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Test report

306911-1TRFWL

Date of issue: August 22, 2016

Applicant:

TableTop Media, LLC

Product:

Battery Pack with integrated NFC radio

Model:

zPay

Specification:

FCC 47 CFR Part 15 Subpart C, §15.225

Radio Frequency devices operating within the 13.110–14.010 MHz band

www.nemko.com

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FCC 15.225.docx; Date: June 2013

Test location

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Site number:	FCC test site registration number: 176392 (3 m semi anechoic chamber)

Tested by	Andrey Adelberg, Senior Wireless/EMC Specialist
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Review date	August 22, 2016
Signature of the reviewer	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	TableTop Media, LLC
Address	12404 Park Central Drive, Ste 350
City	Dallas
Province/State	TX
Postal/Zip code	75251
Country	USA

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.225 Radio Frequency devices operating within the 13.110–14.010 MHz band

1.3 Test methods

ANSI C63.10 v2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Exclusions

None

1.6 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable ¹
§15.31(e)	Variation of power source	Pass ¹
§15.203	Antenna requirement	Pass ²
§15.215(c)	20 dB bandwidth	Pass

Notes: ¹ The EUT is a battery powered device and all tests were performed with fully charged battery

² The Antenna is located within the enclosure of EUT and is not user accessible.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.225(a)	Field strength within 13.553–13.567 MHz band	Pass
§15.225(b)	Field strength within 13.410–13.553 MHz and 13.567–13.710 MHz bands	Pass
§15.225(c)	Field strength within 13.110–13.410 MHz and 13.710–14.010 MHz bands	Pass
§15.225(d)	Field strength outside 13.110–14.010 MHz band	Pass
§15.225(e)	Frequency tolerance of carrier signal	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	August 12, 2016
Nemko sample ID number	133-002588

3.2 EUT information

Product name	Battery Pack with integrated NFC radio
Model	zPay
Serial number	AN36231402D2

3.3 Technical information

Operating band	13.553–13.567 MHz
Operating frequency	13.56 MHz
Modulation type	ASK
Occupied bandwidth (99 %)	454 kHz
Power requirements	7.6 V _{DC} from internal Li-Ion battery
Emission designator	454KA2D
Antenna information	Internal antenna, 0 dBi gain The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The zPay product is a payment device for accepting chip card and contactless EMV payments intended for use in our Ziosk tabletop unit. The payment module is incorporated in a removable battery pack that powers the Ziosk. It uses a 13.56 MHz NFC reader chip to implement the contactless payment protocols, including ISO14443A and B. The NFC antenna is also integrated within the battery pack.

3.5 EUT exercise details

EUT was set to transmit at 13.56 MHz frequency using Laptop and test fixture, then disconnected from the test fixture while transmitting.

3.6 EUT setup diagram

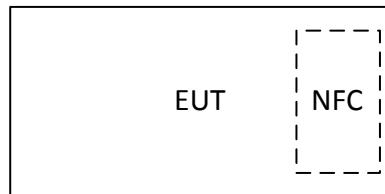


Figure 3.6-1: Setup diagram

3.7 Support equipment

Table 3.7-1: Support equipment

Description	Brand name	Model/Part number	Serial number
Laptop	Dell	E6420	3S8M5Q1
Test fixture	Ziosk	PN: TTM-00535	—

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Dec. 01/16
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Jan. 07/17
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Apr. 28/17
Active loop antenna (0.01–30 MHz)	Com-Power	AL-130	FA002674	1 year	Mar. 10/17
Temperature chamber	Espec	EPX-4H	FA002735	1 year	Jan 26/17

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 15.215(c) 20 dB bandwidth

8.1.1 Definitions and limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

8.1.2 Test summary

Test date:	August 15, 2016	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1008 mbar
Verdict:	Pass	Relative humidity:	32 %

8.1.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode:	Peak
Resolution bandwidth:	≥1 % of span
Video bandwidth:	RBW × 3
Trace mode:	Max Hold

8.1.4 Test data

Table 8.1-1: Lower 20 dBc frequency cross result

Fundamental frequency, MHz	Lower 20 dBc frequency cross, MHz	Limit, MHz	Margin, MHz
13.560	13.6798	13.553	0.1268

Note maximum negative frequency drift is 24 Hz

Table 8.1-2: Upper 20 dBc frequency cross result

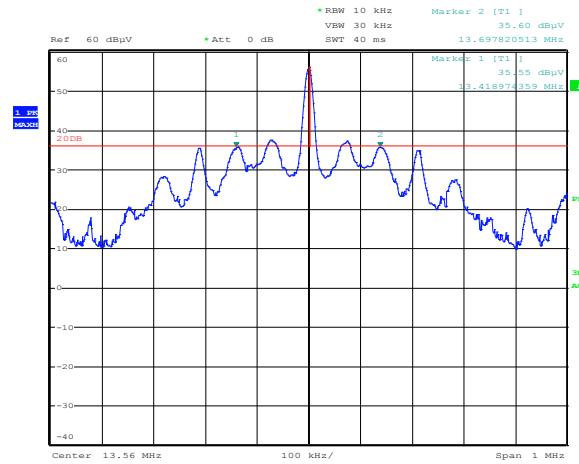
Fundamental frequency, MHz	Upper 20 dBc frequency cross, MHz	Limit, MHz	Margin, MHz
13.560	13.4189	13.567	0.1481

Maximum positive frequency drift is 52 Hz

Table 8.1-3: 99 % occupied bandwidth result

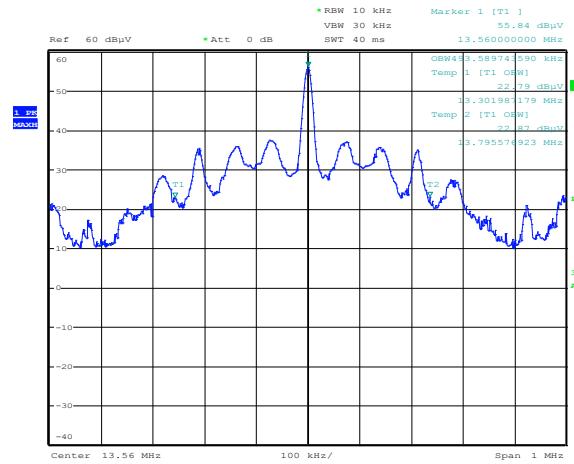
Frequency, MHz	99 % occupied bandwidth, kHz
13.56	453.6

8.1.4 Test data, continued



Date: 15.AUG.2016 12:08:27

Figure 8.1-1: 20 dB bandwidth spectrum plot



Date: 15.AUG.2016 12:07:11

Figure 8.1-2: 99 % occupied bandwidth spectrum plot

8.2 FCC 15.225(a-c) Field strength within the 13.110–14.010 MHz band

8.2.1 Definitions and limits

- a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15848 μ V/m (84 dB μ V/m) at 30 m.
- b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 μ V/m (50.5 dB μ V/m) at 30 m.
- c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 μ V/m (40.5 dB μ V/m) at 30 m.

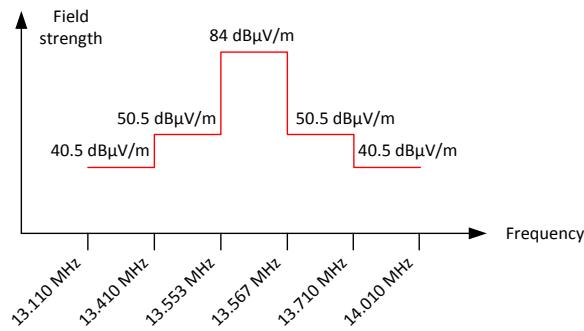


Figure 8.2-1: In-band spurious emissions limit

8.2.2 Test summary

Test date:	August 15, 2016	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1008 mbar
Verdict:	Pass	Relative humidity:	32 %

8.2.3 Observations/special notes

The EUT was measured on three orthogonal axis and was rotated 360°
The measurements were performed at the distance of 3 m.

Spectrum analyzer settings:

Detector mode:	Peak
Resolution bandwidth:	10 kHz
Video bandwidth:	30 kHz
Trace mode:	Max Hold

8.2.4 Test data

Table 8.2-1: Field strength measurement results within the 13.110–14.010 MHz band

Frequency, MHz	Field strength at 3 m, dB μ V/m	Calculated field strength at 30 m, dB μ V/m	Limit _{30 m} , dB μ V/m	Margin, dB
13.3480	46.962	6.962	40.500	33.538
13.4898	46.406	6.406	50.500	44.094
13.5595	70.062	30.062	84.000	53.938
13.6293	46.336	6.336	50.500	44.164
13.7710	46.581	6.581	40.500	33.919

Note: Calculated field strength at 30 m = Measured field strength at 3 m – 40 dB

40 dB distance correction factor* was applied to the measurement result in order to comply with 30 m limit.

* 30 m to 3 m distance correction factor calculation (for 13 MHz band):

$$40 \times \log_{10} (3 \text{ m}/30 \text{ m}) = 40 \times \log_{10} (0.1) = -40 \text{ dB}$$

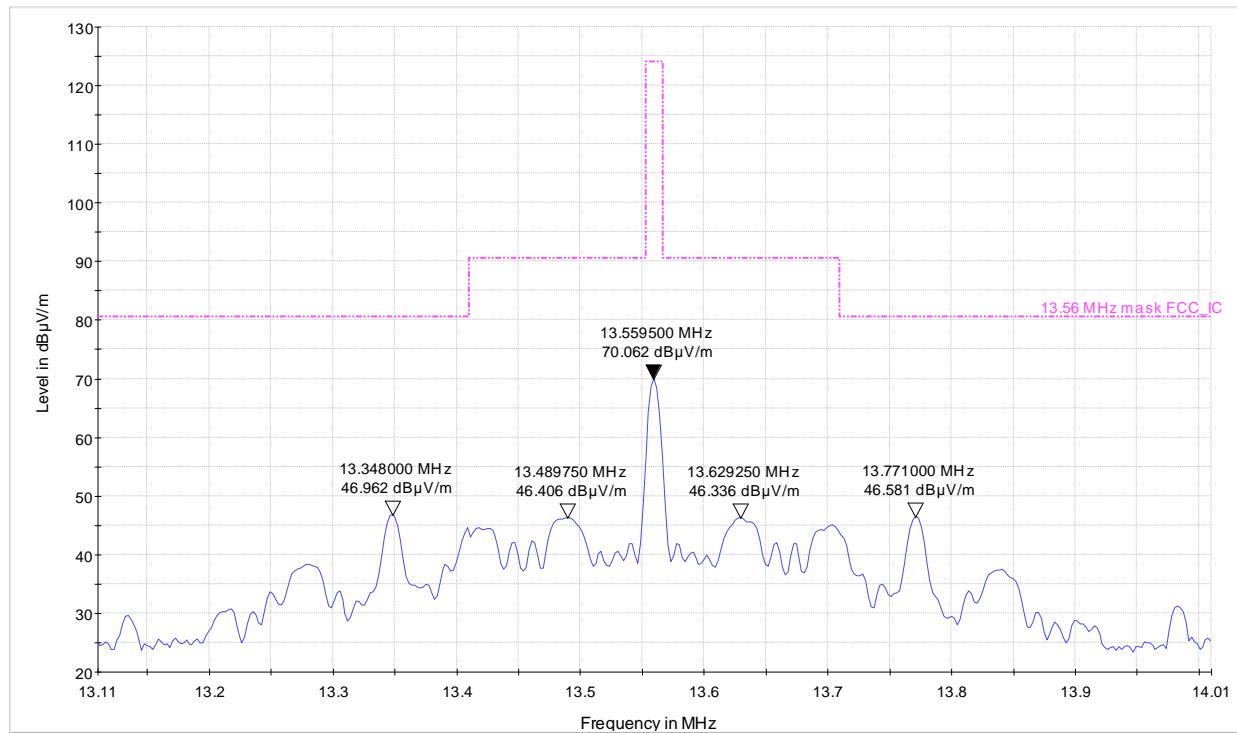


Figure 8.2-2: Field strength measurement spectrum plot within 13.110–14.010 MHz band

8.3 FCC 15.225(d) Field strength of emissions outside 13.110–14.010 MHz band

8.3.1 Definitions and limits

The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209
The field strength of emissions appearing within restricted bands (as specified in §15.205) shall not exceed the limits from §15.209

Table 8.3-1: FCC §15.209 – Radiated emission limits

Frequency, MHz	Field strength of emissions μV/m	Field strength of emissions dBμV/m	Measurement distance, m
0.009–0.490	2400 / F	67.6 – 20 × log ₁₀ (F)	300
0.490–1.705	24000 / F	87.6 – 20 × log ₁₀ (F)	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges. For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. 'F' is a frequency in kHz units.

Table 8.3-2: Restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
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	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.3.2 Test summary

Test date:	August 15, 2016	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1008 mbar
Verdict:	Pass	Relative humidity:	32 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 9 kHz to 1 GHz.
Radiated measurements were performed at a distance of 3 m.

Spectrum analyzer settings for frequencies below 30 MHz:

Detector mode:	Quasi-Peak
Resolution bandwidth:	9 kHz
Video bandwidth:	30 kHz
Trace mode:	Max Hold
Measurement time:	100 ms

Spectrum analyzer settings for frequencies above 30 MHz:

Detector mode:	Peak
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Trace mode:	Max Hold
Measurement time:	100 ms

8.3.4 Test data

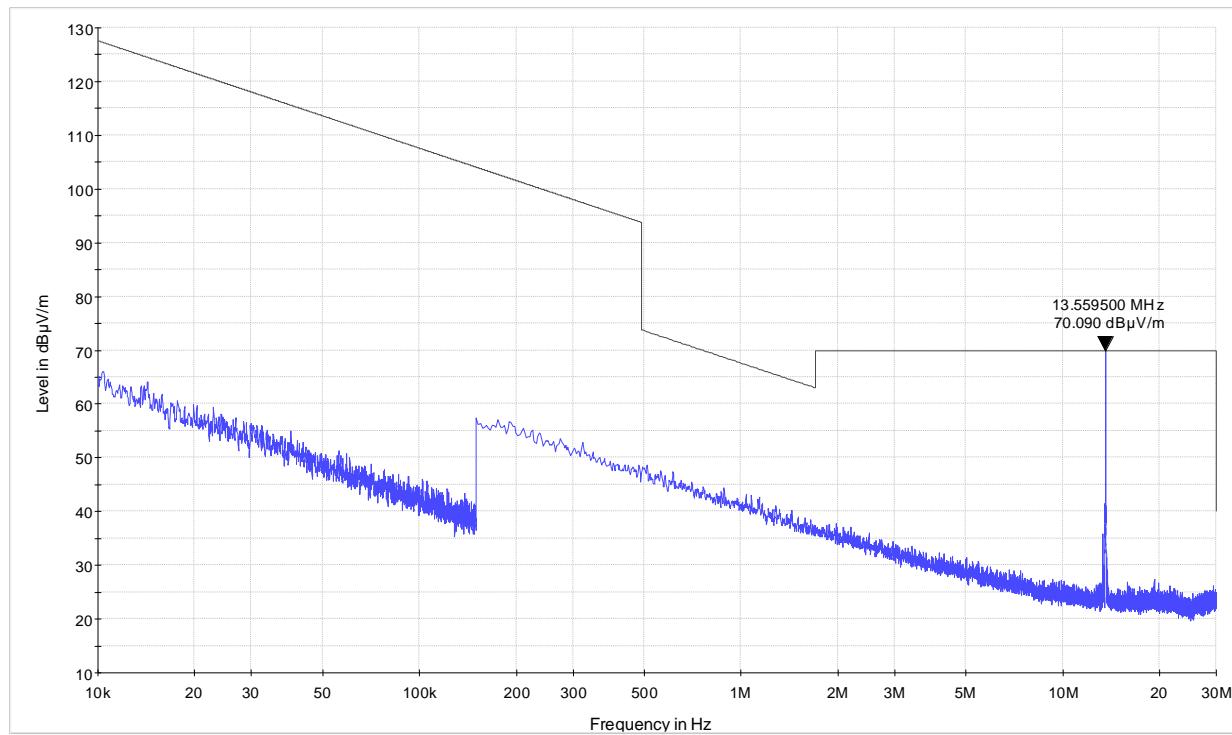


Figure 8.3-1: Field strength of spurious emissions within 10 kHz to 30 MHz band

Note: 13.56 MHz emission is an intended fundamental frequency of the transmitter and it exempt from the spurious emissions measurements.

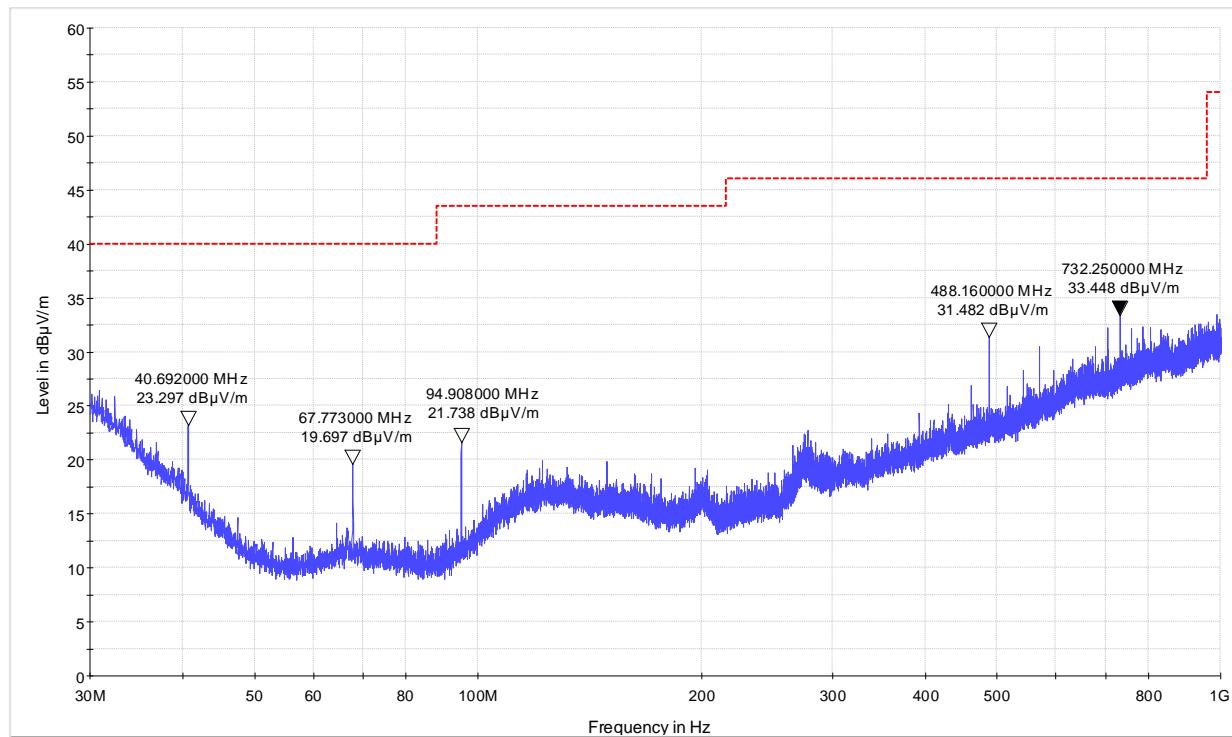


Figure 8.3-2: Field strength of spurious emissions within 30–1000 MHz band

8.4 FCC 15.225(e) Frequency tolerance of the carrier signal

8.4.1 Definitions and limits

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to +50 degrees 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 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.4.2 Test summary

Test date:	August 15, 2016	Temperature:	21 °C
Test engineer:	Andrey Adelberg	Air pressure:	1008 mbar
Verdict:	Pass	Relative humidity:	32 %

8.4.3 Observations/special notes

Spectrum analyzer settings:

Detector mode:	Peak
Resolution bandwidth:	$\geq 1\%$ of emission bandwidth
Video bandwidth:	RBW $\times 3$
Trace mode:	Max Hold

8.4.4 Test data

Table 8.4-1: Frequency drift measurements results

Test conditions	Frequency, MHz	Frequency drift, Hz	Frequency drift, %	Limit, $\pm\%$	Margin, %
+50 °C, Nominal	13.559416000	-24	-0.000177	0.01	0.009823
+40 °C, Nominal	13.559424000	-16	-0.000118	0.01	0.009882
+30 °C, Nominal	13.559439000	-1	-0.000007	0.01	0.009993
+20 °C, +15 %	13.559440000	0	0.000000	0.01	0.010000
+20 °C, Nominal	13.559440000	Reference	Reference	Reference	Reference
+20 °C, -15 %	13.559440000	0	0.000000	0.01	0.010000
+10 °C, Nominal	13.559468000	28	0.000206	0.01	0.009794
0 °C, Nominal	13.559485000	45	0.000332	0.01	0.009668
-10 °C, Nominal	13.559491000	51	0.000376	0.01	0.009624
-20 °C, Nominal	13.559492000	52	0.000383	0.01	0.009617

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up

