



FCC LISTED, REGISTRATION
NUMBER: 720267

Informe de ensayo nº:
Test report No:

NIE: 49640RRF.002

Test report

REFERENCE STANDARD: USA FCC Part 15.225 and Part 15.209

Identificación del objeto ensayado.....: Identification of item tested	MODBUS RFID READER
Marca Trademark	TDE-lighttech
Modelo y/o referencia tipo Model and /or type reference	ModBus RFID + TDE-CitizenM
Other identification of the product	FCC ID: 2AK670026268268
Final HW version	17020802
Final SW version	HotelKey_versie_2.3
Características Features	Multi-protocol cardreader supporting almost all Mifare RFID devices
Solicitante Applicant	TDE-lighttech Verrijn Startweg 11a 1112AW Diemen. The Netherlands
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 15.225 (10–1–15 Edition): Operation within the band 13.110 -14.010. USA FCC Part 15.209 (10–1–15 Edition): Radiated emission limits, general requirements. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Resultado.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) Approved by (name / position & signature)	A. Llamas RF Lab. Manager ALEJANDRO LLAMAS RODRIGUEZ
Fecha de realización Date of issue	2017-06-13
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Competences and guarantees

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DEKRA Testing and Certification is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

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The results presented in this Test Report apply only to the particular item under test established in this document.

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2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification internal document PODT000.

Usage of samples

Samples undergoing test have been selected by: **the client**

Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
49640B/005	Modbus RFID reader	ModBus RFID + TDE-CitizenM	---	2017-03-02

1. Sample S/01 has undergone following test(s).

All tests indicated in appendix A.

Test sample description

The ModBus RFID reader is a multi-protocol cardreader supporting almost all Mifare RFID-devices. The power supply is 24VDC and a ModBus protocol is used for the communication.

Identification of the client

TDE-lighttech

Verrijn Startweg 11a 1112AW Diemen. The Netherlands

Testing period

The performed test started on 2017-03-02 and finished on 2017-03-24.

The tests have been performed at DEKRA Testing and Certification.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 k Ω
Reference resistance to earth	< 1 Ω

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 k Ω
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ± 4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

Remarks and comments

1: Tests have been performed by the technical personnel: Pedro Parada and Jose Carlos Luque.

2: Used instrumentation.

Conducted Measurements

	Last Cal. date	Cal. due date
1. Spectrum analyser Agilent E4440A	2015/10	2017/10
2. Climatic chamber HERAEUS VM 04/35	2016/03	2018/03
3. DC power supply R&S NGPE 40/40	2014/11	2017/11

Radiated Measurements

	Last Cal. date	Cal. due date
1. Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2. BiconicalLog antenna ETS LINDGREN 3142E	2015/09	2018/09
3. Multi Device Controller EMCO 2090	N.A.	N.A.
4. EMI Test Receiver R&S ESU 26	2015/11	2017/11
5. RF pre-amplifier 20 MHz-7 GHz A.H.SYSTEMS PAM-0207	2016/09	2017/09
6. Loop antenna HP 1196 A.	2016/05	2018/05
7. Antenna tripod EMCO 11968C.	N.A.	N.A.

Testing verdicts

Not applicable	N/A
Pass	P
Fail	F
Not measured	N/M

FCC PART 15 PARAGRAPH	VERDICT			
	NA	P	F	NM
15.225 Subclause (a). Field strength of emissions within the band 13.553 MHz - 13.567 MHz		P		
15.225 Subclause (b). Field strength of emissions within the band 13.410 - 13.553 MHz and 13.567 – 13.710 MHz		P		
15.225 Subclause (c). Field strength of emissions within the band 13.110 - 13.410 MHz and 13.710 – 14.010 MHz		P		
15.225 Subclause (d). Field strength of emissions outside of the band 13.110 MHz - 14.010 MHz		P		
15.225 Subclause (e). Frequency tolerance of the carrier signal		P		

Appendix A – Test result

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TEST CONDITIONS

Power supply (V):

$$V_{\text{nom}} = 24 \text{ Vdc}$$

$$V_{\text{max}} = 26.4 \text{ Vdc}$$

$$V_{\text{min}} = 21.6 \text{ Vdc}$$

The subscripts nom, min and max indicate voltage test conditions (nominal, minimum and maximum respectively, as declared by the applicant).

Type of power supply = DC.

Type of antenna = Integral antenna

Operating Temperature Range (°C):

$$T_n = +15 \text{ to } +35$$

TEST FREQUENCIES:

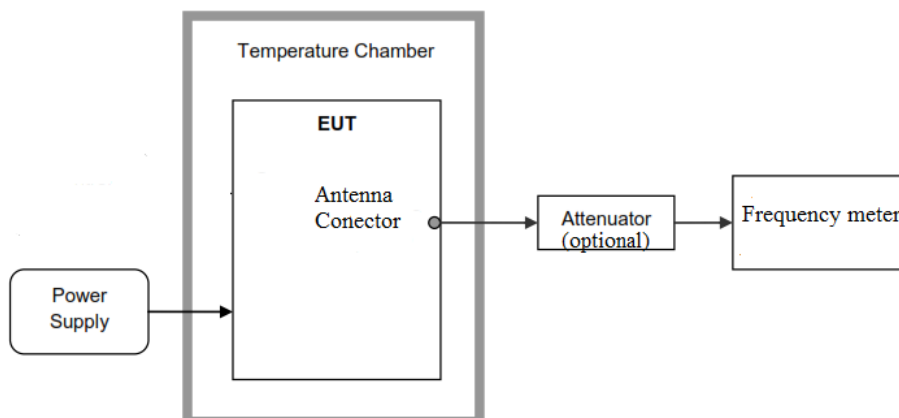
Nominal Operating frequency: 13.56 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyzer through a RF cable. The reading of the spectrum analyzer is corrected taking into account the cable loss.



For frequency stability test the EUT was placed inside a climatic chamber and connected to a frequency meter using a low loss cable. An external DC power supply was connected to the EUT for voltage variation test.



RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Loop antenna for the range between 9 kHz to 30 MHz and Bilog antenna for the range between 30 MHz to 200 MHz) is situated at a distance of 3 m.

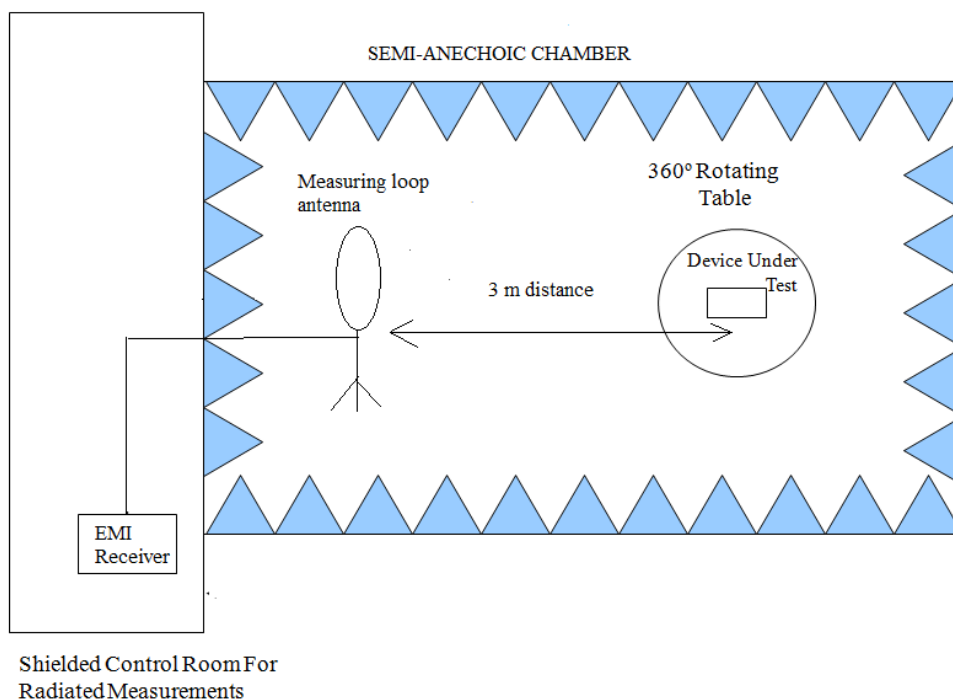
For radiated emissions in the range 9 kHz to 30 MHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 40 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and in the range between 30 MHz and 200 MHz the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

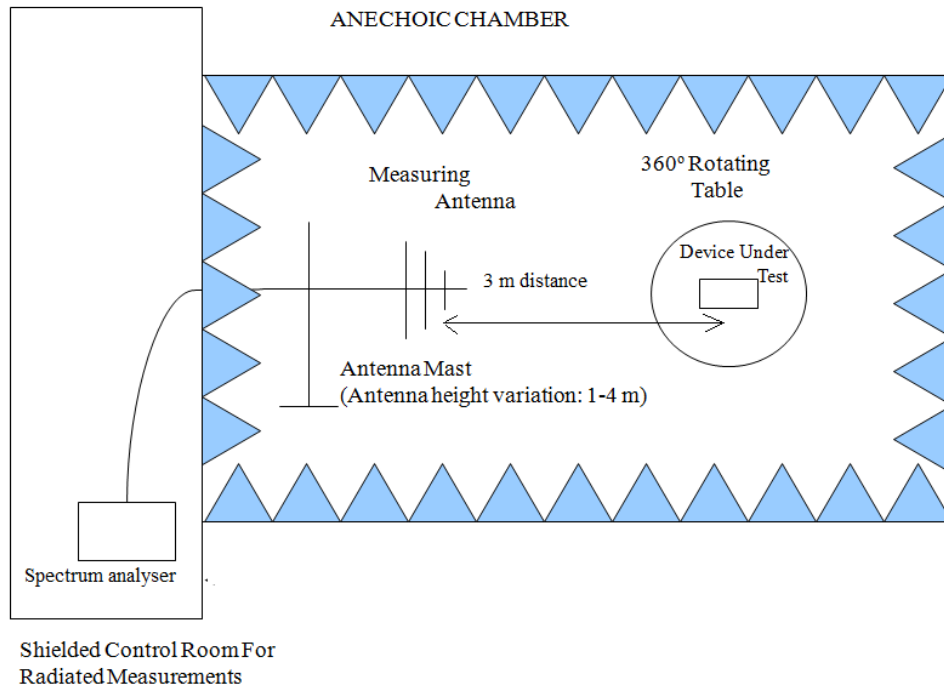
In the range between 9 kHz and 30 MHz the measurements were made in the three different orientation planes of the loop antenna to determine the maximum received field.

In the range between 30 MHz and 200 MHz the measurements were made in both horizontal and vertical planes of polarization.

Radiated measurements setup 9 kHz to 30 MHz.



Radiated measurements setup 30 MHz to 200 MHz.

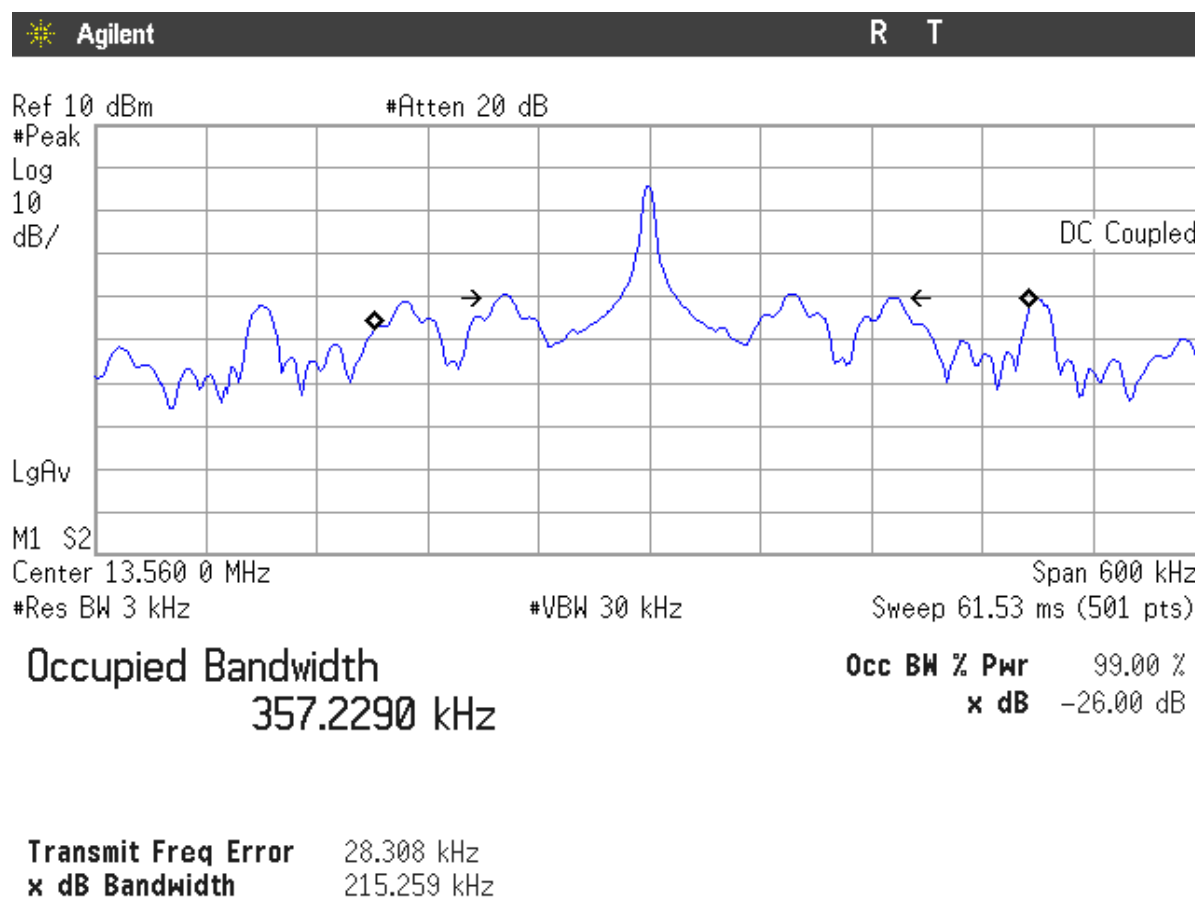


Occupied Bandwidth

RESULTS

99 % Occupied Bandwidth (see next plots).

Operation mode	99% occupied bandwidth (kHz)
NFC	357.2
Measurement uncertainty (KHz)	<±1.00



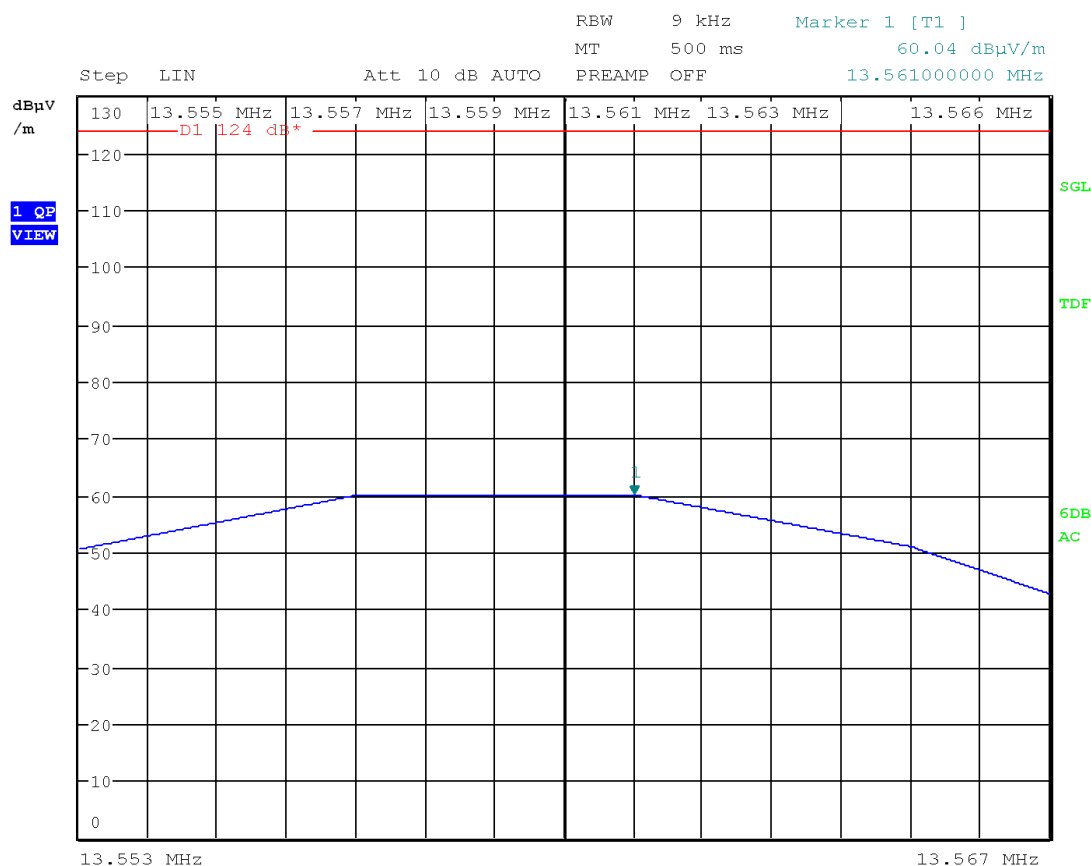
Section 15.225 Subclause (a). Field strength of emissions within the band 13.553 MHz -13.567 MHz

SPECIFICATION

The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts/meter (84 dB μ V/m) at 30 meters.

RESULTS

Measurement distance: 3 meters



Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dB μ V/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dB μ V/m) extrapolated to 30 m (40 dB/decade)
13.561	60.04	20.04
Measurement uncertainty (dB)	< $\pm$ 3,2	

Verdict: PASS

Section 15.225 Subclause (b). Field strength of emissions within the band 13.410 MHz -13.553 MHz and 13.567 MHz -13.710 MHz

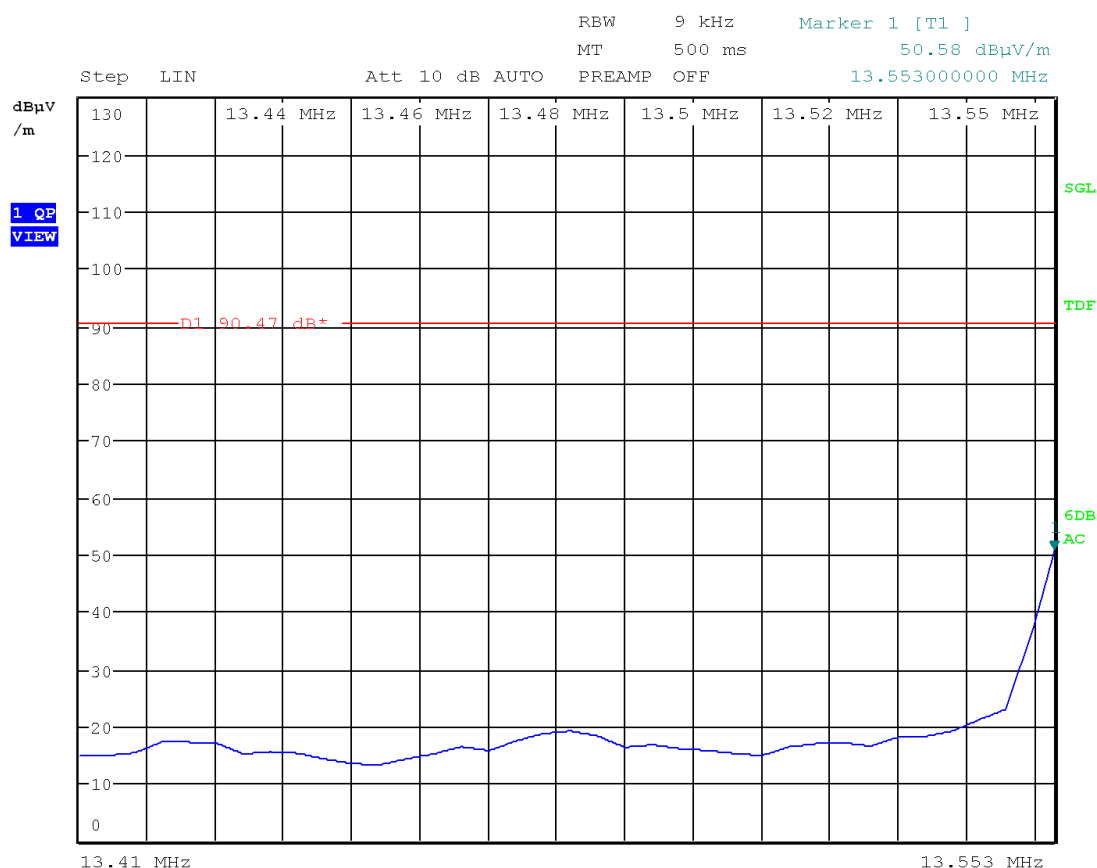
SPECIFICATION

Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter (50.47 dB μ V/m) at 30 meters.

RESULTS

Band 13.410-13.553 MHz

Measurement distance: 3 meters



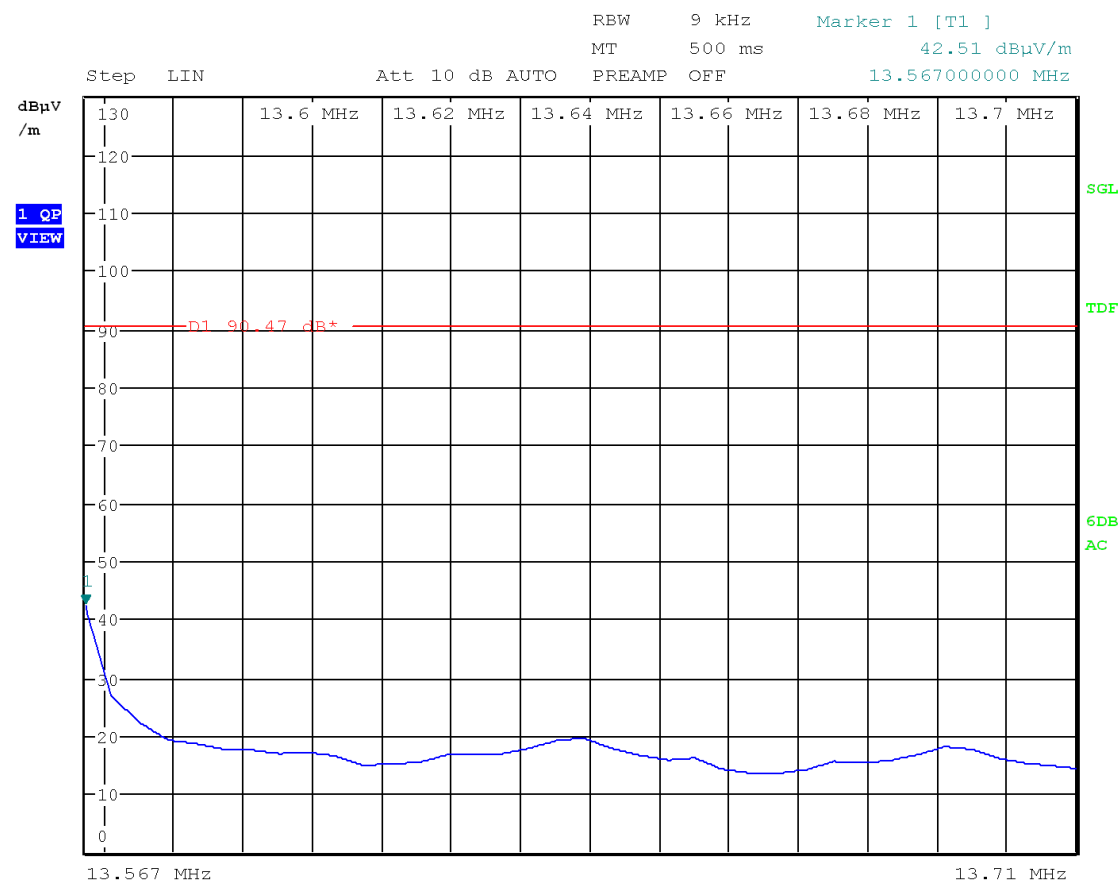
Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dB μ V/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dB μ V/m) extrapolated to 30 m (40 dB/decade)
13.553	50.58	10.58
Measurement uncertainty (dB)	< $\pm$ 3.2	

Verdict: PASS

Band 13.567-13.710 MHz

Measurement distance: 3 meters



Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBµ V/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµ V/m) extrapolated to 30 m (40 dB/decade)
13.567	42.51	2.51
Measurement uncertainty (dB)	<±3.2	

Verdict: PASS

Section 15.225 Subclause (c). Field strength of emissions within the band 13.110 MHz -13.410 MHz and 13.710 MHz -14.010 MHz

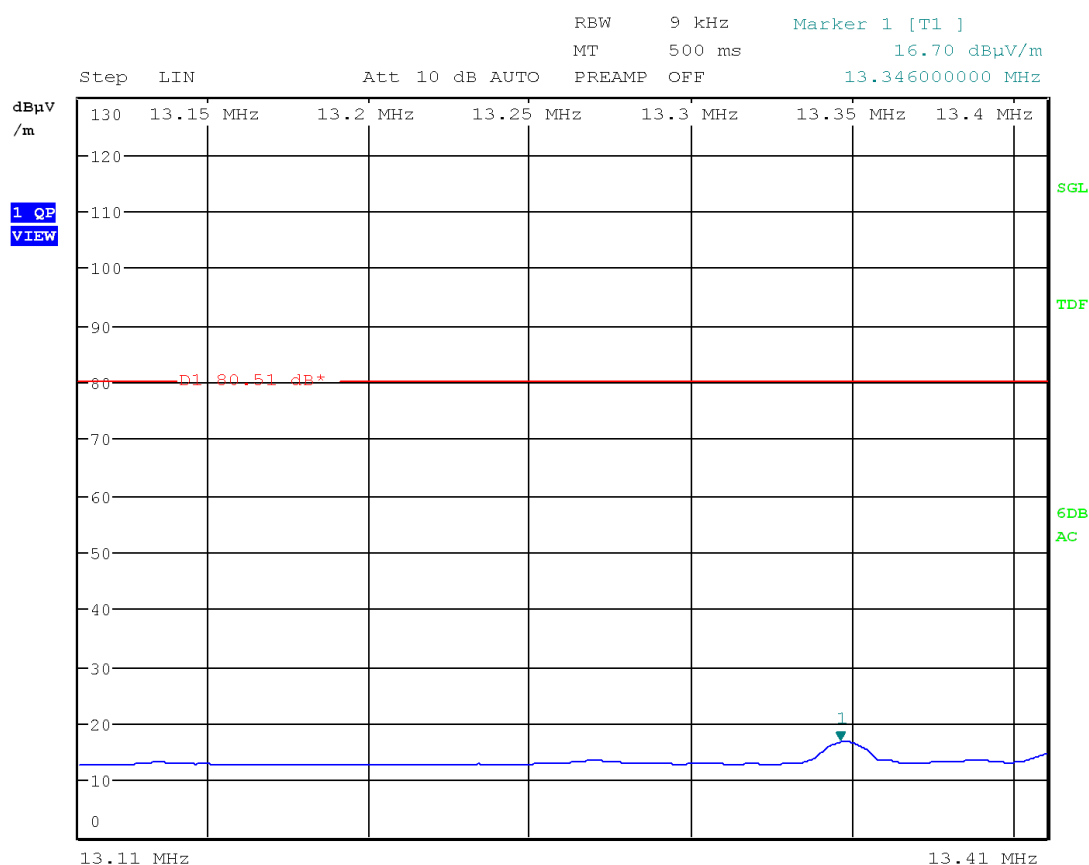
SPECIFICATION

Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz, the field strength of any emissions shall not exceed 106 microvolts/meter (40.51 dB μ V/m) at 30 meters.

RESULTS

Band 13.110-13.410 MHz

Measurement distance: 3 meters



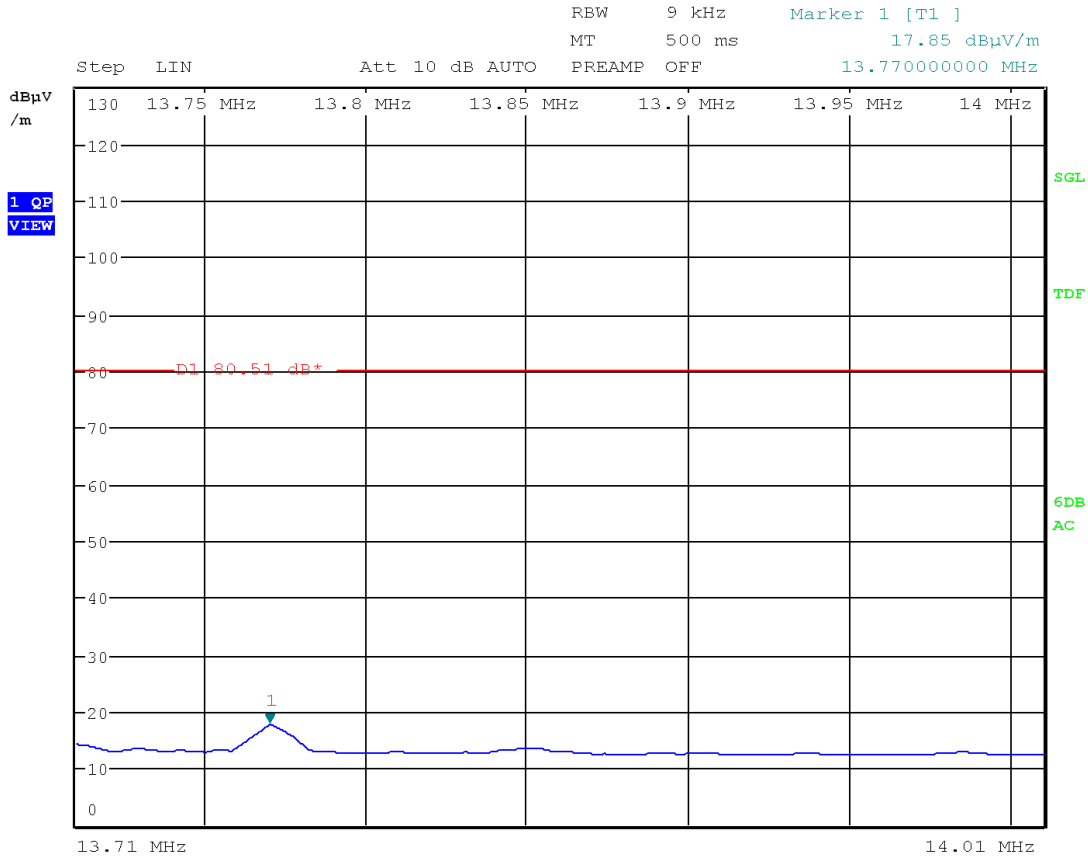
Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dB μ V/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dB μ V/m) extrapolated to 30 m (40 dB/decade)
13.346	16.70	-23.30
Measurement uncertainty (dB)	< $\pm$ 3.2	

Verdict: PASS

Band 13.710-14.010 MHz

Measurement distance: 3 meters



Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBμV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBμV/m) extrapolated to 30 m (40 dB/decade)
13.770	17.85	-22.15
Measurement uncertainty (dB)	±3.2	

Verdict: PASS

Section 15.225 Subclause (d). Field strength of emissions outside of the band 13.110 MHz -14.010 MHz

SPECIFICATION

Field strength of any emissions appearing outside of the band 13.110 MHz - 14.010 MHz band shall not exceed the general radiated emission limits in 15.209/RSS-Gen:

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
0.009-0.490	$2400/F(\text{kHz})$	-	300
0.490-1.705	$24000/F(\text{kHz})$	-	300
1.705 - 30.0	30	29.54	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

RESULTS:

All tests were performed in a semi-anechoic chamber at a distance of 3 m.

The spectrum was inspected from 9 kHz to 200 MHz searching for spurious signals.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifier gain.

Frequency range 9 kHz-30 MHz.

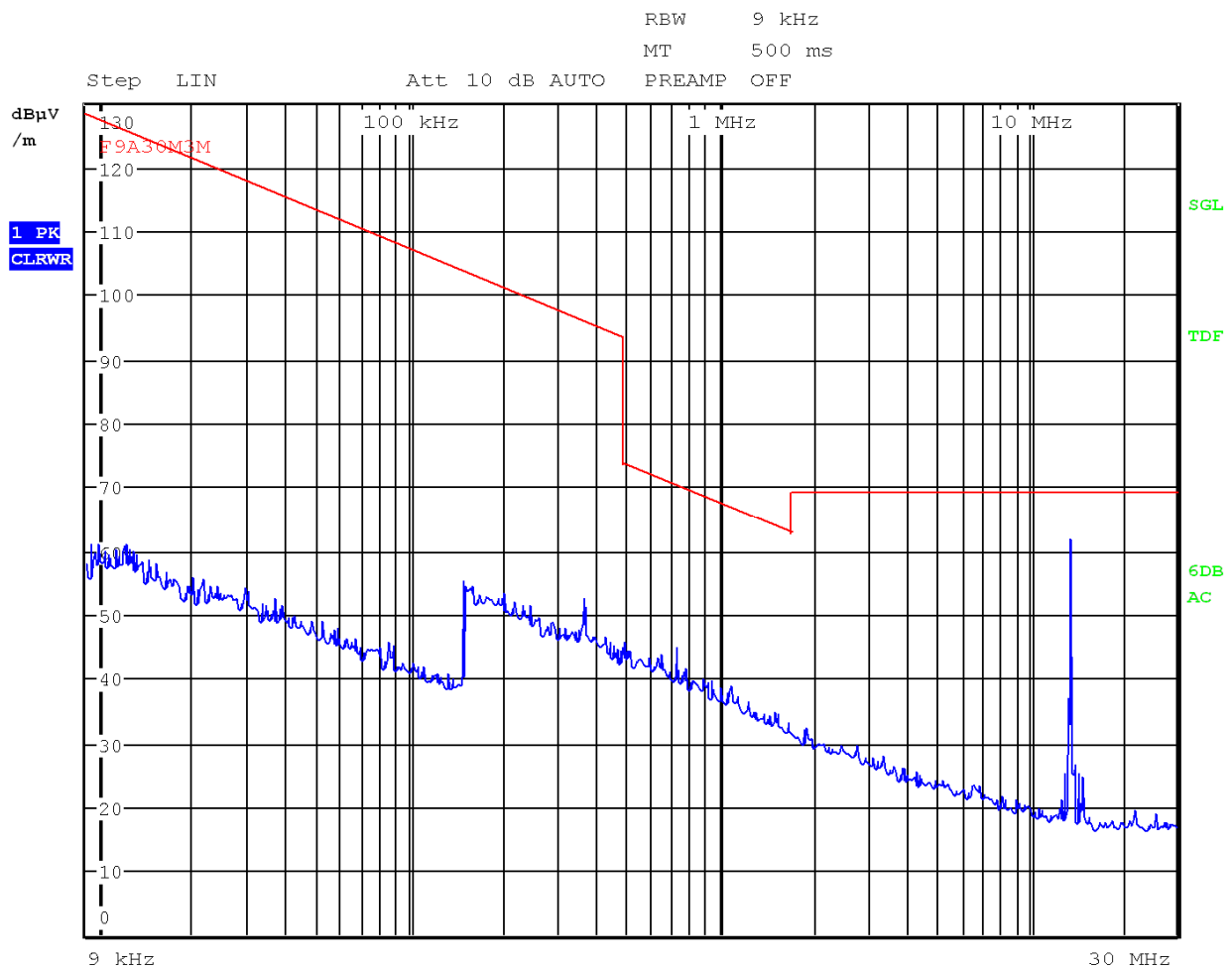
No spurious signals were found at less than 20 dB below the limit.

Frequency range 30 MHz-200 MHz

No spurious signals were found at less than 20 dB below the limit.

Verdict: PASS

FREQUENCY RANGE 9 kHz-30 MHz.



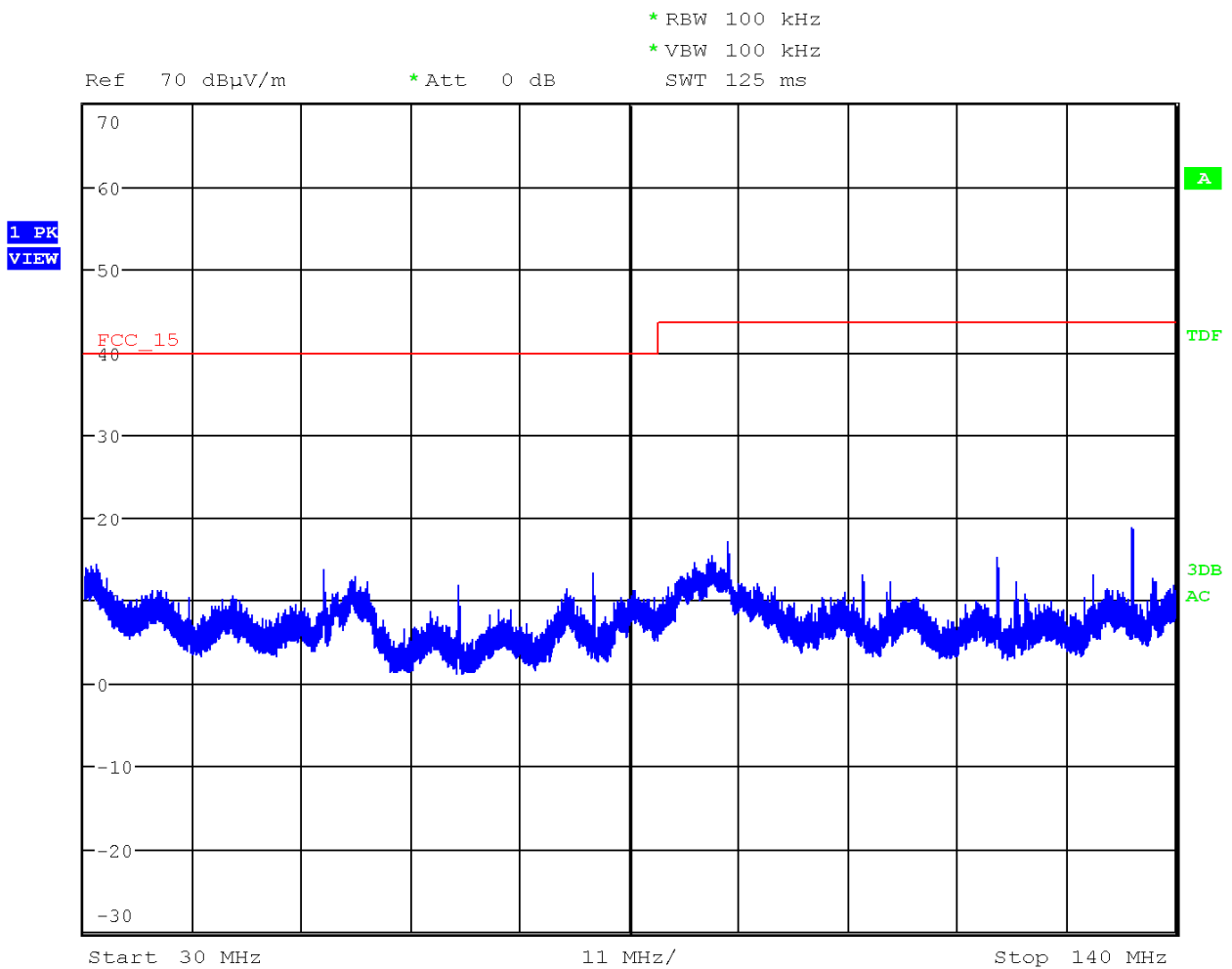
Resolution bandwidth:

200 Hz for $9 \text{ kHz} \leq f \leq 150 \text{ kHz}$

9 kHz for $150 \text{ kHz} \leq f \leq 30 \text{ MHz}$

Note: The limits shown in the above plot are extrapolated to 3 meters. The highest peak corresponds to the carrier level.

FREQUENCY RANGE 30 MHz to 200 MHz.



Note: The above plot shows the results of the scan using peak detector.

Section 15.225 Subclause (e). Frequency tolerance of the carrier signal

SPECIFICATION

The frequency tolerance of the carrier signal shall be maintained within +/- 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 hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

RESULTS

Nominal operating frequency: 13.56 MHz

Frequency stability over temperature variations.

Temperature (°C)	Frequency Error (kHz)	Frequency Error (%)
+50	-1.038	-0.00765
+40	-1.027	-0.00757
+30	-1.010	-0.00742
+20	-0.998	-0.00736
+10	-0.961	-0.00709
0	-0.941	-0.00694
-10	-0.938	-0.00692
-20	-0.975	-0.00719

Frequency stability over voltage variations.

DC Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (%)
V _{max}	26.4	-0.994	-0.00733
V _{min}	21.6	-0.996	-0.00734

Verdict: PASS