

Test report

341753-1TRFFCC

Date of issue: January 19, 2018

Applicant:

REGULA BALTIJA Ltd
97 A. Pumpura
LV-5404 Daugavpils
Latvia

Product:

13.56 MHz RFID documents reader

Model:

7027F.110

FCC ID:

2AOFE-7027F

Specifications:

FCC 47 CFR Part 15.225

Operation within the band 13.110–14.010 MHz

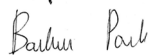
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The test report merely corresponds to the tested sample.

The phase of sampling / collection of equipment under test is carried out by the customer.

Test location

Company name	Nemko Spa
Address	Via del Carroccio, 4
City	Biassono
Province	MB
Postal code	20853
Country	Italy
Site number	FCC test firm registration number: 682159

Tested by (name, function and signature)	P. Barbieri	(project handler)	
Approved by (name, function and signature)	D. Guarnone	(verifier)	
Date	January 18, 2018		

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 Spa ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	REGULA BALTIJA Ltd
Address	97 A. Pumpura
City	Daugavpils
Province/State	--
Postal/Zip code	LV-5404
Country	Latvia

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.225	Operation in the 13.110–14.010 MHz
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1.3 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.

1.4 Exclusions

None

1.5 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
§15.31(e)	Variation of power source	Pass ¹
§15.203	Antenna requirement	Pass ²
§15.215(c)	20 dB bandwidth	Pass

Notes: ¹ Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed

² The Antennas are located within the enclosure of EUT and not user accessible.

³ The EUT is supplied only by a PC USB port.

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	2018-01-11
Nemko sample ID number	341753

3.2 EUT information

Product name	Documents reader
Model	7027F.110
Serial number	7E1073AH0465
Variants	7027F.100; 7027F

3.3 Technical information

Operating band	13.553–13.567 MHz
Operating frequency	13.56 MHz
Modulation type	ASK
Occupied bandwidth (99 %)	1.34 kHz
Power requirements	62.2 dBμV/m
Emission designator	A1D
Antenna information	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The EUT is a multipurpose product which is intended for capturing document images of ID, ID2 or ID3 formats produced in accordance with ISO 7810 standard. The device is power supply at 5V via USB from a PC. It has three light sources inside (white LEDs, IR (870nm) LEDs and UV (365nm) LEDs). The EUT is also provided with an RFID radio module operating at 13.56 MHz.

Models 7027F.110, 7027F.100 and 7027F are electrically and mechanically identical; all LED light sources are mounted on each model, but some light sources are disabled on model 7027F and 7027F.100. Same RFID radio reader.

3.5 EUT exercise details

The EUT work in continuous transmission mode since it's switched on

3.6 EUT setup diagram



Figure 3.6-1: Setup diagram

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

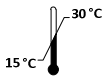
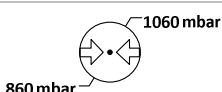
4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Unless different values are declared in the test case, following ambient conditions apply for the tests:

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.

Test equipment used for the monitoring of the environmental conditions

Equipment	Manufacturer	Model	Serial N°
Thermohygrometer data loggers	Testo	175-H2	20012380/305
Thermohygrometer data loggers	Testo	175-H2	38203337/703
Barometer	MSR	MSR145B	330080

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

EUT	Type	Test	Range and Setup features	Measurement Uncertainty	Notes
Transmitter	Conducted	Frequency error	0.001MHz ÷ 18 GHz	0.08 ppm	(1)
		Carrier power RF Output Power	1MHz ÷ 18 GHz With power meter	1.6 dB	(1)
			1MHz ÷ 18 GHz With spectrum/receiver	3.0 dB	(1)
		Adjacent channel power	1MHz ÷ 18 GHz	1.6 dB	(1)
		Conducted spurious emissions	1MHz ÷ 18 GHz	4.2 dB	(1)
		Intermodulation attenuation	1MHz ÷ 18 GHz	2.2 dB	(1)
		Attack time – frequency behaviour	1MHz ÷ 18 GHz	2.0 ms	(1)
		Attack time – power behaviour	1MHz ÷ 18 GHz	2.5 ms	(1)
		Release time – frequency behaviour	1MHz ÷ 18 GHz	2.0 ms	(1)
		Release time – power behaviour	1MHz ÷ 18 GHz	2.5 ms	(1)
		Transient behaviour of the transmitter– Transient frequency behaviour	1MHz ÷ 18 GHz	0.2 kHz	(1)
		Transient behaviour of the transmitter – Power level slope	1MHz ÷ 18 GHz	9%	(1)
		Frequency deviation - Maximum permissible frequency deviation	0.001MHz ÷ 18 GHz	1.3%	(1)
		Frequency deviation - Response of the transmitter to modulation frequencies above 3 kHz	0.001MHz ÷ 18 GHz	0.5 dB	(1)
		Dwell time	-	3%	(1)
		Hopping Frequency Separation	0.01MHz ÷ 18 GHz	1%	(1)
		Occupied Channel Bandwidth	0.01MHz ÷ 18 GHz	2%	(1)
		Modulation Bandwidth	0.01MHz ÷ 18 GHz	2%	(1)
Receiver	Radiated	Radiated spurious emissions	30MHz ÷ 18 GHz	6.0 dB	(1)
		Effective radiated power transmitter	30MHz ÷ 18 GHz	6.0 dB	(1)
	Conducted	Conducted spurious emissions	1MHz ÷ 18 GHz	4.2 dB	(1)

NOTES:

(1) The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$ which has been derived from the assumed normal probability distribution with infinite degrees of freedom and for a coverage probability of 95 %.

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.
EMI receiver	R&S	ESW44	100202	2017-04	2018-04
Trilog Broadband Antenna 25 ÷ 8000 MHz	Schwarzbeck	VULB 9162	9162-025	2017-07	2018-07
Loop antenna	R&S	HFH2-Z2	831247/011	2017-10	2020-10
Shielded room	Siemens	Conducted emission test room	1862	NCR	NCR
Turn-table	R&S	HCT	835 803/03	NCR	NCR
Antenna mast	R&S	HCM	836 529/05	NCR	NCR
Controller	R&S	HCC	836 620/7	NCR	NCR
Semi-anechoic chamber	Nemko	10m semi-anechoic chamber	530	2016-10	2018-10
Shielded room	Siemens	10m control room	1947	NCR	NCR
Climatic Chamber	ESPEC	ARS 1100	4100000067	2017-11	2018-11

Note: NCR - no calibration required, VOI - verify on use

Section 8. Testing data

8.1 FCC 15.215(c) Occupied (Emission) 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. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

8.1.2 Test summary

Test date	January 15, 2018	Temperature	21 °C
Test engineer	Paolo Barbieri	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	38 %

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

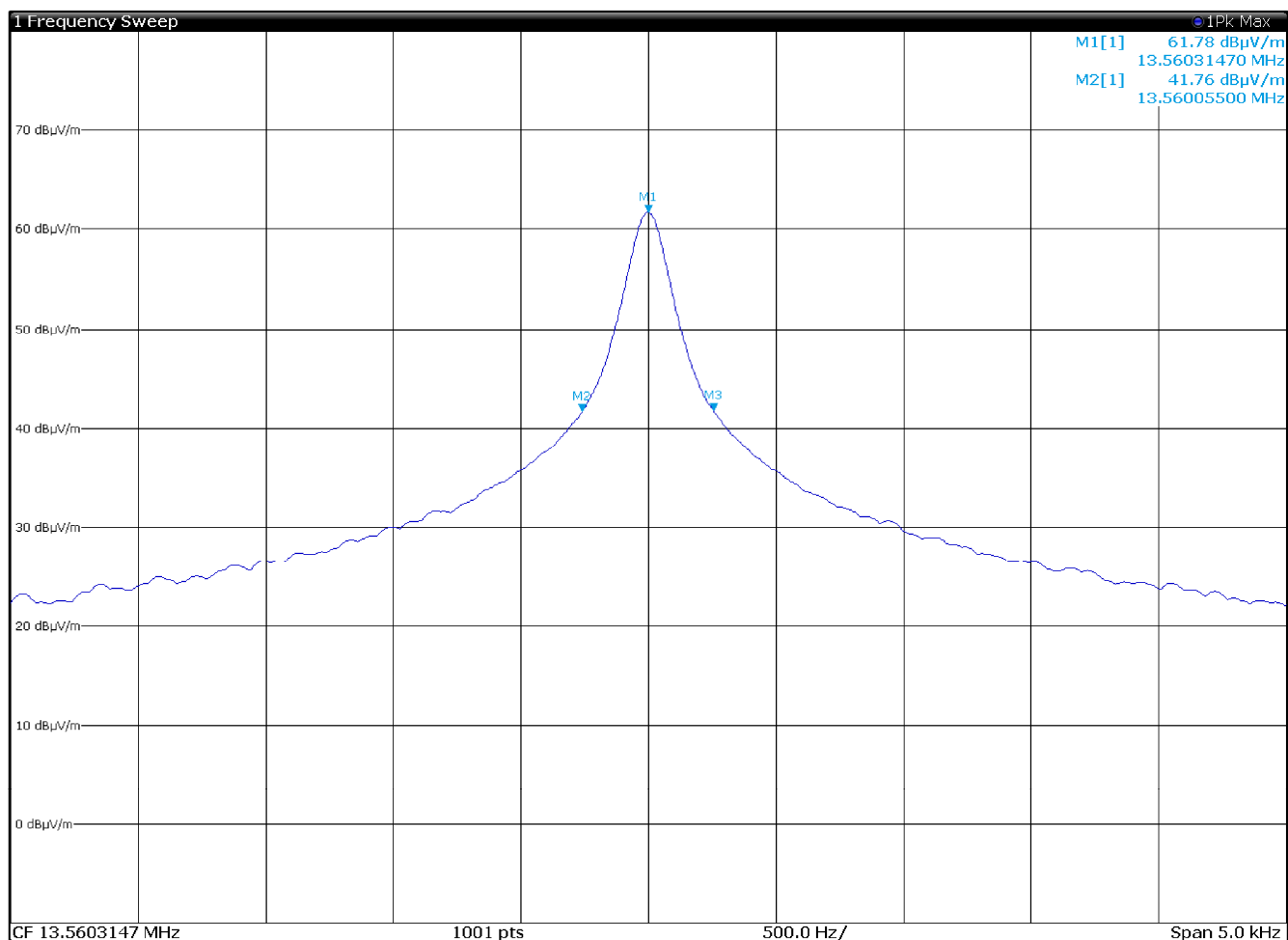
8.1.4 Test data

Table 8.1-1: Lower 20 dBc frequency cross result

Fundamental frequency, MHz	Lower 20 dBc frequency cross, MHz	Limit, MHz	Margin, kHz
13.560	13.56005	13.553	7.05

Table 8.1-2: Upper 20 dBc frequency cross result

Fundamental frequency, MHz	Upper 20 dBc frequency cross, MHz	Limit, MHz	Margin, kHz
13.560	13.56057	13.567	6.43

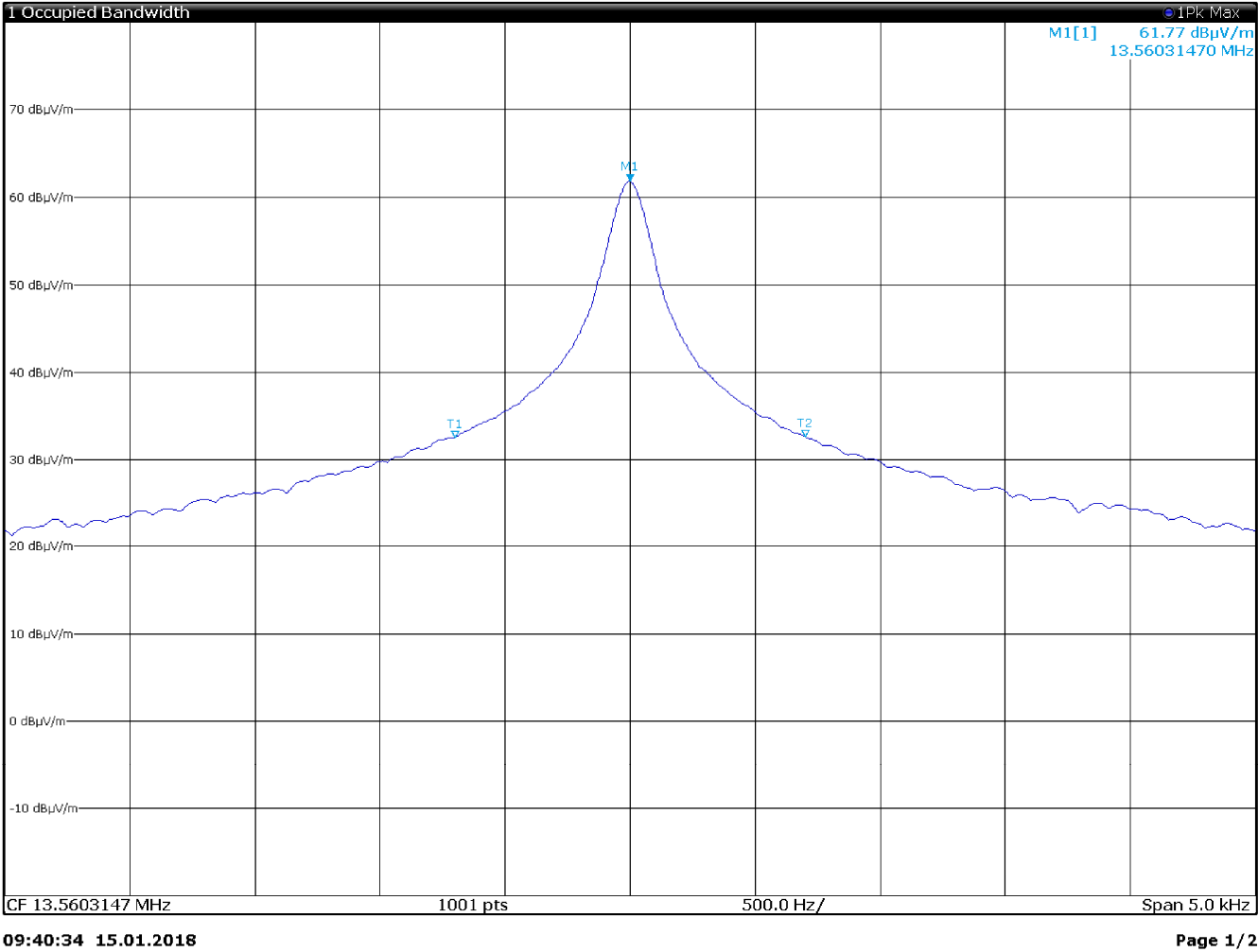


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2 Marker Table						
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		13.5603147 MHz	61.78 dBμV/m		
M2	1		13.560055 MHz	41.76 dBμV/m		
M3	1		13.5605694 MHz	41.79 dBμV/m		

Figure 8.1-1: 20 dB bandwidth



2 Marker Table						
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1	1		13.5603147 MHz	61.77 dBµV/m		
T1	1		13.5596154 MHz	32.41 dBµV/m	Occ Bw	1.398601399 kHz
T2	1		13.561014 MHz	32.56 dBµV/m		

Figure 8.1-2: 99% dB bandwidth

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

8.2.1 Definitions and limits

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

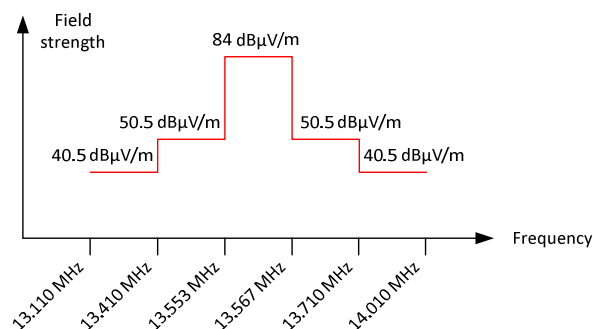


Figure 8.2-1: In-band spurious emissions limit

8.2.2 Test summary

Test date	January 15, 2018	Temperature	21 °C
Test engineer	Paolo Barbieri	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	38 %

8.2.3 Observations/special notes

The measurements were performed at the distance of 3 m. 40 dB distance correction factor* was applied to the measurement result in order to comply with 30 m limits.

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

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

Spectrum analyzer settings:

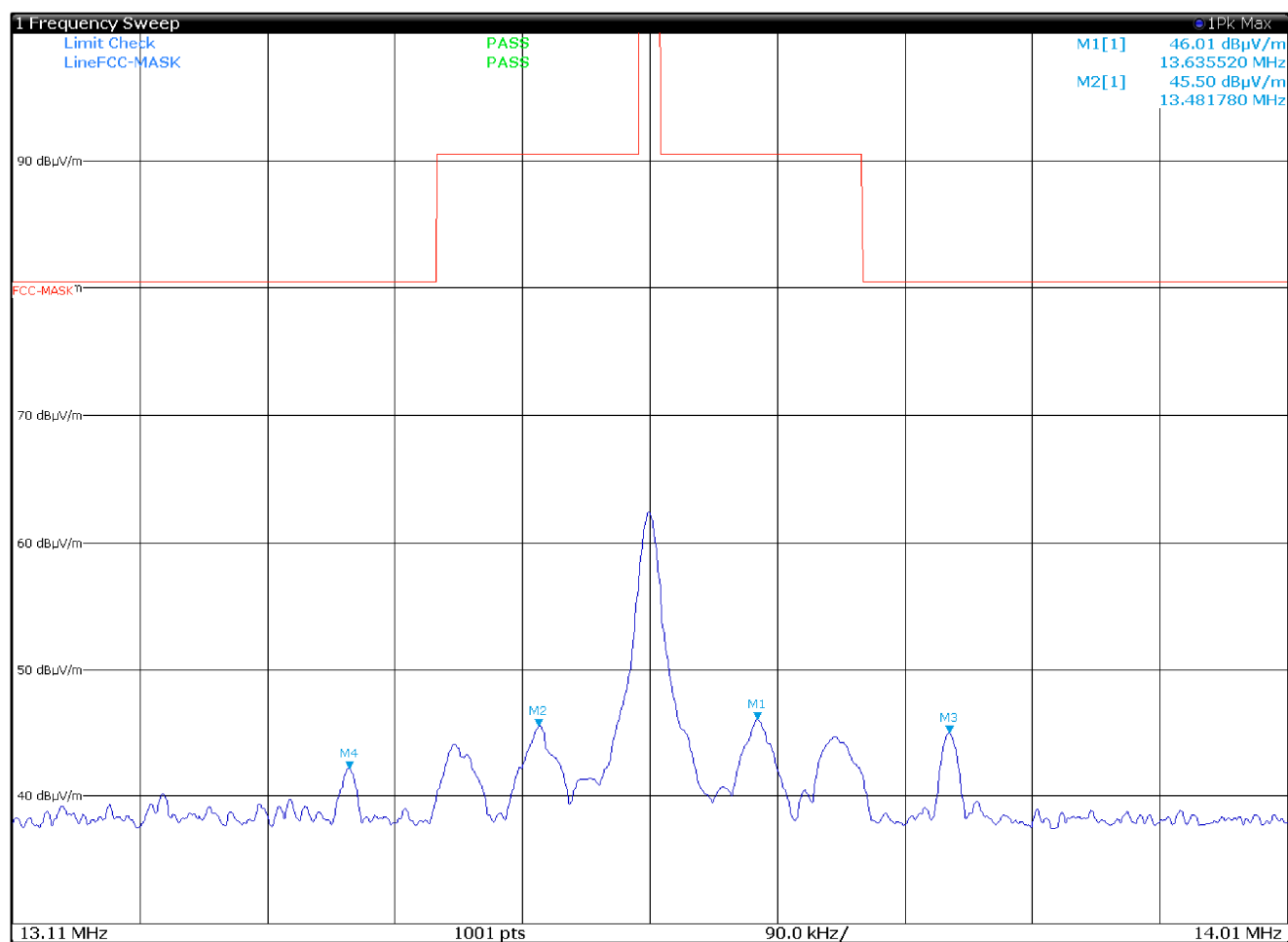
Detector mode	Peak
Resolution bandwidth	10 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: Field strength measurements results

Frequency range, MHz	Frequency, MHz	Field strength at 3 m, dBμV/m	Calculated field strength at 30 m, dBμV/m	Limit, dBμV/m	Margin, dB
13.553–13.567	13.560	62.2	22.2	84.0	-61.8
13.410–13.553	13.482	45.5	5.5	50.5	-45.0
13.567–13.710	13.635	46.0	6.0	50.5	-44.5
13.110–13.410	13.348	42.2	2.2	40.5	-38.3
13.710–14.010	13.771	45.0	5.0	40.5	-35.5

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



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Figure 8.2-2: Field strength 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 and RSS-Gen – Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	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

Table 8.3-2: IC restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677–5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in table above and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

Table 8.3-3: FCC 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	January 15, 2018	Temperature	21 °C
Test engineer	Paolo Barbieri	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	38 %

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 below 30 MHz

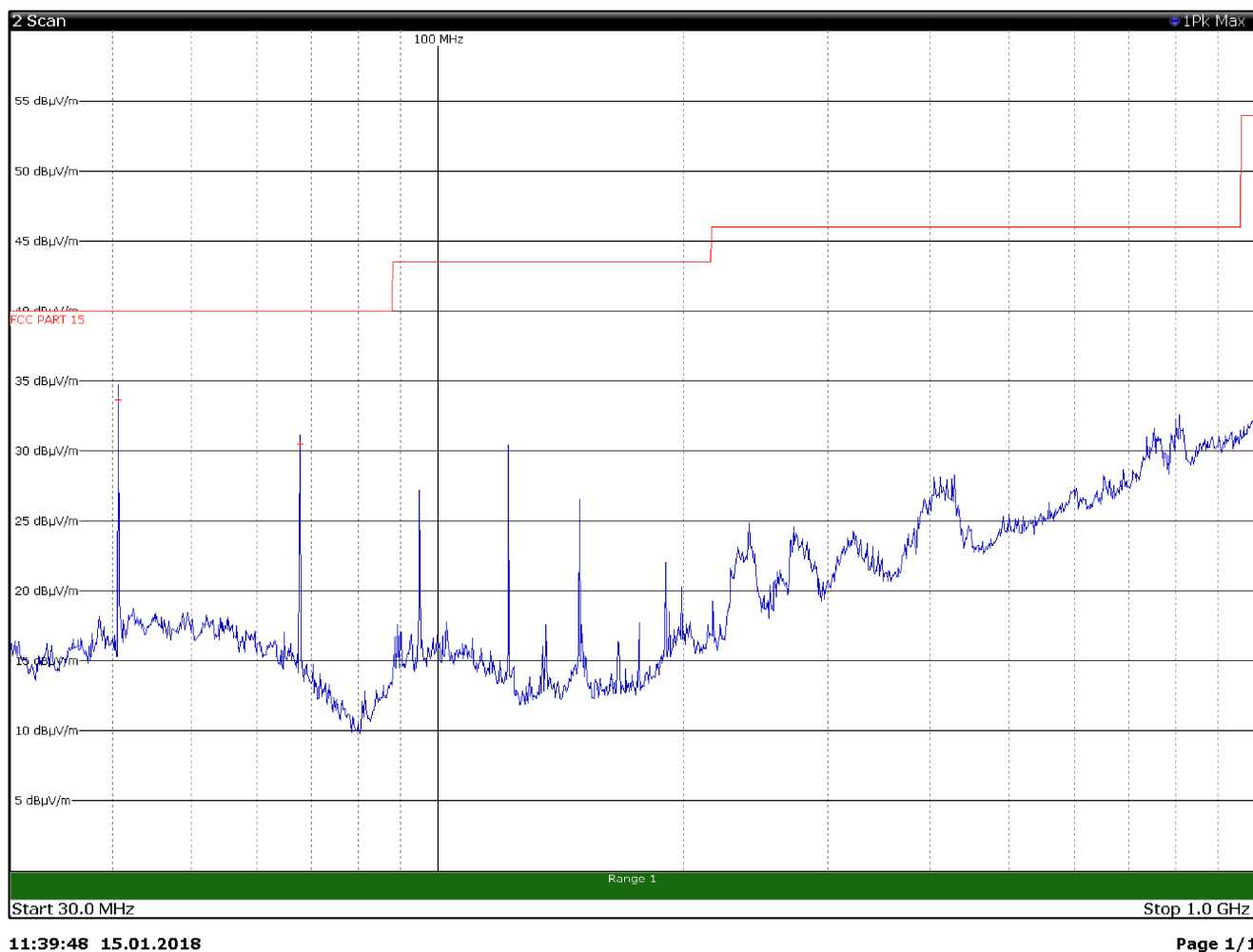


Figure 8.3-2: Field strength of spurious emissions above 30 MHz – Antenna in horizontal polarization

Table 8.3-4: Quasi-Peak spurious emissions results above 30 MHz with antenna in horizontal polarization

Frequency, MHz	Q-Peak result, dBμV	Meas. Time, ms	Bandwidth, kHz	Filter	Correction, dB	Margin, dB	Limit, dBμV
40.6800	33.7	1000	120	On	14.1	-6.3	40.0
67.8000	30.4	1000	120	On	11.5	-9.6	40.0

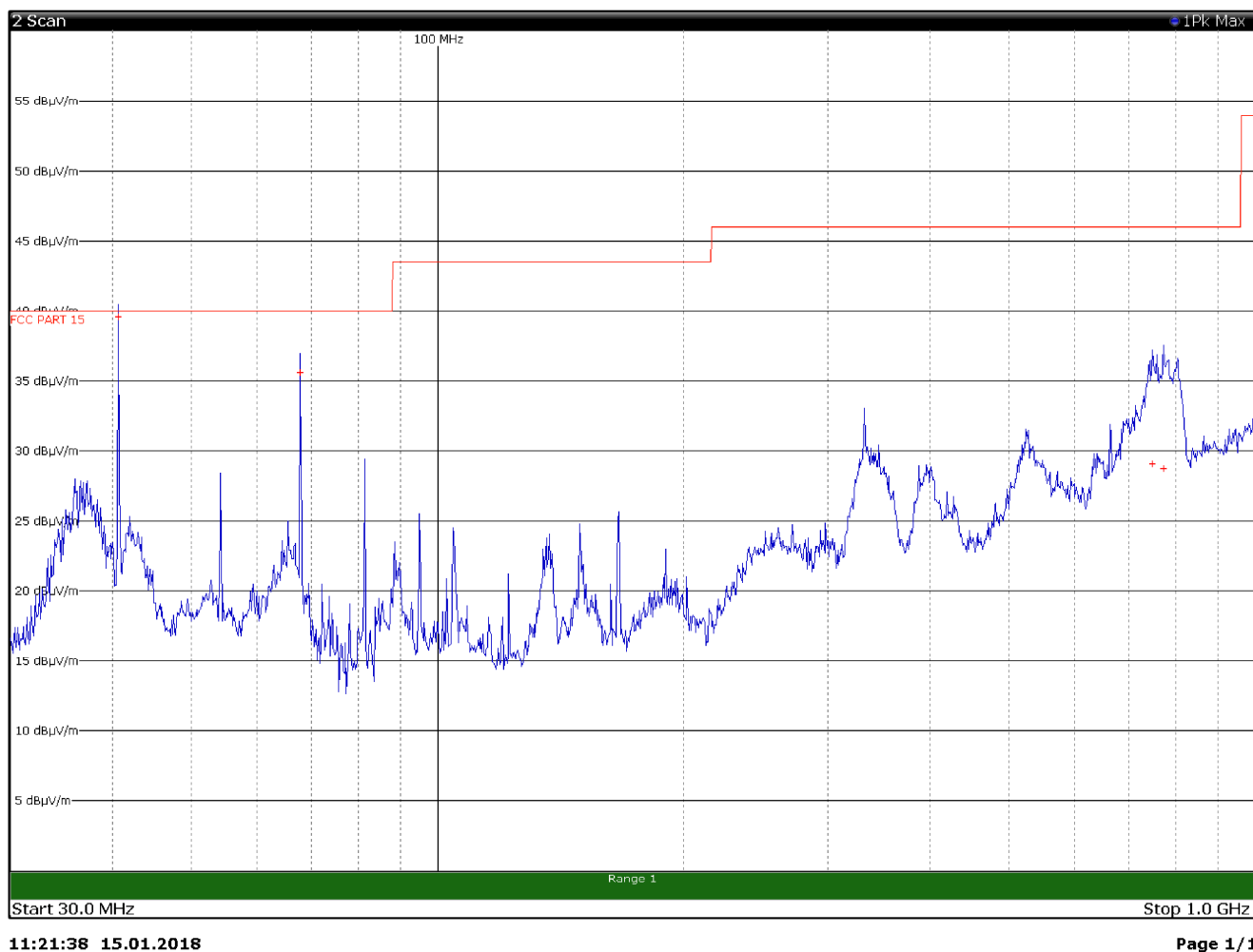


Figure 8.3-3: Field strength of spurious emissions above 30 MHz – Antenna in vertical polarization

Table 8.3-5: Quasi-Peak spurious emissions results above 30 MHz with antenna in horizontal polarization

Frequency, MHz	Q-Peak result, dBμV	Meas. Time, ms	Bandwidth, kHz	Filter	Correction, dB	Margin, dB	Limit, dBμV
40.6800	39.6	1000	120	On	14.1	-0.4	40.0
67.8000	35.6	1000	120	On	11.5	-4.4	40.0
748.3200	29.1	1000	120	On	23.9	-17.0	46.0
772.4100	28.7	1000	120	On	23.8	-17.3	46.0

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 $\pm 0.01\%$ (± 100 ppm) of the operating frequency over a temperature variation of $-20\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$ 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 $20\text{ }^{\circ}\text{C}$. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.4.2 Test summary

Test date	January 16, 2018	Temperature	22 $^{\circ}\text{C}$
Test engineer	Paolo Barbieri	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	37 %

8.4.3 Observations, settings and 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

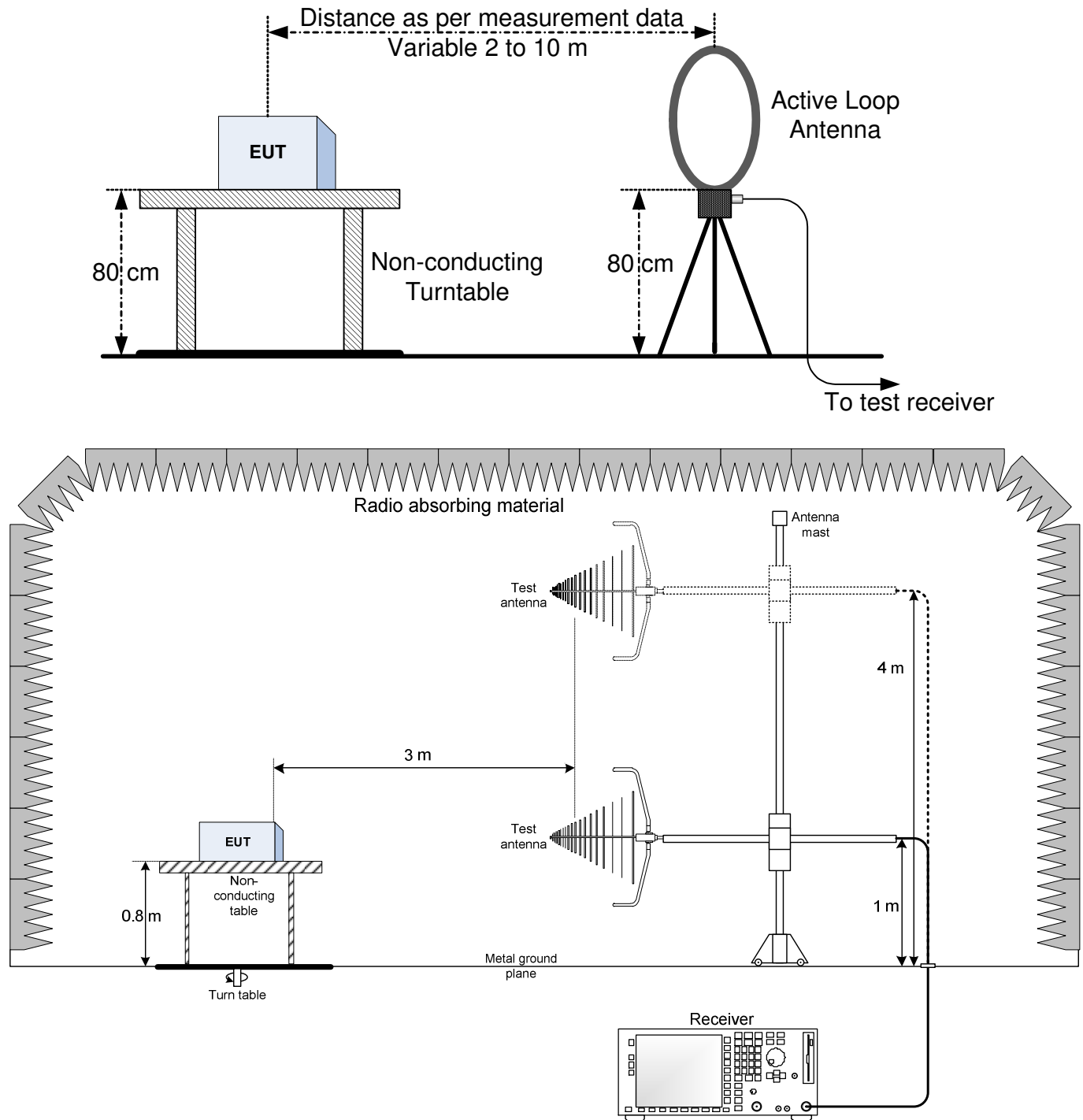
Test conditions	Frequency, MHz	Frequency drift, $\pm$ ppm	Limit, $\pm$ ppm	Margin, ppm
+50 $^{\circ}\text{C}$, Nominal	13.56033	2.2	100	97.8
+20 $^{\circ}\text{C}$, +15 %	13.56036	0	100	100
+20 $^{\circ}\text{C}$, Nominal	13.56036	Reference	Reference	Reference
+20 $^{\circ}\text{C}$, -15 %	13.56036	0	100	100
-20 $^{\circ}\text{C}$, Nominal	13.56039	2.2	100	97.8

Note: frequency drift was calculated as follows:

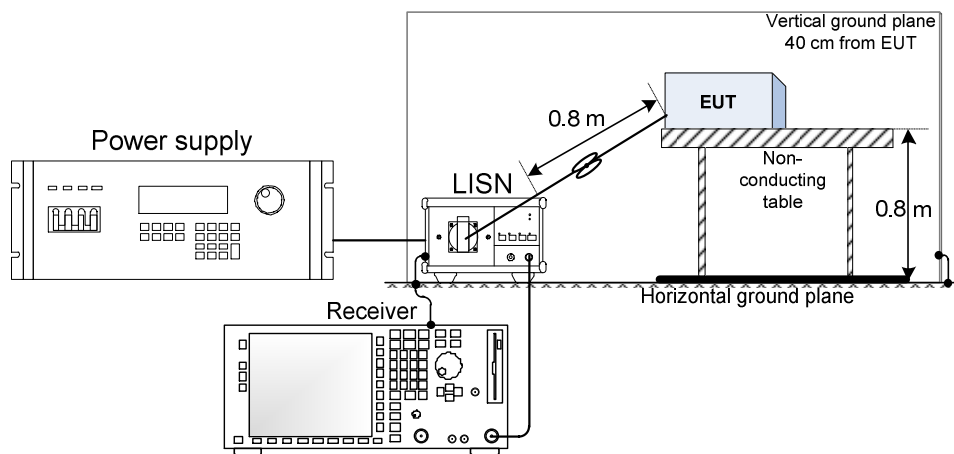
$$\text{Frequency drift (ppm)} = ((F_{\text{measured}} - F_{\text{reference}}) \div F_{\text{reference}}) \times 1 \times 10^6$$

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up



Section 10. Photos

10.1 Photo documentation of the test set-up



10.2 EUT photos





End of report