

Test Report

Report Number:

F221817E4

Equipment under Test (EUT):

CTP3NA

Applicant:

Robert Bosch GmbH

Manufacturer:

Robert Bosch GmbH



Deutsche
Akkreditierungsstelle
D-PL-17186-01-00

References

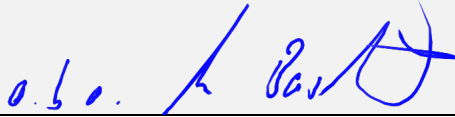
- [1] **ANSI C63.26-2015** American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
- [2] **CFR 47 Part 2** Frequency allocations and radio treaty matters; General rules and regulations
- [3] **CFR 47 Part 22** Public mobile services, Subpart H – Cellular Radiotelephone service
- [4] **CFR 47 Part 24** Public mobile services, Subpart E – Broadband PCS
- [5] **CFR 47 Part 27** Miscellaneous wireless communications services
- [6] **RSS-132 Issue 3** Cellular Telephone Systems Operating in the Bands 824 - 849 MHz and 869 - 894 MHz
- [7] **RSS-133 Issue 6** 2 GHz Personal Communication Services
- [8] **RSS-199 Issue 4** Broadband Radio Service (BRS) Equipment Operating in the Band 2500-2690 MHz

Test Result

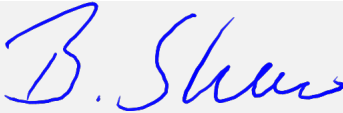
The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test. The complete test results are presented in the following.

“Passed” indicates that the equipment under test conforms with the relevant limits of the testing standard without taking any measurement uncertainty into account as stated in clause 10.2.8.2 of ANSI C63.4 (2014). However, the measurement is calculated and shown in this test report.

Tested and written
by:


Manuel BASTERT
05.03.2024
Signature

Reviewed and
approved by:


Bernd STEINER
05.03.2024
Signature

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Contents:	Page
1 Identification	5
1.1 Applicant.....	5
1.2 Manufacturer	5
1.3 Factory.....	5
1.4 Test Laboratory	5
1.5 EUT (Equipment under Test)	6
1.6 Technical Data of Equipment	7
1.7 Dates	10
2 Operational States	10
3 Additional Information	11
4 Overview.....	12
5 Results.....	12
5.1 Test setups	12
5.2 Radiated emissions results	15
5.2.1 Radiated emissions Results (PCS1900)	15
5.2.2 Radiated emissions (UE) in traffic mode (LTE band 5).....	19
5.2.3 Radiated emissions (UE) in traffic mode (LTE band 7).....	21
6 Measurement Uncertainties	25
7 Test Equipment used for Tests	26
8 Test site Verification.....	27
9 Report History.....	27
10 List of Annexes	27

1 Identification

1.1 Applicant

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Country:	Germany
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Phone:	+49 5121-49-7662
eMail address:	karin.silberhorn@de.bosch.com
Applicant represented during the test by the following person:	-

1.2 Manufacturer

Name:	Robert Bosch GmbH
Address:	Robert-Bosch-Str. 200, 31139 Hildesheim
Country:	Germany
Name for contact purposes:	Karin Silberhorn
Phone:	+49 5121-49-7662
eMail address:	karin.silberhorn@de.bosch.com

1.3 Factory

Name:	Bosch Car Multimedia Portugal, S.A.
Address:	Rua Max Grundig, 35-Lomar, 4705-820 Braga
Country:	Portugal
Name for contact purposes:	-
Phone:	-
eMail address:	-
Manufacturer represented during the test by the following person:	-

1.4 Test Laboratory

The tests were carried out by: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

Accredited by Deutsche Akkreditierungsstelle GmbH (DAkKS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-05 and D-PL-17186-01-06, FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.5 EUT (Equipment under Test)

EUT	
Test object: *	Telematic Control Unit
Model name: *	CTP3NA
Model number: *	CTP3NA Ext
Order number: *	-
FCC ID: *	2AUXS-CTP3NA
IC certification number: *	25847-CTP3NA
PMN: *	CTP3NA
HVIN: *	CTP3NA
FVIN: *	NA

	EUT number		
	1	2	3
Serial number: *	1150003409	-	-
PCB identifier: *	8157-01	-	-
Hardware version: *	C2	-	-
Software version: *	DAIMLER_CTP3_HIGHPOINT_RC2_S.006	-	-

* Declared by the applicant

1 EUT was used for the tests.

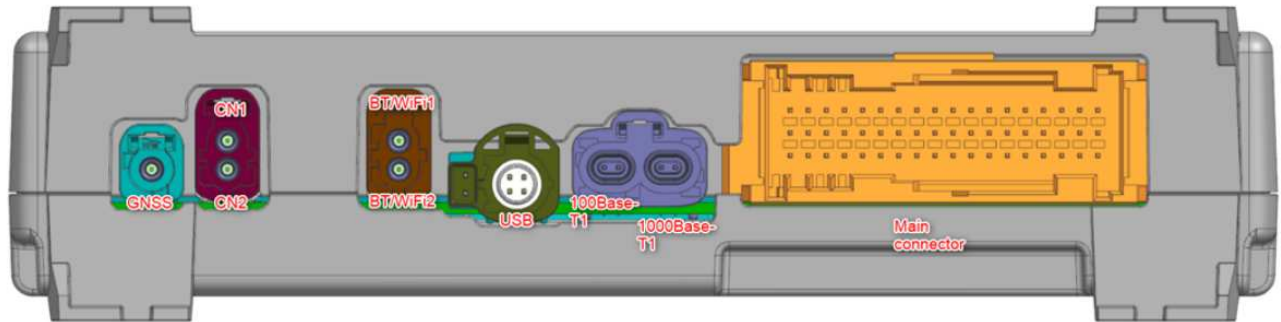
Note: PHOENIX TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.6 Technical Data of Equipment

General EUT data			
Power supply EUT: *	DC		
Supply voltage EUT: *	$U_{Nom} = 12 V_{DC} + 24 V_{DC}$	$U_{Min} = 8.0 V_{DC}$	$U_{Max} = 32.0 V_{DC}$
Temperature range: *	-40°C to +85°C		
Lowest / highest internal radio frequency: *	LTE Band 12: 738MHz / WiFi 5GHz: 5825 MHz		
Lowest / highest internal clock frequency: *	32.768 kHz (Real time clock oscillator) / 125 MHz		

* Declared by the applicant

Cellular module						
Manufacturer:	WNC					
Model name: *	MT2731C					
Power supply module: *	DC via DC/DC converter					
Supply voltage module: *	U _{nom} =	4.0 V DC	U _{min} =	3.8 V DC	U _{max} =	4.2 V DC
Serial Number: *	NA					
IMEI:*	359955910006180					
Hardware version: *	NA					
Firmware version: *	NA					
Supported bands: *	GSM/GPRS/EDGE: 850/1900 MHz					
	LTE FDD: Band 2, 4, 5, 7, 12, 14, 17, 25, 26, 66 (**)					
Max. output power: *	GSM/GPRS/EDGE: Class 4 (33 dBm) @ 850 MHz					
	LTE FDD: Class 1 (30 dBm) @ 1900 MHz Class 3 (23 dBm)					
Antenna type: *	external antenna					
Antenna connector: *	Fakra HFM double male coding D					
Antenna gain: *	Rooftop antenna (A 006 820 39 75): 698 - 960 MHz: 3.4 dBi 1447 - 1511 MHz: 4.0 dBi 1710 - 2690 MHz: 5.0 dBi 3300 - 4200 MHz: 6.1 dBi 4400 - 5000 MHz: 5.7 dBi RX diversity antenna (A 006 820 31 75): 617 - 960 MHz: 2.9 dBi 1447.9 - 1510.9 MHz: 3.8 dBi 1710 - 2690 MHz: 6.5 dBi 3300 - 4200 MHz: 7.0 dBi					



Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Main Connector	54 Pin Connector	Customized	Appr. 3 m	No
GNSS	Fakra HFM single coding C	Fakra (Antenna)	Not connected	Yes
CN1 / CN2	Fakra HFM double coding D	2 x Fakra (Antenna)	~ 2 m	Yes
BT/WiFi1 / BT/WiFi2	Fakra HFM double coding F	2 x Fakra (Antenna)	Not connected	Yes
USB	HSD+2 coding C	USB	Not connected	Yes
100 base T1 / 1000 Base T1	H-MTD	Customized	Not connected	Yes

Equipment used for testing	
-	-
-	-
-	-

*1 Provided by the applicant

*2 Provided by the laboratory

Ancillary equipment	
-	
-	
-	

*1 Provided by the applicant

1.7 Dates

Date of receipt of test sample:	01.05.2023
Start of test:	02.05.2023
End of test:	02.06.2023

2 Operational States

Description of function of the EUT:

The EUT is a telematic Unit to provide fleet management services & remote diagnostics, allows for remote measurement and also serves as AP-Server for Internet via WiFi. CTP3 is intended to support Daimler's new E-Architecture in different countries. It is provided in Non-DIN Variant, with the optional delivery of a DIN-Interface, when necessary, to allow for driver identification via Smart Card.
The device is planned to be introduced in Vehicles of Daimler Trucks AG.

The following states were defined as the operating conditions:

PCS1900 GPRS data connection

- Downlink channel 661 (1960.0 MHz),
- Uplink channel 661 (1880.0 MHz),
- BS-Power -70 dBm; Mobile-Power 30 dBm; Packet switched, GPRS.

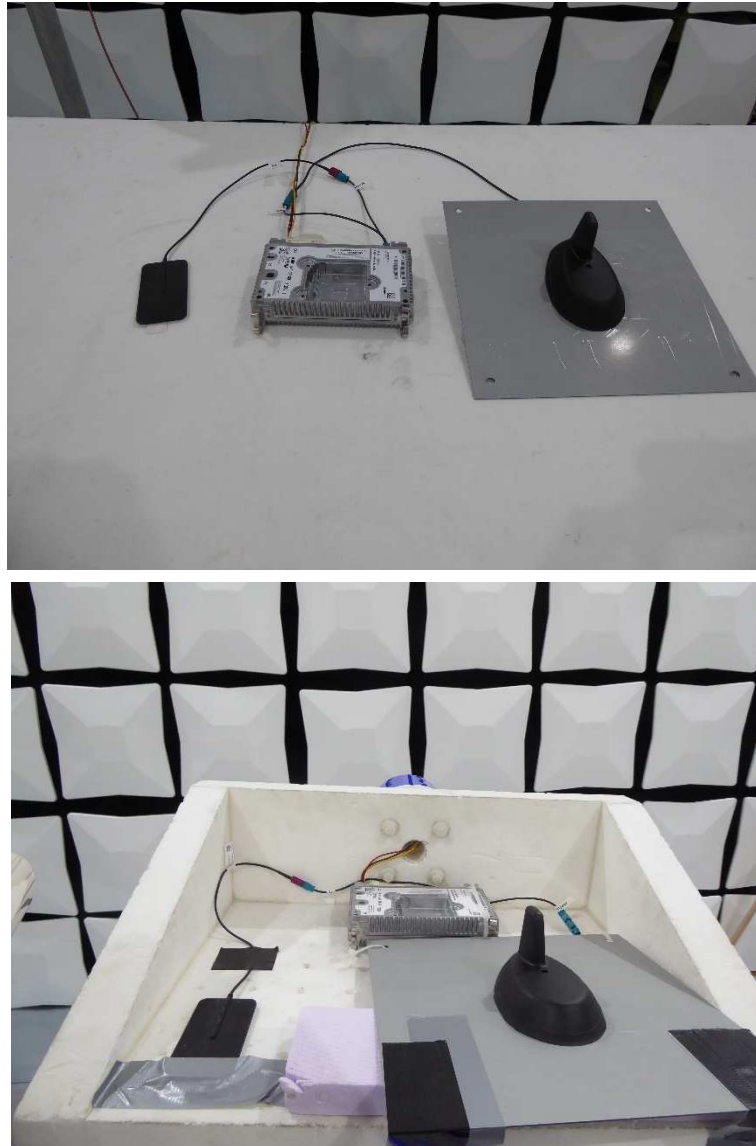
LTE band 5

- Downlink channel UARFCN 2525 (881.5 MHz),
- Uplink channel UARFCN 20525 (836.5 MHz),
- BS-Power -82.8 dBm; Mobile-Power 23 dBm; Mode PRBS9.

LTE band 7

- Downlink channel UARFCN 3100 (2655.0 MHz),
- Uplink channel UARFCN 21100 (2535.0 MHz),
- BS-Power -82.8 dBm; Mobile-Power 23 dBm; Mode PRBS9.

The system was setup as follows:



EUT Setup

A GSM /LTE connection to the EUT was established by using a Wideband Communication Tester (CMW500). The EUT was connected wireless to the tester via a narrowband antenna.

3 Additional Information

The applicant integrates in its device the already certified RF cellular module UMC-MT2731 (FCC ID: NKRUMC-MT2731CBN / IC: 4441A-MT2731CBN).

The test report includes only worst-case test results for radiated emissions as ordered by the applicant. During the tests, the module was not appropriately labelled with the correct FCC and IC IDs.

4 Overview

Application	Frequency range [MHz]	FCC 47 CFR Parts 24 [4], 27 [5] ISED RSSs 132 [6], 133 [7], 199 [8]	Status	Refer page
Radiated spurious emissions	30 – 26,500	22.917 (a) (b) 24.238 (a) (b) 27.53 RSS132 §5.5 RSS133 §6.5 RSS 199 §5.6	Passed	15 et seq.

5 Results

5.1 Test setups

The EUT is measured in the frequency range from 30 MHz to 26.5 GHz in a semi anechoic chamber with a metal ground plane, which has been validated to the requirements of ANSI C63.4. It is placed on a 3D-positioner to allow different positions at a distance of 3 meters from the receiving antenna. Both polarizations (vertical and horizontal) have been evaluated and the turn table has been turned to 360° to maximize the emissions. The receiving antenna is raised from 1 to 4 m.

The frequency range from 30 MHz to 18 GHz has been tested using the substitution method as described in [1], and the frequency range from 18 to 26.5 GHz has been tested using the field strength method [1]. The measured field strength using the field strength method is then converted to an ERP or EIRP [dBm] using the formula:

$E \text{ [dB}\mu\text{V/m]} = \text{EIRP [dBm]} - 20\log(d) + 104.8$ according to chapter 5.2.7 [1].

→ $\text{EIRP} = E - 95.25$ ($d = 3 \text{ m}$ measuring distance)

$\text{ERP [dBm]} = \text{EIRP} - 2.15 \text{ dB}$

Level (dBm) $\triangleq$ ERP (below 1GHz) or EIRP (above 1 GHz)

Procedure preliminary measurement:

The following procedure is used:

1. Set the measurement antenna to 1 m height.
2. Monitor the frequency range at vertical polarisation and a EUT azimuth of 0 °.
3. Rotate the EUT by 360° to maximize the detected signals.
4. Repeat 1) to 2) with the horizontal polarisation of the measuring antenna.
5. Increase the height of the antenna for 0.5 m and repeat steps 2 – 4 until the final height of 4 m is reached.

6. The highest values for each frequency will be saved by the software, including the antenna height, measurement antenna polarization and turntable azimuth for that value.

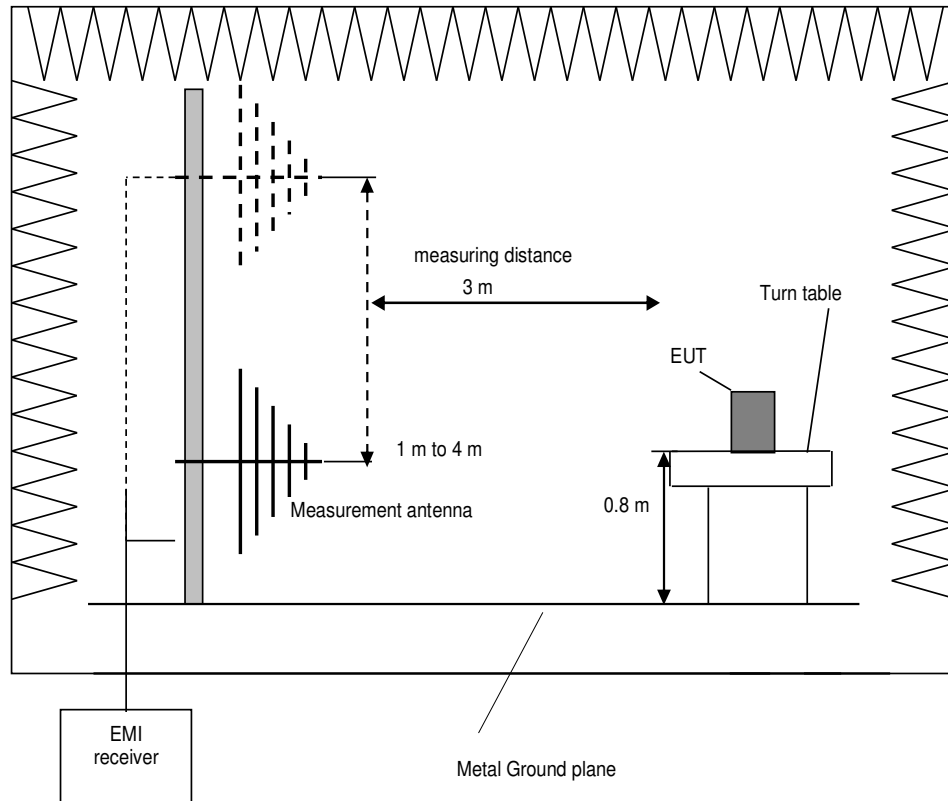
Procedure final measurement:

The following procedure is used:

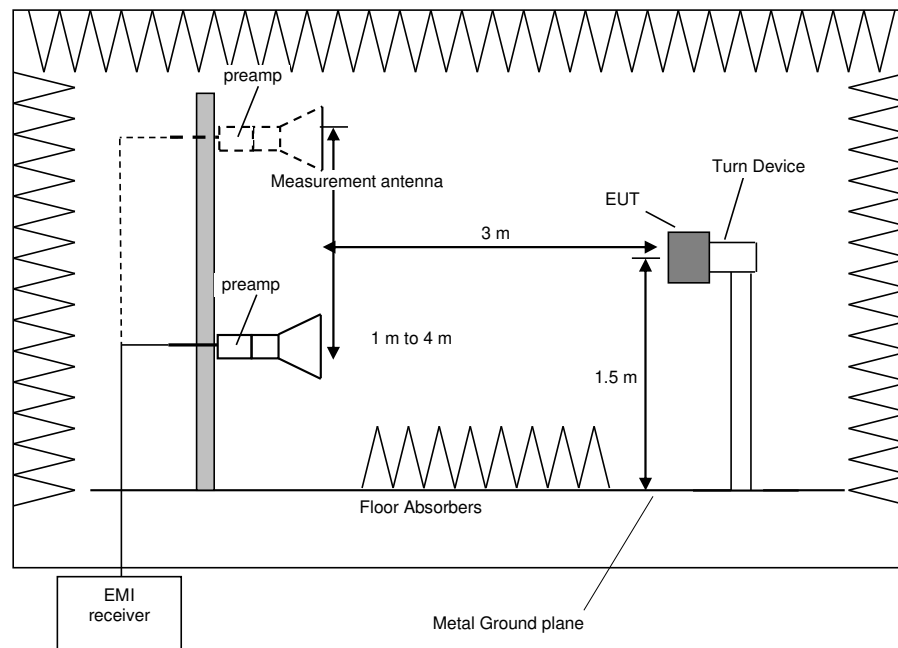
1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst case EUT position (x,y,z) for the final test.
4. The worst measurement antenna height is found by the measurement software by varying the measurement antenna height by +/- 0.5 m from the value obtained in the preliminary measurement, and to monitor the emission level.
5. The worst azimuth turntable position is found by varying the turntable azimuth by +/- 25° from the value obtained in the preliminary measurement, and to monitor the emission level.
6. The final measurement is performed at the worst-case antenna height and the worst-case turntable azimuth
7. Steps 2 – 6 will be repeated for each frequency peak selected in step 1.
- 8.

The resolution bandwidth of the EMI Receiver will be set to the following values:

Frequency range	Resolution bandwidth
30 MHz to 1 GHz	100 kHz
1 GHz to 4 GHz	1 MHz
4 GHz to 12 GHz	1 MHz
12 GHz to 18 GHz	1 MHz
18 GHz to 25 / 26.5 GHz	1 MHz
26.5 GHz to 40 GHz	1 MHz



Test setup for measurements below 1 GHz



Test setup for measurements above 1 GHz

5.2 Radiated emissions results

5.2.1 Radiated emissions Results (PCS1900)

Ambient temperature:	23 °C
Relative humidity:	44 %

Date:	03.05.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 18900:

Frequency [MHz]	QPK Level [dBm]	QPK Limit [dBm]	QPK Margin [dB]	PK+ Level [dBm]	PK+ Limit [dBm]	PK+ Margin [dB]	Correction [dB]	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [ms]
62.16	-83.39	-13.00	70.39	-74.83	-13.0	61.83	19.57	348	1.5	120	1,000
371.27	-67.46	-13.00	54.46	-63.32	-13.0	50.32	24.85	73	1.0	120	1,000
1880.0	Uplink channel, no spurious										
1960.0	Downlink channel, no spurious										

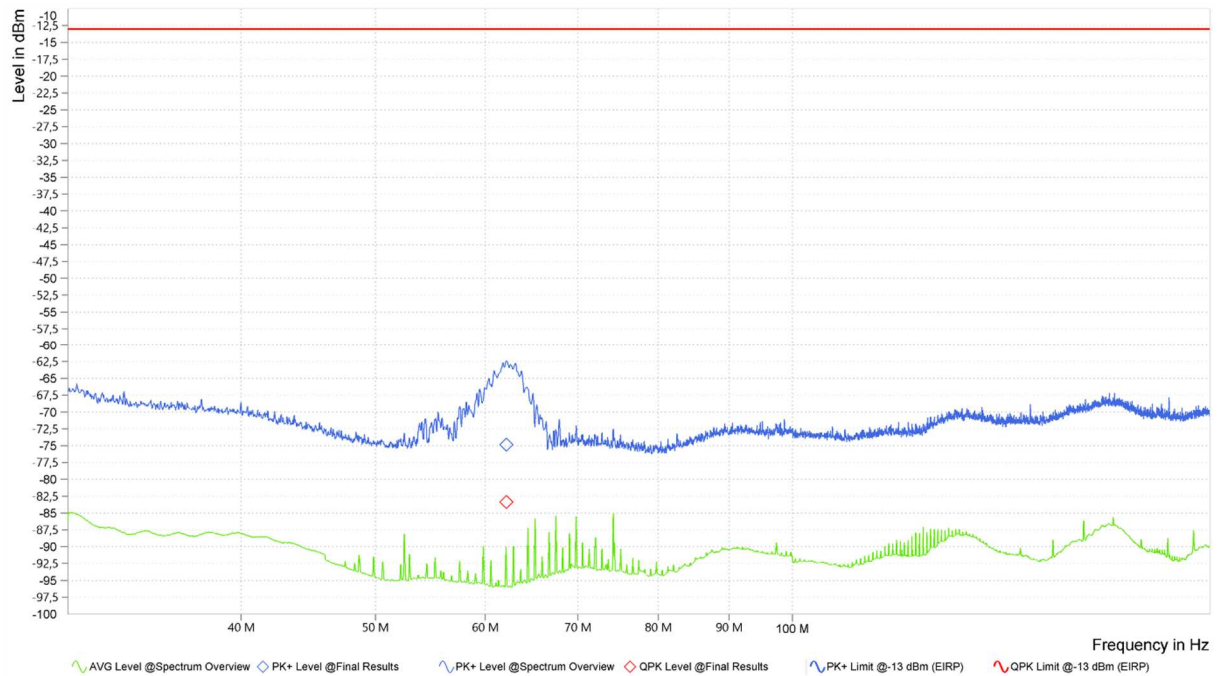
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log (P)$ dB [1].

This results into a limit of -13 dBm for all power levels of the UE.

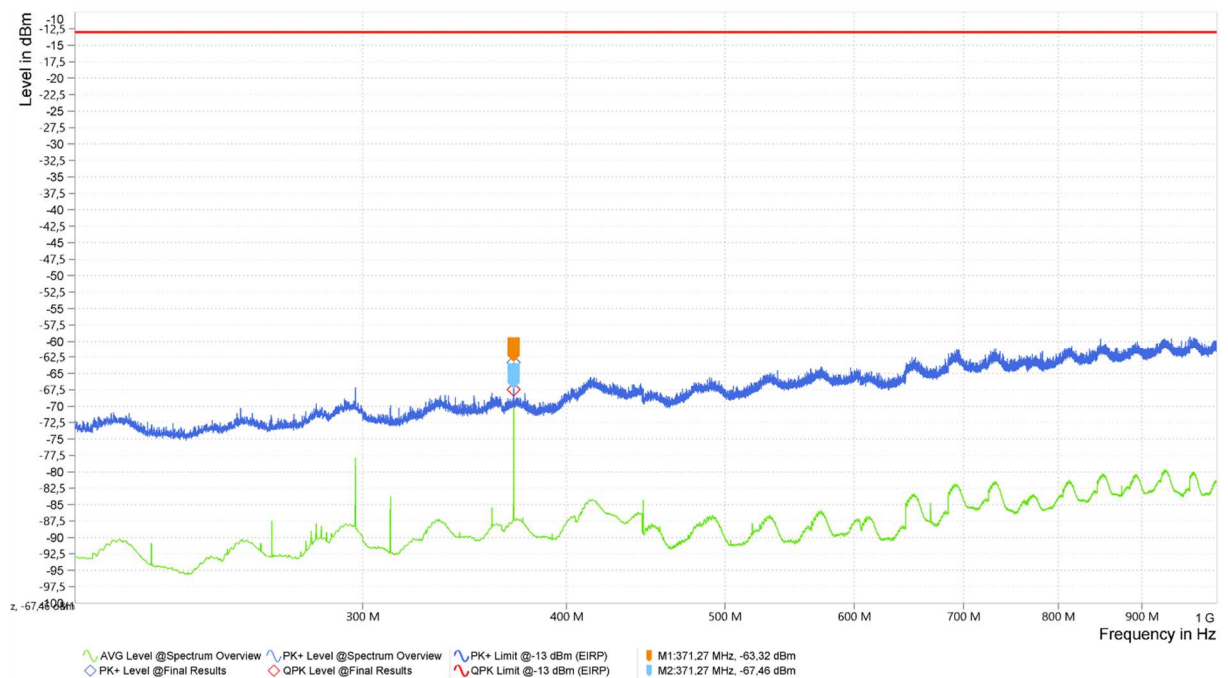
Test equipment used (see chapter 6 for details):

1 – 10, 12-14, 16, 18-27, 30

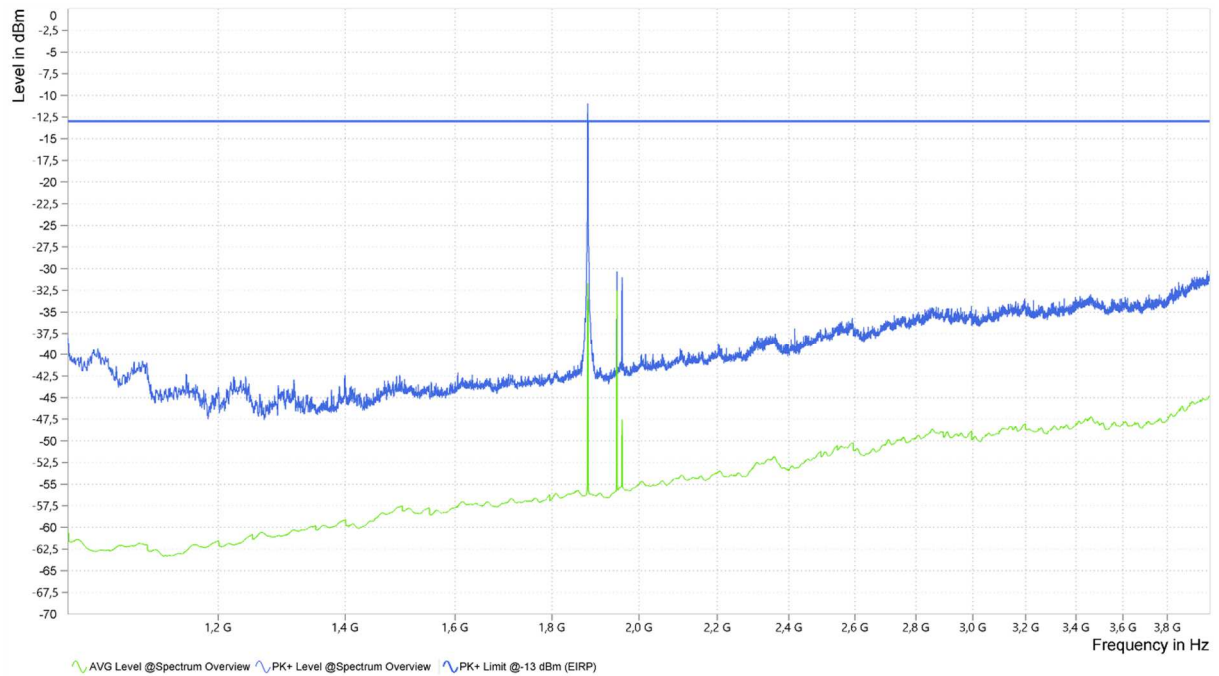
The measurement plots are shown in the following:



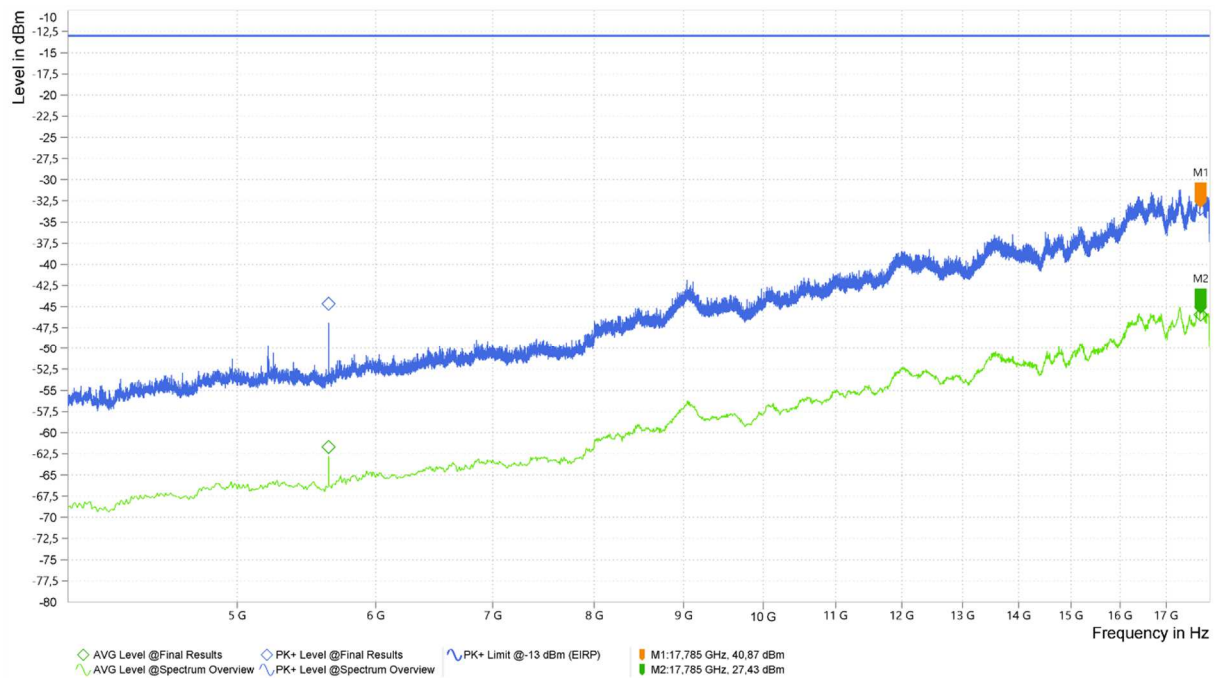
Results 30 MHz to 200 MHz



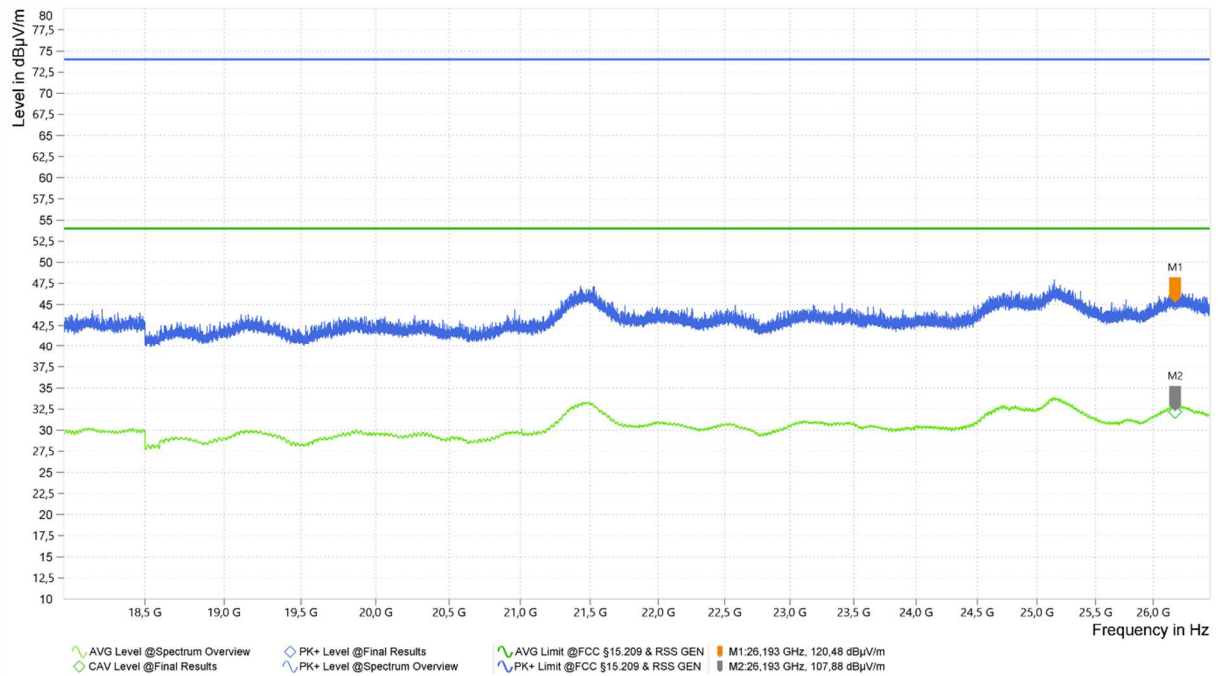
Results 200 MHz to 1 GHz



Results 1 GHz to 4 GHz



Results 4 GHz to 18 GHz



Results 18 GHz to 20 GHz

5.2.2 Radiated emissions (UE) in traffic mode (LTE band 5)

Ambient temperature:	23 °C
Relative humidity:	44 %

Date:	03.05 – 04.05.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 18900:

Measurement at uplink channel 20525:

Spurious emissions level								
Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
836.5	Uplink channel, no spurious							
881.5	Downlink channel, no spurious							

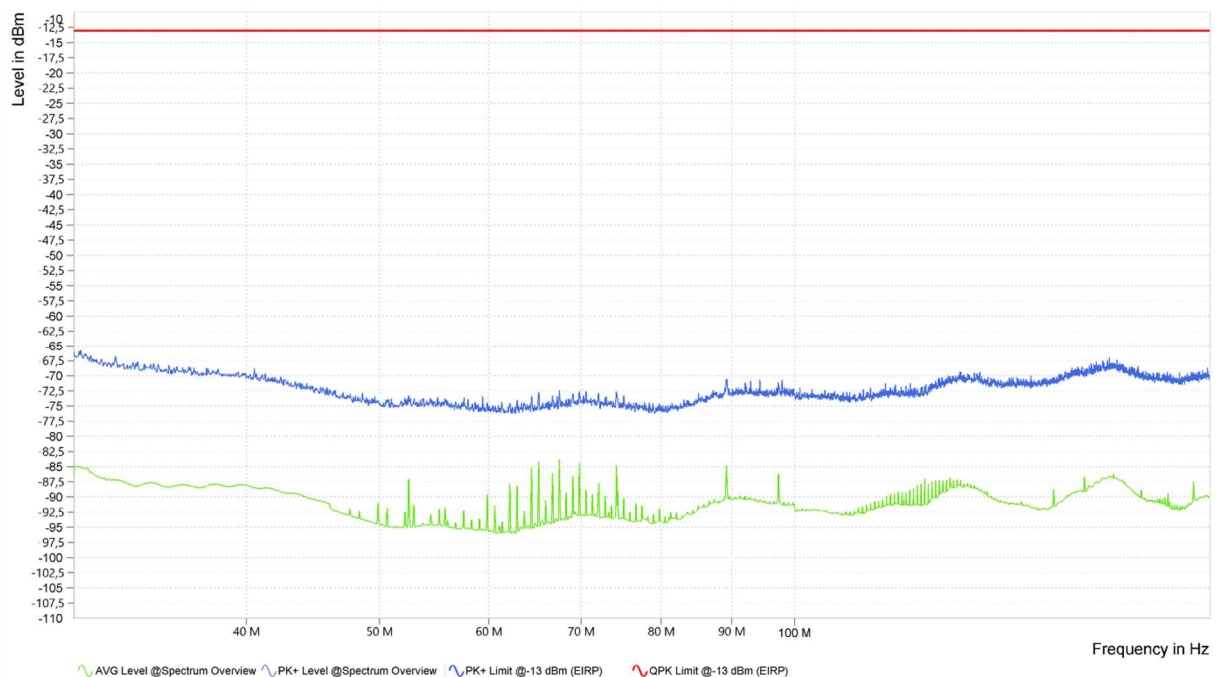
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log (P)$ dB [1].

This results into a limit of -13 dBm for all power levels of the UE.

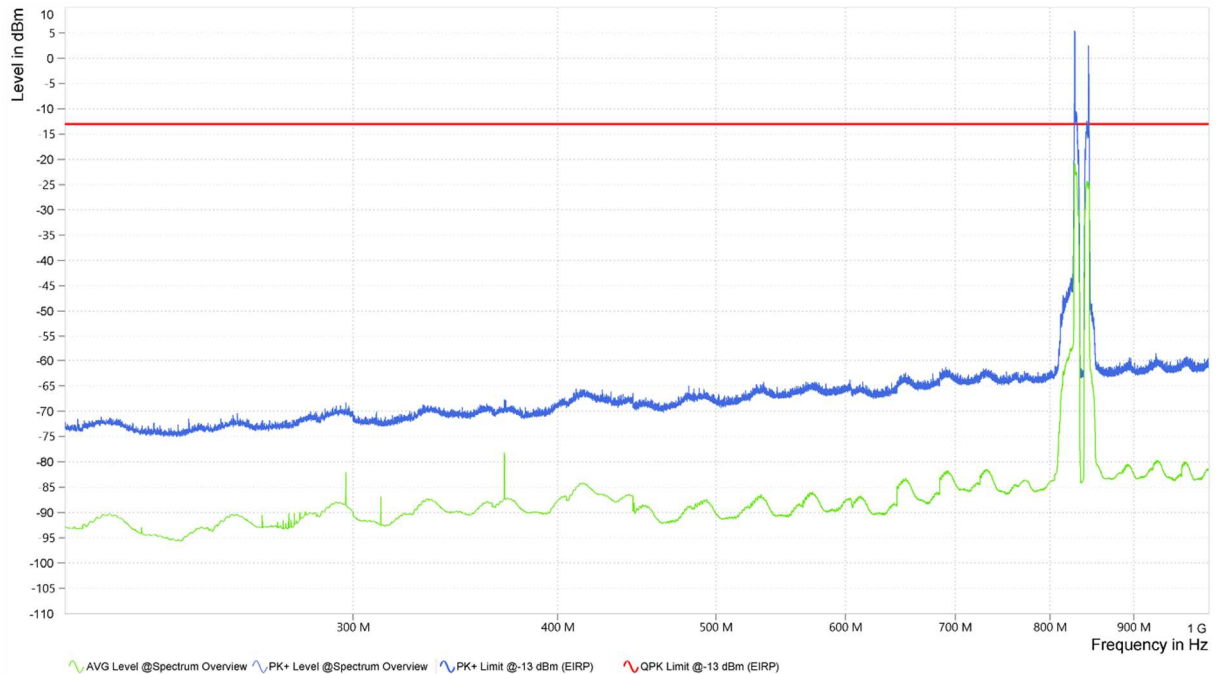
Test equipment used (see chapter 6 for details):

1 – 10, 14, 18-28

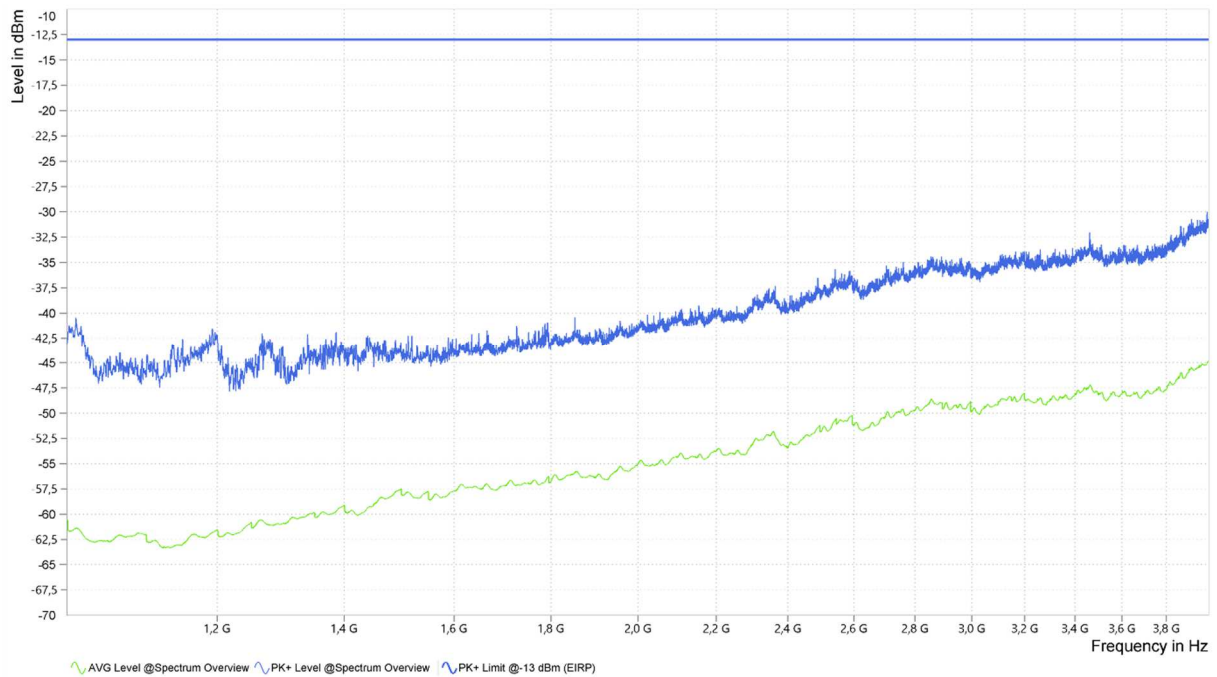
The measurement plots are shown in the following:



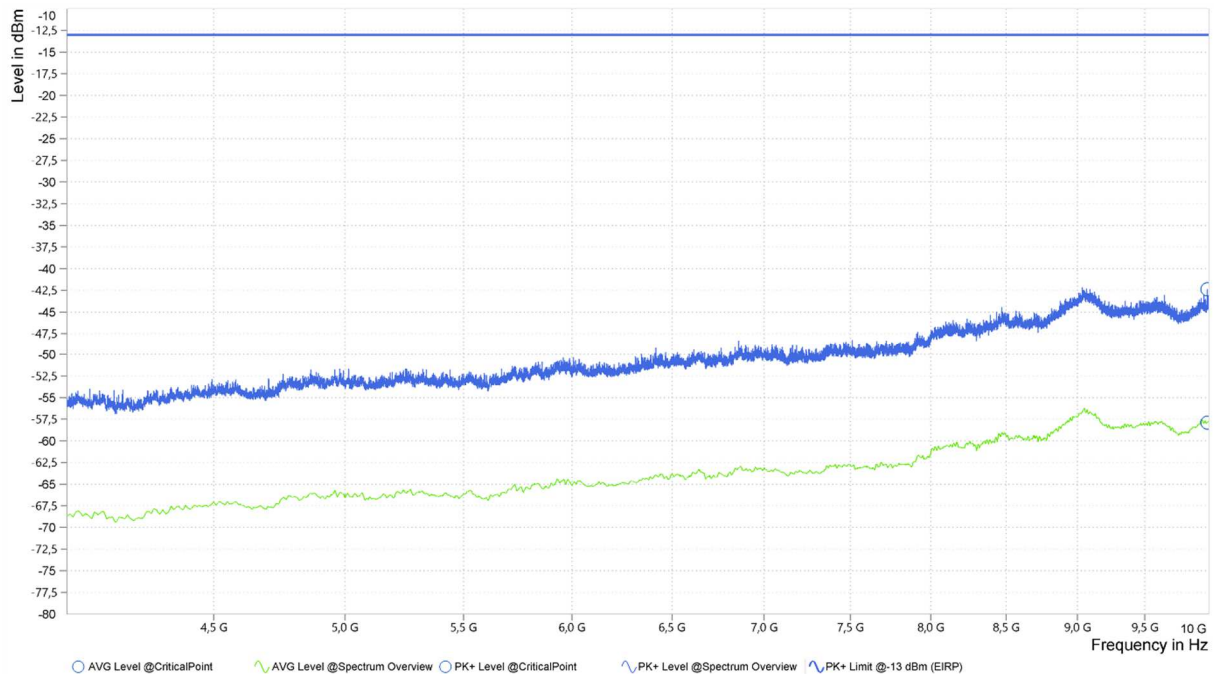
Results 30 MHz to 200 MHz



Results 200 MHz to 1 GHz



Results 1 GHz to 4 GHz



Results 4 GHz to 10 GHz

5.2.3 Radiated emissions (UE) in traffic mode (LTE band 7)

Ambient temperature:	22 °C
Relative humidity:	28 %

Date:	03.05. – 05.05.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 21100:

Spurious emissions level								
Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2535.0	Uplink channel, no spurious							
2655.0	Downlink channel, no spurious							

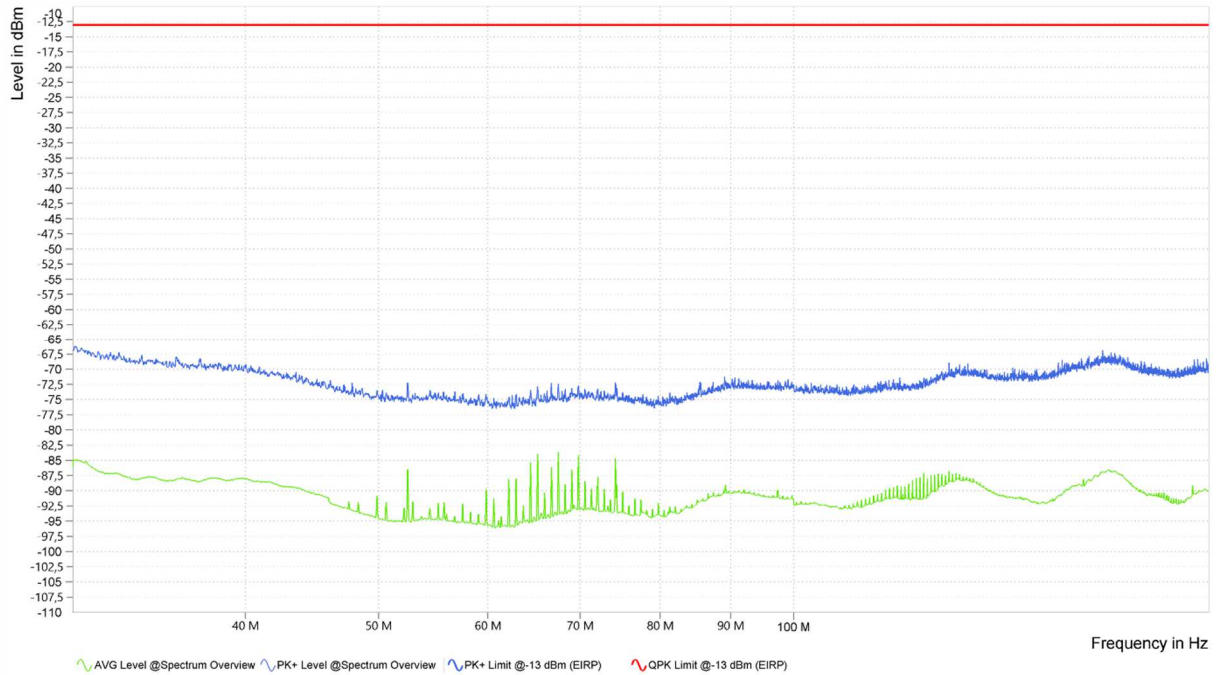
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log (P)$ dB [1].

This results into a limit of -13 dBm for all power levels of the UE.

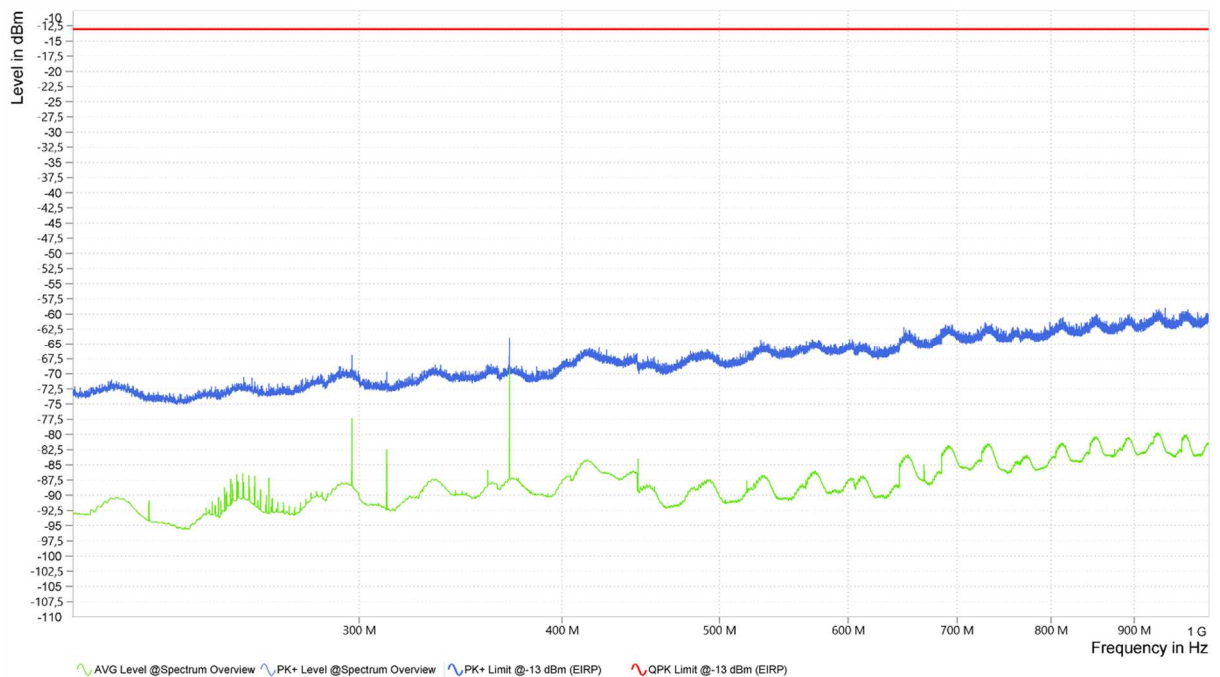
Test equipment used (see chapter 6 for details):

1 – 10, 12-15, 18-27, 30

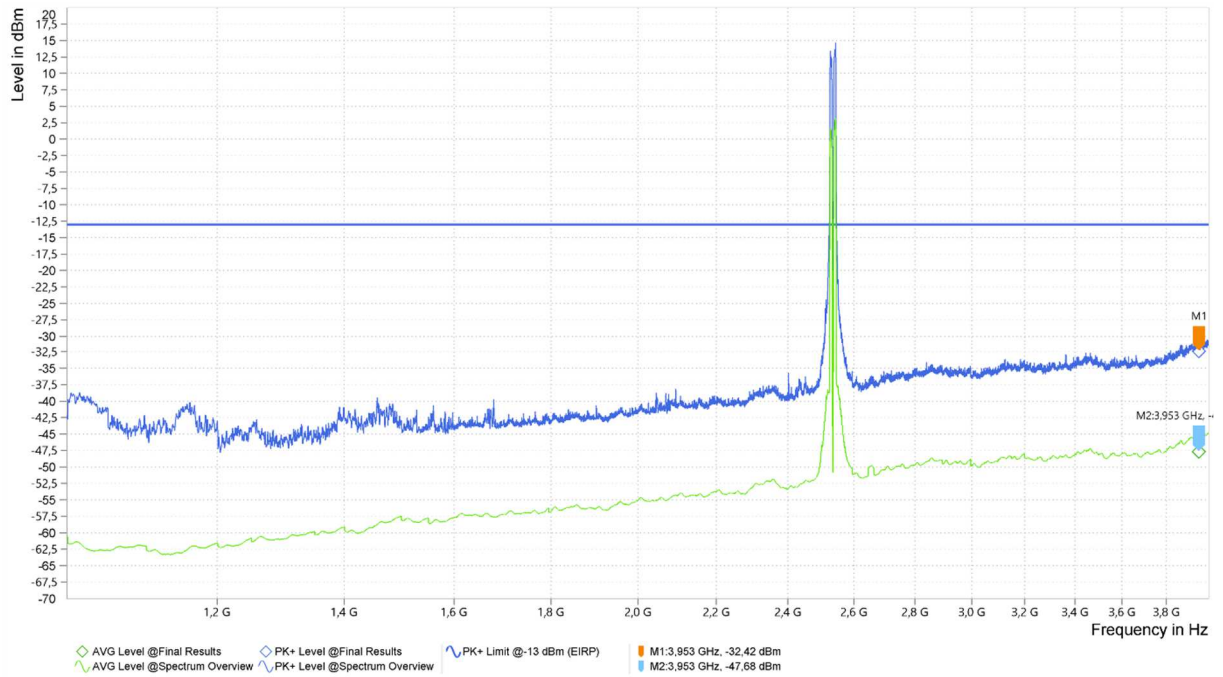
The measurement plots are shown in the following:



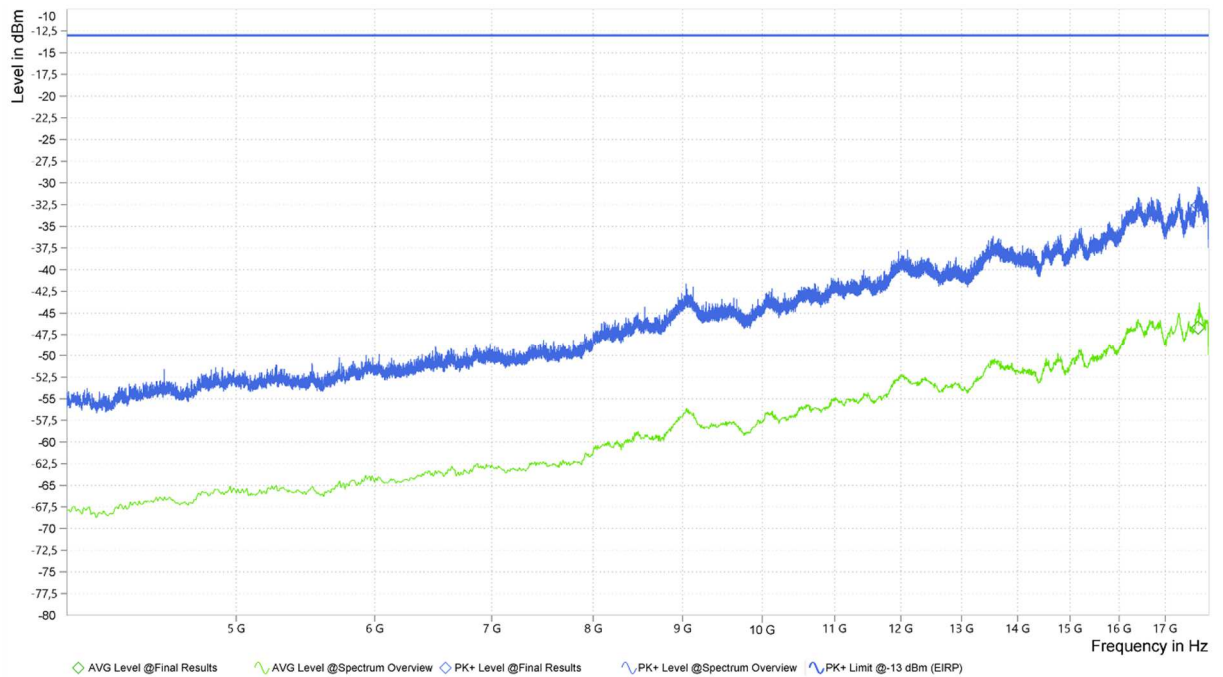
Results 30 MHz to 200 MHz



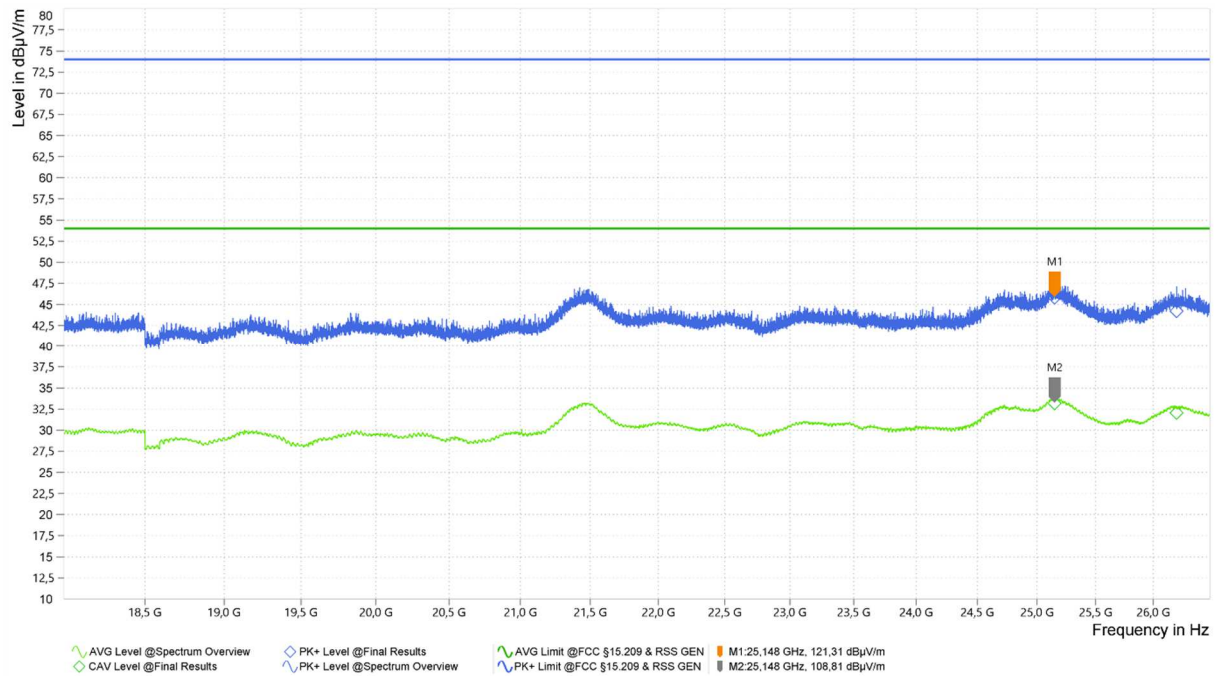
Results 200 MHz to 1 GHz



Results 1 GHz to 4 GHz



Results 4 GHz to 18 GHz



Results 18 GHz to 26.5 GHz

6 Measurement Uncertainties

Conducted measurements		
Measurement method	Standard used for calculating measurement uncertainty	Expanded measurement uncertainty (95 %) U_{lab}
Conducted emissions from 150 kHz to 30 MHz with LISN	CISPR 16-4-2	2.8 dB

Radiated measurements		
Radiated field strength M276		
R&S HL562E @ 3 m 30 MHz – 1 GHz	CISPR 16-4-2	4.8 dB
R&S HL050 @ 3 m	-	
1 – 6 GHz	CISPR 16-4-2	5.1 dB
6 – 18 GHz	CISPR 16-4-2	5.4 dB
Flann Standard Gain Horns 18 – 40 GHz	-	5.9 dB

7 Test Equipment used for Tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
1	Log Per Antenna	VUSLP 9111B	Schwarzbeck	464	483279	Calibration not necessary	
2	Software	EMC32	Rohde & Schwarz	100970	482972	Calibration not necessary	
3	RF Switch Matrix	OSP220	Rohde & Schwarz		482976	Calibration not necessary	
4	Turntable	TT3.0-3t	Maturo	825/2612/.01	483224	Calibration not necessary	
5	Antenna support	BAM 4.5-P-10kg	Maturo	222/2612.01	483225	Calibration not necessary	
6	Controller	NCD	Maturo	474/2612.01	483226	Calibration not necessary	
7	Anechoic chamber M276	SAC5-2	Albatross Projects	C62128-A540-A138-10-0006	483227	Calibration not necessary	
8	EMI Test receiver ESW	ESW44	Rohde & Schwarz	101828	482979	08.12.2021	12.2023
9	Log Per Antenna	HL050	Rohde & Schwarz	4062.4063.02-100908	482977	22.09.2022	09.2025
10	Highpass Filter	WHKX4.0/18G-8SS	Wainwright Instruments	1	480587	Calibration not necessary	
11	Highpass Filter	WHKX12-935-1000-15000-40ST	Wainwright Instruments	1	482908	Calibration not necessary	
12	standard gain horn antenna	20240-20	Flann Microwave	411	480297	Calibration not necessary	
13	Preamplifier 18 GHz - 26 GHz	JS4-18002600-20-5A	MITEQ Hauppauge N.Y.	658697	480342	17.02.2022	02.2024
14	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	167339	483023	21.06.2023	06.2024
15	Tunable Band Reject Filter	WRCT 2300/2650-5/40-10EEK	Wainwright Instruments	1	480446	Calibration not necessary	
16	Tuneable Notch Filter	WRCD1700/2000-0.2/40-10EEK	Wainwright Instruments	14	480415	Calibration not necessary	
17	Tunable Band Reject Filter	WTRCD10-1700-1900-5-13-60EEK	Wainwright Instruments	-	482011	Calibration not necessary	
18	Preamplifier	LNA-30-00101800-25-10P	Narda-Miteq	2110917	482967	Calibration not necessary	
19	Cable	C417	H+S	-	-	Calibration not necessary	
20	Cable	C416	H+S	-	-	Calibration not necessary	
21	Cable	C416.1	H+S	-	-	Calibration not necessary	
22	Cable	C419	H+S	-	-	Calibration not necessary	
23	Biconical antenna	VHA 9103B + VHBB 9124	Schwarzbeck	768	483278	Calibration not necessary	
24	Precision dipole	HZ-13	Rohde & Schwarz	831782/02	480062	Calibration not necessary	
25	Precision dipole	HZ-12	Rohde & Schwarz	831781/02	480061	Calibration not necessary	
26	Signal Generator	SMB100B	Rohde & Schwarz	101314	482975	01.03.2022	03.2024
27	Signal generator	SMHU 58	Rohde & Schwarz	844170/017	480266	21.02.2022	02.2024

No.	Test equipment	Type	Manufacturer	Serial No.	PM. No.	Cal. Date	Cal Due
28	Tunable Band Reject Filter	WTRCT8-800-960-5-13-60EEK	Wainwright Instruments	-	482012	Calibration not necessary	
29	Tunable Band Reject Filter	WRCT 1850/2170-5/40-10EESD	Wainwright Instruments	1	480715	Calibration not necessary	
30	Testsoftware	Elektra V5.01	Rohde & Schwarz	-	483755	Calibration not necessary	

8 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Semi anechoic chamber M276	483227	30 MHz – 1 GHz	NSA/RSM	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	01.03.2023	01.03.2025
Semi anechoic chamber M276	483227	1 GHz – 18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	28.02.2023	28.02.2025

9 Report History

Report Number	Date	Comment
F221817E1	05.03.2024	Initial Test Report
-	-	-
-	-	-

10 List of Annexes

Annex A Test Setup Photos

6 pages