PARTIAL Test Report
20-1-0159101T02a-C01

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

Number of pages:	29	**Date of Report:**	2021-Jun-30
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:**	MobilityCloud Inc
Product: **Model:**	Bikeshare System Controller QR Controller		
FCC ID:	2AY2H010321QR1	**IC:**	27012-010321QR1
Testing has been carried out in accordance with:	Title 47 CFR, Chapter I FCC Regulations, Subchapter B Part 22, Part 24, Part 27 RSS-132, Issue 3; RSS-133, Issue 6; RSS-130, Issue 2; RSS-139, Issue 3 Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Tested Technology:	GSM + BTLE + NFC UMTS + BTLE + NFC LTE + BTLE + NFC		
Test Results:	**☒ The EUT complies with the requirements in respect of selected parameters subject to the test.** The test results relate only to devices specified in this document		

The current version of the Test Report CETECOM_TR20-1-0159101T02a-C1 replaces the test report CETECOM_TR20-1-0159101T02a dated 2021-Jun-11. The replaced test report is herewith invalid.

Signatures:

Ninovic Perez
2021.07.05
15:11:09 +
02'00'

Digitally signed by: Al-Amin
DN: CN = Al-Amin email = Al-Amin.Hossain@cetecom.com C = AD
Date: 2021.07.05 13:14:46 +02'00'

Dipl.-Ing. Ninovic Perez	B.Sc. Al-Amin Hossain
Test Lab Manager	Test manager
Authorization of test report	Responsible of test report

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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.
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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 Disclaimer and Notes

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.

This test report check for emissions generated by the device if operated on the intended typical way. The usual testcase is simulated by switching-on all wireless modular transmitters (allready approved) and checking for different LTE band combinations of the cellular part together with the transmitter Bluetooth® LE Part.

For the emissions generated by the host and the composite system, the less stringent limits requirements, as presented below, are valid. (Cellular limits Part 22/24/27/90 less stringent than Part 15.247 limits valid for the un-licensed transmitter part)

1.3 Summary of Test Results

Test case in GSM850 band	Reference Clause FCC ☒	Reference Clause ISED ☒	Page	Remark	Result
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen Issue 5:§8.8	--	*1)	--
Conducted RF output power	§2.1046(a)	RSS-132: 5.4 + SRSP 503 :5.1.3	--	*1)	--
Radiated RF output power	§22.913(a)	4.4	--	*1)	--
Occupied Channel Bandwidth 99%	§22.917(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	*1)	--
26dB Emission bandwidth	§22.917(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	*1)	--
Radiated Band Edge	§2.1053(a), §2.1057(a)(1) §22.917(a)(b)	RSS-132, Issue 3: 5.5(i)(ii)	--	*1)	--
Conducted RF Band Edge	§22.917(a)(b)(c)(d) §2.1051, §2.1057(a)(1)	RSS-132, Issue 3: 5.5(i)(ii)	--	*1)	--
Peak to Average ratio (PAPR)	§2.1046(a)	RSS-132: 5.4 + SRSP 503 :5.1.3	--	*1)	--
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5:	23	--	Passed
Spurious emissions at antenna terminals	§22.917(a)(b)(c)(d) §2.1051, §2.1057(a)(1)	RSS-132, Issue 3: 5.5(i)(ii)	--	*1	--
Radiated spurious emissions	§2.1053(a), §2.1057(a)(1) §22.917(a)(b)	RSS-132, Issue 3: 5.5(i)(ii)	26	--	Passed
Frequency stability, temperature variation	§22.355, §2.1055(a)(1)(d)	RSS-Gen, Issue 5 RSS-132: 5.3	--	*1)	--
Frequency stability, voltage variation	§22.355, §2.1055(a)(1)(d)	RSS-Gen, Issue 5 RSS-132: 5.3	--	*1)	--
Test case in GSM1900 band	**Reference Clause FCC**	**Reference Clause ISED**	**Page**	**Remark**	**Result**
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen Issue 5:§8.8	--	*1)	--
Conducted RF output power	§2.1046(a)	RSS-133 4.1/6.4 + SRSP-510 :5.1.2	--	*1)	--
Radiated RF output power	§24.232(b)	6.4	--	*1)	--
Occupied Channel Bandwidth 99%	§24.238(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	*1)	--
26dB Emission bandwidth	§24.238(b), §2.202(a), §2.1049(h)	RSS-Gen, Issue 4: §6.7	--	*1)	--
Radiated Band Edge	§2.1053(a), §2.1057(a)(1) §24.238(a)(b)	RSS-133, Issue 6: 6.5.1(i)(ii)	--	*1)	--
Conducted RF Band Edge	§24.238(a)(b)(c)(d) §2.1051, §2.1057(a)(1)	RSS-133, Issue 6: 6.5.1(i)(ii)	--	*1)	--
Peak to Average ratio (PAPR)	§2.1046(a)	RSS-133 4.1/6.4 + SRSP-510 :5.1.2	--	*1)	--
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5:	23	--	Passed

Spurious emissions at antenna terminals	§24.238(a)(b)(c)(d) §2.1051, §2.1057(a)(1)	RSS-133, Issue 6: 6.5.1(i)(ii)	--	*1)	--
Radiated spurious emissions	§2.1053(a), §2.1057(a)(1) §24.238(a)(b)	RSS-133, Issue 6: 6.5.1(i)(ii)	26	--	Passed
Frequency stability, temperature variation	§24.235, §2.1055(a)(1)(d)	RSS-Gen, Issue 5 RSS-133: 6.3	--	*1)	--
Frequency stability, voltage variation	§24.235, §2.1055(a)(1)(d)	RSS-Gen, Issue 5 RSS-133: 6.3	--	*1)	--

We refer to test reports of modules certification for this testcases

PASSED	The EUT complies with the essential requirements in the standard.
FAILED	The EUT does not comply with the essential requirements in the standard.
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) please see "HR/2019/10016E-0101", Test Report GSM850 & GSM1900, Appendix B – GSM850&1900
submit date 2019-Jul- 06

Test case in W-CDMA2	Reference Clause FCC ☒	Reference Clause ISED ☒	Page	Remark	Result
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen, Issue 5:§8.8	--	*2)	--
Conducted RF output power	§2.1046(a)	RSS-133:4.1/6.4 + SRSP-510:5.1.2	--	*2)	--
Radiated RF output power	§24.232(c), §2.1046(a)	RSS-133:6.4 + SRSP-510:5.1.2	--	*2)	--
Occupied Channel Bandwidth 99%	§24.238(b), §2.1049(h)	RSS-Gen, Issue 5:§6.6	--	*2)	--
26dB Emission bandwidth	§24.238(b), §2.1049(h)	RSS-Gen, Issue 5:§6.6	--	*2)	--
Radiated Band Edge	§24.238(a)(b), §2.1053(a), §2.1057(a)	RSS-133, Issue 6: §6.5.1(i)(ii)	--	*2)	--
Conducted RF Band Edge	§24.238(a)(b), §2.1051	RSS-133, Issue 6: §6.5.1(i)(ii)	--	*2)	--
Peak to Average ratio (PAPR)	§2.1046(a)	RSS-133:4.1/6.4 + SRSP-510:5.1.2	--	*2)	--
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5: §8.9 Table 6	23	--	Passed
Spurious emissions at antenna terminals	§24.238(a)(b), §2.1051	RSS-133, Issue 6: §6.5.1(i)(ii)	--	*2)	--
Radiated spurious emissions	§24.238(a)(b), §2.1053(a)	RSS-133, Issue 6: §6.5.1(i)(ii)	26	--	Passed
Frequency stability, temperature variation	§24.235, §2.1055(a)(1)	RSS-133: 6.3	--	*2)	--
Frequency stability, voltage variation	§15.207(a)	RSS-Gen, Issue 5:§8.8	--	*2)	--
Test case in W-CDMA4	**Reference Clause FCC**	**Reference Clause ISED**	**Page**	**Remark**	**Result**
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen, Issue 5:§8.8	--	*2)	--
Conducted RF output power	§27.50(d)(4), §2.1046	RSS-139, Issue 3:§6.5	--	*2)	--
Radiated RF output power	§27.50(d)(4), §2.1046(a)	RSS-139, Issue 3: 6.5 + SRSP-513	--	*2)	--
Occupied Channel Bandwidth 99%	§27.53(h)(3), §2.202(a)	RSS-Gen, Issue 5:§6.6	--	*2)	--
26dB Emission bandwidth	§27.53(h)(3), §2.202(a)	RSS-Gen, Issue 5:§6.6	--	*2)	--
Radiated Band Edge	§27.53(h), §2.1053(a) §2.1057(a)	RSS-139, Issue 3: 6.6 (i)(ii)	--	*2)	--
Conducted RF Band Edge	§27.53(h), §2.1051	RSS-139, Issue 3: §6.6 (i)(ii)	--	*2)	--
Peak to Average ratio (PAPR)	§27.50(d)(4), §2.1046	RSS-139, Issue 3:§6.5	--	*2)	--
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5: §8.9 Table 6	23	--	Passed
Spurious emissions at antenna terminals	§27.53(h), §2.1051	RSS-139, Issue 3: §6.6 (i)(ii)	--	*2)	--
Radiated spurious emissions	§27.53(h), §2.1053(a)	RSS-139, Issue 3: §6.6 (i)(ii)	26		Passed
Frequency stability, temperature variation	§27.54, §2.1055(a)(1)	RSS-139, Issue 3:§6.4	--	*2)	--
Frequency stability, voltage variation	§15.207(a)	RSS-Gen, Issue 5:§8.8	--	*2)	--
Test case in W-CDMA5	**Reference Clause FCC**	**Reference Clause ISED**	**Page**	**Remark**	**Result**
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen, Issue 5:§8.8	--	*2)	--
Conducted RF output power	§22.913(a)(5), §2.1046	RSS-132:5.4 + SRSP 503:5.1.3	--	*2)	--

Radiated RF output power	§22.913, §2.1046(a)	RSS-132: 5.4 + SRSP 503:5.1.3	--	*2)	--
Occupied Channel Bandwidth 99%	§22.917(b), §2.1049(h)	RSS-Gen, Issue 5:§6.6	--	*2)	--
26dB Emission bandwidth	§22.917(b), §2.1049(h)	RSS-Gen, Issue 5:§6.6	--	*2)	--
Radiated Band Edge	§22.917(a)(b), §2.1053(a), §2.1057(a)	RSS-132, Issue 3: §5.5(i)(ii)	--	*2)	--
Conducted RF Band Edge	§22.917(a)(b), §2.1051	RSS-132, Issue 3: §5.5(i)(ii)	--	*2)	--
Peak to Average ratio (PAPR)	§22.913(a)(5), §2.1046	RSS-132:5.4 + SRSP 503:5.1.3	--	*2)	--
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5: §8.9 Table 6	23	--	Passed
Spurious emissions at antenna terminals	§22.917(a)(b), §2.1051	RSS-132, Issue 3: §5.5(i)(ii)	--	*2)	--
Radiated spurious emissions	§22.917(a)(b), §2.1053(a)	RSS-132, Issue 3: §5.5(i)(ii)	26	--	Passed
Frequency stability, temperature variation	§22.355, §2.1055(a)(1)	RSS-132: 5.3	--	*2)	--
Frequency stability, voltage variation	§22.355, §2.1055(a)(1)	RSS-132: 5.3	--	*2)	--

We refer to test reports of modules certification for this testcases

PASSED	The EUT complies with the essential requirements in the standard.
FAILED	The EUT does not comply with the essential requirements in the standard.
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.

*2) please see “HR/2019/10016E-0101”, Test Report WCDMA Band II & IV & V, Appendix B – WCDMA BAND II & IV & V submit date 2019-Jul-06

Test case in LTE12 band	Reference Clause FCC ☒	Reference Clause ISED ☒	Page	Remark	Result
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen, Issue 5:§8.8	--	*3)	--
Conducted RF output power	§27.50(c)(10), §2.1046	RSS-130, Issue 2: §4.6.1/ §4.6.3	--	*3)	--
Radiated RF output power	§27.50(c)(10), §2.1046(a)	RSS-130, Issue 2: §4.6.1/ §4.6.3	--	*3)	--
26dB Emission bandwidth	§2.202(a)	RSS-Gen, Issue 5:§6.7	--	*3)	--
Occupied Channel Bandwidth 99%	§2.202(a)	RSS-130, Issue 1:§4.5 RSS-Gen, Issue 5:§6.7	--	*3)	--
Radiated Band Edge	§27.53(g), §2.1053(a) §2.1057(a)	RSS-130, Issue 1:§4.7.1	--	*3)	--
Conducted RF Band Edge	§27.53(g), §2.1053(a) §2.1057(a)	RSS-130, Issue 1:§4.7.1	--	*3)	--
Peak to Average ratio (PAPR)	§27.50(c)(10), §2.1046	RSS-130, Issue 2: §4.6.1	--	*3)	--
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5: §8.9 Table 6	23	--	Passed
Spurious emissions at antenna terminals	§27.53(g), §2.1051, §2.1057(a)	RSS-130, Issue 2:§4.7.1	--	*3)	--
Radiated spurious emissions	§27.53(g), §2.1053(a) §2.1057(1)	RSS-130, Issue 2:§4.7.1	26	--	Passed
Frequency stability, temperature variation	§27.54 §2.1055(a)(1)	RSS-130, Issue 2:§4.5	--	*3)	--
Frequency stability, voltage variation	§27.54 §2.1055(a)(1)	RSS-130, Issue 2:§4.5	--	*3)	--
Test case in LTE13 band	**Reference Clause FCC**	**Reference Clause ISED**	**Page**	**Remark**	**Result**
AC-Power Lines Conducted Emissions	§15.207(a)	RSS-Gen, Issue 5:§8.8	--	*4)	--
Conducted RF output power	§27.50(b)(10)(11), §2.1046(a)	RSS-130, Issue 2, §4.6.3	--	*4)	--
Radiated RF output power	§27.50(b)(10)(11) §2.1046(a)	RSS-130, Issue 2, §4.6.3	--	*4)	--
26dB Emission bandwidth	§2.202(a)	RSS-Gen, Issue 5:§6.7	--	*4)	--
Occupied Channel Bandwidth 99%	§27.53(h)(3), §2.202(a)	RSS-Gen, Issue 5:§6.6	--	*4)	--
Radiated Band Edge	§27.53(c), §2.1053(a)(b)	RSS-130, Issue 2:§4.7.1	--	*4)	--
Conducted RF Band Edge	§27.53(c), §2.1051, §2.1057(a)	RSS-130, Issue 2, §4.7.1	--	*4)	--
Peak to Average ratio (PAPR)	§2.1046	RSS-130, Issue 2, §4.6.1	--	*4)	--
Radiated field strength emissions below 30 MHz	§15.205, §15.209	RSS-Gen: Issue 5: §8.9 Table 6	23	--	Passed

Spurious emissions at antenna terminals	§2.1051 §2.1057(a)	RSS-130, Issue 2, §4.7.1 §4.7.2(a)	--	*4)	--
Radiated spurious emissions	§27.53(c)(2)(3)(4) §27.53(f) §27.1053(a)(b) §2.1057(a)(1)	RSS-130, Issue 2, §4.7.1 §4.7.2(a)(b)	26	--	Passed
Frequency stability, temperature variation	§27.54, §2.1055(a)(1)	RSS-130, §4.5	--	*4)	--
Frequency stability, voltage variation	§27.54, §2.1055(a)(1)	RSS-130, §4.5	--	*4)	--

We refer to test reports of modules certification for this testcases

PASSED	The EUT complies with the essential requirements in the standard.
FAILED	The EUT does not comply with the essential requirements in the standard.
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.

*3) “HR/2019/10016E-0101”, Test Report LTE Band 12, Appendix B – E-UTRA Band 12 submit date 2019-Jul-06

*4) “HR/2019/10016E-0101”, Test Report LTE Band 13, Appendix B – E-UTRA Band 13 submit date 2019-Jul-06

1.4 Summary of Test Methods

Test case	Test method
AC-Power Lines Conducted Emissions	ANSI C63.4-2014 § 7, ANSI C63.10-2013 § 6.2
Conducted RF output power	ANSI C63.26:2015, §5.2, KDB 971168 D01 v03r01
Radiated RF output power	ANSI C63.26:2015, §5.2.7, KDB 971168 D01 v03r01
Occupied Channel Bandwidth 99%	ANSI C63.26:2015, §5.4.4, KDB 971168 D01 v03r01
26dB Emission bandwidth	ANSI C63.26:2015, §5.4.3, KDB 971168 D01 v03r01
Modulation characteristics	ANSI C63.26:2015, §5.3
Radiated Band Edge	ANSI C63.26:2015, §5.5, KDB 971168 D01 v03r01
Conducted RF Band Edge	ANSI C63.26:2015, §5.7, KDB 971168 D01 v03r01
Peak to Average ratio (PAPR)	ANSI C63.26:2015, §5.2.6
Result calculated with measured conducted RF-power value and stated/measured antenna gain for band of interest	
Radiated field strength emissions below 30 MHz	ANSI C63.4-2014 §5.3, §8.2.1, §8.3.1.1+§8.3.2.1
Spurious emissions at antenna terminals	ANSI C63.26:2015, §5.7, KDB 971168 D01 v03r01
Radiated spurious emissions	ANSI C63.26:2015, §5.5, KDB 971168 D01 v03r01, ANSI C63.26.1:2018

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
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:	B.Sc. Al-Amin Hossain
Receipt of EUT:	2020-Dec-02
Date(s) of test:	2021-Feb-03 – 2021-May-05
Version of template:	14.7

2.5 Applicant's details

Applicant's name:	MobilityCloud Inc
Address:	244 Madison Avenue 10016 New York City New York US
Contact Person:	Marcin Pyla
Contact Person's Email:	marcin@mobility.cloud

2.6 Manufacturer's details

Manufacturer's name:	Same as Applicant's details.
Address:	Same as Applicant's details.

2.7 EUT: Type, S/N etc. and short descriptions used in this test report

Short description*)	PMT Sample No.	Product	Model	Type	S/N	HW status	SW status
EUT 01	20-1-01591S11_C01	Bikeshare System Controller	QR Controller	QR1	SC3-5D05-FA95-DC9B-24D0-R1	1	1.2.3

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

2.8 Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

Short description*)	PMT Sample No.	Auxiliary Equipment	Type	S/N	HW status	SW status
AE 01	20-1-01591S15_C01	Battery Pack	Lithium-ion Battery Pack	Part#SC2-BAT-15A64V2	--	--
AE 02	--	Laptop	CTC522013	--	--	--

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

2.9 Connected cables

Short description*)	PMT Sample No.	Cable type	Connectors	Length
	--	--	--	--

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

2.10 Software

Short description*)	Software	SW status
SW 01	J-Link RTT Viewer	6.84a

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

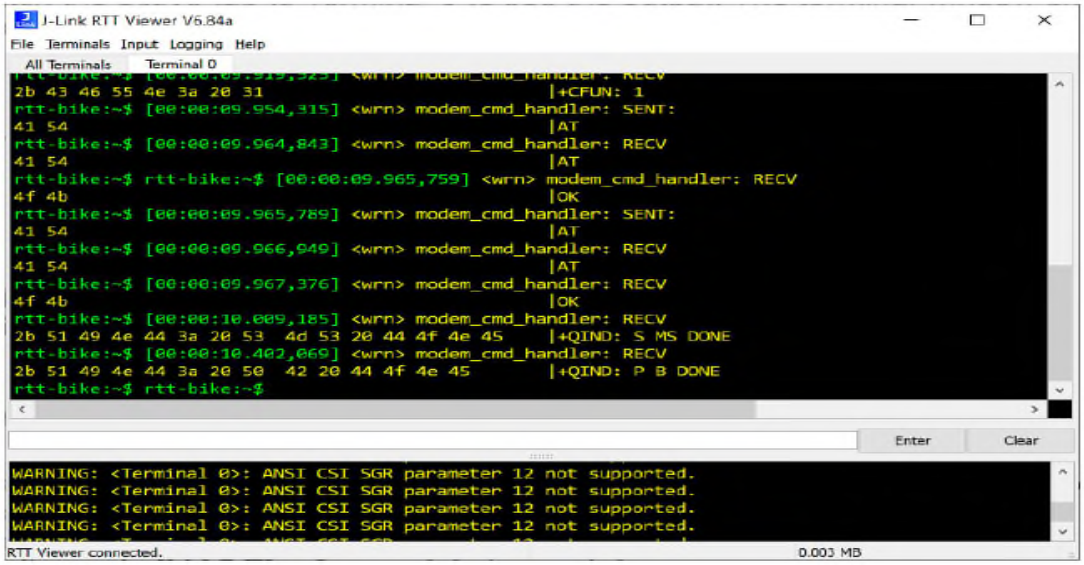
2.11 EUT set-ups

set-up no.*)	Combination of EUT and AE	Description
1	EUT 01 + AE 01	➢ Used for Radiated measurements. ➢ AE 02 has been used before start the measurments to activate the operation mode. ➢ AE 02 has not been used during measurements.

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

Software has been used for Cellular, BT, NFC

Via test software **J-Link RTT Viewer** installed on AE 02 the right mode was set up with help of special commands:



LTE modem: Quectel EG21-G

Modem AT command interface

Quectel EG21-G modem should be enabled after each board under test boot-up. AT command interface is exposed over the RTT console. To send AT command to modem command below should be executed:

```
rtt-bike:~$ modem send 0 AT
```

Modem should respond with the same command (if local echo is enabled) and OK:

```
[00:02:30.299,346] <wrn> modem_cmd_handler: RECV
41 54                                |AT
[00:02:30.300,781] <wrn> modem_cmd_handler: RECV
4f 4b                                |OK
```

To disable local echo command below needs to be executed:

```
rtt-bike:~$ modem send 0 ATE0
```

EG21-G modem AT command documentation:

- Quectel_EC25&EC21_AT_Commands_Manual_V1.3.pdf

Full EG21-G documentation is available on Quectel pages or here:

- LINK

Modem GPIO power control commands

Modem restart GPIO sequence:

- `rtt-bike:~$ bike_gpio modem_rst`

Modem power on GPIO sequence:

- `rtt-bike:~$ bike_gpio modem_pwr on`

Modem power off GPIO sequence:

- `rtt-bike:~$ bike_gpio modem_pwr off`

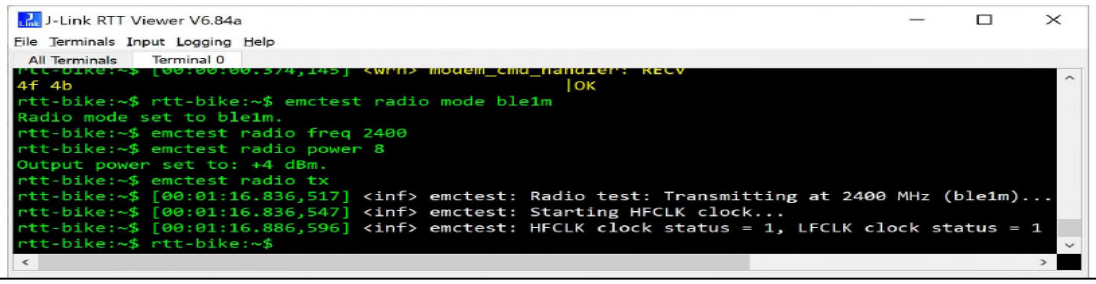
RFID

emctest rfid enable – Enable RFID tag scanning
emctest rfid disable – Disable RFID scanning
emctest rfid random - Start continuous PRBS transmission.
Note: To exit this mode and stop the transmission, the device **must be power-cycled.** Software reset will not stop the transmission.

2.4GHz radio

emctest radio tx – Enable continuous data transmission using currently set parameters
emctest radio rx – Enable data reception test
emctest radio off – Disable radio test
emctest radio mode [MODE] – Set modulation and data rate parameters.
Available modes:
ble1m – Bluetooth Low Energy, 1mbit/s **(default)**
ble2m - Bluetooth Low Energy, 2mbit/s
nrf250k – Nordic proprietary, 250kbit/s
nrf1m - Nordic proprietary, 1mbit/s
nrf2m - Nordic proprietary, 2mbit/s

emctest radio freq [FREQUENCY IN MHZ] – Set the carrier frequency in MHz. 2360 – 2500. Default: 2402.
emctest radio power [POWER OPTION] – Set the radio output power.
Available options:
0 - -40dBm
1 - -20dBm
2 - -16dBm
3 - -12dBm
4 - -8dBm
5 - -4dBm
6 - +0dBm
7 - +3dBm
8 - +4dBm **(default)**



Remarks:

- For more information please see the document "**QR Controller Certification Manual**"

2.12 **EUT operation modes**

EUT operating mode no.*)	Operating modes	Additional information
Operating mode 1	GSM850 Traffic + BT-LE + NFC	GSM 850 Traffic ➢ Uplink Channel 190, Uplink frequency:836.60 MHz Bluetooth-LE ➢ Channel:0, Operating frequency 2402 MHz NFC ➢ Operating frequency 13.56 MHz Worst case has been taken from Cellular and Bluetooth module Test Report, for more information please see remark 2.
Operating mode 2	GSM1900 Traffic + BT-LE + NFC	GSM 1900 Traffic ➢ Uplink Channel 512, Uplink frequency:1850.20 MHz Bluetooth-LE ➢ Channel:0, Operating frequency 2402 MHz NFC ➢ Operating frequency 13.56 MHz Worst case has been taken from Cellular and Bluetooth module Test Report, for more information please see remark 2.
Operating mode 3	UMTS II Traffic + BT-LE + NFC	UMTS II Traffic ➢ Uplink Channel 9262, Uplink frequency:1852.40 MHz Bluetooth-LE ➢ Channel:0, operating frequency 2402 MHz NFC ➢ Operating frequency 13.56 MHz Worst case has been taken from Cellular and Bluetooth module Test Report, for more information please see remark 2.
Operating mode 4	UMTS IV Traffic + BT-LE + NFC	UMTS IV Traffic ➢ Uplink Channel 1312, Uplink frequency:1712.40 MHz Bluetooth-LE ➢ Channel:0, Operating frequency 2402 MHz NFC ➢ Operating frequency 13.56 MHz Worst case has been taken from Cellular and Bluetooth module Test Report, for more information please see remark 2.
Operating mode 5	UMTS V Traffic + BT-LE + NFC	UMTS V Traffic ➢ Uplink Channel 4132, Uplink frequency:826.40 MHz Bluetooth-LE ➢ Channel:0, Operating frequency 2402 MHz NFC ➢ Operating frequency 13.56 MHz Worst case has been taken from Cellular and Bluetooth module Test Report, for more information please see remark 2.

Operating mode 6	LTE Band 12 Traffic + BT-LE + NFC	LTE Band 12 Traffic Uplink Channel 23060, Uplink frequency:704 MHz, RB:1, Start RB:24, BW:10 MHz, Modulation:QPSK Bluetooth-LE ➢ Channel:0, operating frequency 2402 MHz NFC ➢ Operating frequency 13.56 MHz Worst case has been taken from Cellular and Bluetooth module Test Report, for more information please see remark 2.
Operating mode 7	LTE Band 13 Traffic + BT-LE + NFC	LTE Band 13 Traffic Uplink Channel 23230, Uplink frequency:782 MHz, RB:1, Start RB:24, BW:5 MHz, Modulation:QPSK Bluetooth-LE ➢ Channel:0, operating frequency 2402 MHz NFC ➢ Operating frequency 13.56 MHz Worst case has been taken from Cellular and Bluetooth module Test Report, for more information please see remark 2.

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

Remarks:

1) representative operating channels/operating modes are selected for each transmitting cellular band, additionally NFC and Bluetooth-Low Energy wireless connection in order to simulate the real usage case of the device.

2) Worst case in terms of output power has been taken from module test report
"HR/2019/10016E-0101" Test Report LTE Band 12, Appendix B – E-UTRA Band 12 submit date 2019-Jul-06 and
"HR/2019/10016E-0101" Test Report LTE Band 13, Appendix B – E-UTRA Band 13 submit date 2019-Jul-06 and
"HR/2019/10016E-0101" Test Report GSM850 & GSM1900, Appendix B – GSM850&1900 submit date 2019-Jul-06
"HR/2019/10016E-0101" Test Report WCDMA Band II & IV & V, Appendix B – WCDMA BAND II & IV & V submit date 2019-Jul-06
Bluetooth module test report "CETECOM_20-1-0159101T01a" dated 2021-May-12.
NFC Module Test Report "RC-32-PTE-15-105625-2-A(1)" dated 2016-Jul-08

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Product name	**Bikeshare System Controller**		
Kind of product	**QR Controller**		
Firmware	☐ for normal use	☒ Special version for test execution	
Contains certified modules:	Cellular GSM, UMTS, LTE module	FCC ID XMR201906EG21G	
	Bluetooth Low Energy module	FCC ID: 2AY2H010321QR1 IC ID: 27012-010321QR1	
	NFC module	FCC ID XMR201906EG21G	
Power Supply	☐ AC Mains	--	
	☐ DC Mains	--	
	☒ Battery(3.7 V DC)	Lithium Ion battery	
Operational conditions	T_{nom} =21 °C	T_{min} =n/a	T_{max} =n/a
EUT sample type	**Pre-Production**		
Weight	0.5 kg		
Size [LxWxH]	25 cm x 15 cm x 7 cm		
Interfaces/Ports	-		
For further details refer Applicants Declaration & following technical documents			
Description of Reference Document (supplied by applicant)	**Version**	**Total Pages**	
QR Controller Certification Manual	**23-11-2020**	**6**	

3.2 Detailed Technical data of Main EUT as Declared by Applicant

3.2.1 GSM technical information

TX Frequency range	☒ GSM850	824 - 849 MHz (Uplink), 869-894 MHz (Downlink)
	☒ GSM1900	1850 - 1910 MHz (Uplink), 1930-1990 MHz (Downlink)
Number of channels	☒ GSM850	TCH range 128 - 251
	☒ GSM1900	TCH range 512 - 810
Type of modulation	GMSK	
Data rates	Downlink Max 296 kbps	Uplink Max 236 kbps
Emission designator	Nominal CBW	See initial certification of the module:
	See initial certification of modules	
Antenna Type	☒ Integrated	
	☐ External, no RF- connector	
	☐ External, separate RF-connector	
Antenna gain(s)	GSM850: **0.77** dBi	
	GSM1900: **2.92** dBi	
FCC label attached	No	
Test firmware / software and storage location	EUT	

3.2.2 UMTS technical information

TX Frequency range	☒ UMTS-FDD band 2	1850 - 1910 MHz (Uplink), 1930 - 1990 MHz (Downlink)	
	☒ UMTS-FDD band 4	1710 - 1755 MHz (Uplink), 2110 - 2155 MHz (Downlink)	
	☒ UMTS-FDD band 5	824 - 849 MHz (Uplink), 869 -894 MHz (Downlink)	
Number of channels	☒ UMTS-FDD band 2	UARFCN range 9262 - 9538	
	☒ UMTS-FDD band 4	UARFCN range 1312 - 1513	
	☒ UMTS-FDD band 5	UARFCN range 4132 - 4233	
Type of modulation	OFDM, QPSK		
Emission designator	Nominal CBW	See initial certification of the module:	
	See initial certification of modules		
Antenna Type	☒ Integrated		
	☐ External, no RF- connector		
	☐ External, separate RF-connector		
Antenna gain(s)	UMTS-FDD band 2 **2.92** dBi		
	UMTS-FDD band 4: **3.05** dBi		
	UMTS-FDD band 5: **0.77** dBi		
FCC label attached	No		
Test firmware / software and storage location	EUT		
TX Frequency range [MHz] and Number of channels	☐ LTE 2	1850 - 1910 (UL), 1930 - 1990 (DL)	UARFCN range 18600 - 19199
	☐ LTE 4	1710 - 1755 (UL), 2110 - 2155 (DL)	UARFCN range 19950 - 20399
	☐ LTE 5	824 - 849 (UL), 869 -894 (DL)	UARFCN range 20400 - 20649
	☐ LTE 7	2505 - 2565 (UL), 2625 - 2685 (DL)	UARFCN range 20775 - 21350
	☒ LTE 12	699 - 716 (UL), 2625 - 2685 (DL	UARFCN range 23010 - 23179
	☒ LTE 13	782 - 782 (UL), 751 - 751 (DL	UARFCN range 23205 - 23230
	☐ LTE 17	704 - 716 (UL), 734 - 746 (DL	UARFCN range 23755 - 23800

	☐ LTE 26	814 – 848.9 (UL), 859 – 893.9 (DL)	UARFCN range 26690 - 27039
	☐ LTE 28	708 - 743 (UL), 763 - 798 (DL)	UARFCN range 27225 - 27645
	☐ LTE 41	2501 - 2685 (UL), 2501 - 2685 (DL)	UARFCN range 39675 - 41490
Type of modulation	QPSK/16-QAM (Digital)		
Data rates-0.21	Downlink Max 8 Mbps	Uplink Max 9 Mbps	
Emission designator	Nominal CBW	See initial certification of the module:	
	See initial certification of modules		
Antenna Type	☒ Integrated ☐ External, no RF- connector ☐ External, separate RF-connector		
Antenna gain(s)	LTE band 2 XX dBi	LTE band 12: **-0.21** dBi	
	LTE band 4: XX dBi	LTE band 13: **-0.21** dBi	
	LTE band 5: XX dBi	LTE band 17: XX dBi	
	LTE band 7: XX dBi	LTE band 26: XX dBi	
	LTE band 41: XX dBi	LTE band 28: XX dBi	
FCC label attached	No		
Test firmware / software and storage location	EUT		

3.3 Worst case identification

Mode	Worst case identification
GSM 850	Uplink Channel 190, Uplink frequency:836.60 MHz
GSM 1900	Uplink Channel 512, Uplink frequency:1850.20 MHz
UMTS 2	Uplink Channel 9262, Uplink frequency:1852.40 MHz
UMTS 4	Uplink Channel 1312, Uplink frequency:1712.40 MHz
UMTS 5	Uplink Channel 4132, Uplink frequency:826.40 MHz
LTE Band 12	Uplink Channel 23060, Uplink frequency:704 MHz, RB:1, Start RB:24, BW:10 MHz, Modulation:QPSK
LTE Band 13	Uplink Channel 23230, Uplink frequency:782 MHz, RB:1, Start RB:24, BW:5 MHz, Modulation:QPSK
BT LE	Channel:0, Operating frequency 2402 MHz
NFC	Operating frequency 13.56 MHz

Remarks:

- Worst case in terms of output power has been taken from module test report
  "HR/2019/10016E-0101" Test Report LTE Band 12, Appendix B – E-UTRA Band 12 submit date 2019-Jul-06 and
  "HR/2019/10016E-0101" Test Report LTE Band 13, Appendix B – E-UTRA Band 13 submit date 2019-Jul-06 and
  "HR/2019/10016E-0101" Test Report GSM850 & GSM1900, Appendix B – GSM850&1900 submit date 2019-Jul-06
  "HR/2019/10016E-0101" Test Report WCDMA Band II & IV & V, Appendix B – WCDMA BAND II & IV & V submit date 2019-Jul-06
  Bluetooth module test report "CETECOM_20-1-0159101T01a" dated 2021-May-12.
  NFC Module Test Report "RC-32-PTE-15-105625-2-A(1)" dated 2016-Jul-08

Details about modules previous operating modes can be found on previous mentioned full modules test report

3.4 Modifications on Test sample

Additions/deviations or exclusions	--

4 Measurements

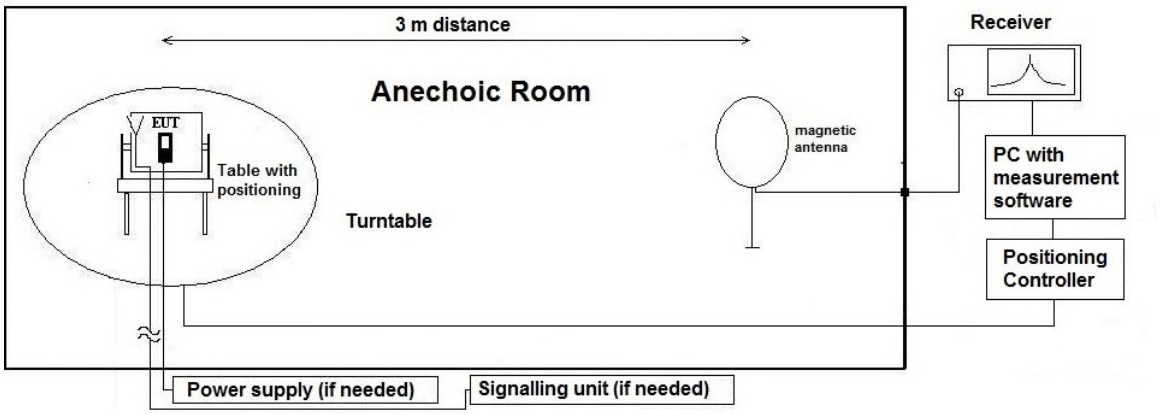
4.1 Radiated field strength emissions below 30 MHz

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 it's 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 main-taining 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.

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)	2'te Condition (Limit distance bigger dnear-field)	Distance Correction accord. Formula
kHz	9.00E+03	33333.33	5305.17	300		fullfilled	not fullfilled	-80.00
	1.00E+04	30000.00	4774.65			fullfilled	not fullfilled	-80.00
	2.00E+04	15000.00	2387.33			fullfilled	not fullfilled	-80.00
	3.00E+04	10000.00	1591.55			fullfilled	not fullfilled	-80.00
	4.00E+04	7500.00	1193.66			fullfilled	not fullfilled	-80.00
	5.00E+04	6000.00	954.93			fullfilled	not fullfilled	-80.00
	6.00E+04	5000.00	795.78			fullfilled	not fullfilled	-80.00
	7.00E+04	4285.71	682.09			fullfilled	not fullfilled	-80.00
	8.00E+04	3750.00	596.83			fullfilled	not fullfilled	-80.00
	9.00E+04	3333.33	530.52			fullfilled	not fullfilled	-80.00
	1.00E+05	3000.00	477.47			fullfilled	not fullfilled	-80.00
	1.25E+05	2400.00	381.97			fullfilled	not fullfilled	-80.00
	2.00E+05	1500.00	238.73			fullfilled	fullfilled	-78.02
	3.00E+05	1000.00	159.16			fullfilled	fullfilled	-74.49
	4.00E+05	750.00	119.37			fullfilled	fullfilled	-72.00
	4.90E+05	612.24	97.44			fullfilled	fullfilled	-70.23
	5.00E+05	600.00	95.49	30		fullfilled	not fullfilled	-40.00
	6.00E+05	500.00	79.58			fullfilled	not fullfilled	-40.00
	7.00E+05	428.57	68.21			fullfilled	not fullfilled	-40.00
	8.00E+05	375.00	59.68			fullfilled	not fullfilled	-40.00
	9.00E+05	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

4.1.2 Measurement Location

Test site	SAC

4.1.3 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

4.1.4 Result

Diagram	Band	Mode	Maximum Level [dBµV/m] Frequency Range 0.009 – 30 MHz	Result
2.01	GSM 850	1	No critical frequency found	Passed
2.02	GSM 850	1	No critical frequency found	Passed
2.03	UMTS Band II	3	No critical frequency found	Passed
2.04	LTE Band 13	7	No critical frequency found	Passed

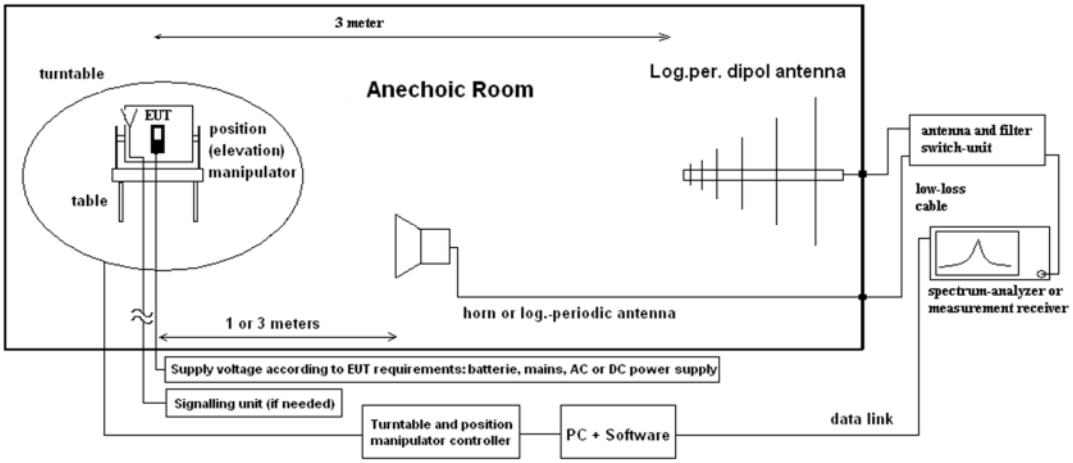
Remark: for more information and graphical plot see annex A1 **CETECOM_TR20-1-0159101T02a-A1**

4.2 Radiated spurious emissions

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 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 1.50 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 45°) and the EUT itself on 3-orthogonal axis (the emission spectrum and it's 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 main-taining 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.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.
The readings on the spectrum analyzer are corrected with conversion value between field strength and E(I)RP, so the readings shown are equivalent to ERP/EIRP values. Critical measurements near the limit are re-measured with a substitution method accord. ANSI/TIA/EIA 603 C/D

Formula:

$P_{EIRP} = P_{MEAS} + C_L + FSL - G_{PreA} – G_{ANT}$ (1)

P_{MEAS} = measured power at instrument
M = Margin
L_T = Limit

FSL = Free Space loss = Function(frequency, measurement distance)

$M = L_T - P_{EIRP}$

C_L= cable loss
G_{PreA} = Gain of pre-amplifier (if used)
G_{ANT} = Gain of antenna in [dBi]

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

4.2.2 Measurement Location

Test site	FAC1

4.2.3 Limit

Operation band	Frequency Range [MHz]	Limit [dBm]	Detector [MaxHold]	RBW / VBW [MHz]
GSM 850	30 - 8500	-13	Peak	1 / 3
GSM 1900	30 - 19100	-13	Peak	1 / 3
UMTS II	30 - 8500	-13	Peak	1 / 3
UMTS IV	30 - 17500	-13	Peak	1 / 3
UMTS V	30 - 19100	-13	Peak	1 / 3
LTE12	30 - 7200	-13	Peak	3 / 3
LTE13	30 - 8000 763-775 and 793-805 1559 – 1610 1559 – 1610	-13 -35 (RBW = 6.25 kHz, ERP) -40 (RBW = 1 MHz) -50 (RBW = 700 Hz)	Peak	3 / 3

4.2.4 Result

Diagram	Band	Mode	30 to 1000 MHz	1 to 2.8 GHz	2.8 to 10th Harmonics	Stop Freq [GHz]	Result
8.01a	GSM 850	1	No critical frequency found	No critical frequency found	No critical frequency found	9	Passed
8.01b	GSM 850	1	No critical frequency found	No critical frequency found	No critical frequency found	18	Passed
8.02	GSM 850	1	No critical frequency found	No critical frequency found	No critical frequency found	26	Passed
8.03	GSM 1900	2	No critical frequency found	No critical frequency found	No critical frequency found	18	Passed
8.04	GSM 1900	2	No critical frequency found	No critical frequency found	No critical frequency found	26	Passed
8.05	UMTS II	3	No critical frequency found	No critical frequency found	No critical frequency found	18	Passed
8.06	UMTS II	3	No critical frequency found	No critical frequency found	No critical frequency found	26	Passed
8.07	UMTS IV	4	No critical frequency found	No critical frequency found	No critical frequency found	18	Passed
8.08	UMTS IV	4	No critical frequency found	No critical frequency found	No critical frequency found	26	Passed
8.09a	UMTS V	5	No critical frequency found	No critical frequency found	No critical frequency found	9	Passed
8.09b	UMTS V	5	No critical frequency found	No critical frequency found	No critical frequency found	18	Passed
8.10	UMTS V	5	No critical frequency found	No critical frequency found	No critical frequency found	26	Passed
8.13a	LTE 12	6	No critical frequency found	**18.26 dB margin to Limit**	No critical frequency found	9	Passed
8.13b	LTE 12	6	No critical frequency found	No critical frequency found	No critical frequency found	18	Passed
8.14	LTE 12	6	No critical frequency found	No critical frequency found	No critical frequency found	26	Passed
8.15a	LTE 13	7	No critical frequency found	**18.55 dB margin to Limit**	No critical frequency found	9	Passed
8.15b	LTE 13	7	No critical frequency found	No critical frequency found	No critical frequency found	18	Passed
8.16	LTE 13	7	No critical frequency found	No critical frequency found	No critical frequency found	26	Passed
8.15c	LTE 13	7	No critical frequency found	N/A	N/A	**763M to 806MHz**	Passed
8.15d	LTE 13	7	N/A	No critical frequency found	N/A	**1559M to 1610 MHz**	Passed

Remark: for more information and graphical plot see annex A1 **CETECOM_TR20-1-0159101T02a-A1**

4.3 Results from external laboratory

None	-

4.4 Opinions and interpretations

None	-

4.5 List of abbreviations

None	-

5 Equipment lists

ID	Description	Manufacturer	SerNo	Cal due date
120904 - FAC1 - Radiated Emissions				
20720	EMC32 [FAC]	Rohde & Schwarz Messgerätebau GmbH	V10.50.00	
20254	High Pass Filter 5HC 2600/12750-1.5KK (GSM1800/1900/DECT)	Trilithic	23042	20.03.2022
20868	High Pass Filter AFH-07000	AtlanTecRF	16071300004	20.03.2022
20291	High Pass Filter WHJ 2200-4EE (GSM 850/900)	Wainwright Instruments GmbH	14	20.03.2022
20020	Horn Antenna 3115 (Subst 1)	EMCO Elektronik GmbH	9107-3699	19.07.2021
20549	Log.Per-Antenna HL025	Rohde & Schwarz Messgerätebau GmbH	1000060	31.07.2021
20302	Horn Antenna BBHA9170 (Meas 1)	Schwarzbeck Mess-Elektronik OHG	155	15.04.2023
20700	PC ctc662012 [FAC]	Dell Inc.		
20338	Pre-Amplifier 100MHz - 26GHz JS4-00102600-38-5P	Miteq Inc.	838697	20.03.2022
20484	Pre-Amplifier 2,5GHz - 18GHz AMF-5D-02501800-25-10P	Miteq Inc.	1244554	20.03.2022
20287	Pre-Amplifier 25MHz - 4GHz AMF-2D-100M4G-35-10P	Miteq Inc.	379418	20.03.2022
20690	Spectrum Analyzer FSU	Rohde & Schwarz Messgerätebau GmbH	100302/026	23.05.2021
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	81650455	25.05.2022
20885	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	--
20670	Radio Communication Tester CMU200	Rohde & Schwarz Messgerätebau GmbH	106833	16.06.2022
20793	Wideband Radio Communication Tester CMW500	Rohde & Schwarz Messgerätebau GmbH	163673	22.05.2021
20732	Signal- and Spectrum Analyzer FSW67	Rohde & Schwarz Messgerätebau GmbH	104023	27.05.2021
120901 - SAC - Radiated Emission <30MHz				
20620	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH	100362	13.05.2021
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH	81650455	25.05.2022
25038	Loop Antenna HFH2-Z2	Rohde & Schwarz Messgerätebau GmbH	879824/13	07.04.2022

6 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	5.01dB						Magnetic field strength
		30 MHz - 1 GHz 1 GHz - 18 GHz 18-26.5 GHz	5.83 dB 4.91 dB 5.06 dB						Electrical Field strength

7 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2021-Jun-11
C01	Updated remarks at chapter 1.3 Summary of Test Results Updated remarks at chapter 2.12 EUT operating modes Updated table at chapter 3.1 General Data of Main EUT… . Updated table and remarks at chapter 3.3 Worst case identification	2021-Jun-30

End Of Test Report