISED rules (FCC ID: VPYLBZY, IC: 772C-LBZY).

Abkürzungen:				*Abbreviations:*			
	P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*
	F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*
	N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*
	N/T	=	*nicht getestet*		*N/T*	=	*not tested*

TEST SUMMARY

5.1.1 ANTENNA REQUIREMENTS
RESULT: PASS

5.1.2 RESTRICTED BANDS OF OPERATION
RESULT: PASS

5.2.1 20DB BANDWIDTH
RESULT: PASS

5.2.2 99% BANDWIDTH

5.2.3 FREQUENCY STABILITY
RESULT: Pass

5.2.4 FIELD STRENGTH OF FUNDAMENTAL
RESULT: Pass

5.2.5 RADIATED SPURIOUS EMISSIONS OF TRANSMITTER
RESULT: PASS

5.3.1 AC POWER LINE CONDUCTED EMISSION OF TRANSMITTER
RESULT: N/A

Contents

1. General Remarks

1.1 Complementary Materials

There is no attachment to this test report.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. – Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facilities and has found these test sites to be in compliance with the requirements of section 2.948 of the FCC rules. The description of the test facility is listed under FCC registration number 299054.

Innovation, Science and Economic Development Canada has reviewed the technical characteristics of the radiated and conducted emission facilities and has found these test sites to be in compliance with Canadian requirements. The description of the test facility is listed under OATS filing number 3466B-1.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2005.

ilac-MRA VLAC Lab Accreditation VLAC-017

TÜV Rheinland Japan Ltd. is accredited by the Federal Communications Commission as a Conformity Assessment Body under Designation Number JP0017 and Test Firm Registration Number 386498.

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
For Frequency Stability							
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2017-07-11	2018-07-11
Temperature Chamber	Voetsch	VT 4018	58566025 090010	BT-8012	1 year	2017-07-21	2018-07-21
For Radiated Emission							
Radiated Emission Measurement Soft-ware (below 30MHz)	Toyo Corporation	EP5/ME	Ver. 5.2.10	RF-0172	1 year	2017-03-31	2018-03-31
Radiated Emission Measurement Soft-ware (above 30MHz)	Toyo Corporation	EP7/RE	Ver. 7.4.30	RF-0026	1 year	2017-03-31	2018-03-31
Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2017-07-11	2018-07-11
Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2017-07-03	2018-07-03
RF Selector (10m Chamber)	Toyo Corporation	NS4900	0703-182	RF-0029	1 year	2017-03-31	2018-03-31
Loop Antenna with Amplifier, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	1 year	2017-05-29	2018-05-29
Trilog Antenna No. 2, 30-1000MHz	Schwarzbeck	VULB 9168	9168-475	RF-0462	1 year	2017-04-04	2018-04-04
5dB Attenuator	Pasternack	PE7047-5	-	RF-0731	1 year	2017-03-01	2018-03-01
Low Noise Preamplifier, 9kHz-1GHz	TSJ	MLA-10K01-B01-35	1370750	RF-0253	1 year	2017-01-18	2018-01-18
Low Pass Filter, DC-1GHz	R&K	LP1000CH 3	12104001	RF-0515	1 year	2017-01-18	2018-01-18
Constant Voltage Constant Frequency Stabilizers and Power Accessories							
DC Power Supply	Agilent	E3646A	MY40004642	BT-8153	N/A	N/A	N/A
True RMS Multimeter	Fluke	87V	97680445	RF-0281	1 year	2017-02-02	2018-02-02

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing.

2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Radiated Emission	150kHz - 30MHz	±4.7dB
	30MHz - 1GHz	±4.8dB

3. General Product Information

3.1 Product Function and Intended Use

The **EUT** (**E**quipment **U**nder **T**est) model ALVBP is a wireless hotel card unlock system. A guest or a staff of the hotel can unlock the door by Mifare card with 13.56MHz RFID or by a smartphone with 2.4GHz **BLE** (**B**luetooth **L**ow **E**nergy) wireless communication.

It also has a radio determination function using with an unmodulated 13.56MHz carrier in order to detect an approach of an object (Mifare card or smart phone) before above mentioned wireless communications starts.

RFID communication and Detection do not operate simultaneously.

Note: ALVBP has another model ALV2P. ALV2P supports Mifare card only. It is depopulated of the pre-certified BLE module. All the other feature is electrically identical.

3.2 System Details

RFID

Radio standard:	ISO 15693 (Based on customers specification)
Frequency range:	13.56MHz
Specified E-field strength:	6.6dBuV/m at 30m
Antenna gain:	-49.6dBi
Antenna type:	Pattern antenna (printed on PCB)
Modulation type:	Mifare ASK 100%
Signal spreading:	None
Transmit speed:	106kbps for RFID
Number of channels:	1

Detection

Radio standard:	-/-
Frequency range:	13.56MHz
Specified E-field strength:	0.6dBuV/m at 30m
Antenna gain:	-52.1.dBi
Antenna type:	Pattern antenna (printed on PCB)
Modulation type:	Non modulation
Signal spreading:	None
Number of channels:	1

FCC classification:	DXX – Part 15 Low Power Communication Device Transmitter
ISED classification:	RFID Device

Rated temperature: ±0 to +40°C (as per specification of the products)
Rated voltage: DC 3V

3.3 Clock Frequencies

The highest frequency generated or used by the EUT is 27.12MHz for the digital interface portions.

3.4 Noise Suppressing Parts

Refer to schematics.

4. Test Set-up and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209, 15.215 and 15.225.

The test methods, which have been used, are based on ANSI C63.10 and RSS-Gen.

For details, see under each test item.

4.2 Operation Modes

The basic operation modes used for testing are:

A. Communication mode: EUT transmits at 13.56MHz with ASK 100%.
B. Detection mode: EUT transmits continuously at 13.56MHz with non-modulation.

Note: 2.4GHz BLE communication feature is out of the scope from this test report.

4.3 Physical Configuration for Testing

The test system was configured in a typical fashion (as a customer would normally use it).

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10.

Figure 1: Block Diagram

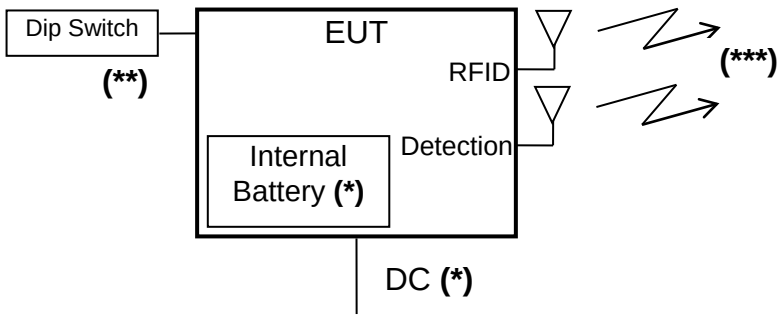

Table 3: Interfaces present on the EUT

No.	Interface	Cable Length for Testing, Shielding	Interface Classification
1.	DC Input	1.0m, un-shielded	DC input power port **(*)**
2.	Dip Switch Cable	0.1m, un-shielded	Signal port **(**)**

Note:

(*) This DC power line was used for voltage variation of frequency stability test for testing purpose. For all the other test items, new batteries were used including temperature variation of frequency stability test.

(**) A dip switch was connected to select an operation mode for the testing purpose.

(***) No simultaneous operation as per product specification

For more details, refer to section: Photographs of the Test Set-Up.

4.4 Test Software

No special test software was used to operate the EUT.

4.5 Special Accessories and Auxiliary Equipment

None

4.6 Countermeasures to achieve Compliance

No additional measures were employed to achieve compliance.

5. Test Results RADIO

5.1 Technical Requirements

5.1.1 Antenna Requirements

RESULT: **PASS**

Requirements:

FCC 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.

Verdict:

The EUT has an internal antenna which is not user accessible. Hence it complies with the antenna requirements.

5.1.2 Restricted Bands of Operation

RESULT: **PASS**

Requirements:

FCC 15.205 and RSS-Gen §8.10

Only spurious emissions are permitted in any of the restricted frequency bands, unless otherwise specified.

Verdict:

The EUT nominal operation frequency is 13.56MHz. Therefore only spurious emissions may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

5.2 Radiated Measurements

5.2.1 20dB Bandwidth

RESULT: **PASS**

Date of testing:	2017-11-08
Ambient temperature:	20°C
Relative humidity:	57%
Atmospheric pressure:	1011hPa

Requirements:

FCC 15.215(c) and FCC 15.225

The 20dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.

Test procedure:

ANSI C63.10 §6.9.2

The EUT was placed on a nonconductive turntable 0.8m above the ground plane in a semi-anechoic chamber.

The 20dB bandwidth was measured with a loop antenna connected to a spectrum using a peak detector with the following settings: RBW = 10kHz, VBW = 30kHz for Mode A and RBW = 10Hz, VBW = 30Hz for Mode B. Markers were placed at the lowest and highest intersections of the trace with a 20dBc line to obtain the value of the emission bandwidth.

Table 4: 20dB Bandwidth Edge Frequencies, Mode A

20dB Bandwidth Edge Side	Operating Frequency [MHz]	Edge Frequency [MHz]	Limit [MHz]	Margin [MHz]
Lower Freq.	13.56	13.3388495	13.110	0.2288495
Upper Freq.	13.56	13.7811572	14.010	0.2288428

Table 5: 20dB Bandwidth, Mode A

Operating Frequency [MHz]	20dB Bandwidth [kHz]
13.56	442.3077

Figure 2: 20dB Bandwidth, Mode A

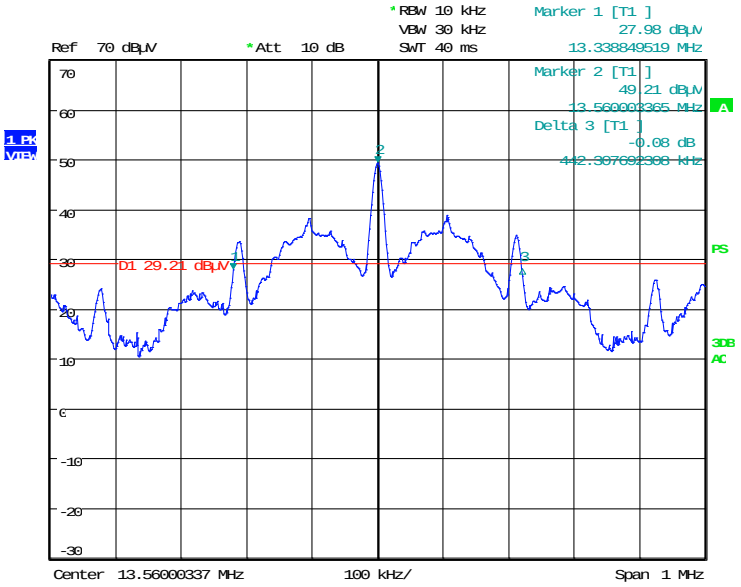

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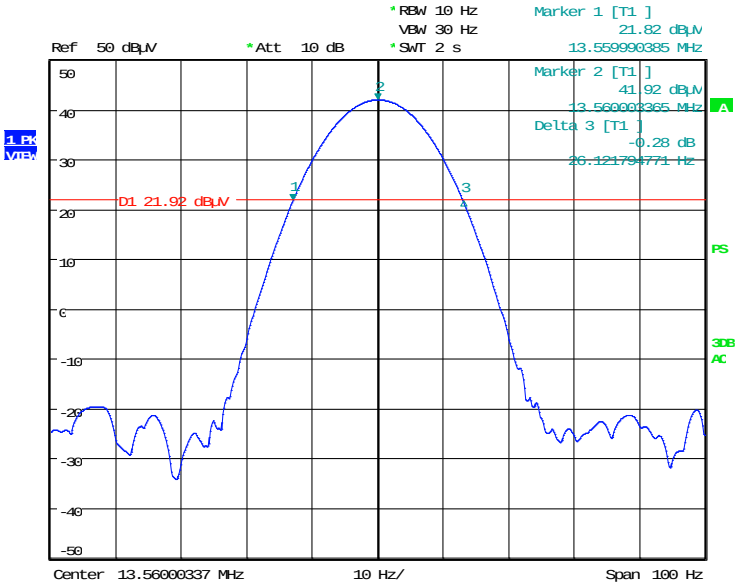
Table 6: 20dB Bandwidth Edge Frequencies, Mode B

20dB Bandwidth Edge Side	Operating Frequency [MHz]	Edge Frequency [MHz]	Limit [MHz]	Margin [MHz]
Lower Freq.	13.56	13.5599903	13.11	0.4499903
Upper Freq.	13.56	13.5600164	14.01	0.4499983

Table 7: 20dB Bandwidth, Mode B

Operating Frequency [MHz]	20dB Bandwidth [kHz]
13.56	0.0261

Figure 3: 20dB Bandwidth, Mode B



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Note: Frequency of T3 is calculated by the following.
13.5599903+0.0000261= 13.5600164 (MHz)

5.2.2 99% Bandwidth

Date of testing:	2017-11-08
Ambient temperature:	20°C
Relative humidity:	57%
Atmospheric pressure:	1011hPa

Requirements:

RSS-Gen §6.6

The 99% bandwidth shall be reported according to RSS-Gen §6.6.

Test procedure:

ANSI C63.10 §6.9.3 and RSS-Gen §6.6

The EUT was placed on a nonconductive turntable 0.8m above the ground plane in a semi-anechoic chamber.

The 99% bandwidth was measured with a loop antenna connected to a spectrum analyzer using a sample detector with the following settings: RBW = 10kHz, VBW = 30kHz for Mode A and RBW = 10Hz, VBW = 30Hz for Mode B. The value of the emission bandwidth was obtained by using the OBW function of the analyzer with a 99% coverage setting.

Table 8: 99% Bandwidth, Mode A

Operating Frequency [MHz]	99% Bandwidth [kHz]
13.56	785.2564

Figure 4: 99% Bandwidth, Mode A

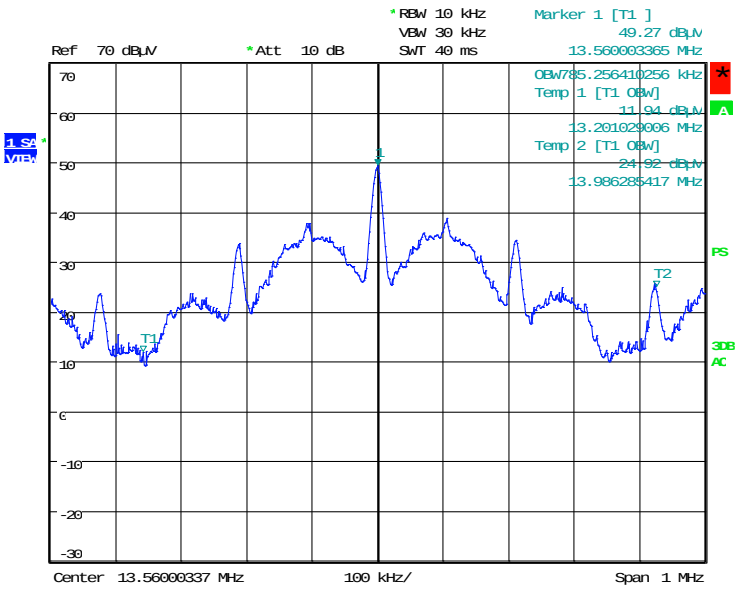

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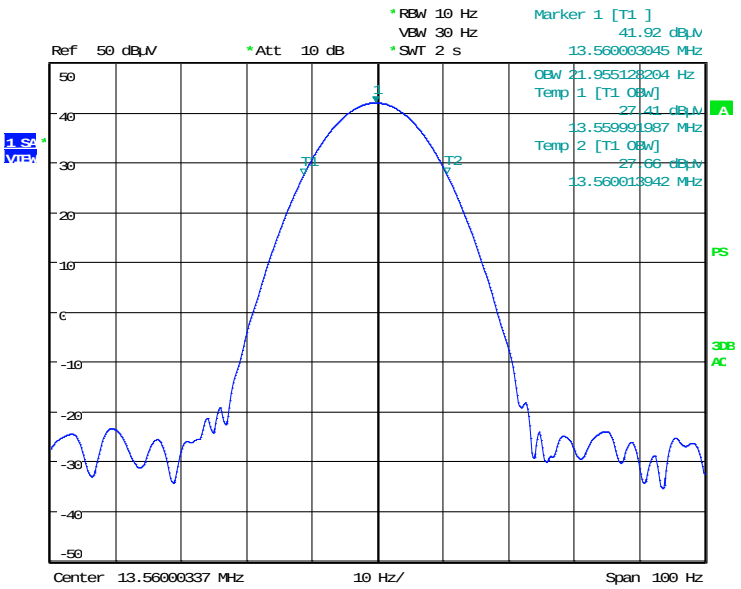
Table 9: 99% Bandwidth, Mode B

Operating Frequency [MHz]	99% Bandwidth [kHz]
13.56	0.02196

Figure 5: 99% Bandwidth, Mode B



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5.2.3 Frequency Stability

RESULT: **Pass**

Date of testing:	2017-11-24
Ambient temperature:	23°C
Relative humidity:	39%
Atmospheric pressure:	1016hPa

Requirements:

FCC 15.225(e), RSS-Gen §6.11 and 8.11 and RSS-210 §B.6

The frequency tolerance of the carrier signal shall be maintained within ± 0.01% of the operating frequency over a temperature variation of -20°C to +50°C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C. For hand-held device with internal battery, voltage variation measurement shall be repeated at the battery's operating end-point voltage declared by the manufacturer.

Test procedure:

ANSI C63.10 §6.8

The EUT was placed inside a temperature chamber and was set to produce a modulated carrier (mode A) and an unmodulated carrier (mode B).

The carrier frequency was measured with a loop antenna connected to a spectrum analyzer. Measurements were performed from 50°C down to -20°C for every 10°C. For each temperature step, the measurements started after the temperature was sufficiently stabilized and were performed at start-up of the EUT, and then after 2, 5 and 10 minutes. The EUT was turned off during temperature changes.

The carrier frequency measurement was then performed at a temperature of 20°C for a variation of ± 15% of the nominal input voltage. Since the EUT is battery powered, voltage variation measurement was further repeated at the battery's operating end-point.

Test temperatures:	-20, -10, 0, 10, 20, 30, 40, 50°C
Battery's operation end point:	DC 2.4V
Low test voltage (85%):	DC 2.55V
Normal test voltage (100%):	DC 3V
High test voltage (115%):	DC 3.45V

Table 10: Frequency Stability at 50°C, DC 3V, Mode A

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.559970000	-0.0002%	± 0.01	Pass
2	13.56	13.559960000	-0.0003%	± 0.01	Pass
5	13.56	13.559960000	-0.0003%	± 0.01	Pass
10	13.56	13.559970000	-0.0002%	± 0.01	Pass

Table 11: Frequency Stability at 40°C, DC 3V, Mode A

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.559970000	-0.0002%	± 0.01	Pass
2	13.56	13.559970000	-0.0002%	± 0.01	Pass
5	13.56	13.559970000	-0.0002%	± 0.01	Pass
10	13.56	13.559970000	-0.0002%	± 0.01	Pass

Table 12: Frequency Stability at 30°C, DC 3V, Mode A

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.559990000	-0.0001%	± 0.01	Pass
2	13.56	13.559980000	-0.0001%	± 0.01	Pass
5	13.56	13.559980000	-0.0001%	± 0.01	Pass
10	13.56	13.559980000	-0.0001%	± 0.01	Pass

Table 13: Frequency Stability at 20°C, DC 3V, Mode A

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.559990000	-0.0001%	± 0.01	Pass
2	13.56	13.559990000	-0.0001%	± 0.01	Pass
5	13.56	13.559990000	-0.0001%	± 0.01	Pass
10	13.56	13.559990000	-0.0001%	± 0.01	Pass

Table 14: Frequency Stability at 10°C, DC 3V, Mode A

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.559990000	-0.0001%	± 0.01	Pass
2	13.56	13.559990000	-0.0001%	± 0.01	Pass
5	13.56	13.559990000	-0.0001%	± 0.01	Pass
10	13.56	13.559990000	-0.0001%	± 0.01	Pass

Table 15: Frequency Stability at 0°C, DC 3V, Mode A

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560000000	0.0000%	± 0.01	Pass
2	13.56	13.560000000	0.0000%	± 0.01	Pass
5	13.56	13.560000000	0.0000%	± 0.01	Pass
10	13.56	13.560000000	0.0000%	± 0.01	Pass

Table 16: Frequency Stability at -10°C, DC 3V, Mode A

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560000000	0.0000%	± 0.01	Pass
2	13.56	13.560000000	0.0000%	± 0.01	Pass
5	13.56	13.560000000	0.0000%	± 0.01	Pass
10	13.56	13.560000000	0.0000%	± 0.01	Pass

Table 17: Frequency Stability at -20°C, DC 3V, Mode A

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560000000	0.0000%	± 0.01	Pass
2	13.56	13.560000000	0.0000%	± 0.01	Pass
5	13.56	13.560000000	0.0000%	± 0.01	Pass
10	13.56	13.560000000	0.0000%	± 0.01	Pass

Table 18: Frequency Stability with Supply Voltage at 20°C, Mode A

Supply Voltage	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
DC 2.4V	13.56	13.559990000	-0.0001%	± 0.01	Pass
DC 2.55V	13.56	13.559990000	-0.0001%	± 0.01	Pass
DC 3V	13.56	13.559990000	-0.0001%	± 0.01	Pass
DC 3.45V	13.56	13.559990000	-0.0001%	± 0.01	Pass

Table 19: Frequency Stability at 50°C, DC 3V, Mode B

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.559970000	-0.0002%	± 0.01	Pass
2	13.56	13.559960000	-0.0003%	± 0.01	Pass
5	13.56	13.559960000	-0.0003%	± 0.01	Pass
10	13.56	13.559970000	-0.0002%	± 0.01	Pass

Table 20: Frequency Stability at 40°C, DC 3V, Mode B

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.559990000	-0.0001%	± 0.01	Pass
2	13.56	13.559980000	-0.0001%	± 0.01	Pass
5	13.56	13.559980000	-0.0001%	± 0.01	Pass
10	13.56	13.559970000	-0.0002%	± 0.01	Pass

Table 21: Frequency Stability at 30°C, DC 3V, Mode B

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.559990000	-0.0001%	± 0.01	Pass
2	13.56	13.559990000	-0.0001%	± 0.01	Pass
5	13.56	13.559990000	-0.0001%	± 0.01	Pass
10	13.56	13.559990000	-0.0001%	± 0.01	Pass

Table 22: Frequency Stability at 20°C, DC 3V, Mode B

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560000000	0.0000%	± 0.01	Pass
2	13.56	13.560000000	0.0000%	± 0.01	Pass
5	13.56	13.560000000	0.0000%	± 0.01	Pass
10	13.56	13.560000000	0.0000%	± 0.01	Pass

Table 23: Frequency Stability at 10°C, DC 3V, Mode B

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560000000	0.0000%	± 0.01	Pass
2	13.56	13.560000000	0.0000%	± 0.01	Pass
5	13.56	13.560000000	0.0000%	± 0.01	Pass
10	13.56	13.560000000	0.0000%	± 0.01	Pass

Table 24: Frequency Stability at 0°C, DC 3V, Mode B

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560000000	0.0000%	± 0.01	Pass
2	13.56	13.560000000	0.0000%	± 0.01	Pass
5	13.56	13.560000000	0.0000%	± 0.01	Pass
10	13.56	13.560000000	0.0000%	± 0.01	Pass

Table 25: Frequency Stability at -10°C, DC 3V, Mode B

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560000000	0.0000%	± 0.01	Pass
2	13.56	13.560000000	0.0000%	± 0.01	Pass
5	13.56	13.560000000	0.0000%	± 0.01	Pass
10	13.56	13.560000000	0.0000%	± 0.01	Pass

Table 26: Frequency Stability at -20°C, DC 3V, Mode B

Elapsed Time [min]	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
Start-up	13.56	13.560000000	0.0000%	± 0.01	Pass
2	13.56	13.560000000	0.0000%	± 0.01	Pass
5	13.56	13.560000000	0.0000%	± 0.01	Pass
10	13.56	13.560000000	0.0000%	± 0.01	Pass

Table 27: Frequency Stability with Supply Voltage at 20°C, Mode B

Supply Voltage	Nominal Frequency [MHz]	Measured Frequency [MHz]	Deviation [%]	Limit [%]	Result
DC 2.4V	13.56	13.560000000	0.0000%	± 0.01	Pass
DC 2.55V	13.56	13.560000000	0.0000%	± 0.01	Pass
DC 3V	13.56	13.560000000	0.0000%	± 0.01	Pass
DC 3.45V	13.56	13.560000000	0.0000%	± 0.01	Pass

5.2.4 Field Strength of Fundamental

RESULT: **Pass**

Date of testing:	2017-11-08
Ambient temperature:	20°C
Relative humidity:	57%
Atmospheric pressure:	1011hPa
Frequency range:	13.110 - 14.010MHz
Measurement distance:	3m
Kind of test site:	Semi Anechoic Chamber

Requirements:

FCC 15.225(a)(b)(c) and RSS-210 §B.6(a)(b)(c)

The field strength of fundamental shall not exceed the level specified in FCC 15.225(a)(b)(c) and RSS-210 B.6(a)(b)(c).

Test procedure:

ANSI C63.10 §6.3 and 6.4 and RSS-Gen §8.1

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Measurements were made at 3m distance and the EUT was rotated 360° in order to determine the emission's maximum level.

Measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode with a 6dB bandwidth set to 9kHz.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report. The field strength values taken at 3m measurement distance were recalculated for a 30m distance using a factor of 40dB/decade according to FCC 15.31(f) and RSS-Gen §6.4.

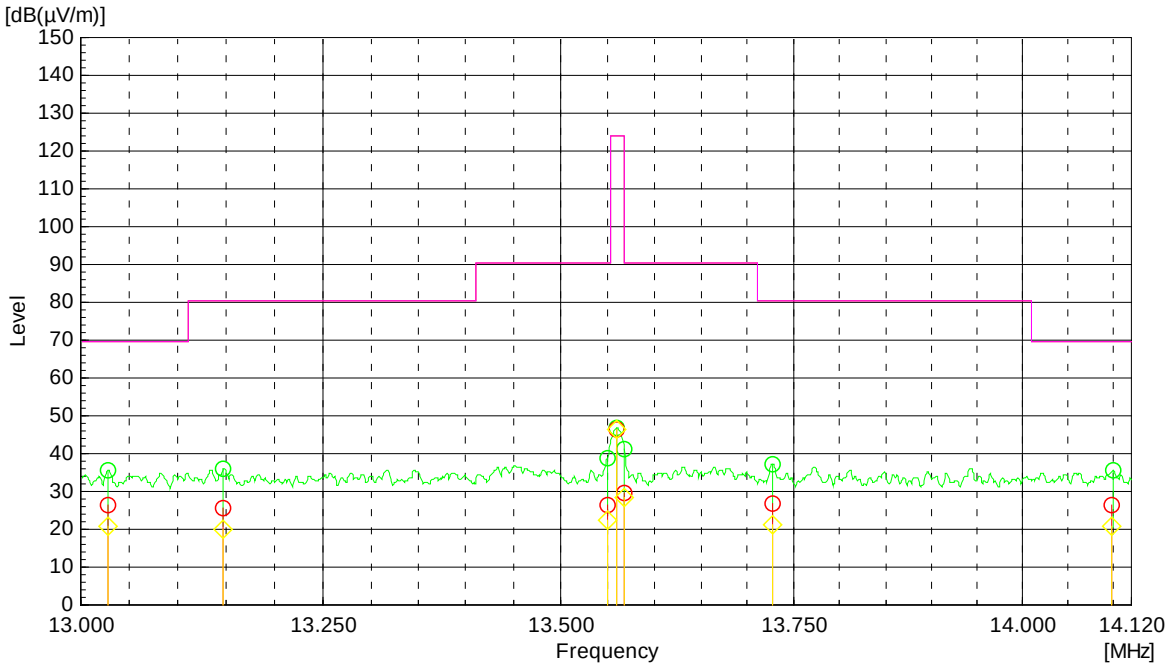
Table 28: Field Strength of Fundamental, Mode A

Frequency [MHz]	Reading QP at 3m [dB(uV)]	Factor [dB(1/m)]	Level QP at 3m [dBuV/m]	Level QP at 30m [dBuV/m]	Limit QP at 30m [dBuV/m]	Margin QP [dB]	Angle [°]
13.02842	6.7	19.8	26.5	-13.5	29.5	43.0	14
13.14658	5.7	19.8	25.5	-14.5	40.5	55.0	229
13.55012	6.7	19.8	26.5	-13.5	50.5	64.0	14
13.56014	26.8	19.8	46.6	6.6	84.0	77.4	359
13.56779	9.9	19.8	29.7	-10.3	50.5	60.8	359
13.72681	7.0	19.8	26.8	-13.2	40.5	53.7	357
14.09867	6.6	19.8	26.4	-13.6	29.5	43.1	357

Notes: Level QP at 3m = Reading QP at 3m + Factor
Level QP at 30m = Level QP at 3m - distance extrapolation factor for one decade
Distance extrapolation factor = 40dB/decade
Margin QP = Limit QP at 30m – Level QP at 30m

Grey shading data shows the highest fundamental in the test result.

Figure 6: Field Strength of Fundamental, Spectral Diagram, Mode A



Note: This spectral diagram is given for reference purpose only.
Measurement distance: 3m (limit is adjusted from 30m to 3m with 40dB correction factor)
Detector: Peak

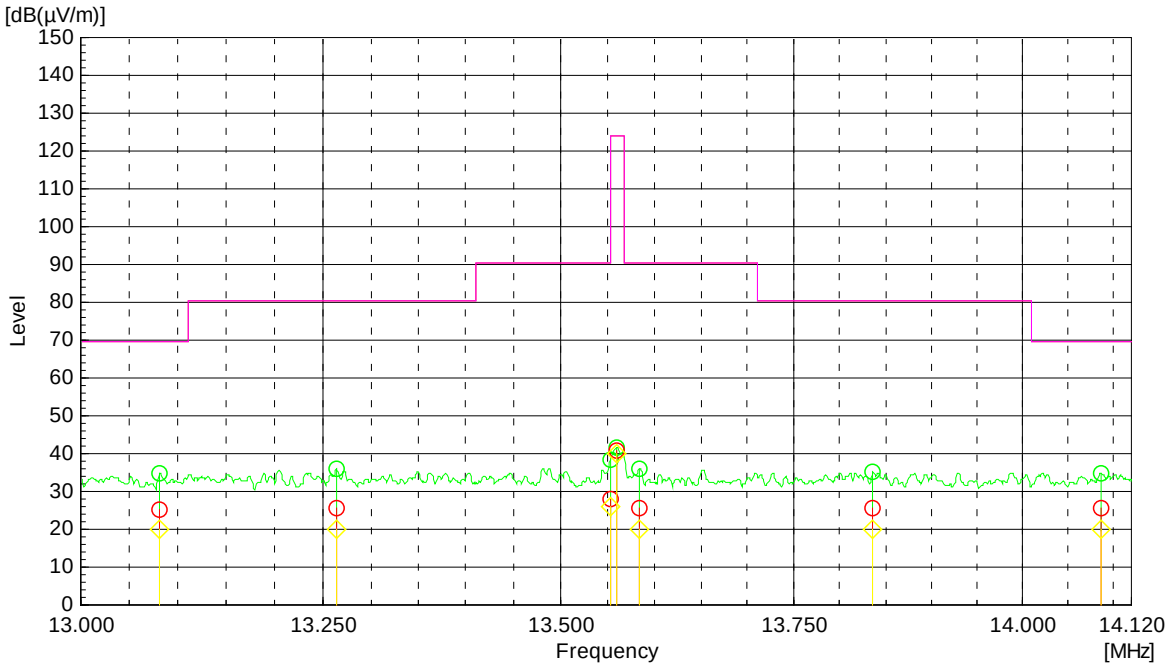
Table 29: Field Strength of Fundamental, Mode B

Frequency [MHz]	Reading QP at 3m [dB(uV)]	Factor [dB(1/m)]	Level QP at 3m [dBuV/m]	Level QP at 30m [dBuV/m]	Limit QP at 30m [dBuV/m]	Margin QP [dB]	Angle [°]
13.08088	5.6	19.8	25.4	-14.6	29.5	44.1	304
13.26391	5.6	19.8	25.4	-14.6	40.5	55.1	176
13.55291	8.2	19.8	28.0	-12.0	50.5	62.5	0
13.55991	20.8	19.8	40.6	0.6	84.0	83.4	0
13.58391	5.7	19.8	25.5	-14.5	50.5	65.0	195
13.83591	5.7	19.8	25.5	-14.5	40.5	55.0	350
14.08591	5.8	19.8	25.6	-14.4	29.5	43.9	95

Notes: Level QP at 3m = Reading QP at 3m + Factor
Level QP at 30m = Level QP at 3m - distance extrapolation factor for one decade
Distance extrapolation factor = 40dB/decade
Margin QP = Limit QP at 30m – Level QP at 30m

Grey shading data shows the highest fundamental in the test result.

Figure 7: Field Strength of Fundamental, Spectral Diagram, Mode B



Note: This spectral diagram is given for reference purpose only.
Measurement distance: 3m (limit is adjusted from 30m to 3m with 40dB correction factor)
Detector: Peak

5.2.5 Radiated Spurious Emissions of Transmitter

RESULT: **PASS**

Date of testing:	2017-11-08, 2017-11-17
Ambient temperature:	20, 25°C
Relative humidity:	57, 42%
Atmospheric pressure:	1011, 1018hPa
Frequency range:	9kHz - 1GHz (except 13.110 - 14.010MHz)
Measurement distance:	3m
Kind of test site:	Semi Anechoic Chamber

Requirements:

FCC 15.209, FCC 15.225(d), RSS-Gen §8.9 and 8.10 and RSS-210 §B.6(d)

Emission radiated outside the band 13.110-14.010MHz must comply with the radiated emission limits specified in FCC 15.209(a), RSS-Gen §8.9 (tables 4 and 5) and RSS-210 §B.6(d).

Test procedure:

ANSI C63.10 §6.3, 6.4, 6.5 and RSS-Gen §6.13 and 8.1

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 9kHz to 1GHz. Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° in order to determine the emission's maximum level. For frequencies above 30MHz, the antenna was raised and lowered from 1 to 4m and measurements were taken using both horizontal and vertical antenna polarizations.

For emissions below 30MHz, measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode with a 6dB bandwidth set to 9kHz.

For emissions between 30MHz and 1GHz, measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode with a 6dB bandwidth set to 120kHz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

No spurious emission was found in the range 9kHz - 30MHz.

Table 30: Radiated Emissions, Quasi Peak Data, 30MHz – 1GHz, Horizontal and Vertical Antenna Orientations, Mode A

Frequency [MHz]	Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
65.774	V	33.5	-22.2	11.3	40.0	28.7	105	4
65.818	H	34.3	-22.2	12.1	40.0	27.9	105	7
94.914	H	38.4	-26.3	12.1	43.5	31.4	190	277
94.938	V	43.9	-25.9	18.0	43.5	25.5	100	172
379.673	V	38.1	-16.9	21.2	46.0	24.8	169	177
867.833	H	36.6	-8.5	28.1	46.0	17.9	151	343

Note: Level QP = Reading QP + Factor

Table 31: Radiated Emissions, Quasi Peak Data, 30MHz – 1GHz, Horizontal and Vertical Antenna Orientations, Mode B

Frequency [MHz]	Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
38.959	H	30.8	-21.9	8.9	40.0	31.1	221	6
39.694	V	30.7	-21.9	8.8	40.0	31.2	151	316
47.309	V	30.6	-21.6	9.0	40.0	31.0	163	357
65.946	H	33.5	-22.2	11.3	40.0	28.7	395	6
66.144	V	32.5	-22.2	10.3	40.0	29.7	105	353
94.902	H	36.4	-26.3	10.1	43.5	33.4	192	107
94.922	V	42.2	-25.9	16.3	43.5	27.2	100	169
705.121	V	49.4	-10.4	39.0	46.0	7.0	140	16.0
705.130	H	49.3	-10.4	38.9	46.0	7.1	105	292

Note: Level QP = Reading QP + Factor

5.3 AC Power Line Conducted Measurements

5.3.1 AC Power Line Conducted Emission of Transmitter

RESULT: **N/A**

Requirements:

FCC 15.207 and RSS-Gen §8.8

The AC power line conducted emission on any frequency within the band 150kHz to 30MHz shall not exceed the limits specified in FCC 15.207 and RSS-Gen §8.8 (table 3).

Test procedure:

ANSI C63.10 §6.2 and RSS-Gen §8.1

Note:

This test is not applicable, since the EUT does not incorporate AC power port. (i.e. Battery operated)

7. List of Tables

8. List of Figures

9. List of Photographs