





LAB Nº 1356

Test Report

47 CFR FCC Part 15 subpart C Par. 15.225 Intentional Radiators

Report reference no...... 28112902-007

FCC Designation Number: 1T0008
FCC Test Firm Registration #: 804595

Tested by (name + signature).....

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Approved by (name + signature).....:

Giovanni Molteni \ TM

Testing Laboratory: TÜV Rheinland Italia S.r.l.

Address Via Mattei 3 - 20010 - Pogliano Milanese (MI) – Italy

Applicant's name: Seco Tools AB

Address....... Björnbacksvägen 2 73782 Fagersta Sweden

Test item description...... Handheld RFID-to-BLE reader

Trade Mark...... Seco Tools AB

Manufacturer...... Seco Tools AB

Model/Type reference.....: S1-A

Ratings...... 3.7Vdc internal Lithium Battery

FCC ID: 2AR2G-03280923

Sample:

Samples received on: 25/01/2019

TUV reference samples: 190056 (sampled by the applicant)

Samples tested n. 1

Testing:

Start Date:: 30/01/2019

End Date:: 05/02/2019

The results in this Test Report are exclusively referred to the tested samples.

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RELEASE CONTROL RECORD					
Test report Number	Date of Issue				
28112902-003	Original release	05/03/2019			
28112902-007	Editorial change – This version cancel and replace the previous TR 28112902-003 issue date 05/03/2019	03/04/2019			

1. Reference Standards				
Standard	Description			
FCC Part 15 (Subpart C)	§15.225 Operation within the band 13.110 – 14.010 MHz.			
FCC Part 15 (Subpart C)	§15.207 Conducted Limits			
FCC Part 15 (Subpart C)	§15.209 Radiated emission limits; general requirements			
FCC Part 15 (Subpart C)	§15.203 Antenna Requirement			
ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz			
ANSI C63.10:2013	American National Standard for Testing Unlicensed Wireless Devices			







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2. Summary of testing					
§ 15.203	Antenna Requirements	PASS			
§ 15.207 (a)	Power Line Conducted Emission	PASS ¹			
§ 15.215 (a) (b) (c)	Additional provisions to the general radiated emission limitations	PASS			
§ 15.215 (c)	20 dB Bandwidth	PASS			
§ 15.225 (a)	Field strength in band 13,553-13,567MHz	PASS			
§ 15.225 (b)	Field strength in band 13,410-13,553 MHz and 13,567-13,710 MHz	PASS			
§ 15.225 (c)	Field strength in band 13,110-13,410 MHz and 13,710-14,010 MHz	PASS			
§ 15.225 (d) § 15.209 (a) (f)	Field strength outside of the 13,110-14,010 MHz band	PASS			
§ 15.225 (e)	Frequency tolerance of the carrier signal	PASS			
§ 15.225 (f)	Radio frequency powered tags	N.A. ²			
§ 47CFR 1.1307(b)(1)	RF humane exposure	PASS			

PASS ¹	As required on §15.207 (c): Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits. For demonstrate compliance with the conducted limits the test has been executed on AC/DC adapter CELLULARLINE mod. ACHSMKIT15WMUSBW powered by AC mains line 115V~60Hz Output 5Vdc 3A max.
N.A. ¹	No powered tag.







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Possible test case verdicts:

test case does not apply to the test object: N/A
 test object does meet the requirement: PASS
 test object does not meet the requirement: FAIL

General remarks:

The test results presented in this report relate only to the object tested.

The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

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"(see appended table)" refers to a table appended to the report.

Throughout this report a comma is used as the decimal separator.







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3. General product information

Handheld RFID-to-BLE reader

4. General Chipset information				
Type of equipment	13.56-MHz multi-protocol contactless transceiver IC with SPI and UART serial access			
Brand	llfe.augmented			
Model	CR95HF			

5. General Antennas information

PCB antenna designed according AN1445.

(6. Equipment Used During Test						
Use*	Use* Product Type Manufacturer Model Comments						
EUT	Handheld RFID- to-BLE reader	Seco Tools AB	S1-A				

Note:

* Use:

EUT - Equipment Under Test,

AE - Auxiliary/Associated Equipment, or SIM - Simulator (Not Subjected to Test)

No other Auxiliary/Associated Equipment was connected/installed on the EUT







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7. Input/Output Ports

CONNECTIONS

Port		Description	Connection	Cable lenght
1	Enclosure	Plastic & metallic		
2	AC Power Port	Port not present		
3	DC Power Port	3,7Vdc powered by internal battery		
4	Signal port	USB	Connector	30cm
5	Antenna	Integrated		

*Note: AC = AC Power Port DC = DC Power Port N/E = Non-Electrical I/O = Signal Input or Output Port (Not Involved in Process Control) WN = Wired Network

8	8. Power Interface					
Mode #	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
Rated	3,7	0,1		DC		Powered by internal battery







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9. EUT Operation Modes					
Operation Description					
#1	Continuous Modulated RF Transmission at 13,56MHz at max power.				
#2	Battery recharging mode (see §2 sumamry testing for details)				

10. EUT Configuration Modes					
	Description				
Module connected t	ro .				
Par.	test	EUT Operation Modes			
§ 15.203	Antenna Requirements	#1			
§ 15.207 (a)	Power Line Conducted Emission	#2			
§ 15.215 (a) (b) (c)	Additional provisions to the general radiated emission limitations	#1			
§ 15.215 (c)	20 dB Bandwidth	#1			
§ 15.225 (a)	Field strength in band 13,553-13,567MHz	#1			
§ 15.225 (b)	Field strength in band 13,410-13,553 MHz and 13,567-13,710 MHz	#1			
§ 15.225 (c)	Field strength in band 13,110-13,410 MHz and 13,710-14,010 MHz	#1			
§ 15.225 (d) § 15.209 (a) (f)	Field strength outside of the 13,110-14,010 MHz band	#1			
§ 15.225 (e)	Frequency tolerance of the carrier signal	#1			
§ 47CFR 1.1307(b)(1)	RF humane exposure	#1			

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength ($dB\mu V/m$) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction ($dB\mu V$)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

 $\begin{tabular}{lll} Measurement & +Antenna & Factor-Amplifier & Gain+Cable & loss=Radiated \\ Emissions & (dBuV/m) & \\ \end{tabular}$

25 dBuV/m + 17.5 dB - 20 dB + 1.0 dB = 23.5 dBuV/m







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11. Test Conditions and Results

11.1 TEST: Antenna requirements				
Parameters required prior to the	Laboratory Ambient Temperature (°C) 15 to 35		;	
test	Relative Humidity (%)	30 to 60 %		
Parameters recorded during the	Laboratory Ambient Temperature (°C)	21°C		
test	Relative Humidity (%)	56%		
	Air pressure (hPa)	1020		
_	Power Supply / Frequency	Application Po	oint	
Fully configured sample tested at the power line frequency	12 Vdc	Enclosure		
Equipment mode:	Operation mode	#1		
FCC Standard §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

Antenna specifications			
N° of authorized antenna types	1		
Antenna type	PCB antenna designed according AN1445.		
Maximum total gain			
External power amplifiers	Not present		







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		•	
Emission			PASS
Laboratory Ambient Temperatu	re (°C)	15 to 35 °C	
Relative Humidity (%)		30 to 60 %	, o
Laboratory Ambient Temperatu	re (°C)	21°C	
Relative Humidity (%)		56%	
Air pressure (hPa)		1020	
Power Supply / Frequenc	у	Application F	oint
115V ~ 60Hz (via AC/DC adapter)			3
Operation mode		#2	
	§15.207		
Quasi-peak (dBuV)	Av	rerage (dBuV)	Result
66 to 56		56 to 46	
56		46	PASS
60		50	PASS
	Relative Humidity (%) Laboratory Ambient Temperatu Relative Humidity (%) Air pressure (hPa) Power Supply / Frequence 115V ~ 60Hz (via AC/DC adapter) Operation mode Quasi-peak (dBuV) 66 to 56 56	Laboratory Ambient Temperature (°C) Relative Humidity (%) Laboratory Ambient Temperature (°C) Relative Humidity (%) Air pressure (hPa) Power Supply / Frequency 115V ~ 60Hz (via AC/DC adapter) Operation mode §15.207 Quasi-peak (dBuV) Av 66 to 56 56	Laboratory Ambient Temperature (°C) Relative Humidity (%) Laboratory Ambient Temperature (°C) Relative Humidity (%) Air pressure (hPa) Power Supply / Frequency Application P 115V ~ 60Hz (via AC/DC adapter) Operation mode #2 \$15.207 Quasi-peak (dBuV) Average (dBuV) 66 to 56 56 to 46

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

	Conducted limit (dBµV)		
Frequency of emission (MHz)	Quasi-peak	Average	
0.15-0.5	66 to 56*	56 to 46*	
0.5-5	56	46	
5-30	60	50	

Further information to test setup







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	Test Equipment Used					
Description	Manufacturer	Model	TUV Identifier	Calibration date	Calibration due	
EMI Test Receiver	R&S	ESR	87020864	12/2018	12/2019	
Two line V-Network	R&S	ENV216	87020993	01/2018	01/2020	
Stabilized Power Supply	Elettrotest	TPS T 30K60S	87020490	09/2018	09/2020	







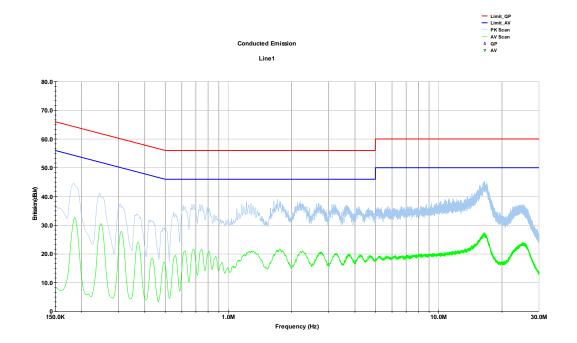
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Test Results

EUT Operating Mode(s) #2

AC MAINS - Phase line









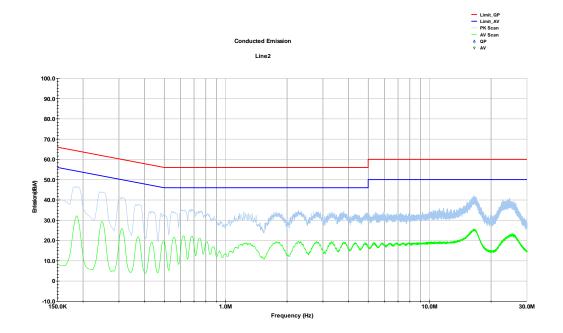
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Test Results

EUT Operating Mode(s) #2

AC MAINS - Neutral line









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11.3 TEST: Radiated Emission			PASS
Parameters required prior to the test	Laboratory Ambient Temperature (°C)	15 to 35 °C	
	Relative Humidity (%)	30 to 60 %	
Parameters recorded during the test	Laboratory Ambient Temperature (°C)	22°C	
	Relative Humidity (%)	54%	
	Air pressure (hPa)	1020	
_	Power Supply / Frequency	Application Po	oint
Fully configured sample tested at the power line frequency	3,7 Vdc	Enclosure	
Equipment mode:	Operation mode	#1	
FCC Standard	§15.205; §15.209; §15.225		

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

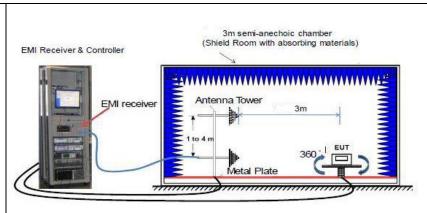
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

Remark: In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is: Extrapolation (dB) = $40\log(300\text{meter}/3\text{meter}) = +80\text{db}$ Extrapolation (dB) = $40\log(300\text{meter}/3\text{meter}) = +40\text{db}$

Further information to test setup.

For frequencies above 1GHz, the anechoic material is also placed on the metallic floor between EUT and Antenna









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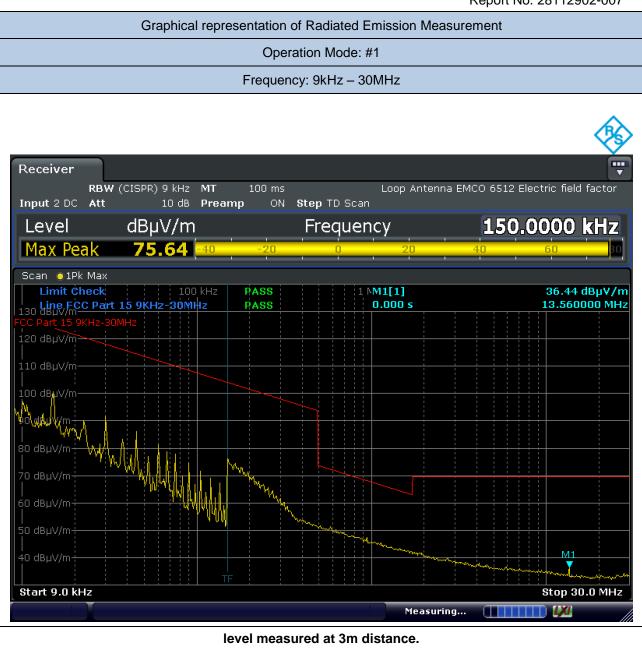
	Test Equipment Used					
Description	Manufacturer	Model	Identifier	Calibration date	Calibration due	
CSSA	ETS Lindgren	FACT3	87020484	10/2018	10/2020	
EMI Test Receiver	R&S	ESW44	87020967	06/2018	06/2019	
Loop Antenna	EMCO	6512	87020465	02/2017	02/2020	
Antenna BiConiLog	ETS Lindgren	3124E-PA	87020457	04/2017	04/2020	







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	QUASI-PEAK RESULT (RBW=120kHz)				
Frequency Reading Antenna Cable Pre-Amp. Correcting value Factor Loss Gain reading					
(MHz)	(dBµV)	(dB3/m)	(dB)	(dB)	(dBµV/m)
				Not present	







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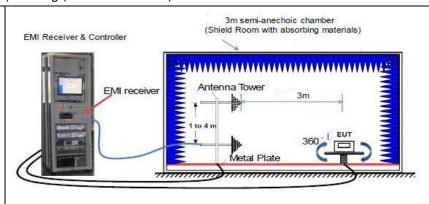
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11.4 TEST: Field strength in ba	nd 13,110-14,010 MHz		PASS
Parameters required prior to the	Laboratory Ambient Temperature (°C)	15 to 35 °C	
test	Relative Humidity (%)	30 to 60 %	
Parameters recorded during the test	Laboratory Ambient Temperature (°C)	22°C	
	Relative Humidity (%)	54%	
	Air pressure (hPa)	1020	
_	Power Supply / Frequency	Application Po	oint
Fully configured sample tested at the power line frequency	3,7Vdc	Enclosure	
Equipment mode:	Operation mode	#1	
FCC Standard	§15.225 (A); §15.225 (B); §15.225 (C)		

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (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 microvolts/meter at 30 meters.
- (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 microvolts/meter at 30 meters.

Remark: In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is:Extrapolation (dB) = 40log (300meter / 3meter) = +80db Extrapolation (dB) = 40log (30meter / 3meter) = +40db

Further information to test setup.









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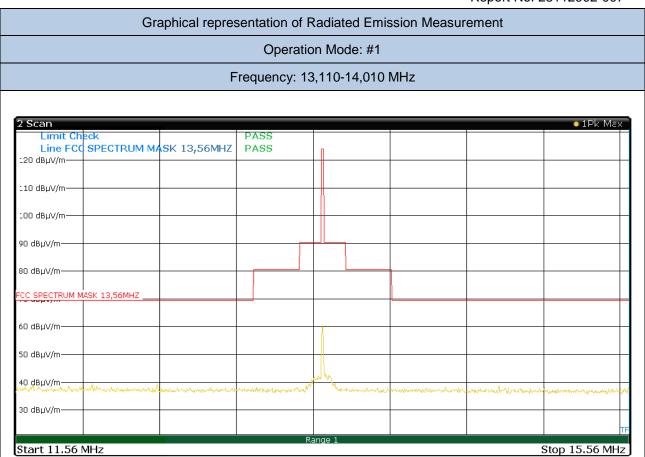
				•		
	Test Equipment Used					
Description Manufacturer Model Identifier Calibration date Calibration due						
CSSA	ETS Lindgren	FACT3	87020484	10/2018	10/2020	
EMI Test Receiver	R&S	ESW44	87020967	06/2018	06/2019	
Loop Antenna	EMCO	6512	87020465	02/2017	02/2020	







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Field strength emission level					
Frequency 13,560MHz Max level measured 60dBµV/m*					
*level measured at 3m distance.					







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11.5 TEST: 20dB Bandwidth			PASS
Parameters required prior to the	Laboratory Ambient Temperature (°C)	15 to 35 °C	
test	Relative Humidity (%)	30 to 60 %	
Parameters recorded during the	Laboratory Ambient Temperature (°C)	24°C	
test	Relative Humidity (%)	48%	
	Air pressure (hPa)	1020	
_	Frequency	Application Po	oint
Fully configured sample tested at the power line frequency	3,7Vdc	Enclosure	
Equipment mode:	Operation mode	#1	
FCC Standard	§ 15.215 (C)		

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.

Further information to test setup.

EMI Receiver & Controller

Antenna Tower

Antenna Tower

Metal Plate

Metal Plate

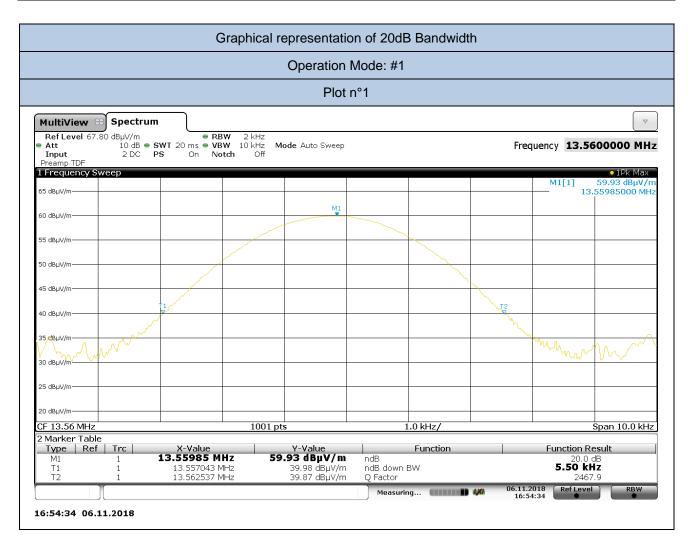






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Test Equipment Used									
Description Manufacturer		Model	Identifier	Calibration date	Calibration due				
EMI Test Receiver	R&S	ESW44	87020967	06/2018	06/2019				



Channel (No.)	Frequency (MHz)	Channel Bandwidth at -20dB (kHz)	Plot (No.)		
1	13,56	5,50	1		

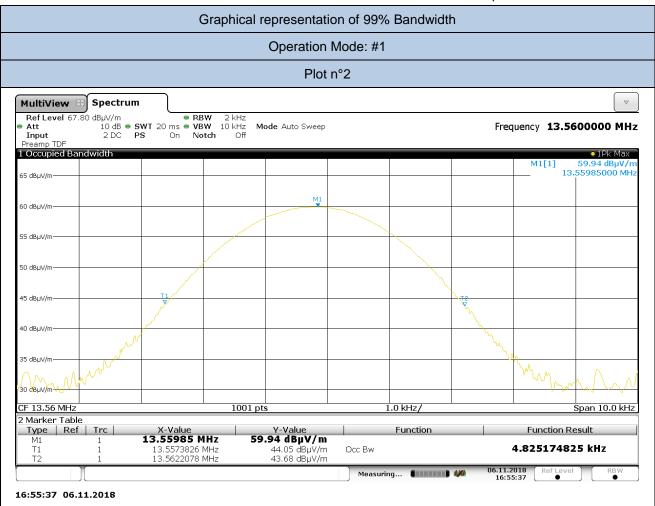
Bandwidth at -20dB (Fmin and Fmax)							
Fmin	13.556	Fmax	13.557				







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Channel Frequency (MHz)		Channel Bandwidth at 99% (kHz)	Plot (No.)		
1	13,559	4,825	2		

Bandwidth at 99% (Fmin and Fmax)								
Fmin	13,562	Fmax	13,557					







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11.6 TEST: Frequency tolerance of the carrier signal								
Parameters required prior to the test	Laboratory Ambient Temperature (°C)	15 to 35 °C						
	Relative Humidity (%)	30 to 60 %						
Parameters recorded during the test	Laboratory Ambient Temperature (°C)	22,5°C						
	Relative Humidity (%)	51%						
	Air pressure (hPa)		1020					
_	Voltage	Application Po	oint					
Fully configured sample tested at the power line frequency	3,7Vdc	Enclosure						
Equipment mode:	Operation mode	#1	#1					
FCC Standard	§ 15.225 (E)							

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 battery operated equipment, the equipment tests shall be performed using a new battery.







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Test Equipment Used										
Description	Manufacturer	Model	Identifier	Calibration date	Calibration due					
Climatic chamber	WEISS	SB22/300/40	87020044	10/2018	10/2019					
EMI Test Receiver	R&S	ESU40	87020455	05/2018	05/2019					

Frequency stability

Operation Mode: #1

Temperature (°C)	Voltage (V)	Measured Frequency (MHz)	Frequency Delta (ppm)		
+20	3.15Vdc	13,55967974	11,82		
	3,7Vdc	13,55967949	Reference frequency		
	4.23Vdc	13,55967955	11.81		

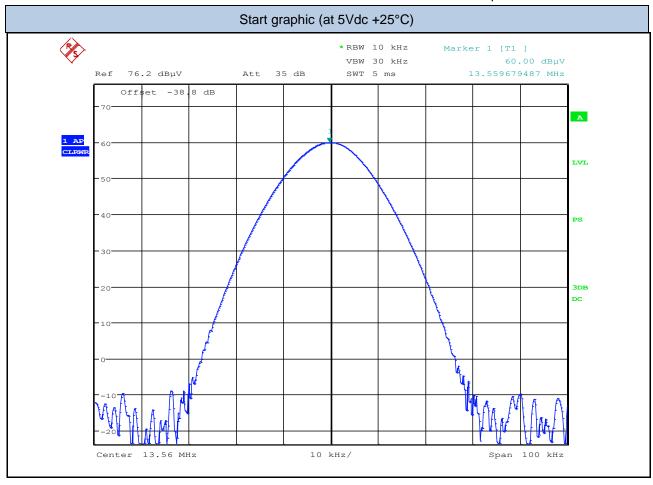
Temperature (°C)	Voltage (V)	Measured Frequency (MHz)	Frequency Delta (ppm)
-20	3,7Vdc	13,55983974	11,82
-10	3,7Vdc	13,55983977	11,82
0	3,7Vdc	13,55983944	11,80
+10	3,7Vdc	13,55983974	11,82
+20	3,7Vdc	13,55983974	11,82
+30	3,7Vdc	13,55967949	0,00
+40	+40 3,7Vdc		0,00
+50	3,7Vdc	13,55967949	0,00







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11.7 TEST: Additional provision	s to the general radiated emission limit	tations.	PASS	
Parameters required prior to the	Laboratory Ambient Temperature (°C)	15 to 3	35 °C	
test	Relative Humidity (%)	30 to (o 60 %	
Parameters recorded during the	Laboratory Ambient Temperature (°C)	24°	°C	
test	Relative Humidity (%)	37	%	
	Air pressure (hPa)	102	20	
_	Frequency	Application	on Point	
Fully configured sample tested at the power line frequency	3,7Vdc			
Equipment mode:	#*	1		
FCC Standard) (B) (C)			
(A) The regulations in §§ 15.217-15 emission limits for intentional radiate otherwise stated, there are no restri sections.	ls. Unless			
	ons outside of the frequency bands show		VERDICT	
no case shall the level of the unwan	uated to the emission limits shown in Sec ted emissions from an intentional radiato sceed the field strength of the fundament	r operating	PASS	
	nder the alternative provisions to the gen ough 15.257 and in Subpart E of this par		VERDICT	
designed to ensure that the 20 dB be otherwise be specified in the specific contained within the frequency band equipment is operated. The required emission within the specified frequency frequency hopping and other modul frequency stability of the transmitter voltage. If a frequency stability is not fundamental emission be kept within	andwidth may t operates, is ich the n of the ency sweeping, as well as the and supply	PASS		







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11.8 TEST: RF Exposure Requirements								
Parameters required prior to the	Laboratory Ambient Temperature (°C)	15 to 35 °C						
test	Relative Humidity (%)	30 to 60 %						
Parameters recorded during the	Laboratory Ambient Temperature (°C)							
test	Relative Humidity (%)							
	Air pressure (hPa)	1020)20					
_	Frequency	Application Point						
Fully configured sample tested at the power line frequency	3,7Vdc							
Equipment mode:	Operation mode	#1						
FCC Standard	§ 1.1310 (1)	(B)						
	sions of this section shall be operated in requency energy levels in excess of the							
EUT classification (fixed, mobile or portable devices)	Portable device							
Limits Freq. 13,56 MHz	According to 447498 D01 General RF Exposure Guidance v06 (Setable below)							

Appendix C

SAR Test Exclusion Thresholds for $\leq 100 \text{ MHz}$ and $\leq 200 \text{ mm}$

Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table. The equation and threshold in 4.3.1 must be applied to determine SAR test exclusion.

MHz	< 50	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	mm
100	237	474	481	487	494	501	507	514	521	527	534	541	547	554	561	567	
50	308	617	625	634	643	651	660	669	677	686	695	703	712	721	729	738	
10	474	948	961	975	988	1001	1015	1028	1041	1055	1068	1081	1095	1108	1121	1135	
1	711	1422	1442	1462	1482	1502	1522	1542	1562	1582	1602	1622	1642	1662	1682	1702	mW
0.1	948	1896	1923	1949	1976	2003	2029	2056	2083	2109	2136	2163	2189	2216	2243	2269	
0.05	1019	2039	2067	2096	2125	2153	2182	2211	2239	2268	2297	2325	2354	2383	2411	2440	
0.01	1185	2370	2403	2437	2470	2503	2537	2570	2603	2637	2670	2703	2737	2770	2803	2837	







LAB Nº 1356

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Operation Mode: #1						
СН	Frequency	Radiated Output Power	Radiated Output Power EIRP*	Radiated Output Power EIRP	Min. test separation Distance (r)	Limit (mW)
	(MHz)	(dBuV/m)	(dBm)	(mW)	(mm)	
1	13,56	60.0	-35,23	0.0003	<50	459**

VERDICT

SAR evaluation is not required because the output power value is less than exemption limit (separation distance ≤5mm)

END OF TEST REPORT

^{*} according to formula EIRP[dBm] = E[dB μ V/m] + 20 log(d[meters]) – 104.77

^{**}Linear interpolation.