

Gantner Electronic GmbH

TEST REPORT

6SCOPE OF WORK

RADIO TESTING – PRODUCT TYPE: GAT ECO.LOCK 7101 NW F/ISO

REPORT NUMBER

2245805KAU-003

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DOCUMENT CONTROL NUMBER

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TYPE: GAT ECO.Lock 7101 NW F/ISO
DESCRIPTION: Battery Powered RFID Lock with Bluetooth
SERIAL NO: 2213010003
**MODEL NOT TESTED BUT
DECLARED EQUIVALENT BY
THE CUSTOMER:** GAT ECO.Lock 7151 NW F/ISO

All measurement results refer to the equipment which was tested

MANUFACTURER: Gantner Electronic GmbH
CUSTOMER NAME: Gantner Electronic GmbH
ADDRESS (CUSTOMER): Bundesstr. 12
AT-6714 Nüziders
AUSTRIA

REPORT NO: 2245805KAU-003

TEST RESULT: The equipment complies to 47 CFR Part 15, Subpart C, Intentional radiators, section 15.225 / RSS-210, Issue 10 and RSS-GEN, Issue 5 (Referring to the operating modes specified in this report).

TEST LABORATORY: Intertek Deutschland GmbH
Innovapark 20, 87600 Kaufbeuren
Germany

**FCC DESIGNATION
NUMBER:** DE0014

**FCC TEST FIRM
REGISTRATION NUMBER:** 359260

**ISED CAB IDENTIFIER:
ISED #:** DE0014
24854

TEST ENGINEER: R. Dressler
Technical Manager EMC/ Radio

REVIEWER: U. Gronert
Senior Project Engineer



Details about Accreditations/Acceptances

EMC / Radio National

 Deutsche Akkreditierungsstelle D-PL-12085-01-01	The Intertek Deutschland EMC-Lab is accredited by the Deutsche Akkreditierungsstelle GmbH (DAkkS) Registration Number (EMC general): D-PL-12085-01-01 Registration Number (EMC Med): D-PL-12085-01-03
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International

	The Intertek Deutschland EMC-Lab is accepted to participate in the IECEE (IEC Conformity assessment for Electrotechnical Equipment and Components) CB-Scheme CB Test Laboratory: TL118
	The Intertek Deutschland EMC-Lab is listed at the Federal Communications Commission (FCC) Designation Number: DE0014 Test Firm Registration Number: 359260
 BNetzA-CAB-16/21-10	The <i>Bundesnetzagentur</i> recognizes Intertek Deutschland GmbH as Conformity Assessment Body in the sector electromagnetic compatibility (EMC).
	The Intertek Deutschland EMC-Lab is accredited for Innovation, Science and Economic Development Canada (ISED) ISED CAB IDENTIFIER: DE0014 ISED #: 24854

Automotive

 Anerkennungsstelle Anerkannt unter KBA-P 00046-03	The Intertek Deutschland EMC-Lab is recognized as technical service of the Kraftfahrt-Bundesamt (KBA) Registration Number: KBA-P 00046-03
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SECTION 2

MEASUREMENT AND TEST SPECIFICATION

47 CFR Part 15, Subpart C, Intentional radiators, section 15.207 and section 15.225 /
RSS-210, Issue 10 and RSS-GEN, Issue 5

Test methods in:

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

No additions, deviations or exclusions have been made from standards and accreditation.

The test results detailed in this report apply only to the GAT ECO.Lock 7101 NW F/ISO with the test setup described. Any modification such as a change, addition to or inclusion of another device into this product will require an additional evaluation.

The support equipment listed as part of the emission tests is required to properly exercise and test the device under test.

SECTION 3

GENERAL INFORMATION

Possible test case verdicts:

Test case does not apply to the test object: N/A (Not Applicable)

Test object does meet the requirement: P (Pass)

Test object does not meet the requirements: F (Fail)

Samples arrived: 2022-04-07

Testing: 2022-04-28 to 2022-07-08

Decimal separator: ☒ Point ☐ Comma

Environmental conditions during testing:	Temperature:	15 °C - 35 °C
	Humidity:	20 % - 60 %
	Atmospheric pressure:	900 mbar - 1000 mbar
	If explicitly required by a basic standard the measured climatic conditions are documented in the corresponding test section.	

SECTION 4

SUMMARY OF TESTING

4.1 General annotation

The tests were performed in the order of the right column in the “Test Results – Overview” table.

The tests were carried out according to the manufacturer’s/customer’s technical specifications (ratings, clock frequencies, etc.) before test start.

4.2 Measurement uncertainty

For each test method an uncertainty evaluation was carried out. The results of the evaluation can be found in the annex of this test report.

4.3 Identical types

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

GAT ECO.Lock 7151 NW F/ISO

The differences are according to the manufacturer/customer:

The GAT ECO.Lock 7151 NW F/ISO has a protective lacquer on the PCB.

Beside of this they are completely identical.

The protective lacquer helps to prevent the electronic from influence through humidity when the locks are used in indoor swimming pools.

The Bluetooth module doesn’t get the transparent protective lacquer.

The 13.56 MHz antenna is not a PCB track, but a wire loop antenna that is soldered to the PCB after the protective lacquer was applied.

The protective lacquer will not cover the antenna and will not have an affect on the radiated emission result.

4.4 Document History

REVISION	DATE	REPORT	CHANGES	AUTHOR
Initial release	2022-09-08	2245805KAU-003	Initial issue	RDR

SECTION 5

TEST RESULTS – OVERVIEW

EMISSION	REQUESTED	VERDICT	DATE	NO
Field strength (13.110 MHz – 14.010 MHz)	see 7.2	P	2022-04-29	3
Radiated emissions (< 30 MHz)	see 7.3	P	2022-04-29	2
Radiated emissions (30 MHz – 500 MHz)	see 7.4	P	2022-04-28	1
Frequency Stability Test (Temperature variation)	see 7.5	P	2022-05-06	4
Frequency Stability Test (Voltage Variation)	see 7.5	P	2022-05-19	6
			2022-07-08*	7
Occupied bandwidth test	see 7.6	P	2022-05-06	5

Omission of tests:

Conducted emissions is not applicable, because the EUT is battery operated.

* Partly the temperature variations were applied on the 2022-05-19 and partly on the 2022-07-08.

SECTION 6

INFORMATION ABOUT THE EUT

6.1 Description of the EUT

☒ table-top EUT		☐ floor-standing EUT	
Dimensions:	Height:	Width:	Length:
	109 mm	109 mm	33 mm
Software version:	A special test firmware was written for the EMC/Radio tests, to have a continuous transmission with a 100 ms interval. In reality the RFID and Bluetooth modules are just transmitting, when the lock button is pushed. They are never transmitting at the same time.		
Product version:	2.1		
Description: With the GAT ECO.Lock 7101 NW F/ISO, lockers and depot boxes can be electronically locked and unlocked. The user simply presses the lock button in using their data carrier while the locker door is closed. This action activates the lock electronics and the authorization of the user's data carrier is checked. If the authorization is valid, the locker door is locked or unlocked by the GAT ECO.Lock 7101 NW F/ISO accordingly. System users are identified at the lock using contactless RFID data carriers (Radio Frequency Identification). With a Bluetooth radio interface.			
Transmitter frequency range: 13.56 MHz			
Frequency agile or hopping:	☐ Yes	☒ No	
Antenna:	☒ Internal antenna	☐ External antenna	
Antenna connector:	☒ None, internal antenna	☐ Yes, type	
Type of used TAG:	GAT Testcard, Mifare		
Temperature range (specified by the manufacturer):	☐ Category I (General): -20°C to +55°C ☐ Category II (Portable equipment): -10°C to +55°C ☐ Category III (For normal indoor use): +5°C to +35°C ☒ Other: 0°C to +60°C		
Power rating:	4.5 V DC to 2.7 V DC		

6.1.1 Photo of the device and the rating plate

Sample of the rating plate:



6.2 Power interface

MODE	VOLTAGE (V)	FREQUENCY (Hz)	COMMENT
1	4.5	DC	3 batteries (Type: AA LR6-1,5V)
2	2.7	DC	Power supply for the frequency stability test (voltage variation)

Power sources/associated test equipment

DEVICE	MANUFACTURER	TYPE	SN	ASSET NO.
Power supply	EPS	EP-1805	3971112	PM KF 0321

6.3 Configuration mode

MODE	DESCRIPTION
1	Batteries were inserted and the EUT was placed stand alone on the test setup.
2	See schematic diagram under 6.10. Instead of each battery a 1.3 Ω resistor was soldered. The input current of the EUT is 65 mA. A higher current is flowing through the resistors. On this way the EUT input voltage can be regulated by the power supply.

6.4 Operation mode

MODE	DESCRIPTION
1	To bring the EUT in the test mode, a notebook was connected by an USB cable and with the Test Software "activateEMCTestMode.exe" a permanent RFID field was started and the BLE (BluetoothLowEnergy) activated. In this mode the lock transmits permanently at 13.56 MHz and the Bluetooth with a 100 ms interval at the same time.

6.5 Major subassemblies or internal peripherals

DEVICE	MANUFACTURER / NEW GRANTEE	TYPE	SN	FCC ID / IC ID
Bluetooth LE wireless radio module	SILICON LABS / Gantner Electronic	BG BLEM-SL22	-	NC4-GEA2200192A 11873A-2200192A

6.6 Peripheral devices used for testing

N/A

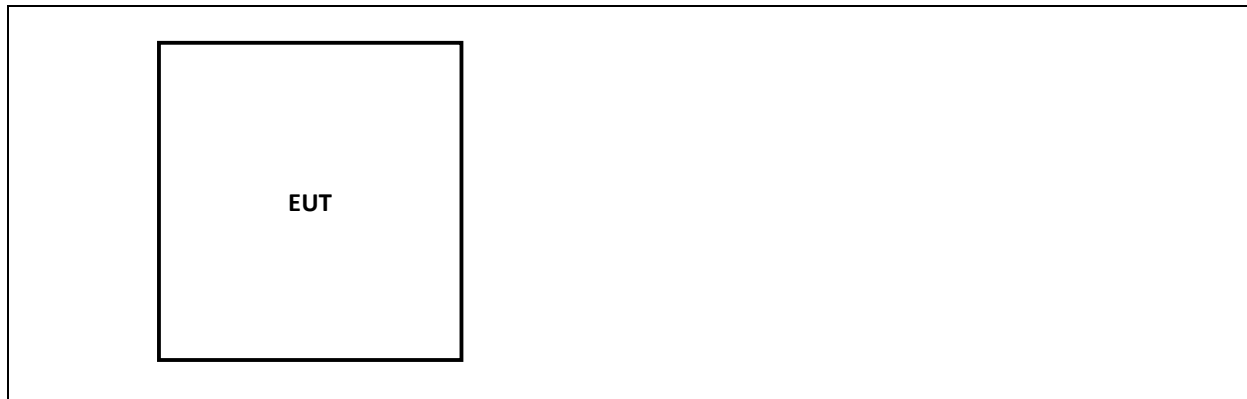
6.7 Supply and interconnecting cables used for testing

N/A

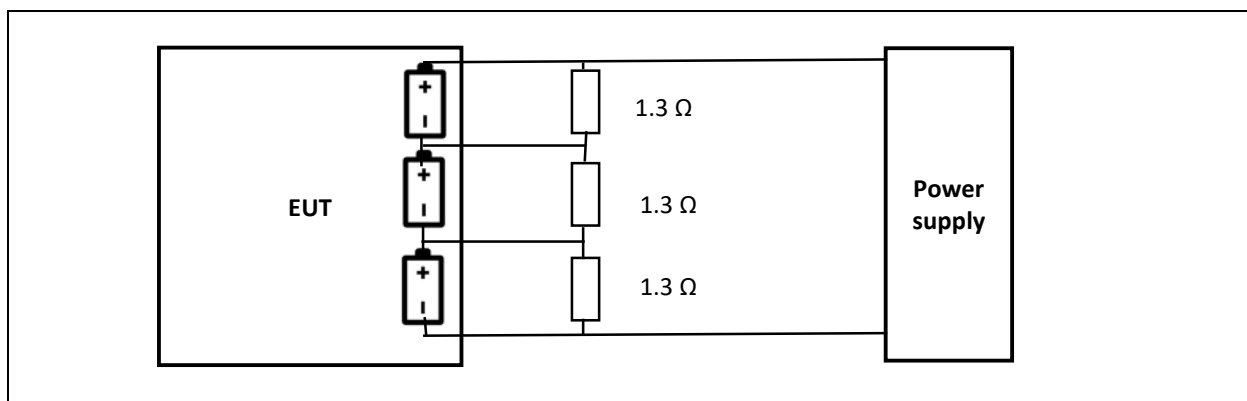
6.8 Clock frequencies of the EUT

SOURCE	FREQUENCY
RFID	13.56 MHz
μ -Prozessor	48 MHz
BLE	2.4 GHz range

6.9 Block diagram of the test setup



6.10 Block diagram at the frequency stability test (voltage variation)



SECTION 7

CONFORMANCE REQUIREMENTS

7.1 Field strength 13.110 MHz – 14.010 MHz (Emission Mask)

NORMATIVE REFERENCES			RESULT
Limits according to:	FCC §15.225 (a) – (c) RSS-210, Issue 10, section B6		P
Methods of measurement according to:	ANSI C63.10, section 6.3, 6.4 RSS-Gen 6.13, 8.9		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	13.110 MHz – 14.010 MHz	
	Measurement time	1 s	
	Antenna height	1 m	

Limits

The limits below 30 MHz are given for different measurement distances. The measurement results below 30 MHz are converted to 3 m by using the extrapolation factor 40 dB/decade (according to §15.31).

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)	Field strength (dBµV/m)	Measurement distance (m)
13.110 - 13.410	106	40.5	30	80.5	3
13.410 - 13.553	334	50.5	30	90.5	3
13.553 - 13.567	15848	84.0	30	124.0	3
13.567 - 13.710	334	50.5	30	90.5	3
13.710 - 14.010	106	40.5	30	80.5	3

Test setup details

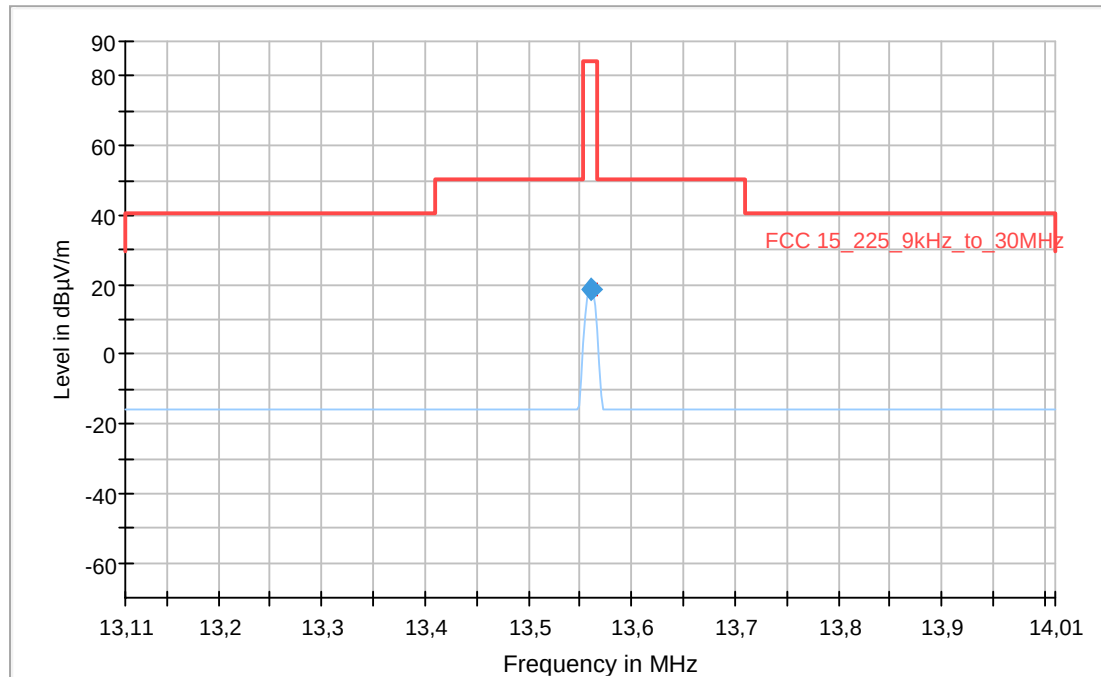
Compliance with the spectrum mask is tested using a spectrum analyzer with resolution bandwidth set to 10 kHz or 9 kHz CISPR. The video bandwidth shall be at least three times greater than the resolution bandwidth. The test was carried out automatically by the test receiver. The EUT is a table-top EUT and was standing on a table made of Styrodur with a Rohacell plate on top and the dimensions 1.6 m x 1.0 m x 0.8 m (Length x Width x Height). The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber	Siepel	REF W460SLB	-	PM KF 1150-01	2019-12 (3 years)
Turntable	Inn-Co	-	-	PM KF 2949-04	-
Controller	Inn-Co	CO 3000	4970815	PM KF 2949	-
Receiver 9 kHz - 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2022-04 (1 year)
Loop Antenna 9 kHz – 30 MHz	Rohde & Schwarz	HFH2-Z2	881 058/48	PM KF 1401	2021-08 (1 year)
Test software	Rohde & Schwarz	EMC 32 V10.50.40	-	PM KF 2983	-

Measurement results – Field strength 13.110 MHz – 14.010 MHz (Emission Mask):

EUT: GAT ECO. Lock 7101 NW F/ISO
Test Verdict: Passed
Test Description: 15.225
Operating Conditions: See section 6.4 of this test report
Operator Name: RDR
Project Number: 45805
Date: 29.04.2022



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)
13.560000	18.62	---	84.00	65.38	1000.0	9.000	H	352.0

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Corr. (dB/m)
13.560000	-20

EMI Auto Test Template: xF-RE-R17-AN23

Hardware Setup: xF-RE-R17-AN23
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 9 kHz - 30 MHz
Graphics Level Range: -80 dBμV/m - 50 dBμV/m

Preview Measurements:
Antenna height: 0 - 1000 cm , Step Size = 0 cm , Positioning Speed = 1
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Scan Test Template: xF-RE-R17-AN23_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
9 kHz - 150 kHz	50 Hz	QPK	200 Hz	1 s	0 dB
150 kHz - 30 MHz	2,25 kHz	QPK	9 kHz	1 s	0 dB

Anechoic chamber

Test procedure

The test site is an anechoic chamber suitable for radiated emission measurements in the frequency range of 9 kHz – 30 MHz¹⁾. It includes automatic turntable of radius 2 m. It enables manual and fully automatic measurements.

To find the highest level of radiation

- the height of the antenna is 1m with antenna in horizontal and vertical polarization;
- the turntable is rotated in range from 0° to 360°.

The system was configured for testing in a typical worst case fashion (as a customer may use it). All interface cables were moved to determine the position which resulted in the highest emission levels.

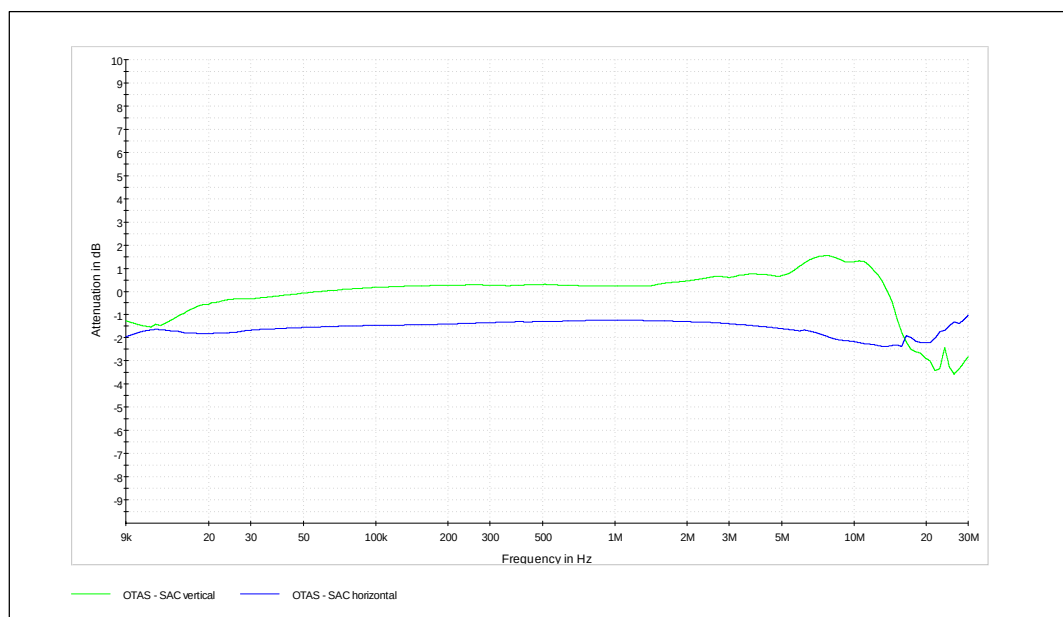
Correction factors

The field strength is calculated by adding the antenna factor and cable attenuation. The calculations are performed automatically by the measurement software EMC 32. As example consider the following input values and result:

FREQUENCY (MHZ)	RECEIVER READING U (dBμV)	ANTENNA FACTOR AF (dB/m)	CABLE ATTENUATION A (dB)	CORRECTION ANTENNA + CABLE (dB)	RADIATED FIELD STRENGTH E (dBμV/m)
30.0	20	20.6	0.8	21.4	41.4

$$E = U + AF + A$$

- 1) Comparison field attenuation: free field (OTAS) to anechoic chamber (SAC):



7.2 Radiated emissions < 30 MHz

NORMATIVE REFERENCES			RESULT
Limits according to:	FCC §15.225 (d), §15.209 RSS-210, Issue 10, section B6		P
Methods of measurement according to:	ANSI C63.10, section 6.3, 6.4 RSS-Gen 6.13, 8.9		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	9 kHz - 30 MHz	
	Antenna height	1 m	

Limits

The limits below 30 MHz are given for different measurement distances. The measurement values below 30 MHz are converted to 3 m by using the extrapolation factor 40 dB/decade (according to §15.31).

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	67.6 - 20 · log(F(kHz))	300
0.490 - 1.705	24000/F(kHz)	87.6 - 20 · log(F(kHz))	30
1.705 - 13.110	30	29.5	30
14.010 - 30.000	30	29.5	30
Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.			

Test setup details

Compliance with the spectrum mask is tested using a spectrum analyzer with resolution bandwidth set to 10 kHz or 9 kHz CISPR. The video bandwidth shall be at least three times greater than the resolution bandwidth.

The test was carried out automatically by the test receiver.

The EUT is a table-top EUT and was standing on a table made of Styrodur with a Rohacell plate on top and the dimensions 1.6 m x 1.0 m x 0.8 m (Length x Width x Height).

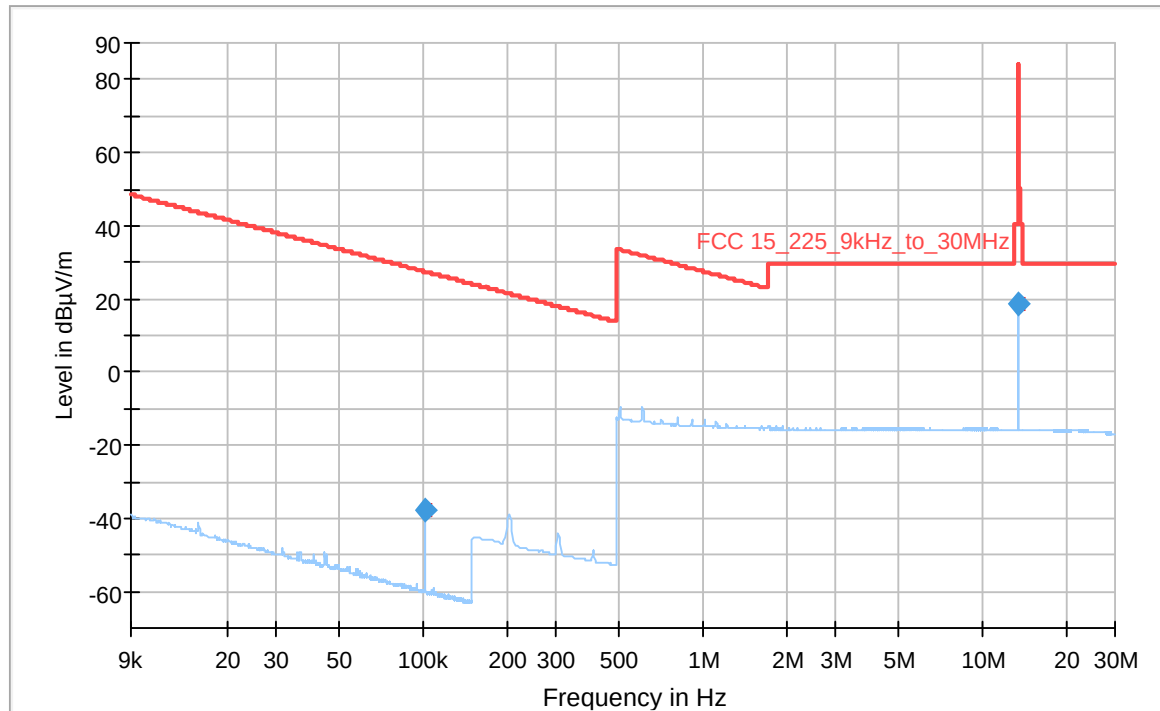
The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber	Siepel	REF W460SLB	-	PM KF 1150-01	2019-12 (3 years)
Turntable	Inn-Co	-	-	PM KF 2949-04	-
Controller	Inn-Co	CO 3000	4970815	PM KF 2949	-
Receiver 9 kHz - 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2022-04 (1 year)
Loop Antenna 9 kHz - 30 MHz	Rohde & Schwarz	HFH2-Z2	881 058/48	PM KF 1401	2021-08 (1 year)
Test software	Rohde & Schwarz	EMC 32 V10.50.40	-	PM KF 2983	-

Measurement results – Radiated emissions < 30 MHz:

EUT: GAT ECO. Lock 7101 NW F/ISO
Test Verdict: Passed
Test Description: 15.225 / 15.209
Operating Conditions: See section 6.4 of this test report
Operator Name: RDR
Project Number: 45805
Date: 29.04.2022



Preview Result 1-QPK [Preview Result 1.Result:1]
* Critical_Freqs AVG [Critical_Freqs.Result:5]
* Critical_Freqs QPK [Critical_Freqs.Result:4]
FCC 15_225_9kHz_to_30MHz [..zF radiated\FCC Part 15C]
◆ Final_Result QPK [Final_Result.Result:4]
◆ Final_Result AVG [Final_Result.Result:5]

The RSS-Gen limit in $\mu\text{A/m}$ is essentially equivalent to the FCC 15.209 limit in $\mu\text{V/m}$.

The conversion between E and H is: $H=E-51.5$.

The EUT is also according to RSS-Gen from 9 kHz to 30 MHz pass.

Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)
0.101850	-38.00	---	27.45	65.45	1000.0	0.200	H	286.0
13.560000	18.62	---	84.00	65.38	1000.0	9.000	H	352.0

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Corr. (dB/m)
0.101850	-60
13.560000	-20

EMI Auto Test Template: xF-RE-R17-AN23

Hardware Setup: xF-RE-R17-AN23
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 9 kHz - 30 MHz
Graphics Level Range: -80 dBμV/m - 50 dBμV/m

Preview Measurements:
Antenna height: 0 - 1000 cm , Step Size = 0 cm , Positioning Speed = 1
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Scan Test Template: xF-RE-R17-AN23_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
9 kHz - 150 kHz	50 Hz	QPK	200 Hz	1 s	0 dB
150 kHz - 30 MHz	2,25 kHz	QPK	9 kHz	1 s	0 dB

Anechoic chamber

Test procedure

The test site is an anechoic chamber suitable for radiated emission measurements in the frequency range of 9 kHz – 30 MHz.¹⁾ It includes automatic turntable of radius 2 m. It enables manual and fully automatic measurements.

To find the highest level of radiation

- the height of the antenna is 1m with antenna in horizontal and vertical polarization;
- the turntable is rotated in range from 0° to 360°.

The system was configured for testing in a typical worst case fashion (as a customer may use it). All interface cables were moved to determine the position which resulted in the highest emission levels.

Correction factors

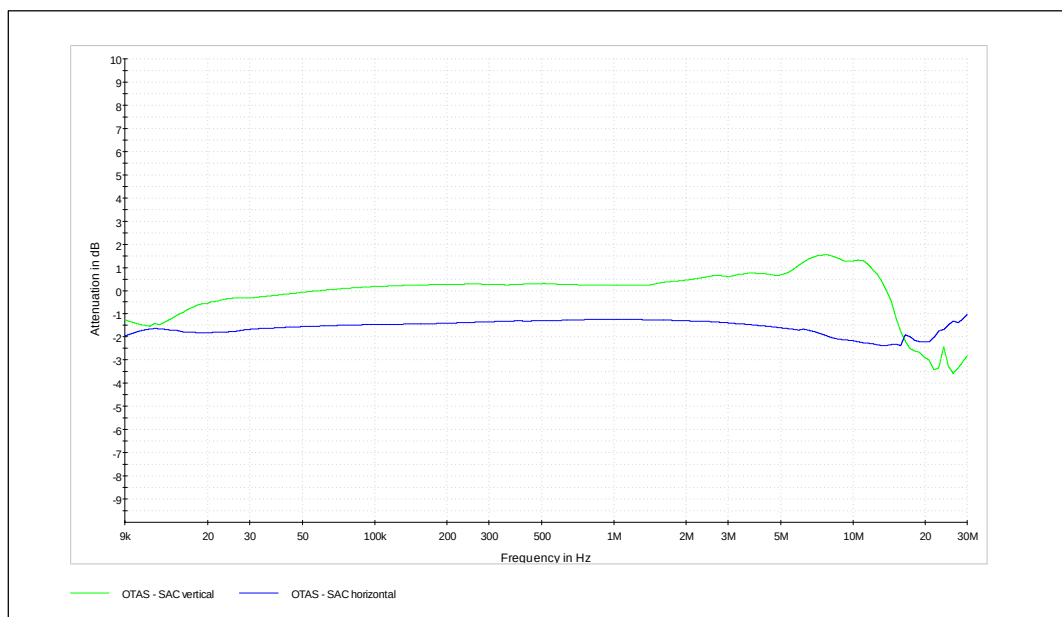
The field strength is calculated by adding the antenna factor and cable attenuation. The calculations are performed automatically by the measurement software EMC 32.

As example consider the following input values and result:

FREQUENCY (MHZ)	RECEIVER READING U (dBμV)	ANTENNA FACTOR AF (dB/m)	CABLE ATTENUATION A (dB)	CORRECTION ANTENNA + CABLE (dB)	RADIATED FIELD STRENGTH E (dBμV/m)
30.0	20	20.6	0.8	21.4	41.4

$$E = U + AF + A$$

- 1) Comparison field attenuation: free field (OTAS) to anechoic chamber (SAC):



7.3 Radiated emissions 30 MHz to 500 MHz

NORMATIVE REFERENCES			RESULT
Limits according to:	FCC §15.225 (d), §15.209 RSS-210, Issue 10, section B6		P
Methods of measurement according to:	ANSI C63.10, section 6.3, 6.5 RSS-Gen 6.13, 8.9		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	30 MHz – 500 MHz	

Limits

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
30 – 88	100	40.0	3
88 – 216	150	43.5	3
216 – 960	200	46.0	3
Above 960	500	54.0	3

Test setup details

The EUT is a table-top EUT and was standing on a table made of Styrodur with a Rohacell plate on top and the dimensions 1.6 m x 1.0 m x 0.8 m (Length x Width x Height).

Overview sweeps performed with peak detectors and final measurement with quasi-peak detectors.

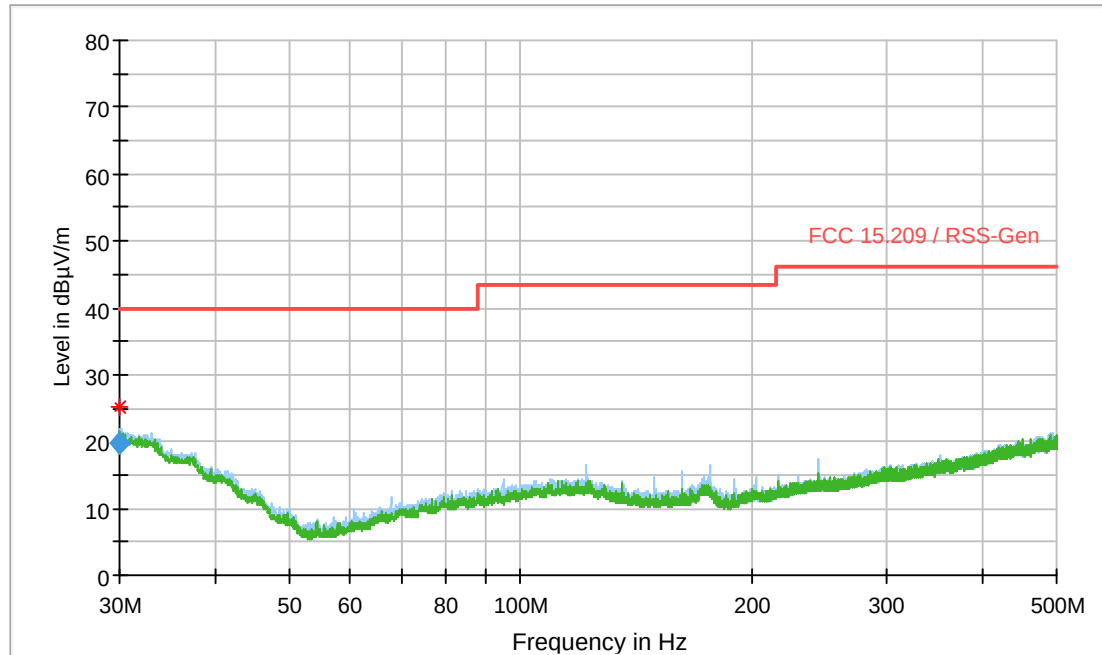
The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber (30 – 1000 MHz)	Siepel	REF W460SLB	-	PM KF 1150-01	2019-12 (3 years)
Turntable	Inn-Co	-	-	PM KF 2949-04	-
Tower	Inn-Co	MA4484-XPET	-	PM KF 2949-03	-
Controller	Inn-Co	CO 3000	4970815	PM KF 2949	-
Receiver 9 kHz - 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2022-04 (1 year)
Trilog broadband antenna	Schwarzbeck	VULB 9163	9163-974	PM KF 3196	2021-01 (2 years)
Test software	Rohde & Schwarz	EMC 32 V10.50.40	-	PM KF 2983-2	-
Antenna 30 MHz - 3GHz	Rohde & Schwarz	HL 562	100354	PM KF 1123	2020-05 (2 years)
Receiver 10 Hz - 7 GHz	Rohde & Schwarz	ESR7	101095	PM KF 2441	2021-08 (1 year)

Measurement results – Radiated emissions 30 MHz to 500 MHz:

EUT: GAT ECO. Lock 7101 NW F/ISO
Test Verdict: Passed
Test Description: Radiated Emission FCC Part 15B
Operating Conditions: See section 6.4 of this test report
Operator Name: RDR
Project Number: 45805
Date: 28.04.2022



- Preview Result 1H-PK+ [Preview Result 1H.Result:2]
- Preview Result 1V-PK+ [Preview Result 1V.Result:2]
- * Critical_Freqs PK+ [Critical_Freqs.Result:4]
- FCC Part 15B 30-1000 MHz QP Class B [.\EMI radiated\FCC Part 15B\]
- Final_Result QPK [Final_Result.Result:4]
- x MaxPeak-PK+ (Single) [Result Table_Single.Result:1]
- + QuasiPeak-QPK (Single) [Result Table_Single.Result:2]

Overview sweeps performed with peak detectors and final measurement with quasi-peak detectors.

Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.030000	19.74	40.00	20.26	1000.0	120.000	101.0	H	323.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)
30.030000	20

EMI Auto Test Template: FCC-RE-R17-AN08

Hardware Setup: EN-RE-R12-AN08
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 30 MHz - 1 GHz
Graphics Level Range: 0 dB μ V/m - 80 dB μ V/m

Preview Measurements:
Antenna height: 100 - 355 cm , Step Size = 85 cm , Positioning Speed = 8
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Graphics Display: Show separate traces for horizontal and vertical polarization
Scan Test Template: EN-RE-R12-AN08_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
30 MHz - 1 GHz	30 kHz	PK+	120 kHz	0,15 s	20 dB
1 GHz - 3 GHz	250 kHz	PK+	1 MHz	0,1 s	20 dB

Frequency Zoom:
Zoom Scan Template: EN-RE-R12-AN08_ZOOM

Adjustment:
Antenna height: Range = 180 cm , Measuring Speed = 1
Turntable position: Range = 60 deg , Measuring Speed = 2
Template for Single Meas.: EN-RE-R12-AN08_MAX_1s

Final Measurements:
Template for Single Meas.: EN-RE-R12-AN08_FIN_15s

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
30 MHz - 200 MHz	40 kHz	QPK	120 kHz	1 s	20 dB
200 MHz - 1 GHz	40 kHz	QPK	120 kHz	1 s	20 dB
1 GHz - 3 GHz	40 kHz	QPK	1 MHz	1 s	20 dB

Anechoic chamber

Test procedure

The test site is an anechoic chamber suitable for radiated emission measurements in the frequency range of 30 MHz – 18 GHz (40 GHz). It includes automatic antenna mast of height 4 m and turntable of radius 2 m. It enables both manual and fully automatic measurements. To find the highest level of radiation

- the height of the antenna is scanned in range 1m to 4 m with antenna in horizontal and vertical polarization;
- the turntable is rotated in range from 0° to 360°.

The system was configured for testing in a typical worst case fashion (as a customer may use it). All interface cables were moved to determine the position which resulted in the highest emission levels.

Correction factors

The field strength is calculated by adding the antenna factor and cable attenuation. The calculations are performed automatically by the measurement software EMC 32. As example consider the following input values and result:

FREQUENCY (MHZ)	RECEIVER READING U (dBμV)	ANTENNA FACTOR AF (dB/m)	CABLE ATTENUATION A (dB)	CORRECTION ANTENNA + CABLE (dB)	RADIATED FIELD STRENGTH E (dBμV/m)
30.0	20	20.6	0.8	21.4	41.4

$$E = U + AF + A$$

7.4 Frequency stability measurement

NORMATIVE REFERENCES			RESULT
Limits according to:	FCC §15.225 (e) RSS-210, Issue 10, section B6 RSS-Gen Issue 5, section 6.11		P
Methods of measurement according to:	ANSI C63.10, section 9.14 ANSI C63.10, section 6.8.1		
Equipment mode	Power interface	1, 2	
	EUT configuration mode	1, 2	
	Operation mode	1	

Limits

Limit:	The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ (± 100 ppm) of the carrier frequency under nominal conditions.
Temperature range:	-20°C to +60°C
Voltage range:	4.5 V to 2.7 V

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Temperature chamber	Heraeus-Vötsch	HT4010	45021	PM KF 1402	2022-04 (1 year)
Spectrum analyser	Rohde & Schwarz	FSV40	837356/012	PM KF 2783	2021-08 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2020-05 (3 year)

The locks are specified by the manufacturer for a temperature range of 0°C to +60°C.

Due to the required temperature range according to the standards of -20°C to +50°C the temperature variation was applied between -20°C to +60°C to cover the complete range.

Measurement results – Frequency stability measurement:

Temperature °C	Carrier 13.5605 MHz	Limit: frequency tolerance $\pm 0.01\%$ (± 100 ppm) equates to ± 135.605 kHz	
		Frequency deviation	
		kHz	%
-20	13.5606 MHz	+ 0.1	$+ 7.37 \times 10^{-6}$
-10	13.5606 MHz	+ 0.1	$+ 7.37 \times 10^{-6}$
0	13.5605 MHz	0	0
+10	13.5605 MHz	0	0
+20	13.5605 MHz	Reference value	
+30	13.5604 MHz	- 0.1	$- 7.37 \times 10^{-6}$
+40	13.5604 MHz	- 0.1	$- 7.37 \times 10^{-6}$
+50	13.5604 MHz	- 0.1	$- 7.37 \times 10^{-6}$
+60	13.5604 MHz	- 0.1	$- 7.37 \times 10^{-6}$

Comment

The frequency tolerance of the carrier signal was with the result of $\pm 7.37 \times 10^{-6}\%$ was at the test within $\pm 0.01\%$ (± 100 ppm) of the carrier frequency under nominal conditions.

The EUT was supplied with the intended batteries. After the test the batteries had still a voltage of 1.42 V and the carrier frequency at +20°C was identical as at the beginning of the test.

According to the manufacturer the battery's operating end-point voltage is 2.7 V DC (three serial batteries).

Through the voltage variation from 4.5 V DC to 2.7 V DC (at +20°C) the frequency remained on 13.5605 MHz.

7.5 Occupied bandwidth

NORMATIVE REFERENCES			RESULT
Limits according to:	RSS-Gen, Issue 5, 6.7		P
Methods of measurement according to:	RSS-Gen, Issue 5, 6.7		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	

Test equipment

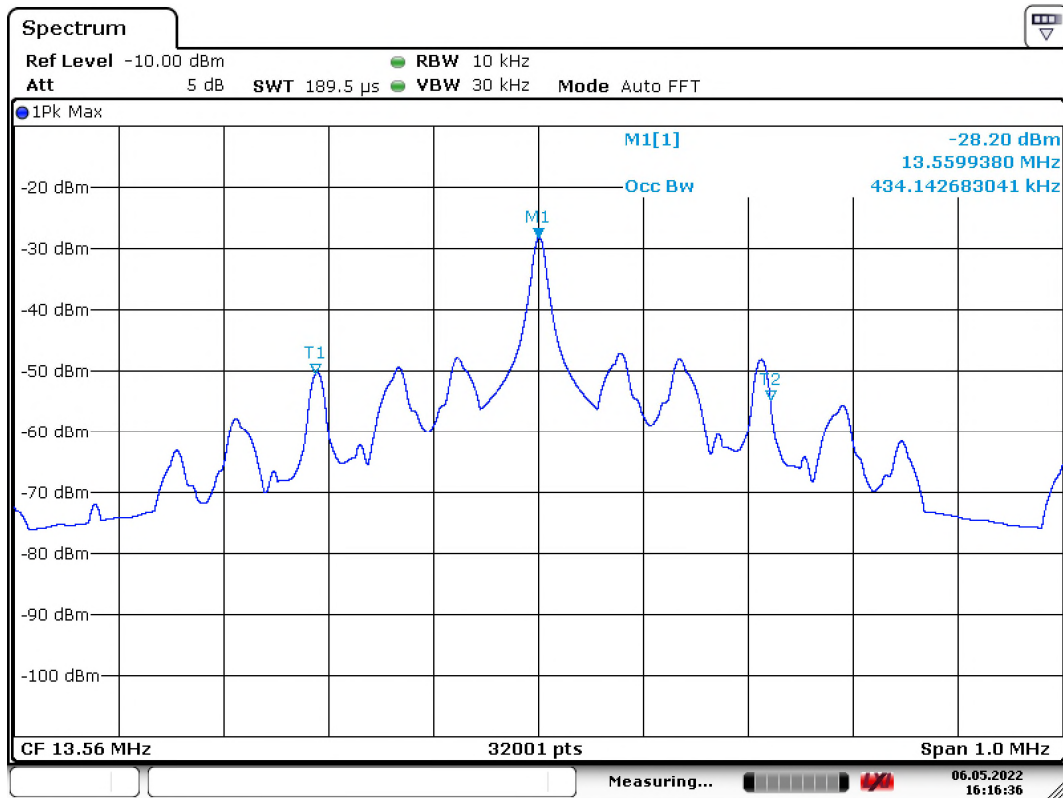
DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Spectrum analyser	Rohde & Schwarz	FSV40	837356/012	PM KF 2783	2021-08 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2020-05 (3 year)

Comment

The 99% occupied bandwidth is 434 kHz without TAG (RFID card).

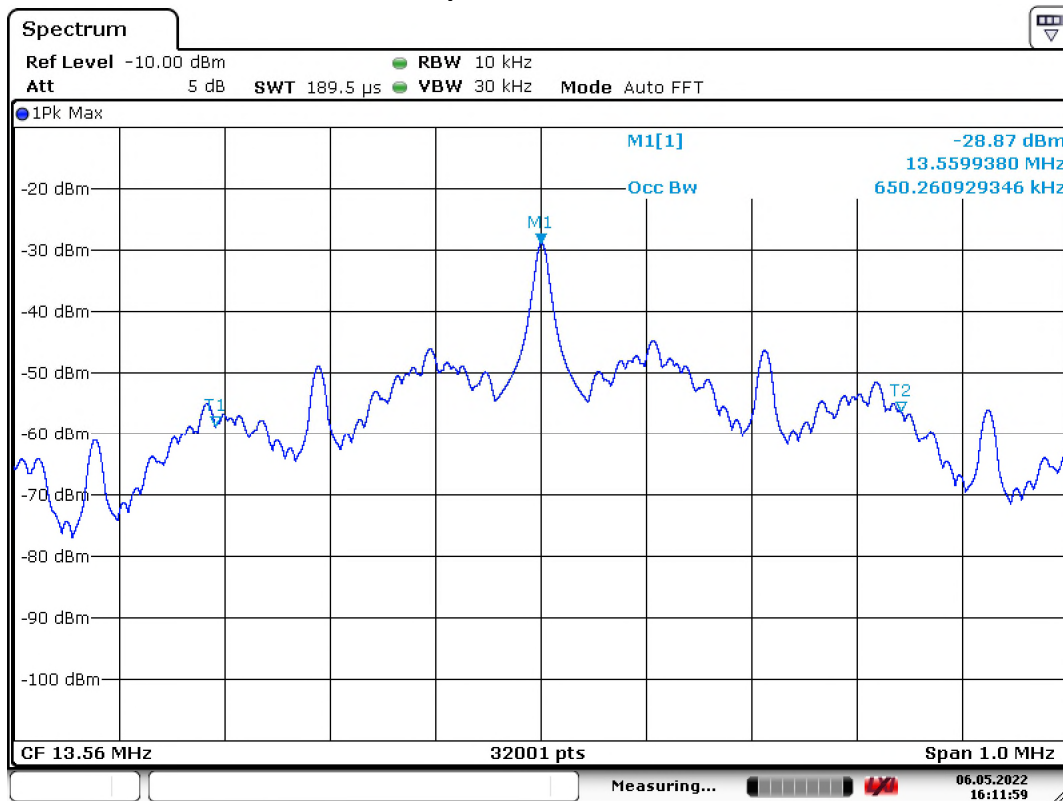
The 99% occupied bandwidth is 650 kHz with TAG (RFID card).

Measurement results – 99% occupied bandwidth – without TAG:



Date: 6.MAY.2022 16:16:36

Measurement results – 99% occupied bandwidth – with TAG:



Date: 6.MAY.2022 16:11:59

SECTION 8

Product labelling

FCC, Part 15 C, Certification

Information to the user:

For a **Class A** digital device or peripheral, the instructions furnished the user shall include the following or similar statement, **placed in a prominent location in the text of the manual**:

NOTE: This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of these equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

For a **Class B** digital device or peripheral, the instructions furnished the user shall include the following or similar statement, **placed in a prominent location in the text of the manual**:

NOTE: This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/ TV technician for help

Systems incorporating several digital devices:

For systems incorporating several digital devices, the statement mentioned above needs to be contained only in the instruction manual for the main control unit.

Manual is provided in a form other than paper:

In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

Label on the device:

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

(Where a device is constructed in two or more sections connected by wires and marketed together, the statement of this section is required to be affixed only on the main control unit.)

Small devices:

When the device is so small or for such use that it is not practicable to place the statement specified under paragraph "Label on the device" of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed.

SECTION 9

ANNEX

9.1 Measurement uncertainty evaluation

Measurement uncertainty for radiated magnetic field, 9 kHz – 30 MHz	± 3.9 dB
Measurement uncertainty for radiated emission, 30 MHz - 1000 MHz	
Uncertainty for the frequency range 30 to 300 MHz using a biconical or a combination antenna at 3 m	± 4.9 dB
Uncertainty for the frequency range 300 to 1000 MHz using a logperiodic or a combination antenna at 3 m	± 4.7 dB
Measurement uncertainty for conducted disturbances at the antenna port on radio equipment	
Frequency range 9 kHz - 1 GHz	± 1.9 dB
Frequency range 1 GHz - 18 GHz	± 3.0 dB
Frequency range 18 GHz -26,5 GHz	± 3.6 dB
Measurement uncertainty for Frequency error	± 1 x 10 ⁻⁸
Measurement uncertainty for Output power (Conducted), 9 kHz - 18 GHz	± 1.0 dB
Measurement uncertainty for RF Power density	
Frequency range 9 kHz - 1 GHz	± 1.9 dB
Frequency range 1 GHz - 18 GHz	± 3.0 dB
Frequency range 18 GHz -26,5 GHz	± 3.6 dB
Measurement uncertainty for humidity	± 4 %
Measurement uncertainty for temperature	± 0.5 °C
Measurement uncertainty for voltage	
DC	± 0.1 %
AC up to 10 kHz	± 1.8 %
Measurement uncertainty for time	± 0.058 %
Measurement uncertainty for conducted emissions, LISN, 150 kHz -30 MHz	± 2.3 dB
Measurement uncertainty for OBW	± 4.3 %
601 points resolution (Spectrum analyzer)	± 0.83 %
30000 points resolution (Spectrum analyzer)	± 0.016 %

End of test report