Test Report
21-1-0132201T09a

D-PL-12047-01-01
D-PL-12047-01-03
D-PL-12047-01-04

Number of pages:	26	**Date of Report:**	2022-Mar-09
Testing company:	CETECOM GmbH Im Teelbruch 116 45219 Essen Germany Tel. + 49 (0) 20 54 / 95 19-0 Fax: + 49 (0) 20 54 / 95 19-150	**Applicant:**	SOMMER Antriebs- und Funktechnik GmbH
Product: **Model:**	**garage door opener** **2110 pro+**		
FCC ID:	T8C206	**IC:**	6496A-206
Testing has been carried out in accordance with:	**FCC Regulations:** Title 47 CFR, Chapter I, Subchapter A, Subpart C: §15.231 **ISED Regulations:** RSS-210, Issue 10 | RSS-Gen, Issue 5 Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Tested Technology:	SRD		
Test Results:	☒ **The EUT complies with the requirements in respect of all parameters subject to the test.** The test results relate only to devices specified in this document		
Signatures:	ninovic.perez@cetecom.com 2022.03.09 10:35:48 +01'00'		Digital signiert von: timo.franke@cetecom.com Name: CN = timo.franke@cetecom.com Datum: 2022.03.09 09:37:48 +01'00'
	Dipl.-Ing. Ninovic Perez Test Lab Manager Authorization of test report		Timo Franke Test manager Responsible of test report

Table of Contents

Table of Annex			
Annex No.	**Contents**	**Reference Description**	**Total Pages**
Annex 1	Test result diagrams	**CETECOM_TR21-1-0132201T09a_A1**	13
Annex 2	Internal photographs of EUT	**Provided by applicant**	--
Annex 3	External photographs of EUT	**CETECOM_TR21-1-0132201T09a_A3**	7
Annex 4	Test set-up photographs	**CETECOM_TR21-1-0132201T09a_A4**	7
The listed attachments are separate documents.			

1 General information

1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. CETECOM does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM.
The testing service provided by CETECOM has been rendered under the current "General Terms and Conditions for CETECOM".
CETECOM will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.
Under no circumstances does the CETECOM test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.
Under no circumstances does the CETECOM test report include or imply any product or service warranties from CETECOM, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CETECOM.
All rights and remedies regarding vendor's products and services for which CETECOM has prepared this test report shall be provided by the party offering such products or services and not by CETECOM.
In no case this test report can be considered as a Letter of Approval.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at CETECOM.

Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

1.2 Attestation

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All of the above requirements are met in accordance with enumerated standards.

1.3 Summary of Test Results

The EUT integrates a Bluetooth transmitter. Other implemented wireless technologies were not considered within this test report.

Test case	Reference Clause FCC ☒	Reference Clause ISED ☒	Page	Remark	Result
Radiated field strength emissions below 30 MHz	§15.205(a) §15.209(a)	RSS-Gen: Issue 5 §8.9 Table 6 §8.10 Table 7	10	--	PASSED
Radiated field strength emissions 30 MHz – 1 GHz	§15.209(a) §15.205(a) §15.231(b)	RSS-Gen: Issue 5; §8.9 Table 5 §8.10 Table 7 RSS-210: Issue 10 Annex A.1.2(b) Annex A.1.2 Table A1	14	--	PASSED
Radiated field strength emissions above 1 GHz	§15.209(a) §15.231(b)	RSS-Gen: Issue 5: §8.9 Table 5 §8.10 Table 7 RSS-210: Issue 10 Annex A.1.2(b) Annex A.1.2 Table A1	17	--	PASSED
Transmitter timing	§15.231(a)(2)	RSS-210: Issue 10: Annex A.1.1	19	--	PASSED
Emission Bandwidth 20 dB	§15.231(c)	RSS-Gen, Issue 5: §6.7	20	--	PASSED
Occupied Channel Bandwidth 99%	2.1049(h)	RSS-Gen, Issue 5: §6.7 RSS-210, Issue 10: Annex A.1.3	21	--	PASSED

PASSED	The EUT complies with the essential requirements in the standard.
FAILED	The EUT does not comply with the essential requirements in the standard.
N/A	Test case does not apply to the test object.
NP	The test was not performed by the CETECOM Laboratory.

*The calculation of the measurement uncertainty shows compliance with the "maximum measurement uncertainties" of the tested standard and therefore for result evaluation the stated uncertainties will not be additionally added to the measured results.

1.4 Summary of Test Methods

Test case	Test method
Emission Bandwidth 20 dB	ANSI C63.10:2013, §6.9
Occupied Channel Bandwidth 99%	ANSI C63.10:2013, §6.9
Radiated field strength emissions below 30 MHz	ANSI C63.10-2013 §6.3, §6.4
Radiated field strength emissions 30 MHz - 1 GHz	ANSI C63.10-2013 §6.3, §6.5
Radiated field strength emissions above 1 GHz	ANSI C63.10-2013 §6.3, §6.6

2 Administrative Data

2.1 Identification of the Testing Laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Dipl.-Ing. Ninovic Perez
Accreditation scope:	**DAkkS Webpage: FCC ISED**
IC Lab company No. / CAB ID:	3462D / DE0005
Test location:	CETECOM GmbH; Im Teelbruch 116; 45219 Essen - Kettwig

2.2 General limits for environmental conditions

Temperature:	22±2 °C
Relative. humidity:	45±15% rH

2.3 Test Laboratories sub-contracted

Company name:	--

2.4 Organizational Items

Responsible test manager:	Timo Franke
Receipt of EUT:	2022-Jan-05
Date(s) of test:	21-Jan-2022 to 01-Feb-2022
Version of template:	22.0101

2.5 Applicant's details

Applicant's name:	SOMMER Antriebs- und Funktechnik GmbH
Address:	Hans-Boeckler Straße 27 73230 Kirchheim unter Teck Baden-Wuerttemberg Germany
Contact Person:	Jochen Lude
Contact Person's Email:	j.lude@sommer.eu

2.6 Manufacturer's details

Manufacturer's name:	SOMMER Antriebs- und Funktechnik GmbH
Address:	Hans-Boeckler Straße 27 73230 Kirchheim unter Teck Baden-Wuerttemberg Germany

2.7 Equipment under Test (EUT)

EUT No.*)	Sample No.	Product	Model	Type	SN	HW	SW
EUT 1	21-1-01322S12_C01	garage door opener	2110 pro+	n/a	11PP-1613000391	LW-A-1-TRM01-868	S10065-00251
EUT 2	21-1-01322S25_C01	Rail, chain and carriage, pre assembled	2110 pro+	n/a	11PP-1613000391	LW-A-1-TRM01-868	S10065-00251

*) EUT short description is used to simplify the identification of the EUT in this test report.

2.8 Untested Variant (VAR)

2.9 Auxiliary Equipment (AE)

AE No.*)	Sample No.	Auxiliary Equipment	Model	SN	HW	SW
AE 1	21-1-01322S14_01	Remote Control	Pearl	0124862905	TX55-922-4	S10159-00704

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report. If the table above does not show any other line than the headline, no AE was used during testing nor was taken into account for evaluation

2.10 Connected cables (CAB)

CAB No.*)	Sample No.	Cable Type	Connectors / Details	Length

*) CAB short description is used to simplify the identification of the connected cables in this test report. If the table above does not show any other line than the headline, no cable was used during testing nor was taken into account for evaluation

2.11 Software (SW)

SW No.*)	Sample No.	SW Name	Description	SW Status

*) SW short description is used to simplify the identification of the used software in this test report. If the table above does not show any other line than the headline, no SW was used during testing nor was taken into account for evaluation.

2.12 EUT set-ups

set-up no.*)	Combination of EUT and AE	Description
Set. 1	EUT 1	EUT with test mode firmware for radiated and conducted measurements (near field probe)
Set. 2	EUT 2 + AE 1	EUT with standard firmware for conducted measurements (near field probe) which is activated by AE 1

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

2.13 EUT operation modes

EUT operating mode no.*1)	Operating modes	Additional information
Op. 1	TX CW	Unmodulated continuous transmission
Op. 2	TX Mod	Modulated continuous transmission
Op. 3	Normal Mode	Standard periodic transmission mode, sending a response when triggered by AE 1

*1) EUT operating mode no. is used to simplify the test report.

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Firmware	☒ for normal use	☒ Special version for test execution	
Power supply	☐ AC Mains	-	
	☒ DC Mains	**24** V DC via **Banana** Connector	
	☐ Battery	--	
Operational conditions	T_{nom} =21 °C	T_{min} =-- °C	T_{max} =-- °C
EUT sample type	**Engineering Samples**		
Weight	2.1 kg		
Size [LxWxH]	28 cm x 15 cm x 11 cm		
Interfaces/Ports	--		
For further details refer Applicants Declaration & following technical documents			

3.2 Detailed Technical data of Main EUT as Declared by Applicant

Frequency Band	922.5 MHz
Number of Channels (USA/Canada -bands)	1
Nominal Channel Bandwidth	150 kHz
Type of Modulation | Data Rate	GFSK 40 kbps
Other installed options	☒ None
Max. Conducted Output Power	+3 dBm
Antenna Type	PCB antenna
Antenna Gain	Not reported
FCC label attached	Yes
Test firmware / software and storage location	EUT
For further details refer Applicants Declaration & following technical documents	

Description of Reference Document (supplied by applicant)	**Version**	**Total Pages**
Operational Description (GTA 2110 pro+ S10255).docx	**08.12.2021**	**1**
Description_LW-A_FCC.pdf	**08.12.2021**	**1**
BOM_LW-A-1-TRM01-868.pdf	**07.12.2021**	**3**
PcbBottom_LW-A-1-TRM01-868.pdf	**07.12.2021**	**1**
PcbTop_LW-A-1-TRM01-868.pdf	**07.12.2021**	**1**
Schematic_LW-A-1-TRM01-868.pdf	**07.12.2021**	**2**

3.3 Modifications on Test sample

Additions/deviations or exclusions	--

4 Measurements

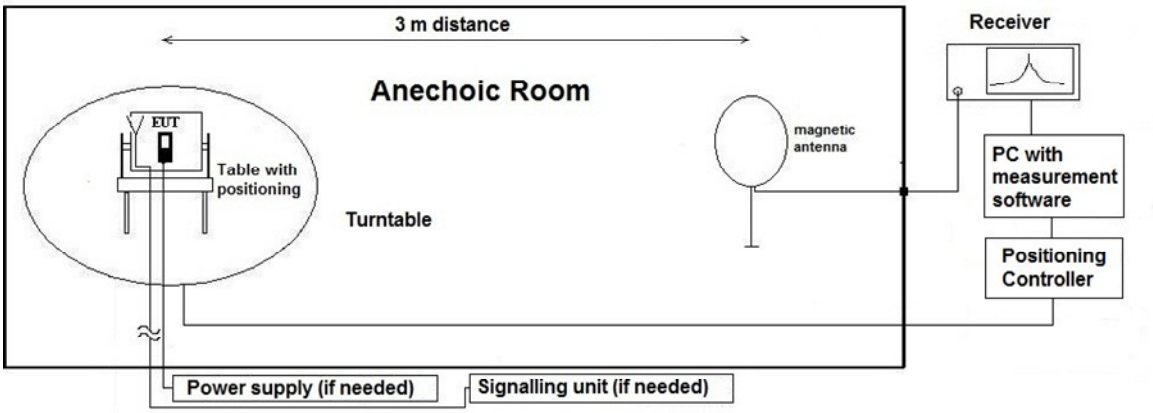
4.1 Radiated field strength emissions below 30 MHz

4.1.1 Description of the general test setup and methodology, see below example:

Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter "General Limit - Radiated field strength emissions below 30 MHz". The tests are performed in the semi anechoic room recognized by the regulatory commission.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0°to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded.

The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$

$M = L_T - E_C$

AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
E_C = Electrical field – corrected value
E_R = Receiver reading
G_A = Gain of pre-amplifier (if used)
L_T = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

4.1.2 Measurement Location

Test site	120901 - SAC - Radiated Emission <1GHz

4.1.3 Correction factors due to reduced meas. distance (f < 30 MHz):

The used correction factors when the measurement distance is reduced compared to regulatory measurement distance, are calculated according Extrapolation formulas valid for EUT's with maximum dimension of 0.625xLambda. Formula 2+3+4 as presented in ANSI C63.10, Chapter 6.4.4 are used for the calculations of proper extrapolation factors

Frequency Range	f [kHz/MHz]	Lambda [m]	Far-Field Point [m]	Distance Limit accord. 15.209 [m]	1st Condition (dmeas < Dnear-field)	2nd Condition (Limit distance bigger dnear-field)	Distance Correction accord. Formula
kHz	9	33333.33	5305.17	300	fullfilled	not fullfilled	-80.00
	10	30000.00	4774.65		fullfilled	not fullfilled	-80.00
	20	15000.00	2387.33		fullfilled	not fullfilled	-80.00
	30	10000.00	1591.55		fullfilled	not fullfilled	-80.00
	40	7500.00	1193.66		fullfilled	not fullfilled	-80.00
	50	6000.00	954.93		fullfilled	not fullfilled	-80.00
	60	5000.00	795.78		fullfilled	not fullfilled	-80.00
	70	4285.71	682.09		fullfilled	not fullfilled	-80.00
	80	3750.00	596.83		fullfilled	not fullfilled	-80.00
	90	3333.33	530.52		fullfilled	not fullfilled	-80.00
	100	3000.00	477.47		fullfilled	not fullfilled	-80.00
	125	2400.00	381.97		fullfilled	not fullfilled	-80.00
	200	1500.00	238.73		fullfilled	fullfilled	-78.02
	300	1000.00	159.16		fullfilled	fullfilled	-74.49
	400	750.00	119.37		fullfilled	fullfilled	-72.00
	490	612.24	97.44		fullfilled	fullfilled	-70.23
	500	600.00	95.49	30	fullfilled	not fullfilled	-40.00
	600	500.00	79.58		fullfilled	not fullfilled	-40.00
	700	428.57	68.21		fullfilled	not fullfilled	-40.00
	800	375.00	59.68		fullfilled	not fullfilled	-40.00
	900	333.33	53.05		fullfilled	not fullfilled	-40.00
MHz	1.00	300.00	47.75		fullfilled	not fullfilled	-40.00
	1.59	188.50	**30.00**		fullfilled	not fullfilled	-40.00
	2.00	150.00	23.87		fullfilled	fullfilled	-38.02
	3.00	100.00	15.92		fullfilled	fullfilled	-34.49
	4.00	75.00	11.94		fullfilled	fullfilled	-32.00
	5.00	60.00	9.55		fullfilled	fullfilled	-30.06
	6.00	50.00	7.96		fullfilled	fullfilled	-28.47
	7.00	42.86	6.82		fullfilled	fullfilled	-27.13
	8.00	37.50	5.97		fullfilled	fullfilled	-25.97
	9.00	33.33	5.31		fullfilled	fullfilled	-24.95
	10.00	30.00	4.77		fullfilled	fullfilled	-24.04
	10.60	28.30	4.50		fullfilled	fullfilled	-23.53
	11.00	27.27	4.34		fullfilled	fullfilled	-23.21
	12.00	25.00	3.98		fullfilled	fullfilled	-22.45
	13.56	22.12	3.52		fullfilled	fullfilled	-21.39
	15.00	20.00	3.18		fullfilled	fullfilled	-20.51
	15.92	18.85	**3.00**		fullfilled	fullfilled	-20.00
	17.00	17.65	2.81		not fullfilled	fullfilled	-20.00
	18.00	16.67	2.65		not fullfilled	fullfilled	-20.00
	20.00	15.00	2.39		not fullfilled	fullfilled	-20.00
	21.00	14.29	2.27		not fullfilled	fullfilled	-20.00
	23.00	13.04	2.08		not fullfilled	fullfilled	-20.00
	25.00	12.00	1.91		not fullfilled	fullfilled	-20.00
	27.00	11.11	1.77		not fullfilled	fullfilled	-20.00
	29.00	10.34	1.65		not fullfilled	fullfilled	-20.00
	30.00	10.00	1.59		not fullfilled	fullfilled	-20.00

4.1.4 Limit

Radiated emissions limits (3 meters)					
Frequency Range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Distance [m]	Detector	RBW [kHz]
0.009 – 0.09	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.09 – 0.11	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Quasi peak	0.2
0.11 – 0.15	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.15 – 0.49	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	9
0.49 – 1.705	24000 / f [kHz]	87.6 – 20Log(f) (kHz)	30	Quasi peak	9
1.705 - 30	30	29.5	30	Quasi peak	9

*Remark: In Canada same limits apply, just unit reference is different

4.1.5 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 0.009 – 30 MHz	Result
2.01	1	Op. 1 / standing	20.911 (PK) *)	PASSED
2.02	1	Op. 1 / lying	19.745 (PK) *)	PASSED

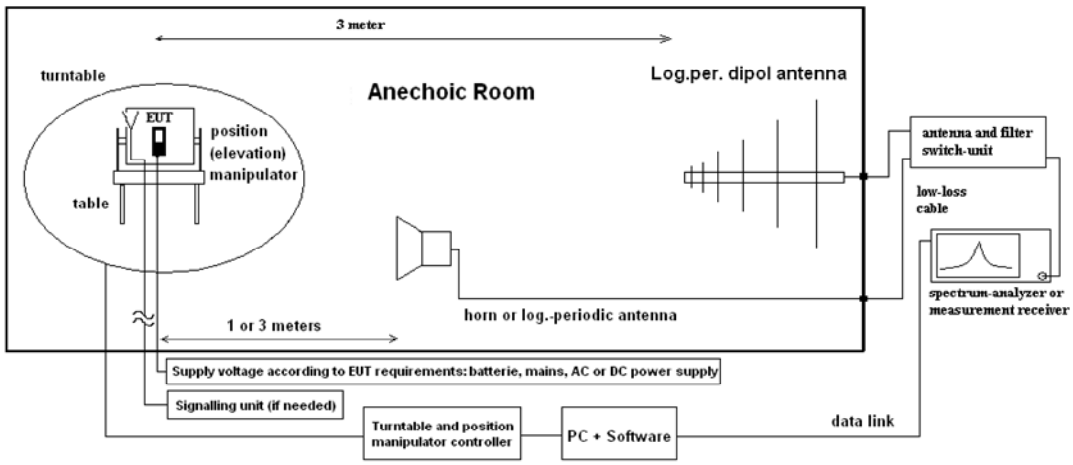
Remark: for more information and graphical plot see annex A1 **CETECOM_TR21-1-0132201T09a_A1**
Remark *): noise level

4.2 Radiated field strength emissions 30 MHz – 1 GHz

4.2.1 Description of the general test setup and methodology, see below example:

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-1-4:2010 compliant semi anechoic room (SAR) and fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc. either on 10m OATS or 3m semi-anechoic room.
First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.
On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
E_C = Electrical field – corrected value
E_R = Receiver reading
G_A = Gain of pre-amplifier (if used)
L_T = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

4.2.2 Measurement Location

Test site	120901 - SAC - Radiated Emission <1GHz

4.2.3 Limit

Fundamental radiated emissions limits (3 meters)				
Frequency Range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector	RBW / VBW [kHz]
30 – 70	Not allowed 2)	Not allowed 2)	Average / CISPR quasi-peak	100 / 300
40.66 - 40.70 1)	2,250	67.04	Average / CISPR quasi-peak	100 / 300
70 – 130	1250	61.93	Average / CISPR quasi-peak	100 / 300
130 – 174	1,250 – 3,750	61.93 – 71.48	Average / CISPR quasi-peak	100 / 300
174 – 260	3750	71.48	Average / CISPR quasi-peak	100 / 300
260 – 470	3,750 – 12,500	71.48 – 81.93	Average / CISPR quasi-peak	100 / 300
Above 470	12,500	81.93	Average / CISPR quasi-peak	100 / 300

Spurious radiated emissions limits (3 meters)				
Frequency Range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector	RBW / VBW [kHz]
30 – 70	100	40.0	Average / CISPR quasi-peak	100 / 300
40.66 - 40.70 1)	225	47.04	Average / CISPR quasi-peak	100 / 300
70 – 130	125	41.93	Average / CISPR quasi-peak	100 / 300
130 – 174	125 – 375	41.93 – 51.48	Average / CISPR quasi-peak	100 / 300
174 – 260	375	51.48	Average / CISPR quasi-peak	100 / 300
260 – 470	375 – 1250	51.48 – 61.93	Average / CISPR quasi-peak	100 / 300
Above 470	1250	61.93	Average / CISPR quasi-peak	100 / 300

Remark 1): only USA

Remark 2): no operation, except frequency band mentioned in Remark 1, allowed

4.2.4 Result

Fundamental emissions

Diagram	Channel	Mode	Maximum Level (PK) [dBµV/m]	Maximum Level (AV / QP) [dBµV/m] *)	Result
3.01	1	Op. 1 / standing	96.29	79.94	PASSED

Remark: for more information and graphical plot see annex A1 **CETECOM_TR21-1-0132201T09a_A1**

Spurious emissions

Diagram	Channel	Mode	Maximum Level (PK) [dBµV/m]	Result
3.02	1	Op. 1 / standing	21.061	PASSED
3.03	1	Op. 1 / lying	21.351	PASSED

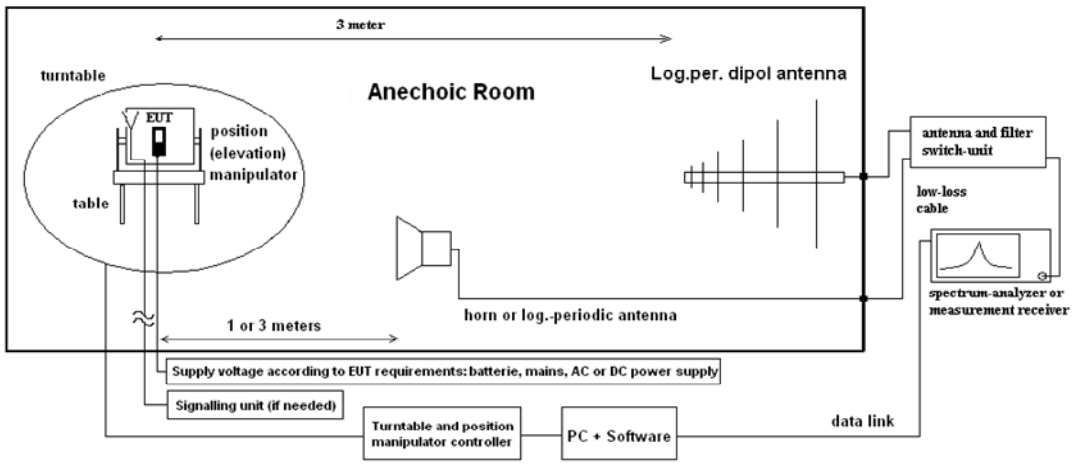
Remark: for more information and graphical plot see annex A1 **CETECOM_TR21-1-0132201T09a_A1**

4.3 Radiated field strength emissions above 1 GHz

4.3.1 Description of the general test setup and methodology, see below example:

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 18-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions or three axis scan for portable/small equipment.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$E_C = E_R + A_F + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

E_C = Electrical field – corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
A_F = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
G_A = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

4.3.2 Measurement Location

Test site 1 – 10 GHz	120904 - FAC1 - Radiated Emissions

4.3.3 Limit

Radiated emissions limits (3 meters)				
Frequency Range [MHz]	**Limit [µV/m]**	**Limit [dBµV/m]**	**Detector**	**RBW / VBW [kHz]**
Above 1000	1,250	61.93	Average	1000 / 3000
Above 1000	12,500	81.93	Peak	1000 / 3000

4.3.4 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 1 – 10 GHz	Result
4.01	1	Op. 1	52.17 (AV)	PASSED

Remark: for more information and graphical plot see annex A1 **CETECOM_TR21-1-0132201T09a_A1**

4.4 Transmitter timing

4.4.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector. The direct RF-path is connected to the spectrum – analyzer for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

EUT settings
The EUT is set to normal operating mode.

4.4.2 Measurement Location

Test site	120910 - Radio Laboratory 2

4.4.3 Limit

(1) A manually operated transmitter shall automatically cease transmission within not more than 5 seconds.
(2) A automatically activated transmitter shall cease transmission within 5 seconds after activation.
(3) Periodic transmissions at regular predetermined intervals are not permitted. Polling, supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed as long the total transmission time does not exceed **2s/hour**.
(4) During emergencies involving fire, security, and safety of life, may operate during the pendency of the alarm condition.
(5) Transmission of set-up information for security systems may exceed the transmission duration limits, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically

4.4.4 Result

Activation of transmitter	Applicable Limit	Result
☐ manual activated transmitter ☒ automatic activated transmitter	☐ (1) ☒ (2) ☐ (3) ☐ (4) ☐ (5)	PASSED

Remark: for more information and graphical plot see annex A1 **CETECOM_TR21-1-0132201T09a_A1**

4.5 Emission Bandwidth 20 dB

4.5.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector. The direct RF-path is connected to the spectrum – analyzer for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

EUT settings
EUT is set to modulated continuous transmission mode.

4.5.2 Measurement Location

Test site	120910 - Radio Laboratory 2

4.5.3 Limit

Frequency [MHz]	Limit	Detector [MaxHold]	RBW [kHz]	VBW [kHz]
70 < f_c < 900	0.25% of f_c	MaxPeak	1% to 5% of OBW	3x RBW
> 900	0.5% of f_c	MaxPeak		

Remark: RBW shall be between 1% and 5% of f_c

4.5.4 Result

Diagram	Channel	Mode	Frequency [MHz]	20 dB bandwidth [kHz]	Result
D004_01	1	Op. 2	922.52	105.77	PASSED

Remark: for more information and graphical plot see annex A1**CETECOM_TR21-1-0132201T09a_A1**

4.6 Occupied Channel Bandwidth 99%

4.6.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector. The direct RF-path is connected to the spectrum – analyzer for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

EUT settings
EUT is set to modulated continuous transmission mode.

4.6.2 Measurement Location

Test site	120910 - Radio Laboratory 2

4.6.3 Limit

Frequency	Detector [MaxHold]	RBW [kHz]	VBW [kHz]
70 MHz < f_c < 900 MHz	MaxPeak	1% to 5% of OBW	3x RBW
> 900 MHz	MaxPeak		

4.6.4 Result

Diagram	Channel	Mode	Frequency [MHz]	99% OBW [kHz]	Result
D004_01	1	Op. 2	922.54	92.95	PASSED

Remark: for more information and graphical plot see annex A1**CETECOM_TR21-1-0132201T09a_A1**

4.7 Equipment lists

ID	Description	Manufacturer	SerNo	CheckType	Last Check	Interval	Next Check
	120901 - SAC - Radiated Emission <1GHz			calchk	cal: 07-21-2015 chk: 05-19-2020	cal: 10Y chk: 12M	cal: July 2025 chk: May 2021
20574	Biconilog Hybrid Antenna BTA-L	Frankonia GmbH	980026L	cal	cal: 05-03-2019	cal: 36M	cal: May 2022
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	81650455	cal	cal: 05-25-2020	cal: 24M	cal: May 2022
20620	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH	100362	cal	cal: 05-21-2021	cal: 12M	cal: May 2022
20482	filter matrix Filter matrix SAR 1	CETECOM GmbH	-	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
25038	Loop Antenna HFH2-Z2	Rohde & Schwarz Messgerätebau GmbH	879824/13	cal	cal: 04-07-2020	cal: 24M	cal: April 2022
20885	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20442	Semi Anechoic Chamber	ETS-Lindgren Gmbh / Taufkirchen	-	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
	120904 - FAC1 - Radiated Emissions			chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20489	EMI Test Receiver ESU40	Rohde & Schwarz Messgerätebau GmbH	100030	cal	cal: 05-19-2021	cal: 12M	cal: May 2022
20558	Fully Anechoic Chamber 1	ETS-Lindgren Gmbh / Taufkirchen	-	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20254	High Pass Filter 5HC 2600/12750-1.5KK	Trilithic	23042	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20868	High Pass Filter AFH-07000	AtlanTecRF	16071300004	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20291	High Pass Filter WHJ 2200-4EE	Wainwright Instruments GmbH	14	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20020	Horn Antenna 3115 (Subst 1)	EMCO Elektronik GmbH	9107-3699	calchk	cal: 08-17-2021 chk: 04-20-2013	cal: 36M chk: 12M	cal: August 2024
20302	Horn Antenna BBHA9170 (Meas 1)	Schwarzbeck Mess-Elektronik OHG	155	calchk	cal: 04-15-2020 chk: 04-15-2020	cal: 36M chk: 12M	
20549	Log. Per. Antenna HL025	Rohde & Schwarz Messgerätebau GmbH	1000060	calchk	cal: 08-18-2021	cal: 36M chk: 12M	cal: August 2024
20720	Measurement Software EMC32 [FAC]	Rohde & Schwarz Messgerätebau GmbH	V10.xx	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20512	Notch Filter WRCA 800/960-02/40-6EEK (GSM 850)	Wainwright Instruments GmbH	24	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20290	Notch Filter WRCA 901,9/903,1SS	Wainwright Instruments GmbH	3RR	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20122	Notch Filter WRCB 1747/1748	Wainwright Instruments GmbH	12	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20121	Notch Filter WRCB 1879,5/1880,5EE	Wainwright Instruments GmbH	15	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20448	Notch Filter WRCT 1850.0/2170.0-5/40-10SSK	Wainwright Instruments GmbH	5	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20066	Notch Filter WRCT 1900/2200-5/40-10EEK	Wainwright Instruments GmbH	5	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20449	Notch Filter WRCT 824.0/894.0-5/40-8SSK	Wainwright Instruments GmbH	1	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20611	Power Supply E3632A	Agilent Technologies Deutschland GmbH	KR 75305854	cpu			
20338	Pre-Amplifier 100MHz - 26GHz JS4-00102600-38-5P	Miteq Inc.	838697	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20484	Pre-Amplifier 2,5GHz - 18GHz AMF-5D-02501800-25-10P	Miteq Inc.	1244554	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20287	Pre-Amplifier 25MHz - 4GHz AMF-2D-100M4G-35-10P	Miteq Inc.	379418	chk	chk: 06-11-2021	chk: 12M	chk: June 2022
20670	Radio Communication Tester CMU200	Rohde & Schwarz Messgerätebau GmbH	106833	cal	cal: 06-16-2020	cal: 24M	cal: June 2022
20439	Ultrabroadband-Antenna HL562	Rohde & Schwarz Messgerätebau GmbH	100248	calchk	cal: 03-10-2017	cal: 72M chk: 12M	cal: March 2023
	120911 - Radio Laboratory 2			cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20869	Climatic Chamber VT4002	Vötsch Industrietechnik GmbH, a schunk company / Balingen-Frommern	521/79152	chk	chk: 12-29-2021	chk: 12M	chk: December 2022
20468	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	90090455	cal	cal: 06-01-2021	cal: 36M	cal: June 2024
20431	Near-Field Probe Set Model 7405	EMCO Elektronik GmbH	9305-2457	cpu			
20457	Power Supply EA-3013 S	EA Elektro-Automatik GmbH & Co. KG	9624680	cpu			
20690	Spectrum Analyzer FSU	Rohde & Schwarz Messgerätebau GmbH	100302/026	cal	cal: 05-20-2021	cal: 24M	cal: May 2023

Tools used in 'P2M1'

4.7.1 Legend

Note / remarks	Interval of calibration & Verification
12M	12 months
24M	24 months
36M	36 months
10Y	10 Years

Abbreviation Check Type	Description
cnn	Calibration and verification not necessary
cal	Calibration

calchk	Calibration plus intermediate Verification
chk	Verification
cpu	Verification before usage

5 Results from external laboratory

None	-

6 Opinions and interpretations

None	-

7 List of abbreviations

None	-

8 Measurement Uncertainty valid for conducted/radiated measurements

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved. For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it contribution to the overall uncertainty according its statistical distribution calculated.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%						Remarks
Conducted emissions (U_{CISPR})	-	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB						-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB						Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--	
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--	-
		12.75 GHz - 26.5 GHz	N/A	0.82	--	N/A	N/A	--	
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable
		2.8 GHz - 12.75 GHz	1.48	N/A	1.51	N/A	1.43	--	
		12.75 GHz – 18 GHz	1.81	N/A	1.83	N/A	1.77	--	
		18 GHz - 26.5 GHz	1.83	N/A	1.85	N/A	1.79	--	
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			1.0 dB						Power
Emission bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
	-		See above: 0.70 dB						Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm						-
Radiated emissions Enclosure	-	150 kHz - 30 MHz	5.01 dB						Magnetic field strength
		30 MHz - 1 GHz 1 GHz - 18 GHz 18 GHz - 26.5 GHz	5.83 dB 4.91 dB 5.06 dB						Electrical Field strength

9 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2022-Mar-09
--	--	--
--	--	--

End Of Test Report