PHOENIX TESTLAB

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Test Report

Report Number:

F222063E1 2nd version

Equipment under Test (EUT):

WWAN Module inside dedicated/specific host device "Hino Telematics control unit 1"

Applicant:

Hino Motors Sales U.S.A., Inc

Manufacturer:

Hino Motors Sales U.S.A., Inc

ilac-MRA

DAkkS 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

[4] **CFR 47 Part 24** Public mobile services, Subpart E – Broadband PCS

[5] **CFR 47 Part 27** Miscellaneous wireless communications services

[6] **RSS-130 Issue 2** Equipment Operating in the Frequency Bands 617 - 652 MHz, 663 - 698 MHz, 698 - 756 MHz and 777 - 787 MHz

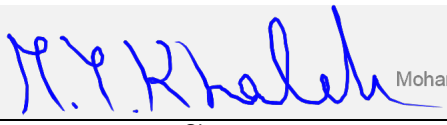
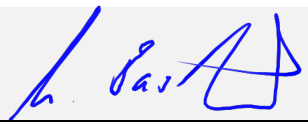
[7] **RSS-199 Issue 4** Broadband Radio Service (BRS) Equipment Operating in the Band 2500-2690 MHz

[8] **RSS-133 Issue 6** 2 GHz Personal Communication Services

[9] **RSS-139 Issue 4** Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710 - 1780 MHz and 2110 - 2180 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 uncertainty is calculated and shown in this test report.

Tested and written by:		Mohamed Yassine Khalek 14.02.2024
	Signature	
Reviewed and approved by:		Manuel BASTERT 14.02.2024
	Signature	

This test report is only valid in its original form.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

Contents: Page

1 Identification

1.1 Applicant

Name:	Hino Motors Sales U.S.A., Inc
Address:	45501 Twelve Mile Road, Novi, MI 48377
Country:	United States of America
Name for contact purposes:	Anthony Luttman
Phone:	248-221-9683
eMail address:	Luttman@hino.com
Applicant represented during the test by the following person:	None

1.2 Manufacturer

Name:	Hino Motors Sales U.S.A., Inc
Address:	45501 Twelve Mile Road, Novi, MI 48377
Country:	United States of America
Name for contact purposes:	Anthony Luttman
Phone:	248-221-9683
eMail address:	Luttman@hino.com
Manufacturer represented during the test by the following person:	None

1.3 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.

1.4 EUT (Equipment under Test)

Type of equipment: *	WWAN Module
Type / PMN: *	TOBY-L3
Product number: *	TOBY-L3414-50A-00-00
FCC ID: *	2AXKDTOBYL3414
IC certification number: *	26600-TOBYL3414
HVIN (Hardware Version Identification Number): *	TOBY-L3414
FVIN (Firmware Version Identification Number): *	N/A
HMN (Host Marketing Name)	HINO TELEMATICS CONTROL UNIT 1
EUT marking:	N/A

Manufacturer:	Hino Motors Sales U.S.A., Inc					
Model name: *	TOBY-L3414					
Power supply module: *	by host					
Supply voltage module: *	U_{nom} =	n.a.	U_{min} =	n.a.	U_{max} =	n.a.
Serial Number: *	n.a.					
IMEI: *	864884060002542					
Supported bands: *	2G: PCS 1900 MHz		3G: 2 (1900 MHz) 4 (1700 MHz)		4G: FDD: 2 (1900 MHz) 4 (1700 MHz) 7 (2600 MHz) 12 (700 MHz) 13 (700 MHz) 66 (1700 MHz) 71(600 MHz) TDD: 41 (2500 MHz)	
Max. output power: *	PCS 1900: Power Class 1 (30 dBm) UMTS/HSDPA/HSUPA: Power Class 3 (24 dBm) LTE (23 dBm)					
Antenna type: *	4-in-1 internal antenna for use on vehicles					
Antenna name: *	PP407087 by TAOGLAS					
Antenna S/N	08/20-00xx					
Antenna connector: *	FAKRA					

Antenna gain: *	Cellular:	6 dBi (Max. peak gain @ 1710 - 2170 MHz) 0 dBi (Min. peak gain @ 699 - 746 MHz) 1.5 dBi (Peak gain @756 -777 MHz) 2 dBi (Peak gain @ 814 – 894 MHz) 3.5 dBi (Peak gain @ 2500-2690 MHz)

	EUT number		
	1 (for UMTS and LTE Tests)	2 (for PCS tests)	3
Serial number: *	-	-	-
PCB identifier: *	V1.0	V1.0	-
IMEI	864884060002542	864884060003615	
Host S/N	0015496	0009362	
Hardware version: *	V1.0	V1.0	-
Software version: *	M31.04.11.01.01/ A31.50.20.01	M31.04.11.01.01/ A31.50.20.01	-

* Declared by the applicant

2 EUTs were used for the tests as described in the table above.

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

1.5 Technical Data of Equipment

General			
Power supply EUT: *	DC		
Supply voltage EUT: *	U_{nom} = 12 V	U_{min} = 8 V	U_{max} = 16 V
Temperature range: *	-40°C to 70°C		
Highest internal frequency: *	2600 MHz		

* Declared by the applicant

Ports / Connectors				
Identification	Connector		Length during test	Shielding (Yes / No)
	EUT	Ancillary		
Antennas	SMB FAKRA plugs	Combined GPS/cellular/WLAN/BT antenna	~ 1.8 m	Yes
Host main connector	Customized 24 pin	DC Laboratory plug used for power supply	~ 1.8 m	No
Host SIM plug	SIM plug	-	-	-
Host USB	Micro USB port, type B	Test laptop	~ 3 m	Yes

Equipment used for testing	
Laptop PC:*1	LENOVO ThinkPad T14 G2 (S/N: PF38R8H3)
-	-
-	-

*1 Provided by the applicant
*2 Provided by the laboratory

Ancillary equipment	
-	-
-	-
-	-

*1 Provided by the applicant

1.6 Dates

Date of receipt of test sample:	12.05.2023
Start of test:	15.05.2023
End of test:	26.07.2023

2 Operational States

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.

UMTS band 2

- Downlink channel UARFCN 900 (1960.0 MHz),
- Uplink channel UARFCN 18900 (1880.0 MHz),
- BS-Power -70 dBm; Mobile-Power 24 dBm; Mode PRBS9.

UMTS band 4

- Downlink channel UARFCN 1637 (2132.4 MHz),
- Uplink channel UARFCN 1412 (1732.4 MHz),
- BS-Power -85 dBm; Mobile-Power 24 dBm; Mode PRBS9.

LTE band 2 (FDD)

- Downlink channel UARFCN 900 (1960.0 MHz),
- Uplink channel UARFCN 18900 (1880.0 MHz),
- BS-Power -85 dBm; Mobile-Power 23 dBm; Mode PRBS9.

LTE band 4 (FDD)

- Downlink channel UARFCN 2174 (2132.4 MHz),
- Uplink channel UARFCN 20174 (1732.4 MHz),
- BS-Power -85 dBm; Mobile-Power 23 dBm; Mode PRBS9.

LTE band 7 (FDD)

- Downlink channel UARFCN 3100 (2655.0 MHz),
- Uplink channel UARFCN 21100 (2535.0 MHz),
- BS-Power -85 dBm; Mobile-Power 23 dBm; Mode PRBS9.

LTE band 12 (FDD)

- Downlink channel UARFCN 5095 (737.5 MHz),
- Uplink channel UARFCN 23095 (707.5 MHz),
- BS-Power -85 dBm; Mobile-Power 23 dBm; Mode PRBS9.

LTE band 13 (FDD)

- Downlink channel UARFCN 5230 (751.0 MHz),
- Uplink channel UARFCN 23230 (782.0 MHz),
- BS-Power -85 dBm; Mobile-Power 23 dBm; Mode PRBS9.

LTE band 41 (TDD)

- Uplink channel / Downlink channel UARFCN 40620 (2593.0 MHz),
- BS-Power -85 dBm; Mobile-Power 23 dBm; Mode PRBS9.

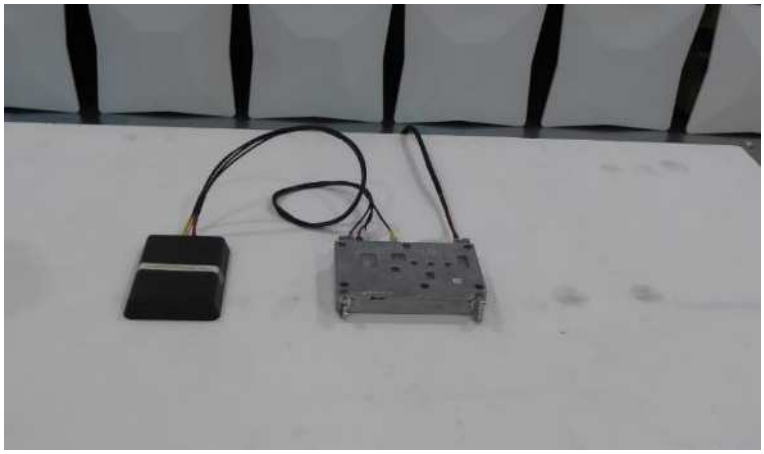
LTE band 66 (FDD)

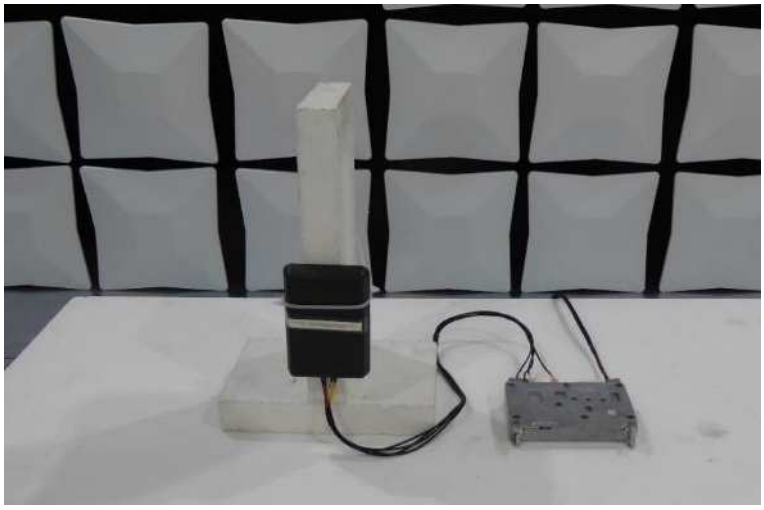
- Downlink channel UARFCN 132322 (1745.0 MHz),
- Uplink channel UARFCN 66886 (2145.0 MHz),
- BS-Power -85 dBm; Mobile-Power 23 dBm; Mode PRBS9.

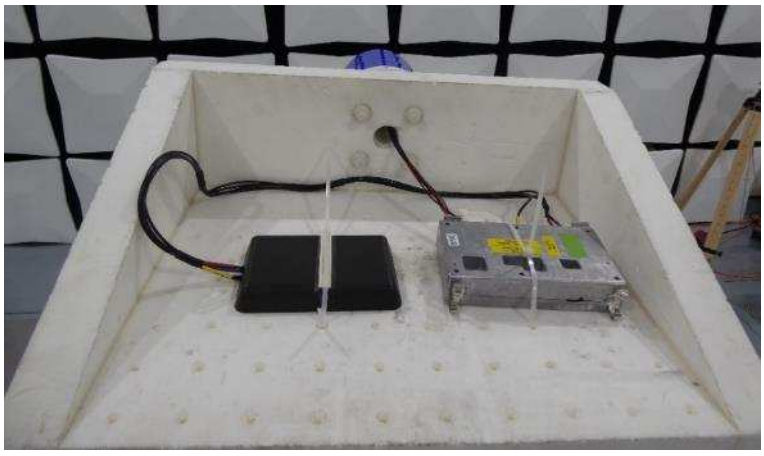
LTE band 71 (FDD)

- Downlink channel UARFCN 133297 (680.5 MHz),
- Uplink channel UARFCN 66761 (634.5 MHz),
- BS-Power -85 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.
Additionally, the WIFI module of the host was set to transmit in b-mode 1 Mbps on channel 1 with maximum output power to reflect a simultaneous transmission scenario. This has been done by means of a software called “Kitty” and Labtool (Version 2.0.0.75), provided by the applicant.
The simultaneous transmission has been performed for LTE Band 7 and PCS1900 together with WLAN.
The GPS reception was also active during the measurement.

3 Additional Information

The applicant integrates in its device the already certified RF cellular module TOBY-L3 (FCC ID: 2AXKDTOBYL3414 / IC: 26600-TOBYL3414) with a change in the RF trace layout design.
Therefore, retesting of radiated spurious emissions has been requested to apply for a class 2 permissive change to add the trace design. 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 130 [6], 133 [8], 139 [9], 199 [7]	Status	Refer page
Radiated spurious emissions	30 – 26,500	24.238 (a) (b) 27.53 RSS130 / 4.7.1 RSS133 / 6.5 RSS 139 / 6.6 RSS 199 / 5.6	Passed	16 et seq.

5 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 [dBµV/m] = EIRP [dBm] – 20log(d) + 104.8 according to chapter 5.2.7 [1].

➔ EIRP = E – 95.25 (d = 3 m measuring distance)

ERP [dBm] = EIRP – 2.15 dB

Level (dBm) ≙ 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.

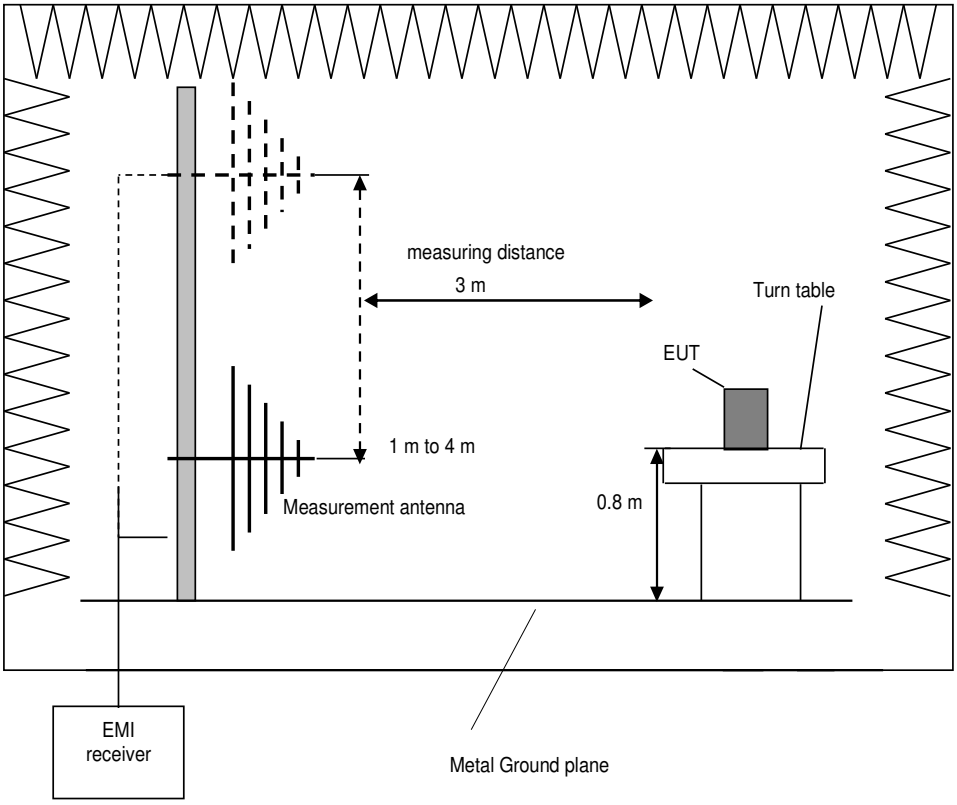
Procedure final measurement:

The following procedure is used:

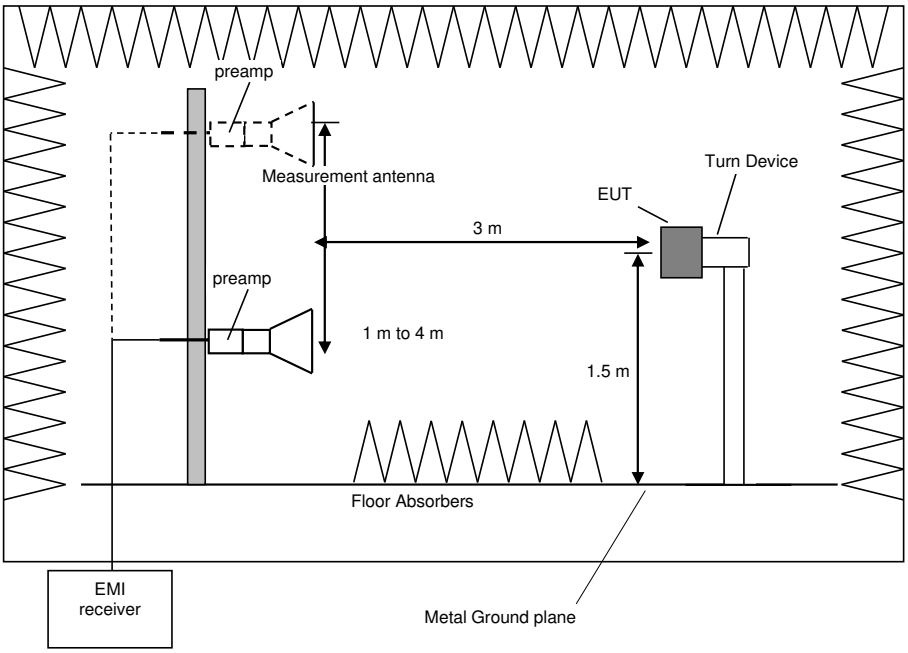
1. Select the highest frequency peaks to the limit for the final measurement.
2. The software will determine the exact peak frequencies by doing a partial scan with reduced RBW with +/- 10 times the RBW of the pre-scan of the selected peaks.
3. If the EUT is portable or ceiling mounted, find the worst 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.

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

6 Results

6.1 Radiated emission measurement

6.1.1 Radiated emissions - UE in traffic mode (PCS1900)

Ambient temperature:	22 °C
Relative humidity:	39 %

Date:	01.06-02.06.2023
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]
38.220	-58.23	-13.00	45.23	-53.73	-13.00	40.73	18.98	156	1.08	120	1,000
164.190	-80.85	-13.00	67.85	-69.13	-13.00	56.13	25.01	355	1.32	120	1,000
416.270	-78.95	-13.00	65.95	-69.32	-13.00	56.32	26.86	6	2	120	1,000
841.520	-70.21	-13.00	57.21	-61.62	-13.00	48.62	32.90	268	1.99	120	1,000
1880.000	Uplink channel, no spurious										
1960.000	Downlink channel, no spurious										

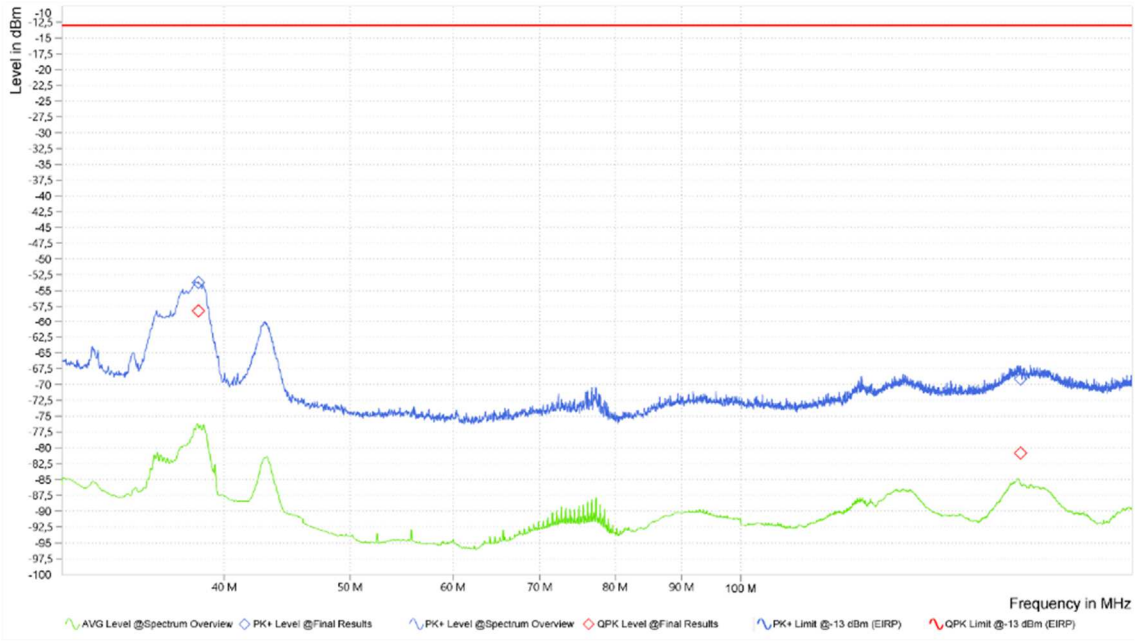
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

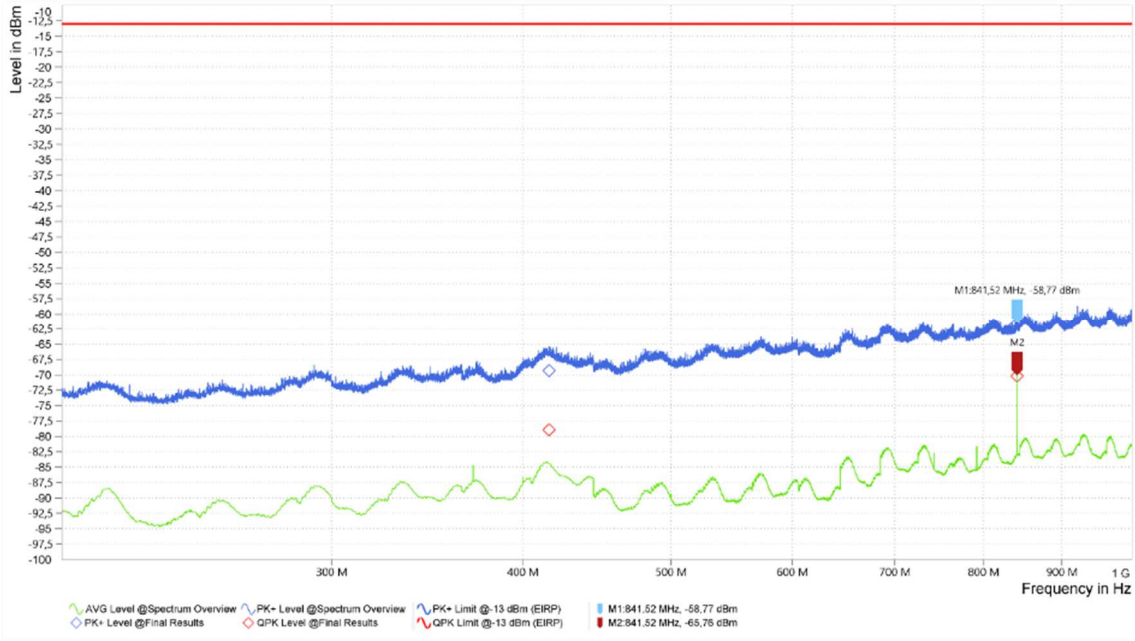
Test equipment used (see chapter 6 for details):

1 – 10, 12-14, 16, 18-27

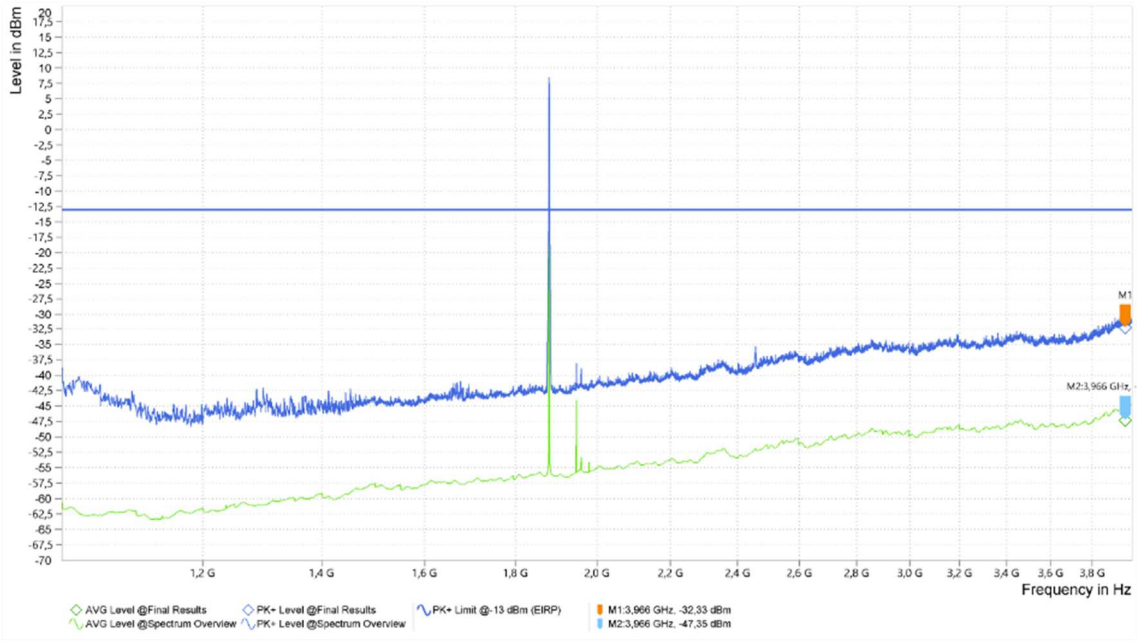
The measurement plots are shown in the following:



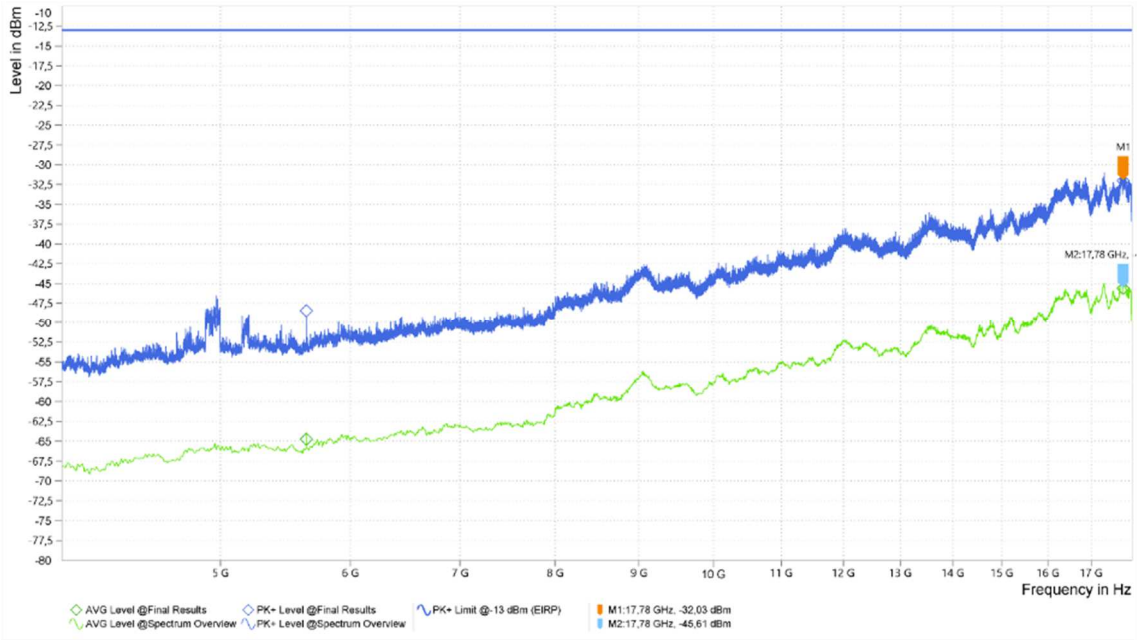
Results 30 MHz to 200 MHz



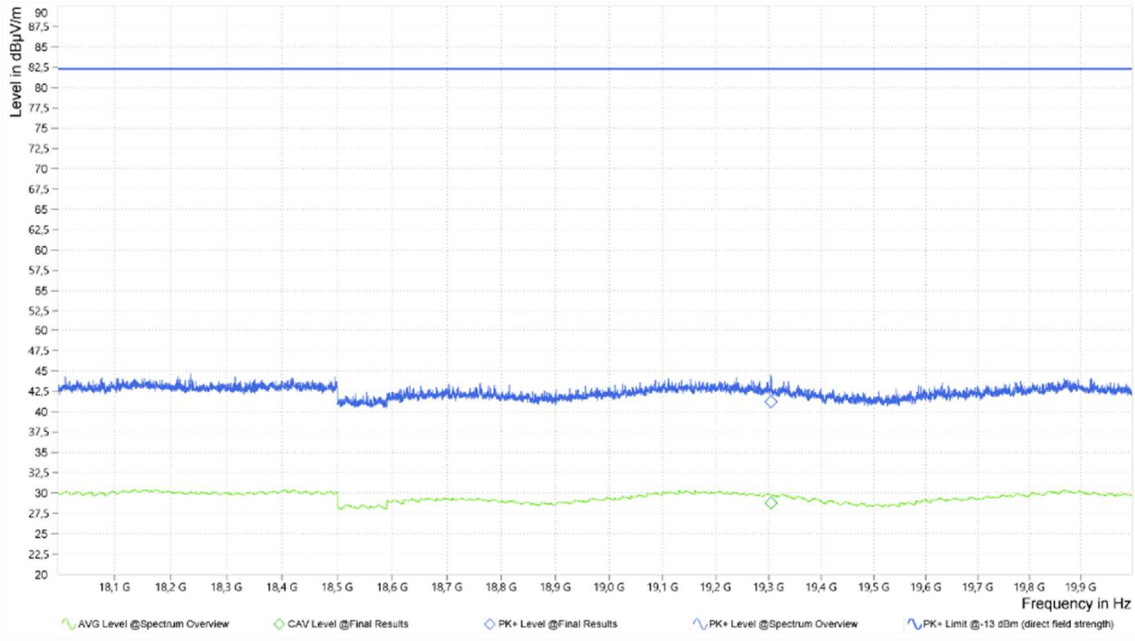
Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 18 GHz



Results 18 to 20 GHz

6.1.2 Radiated emissions - UE in traffic mode (UMTS band 2)

Ambient temperature:	23 °C
Relative humidity:	40 %

Date:	22.05-31.05.23
Tested by:	Y. KHALEK

Measurement at uplink channel 20175:

Frequency [MHz]	PK+ Level [dBm]	PK+ Limit [dBm]	PK+ Margin [dB]	AVG Level [dBm]	Correction [dB]	Elevation [deg]	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [ms]
1880.000	Uplink channel, no spurious									
2132.500	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.

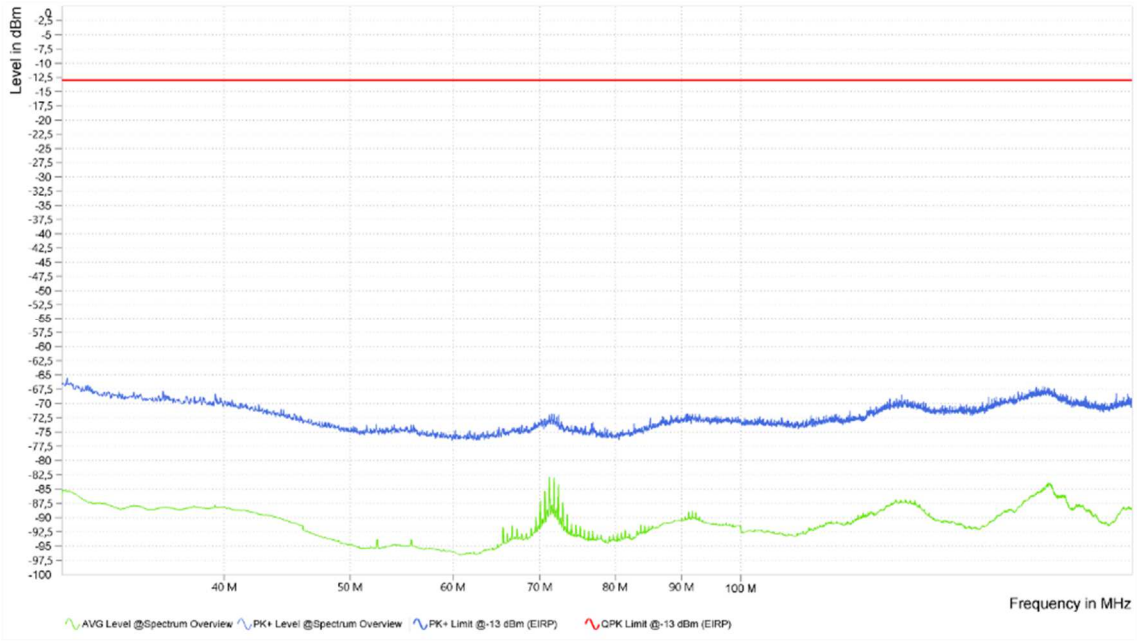
This results into a limit of -13 dBm for all power levels of the UE.

No significant frequencies were found during the spurious emission measurement.

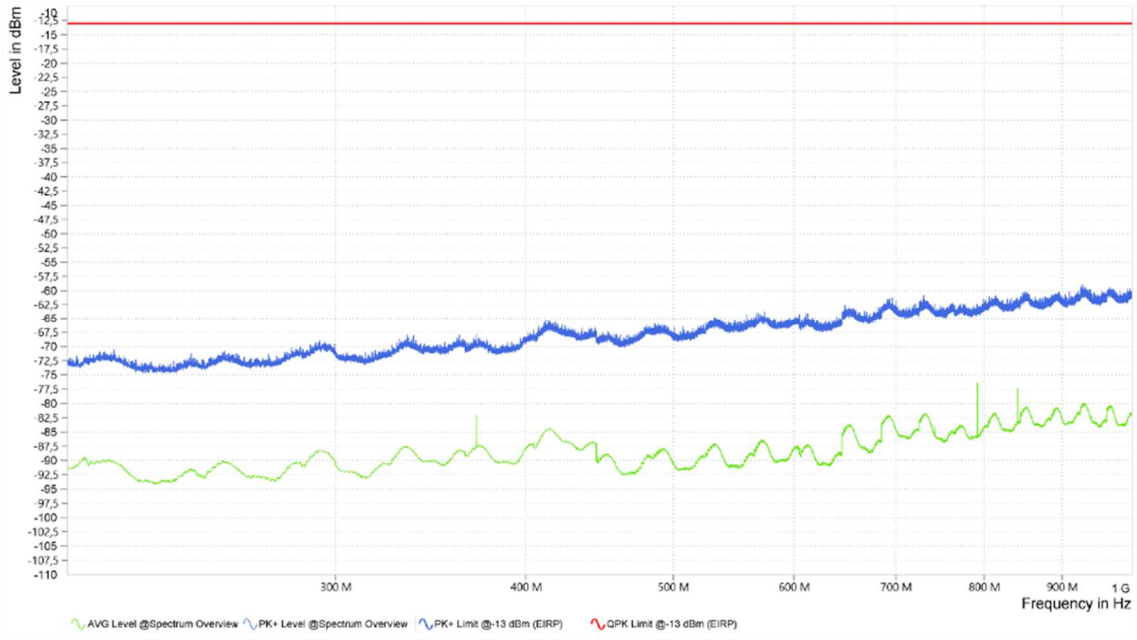
Test equipment used (see chapter 6 for details):

1 – 10, 14, 18-27, 29

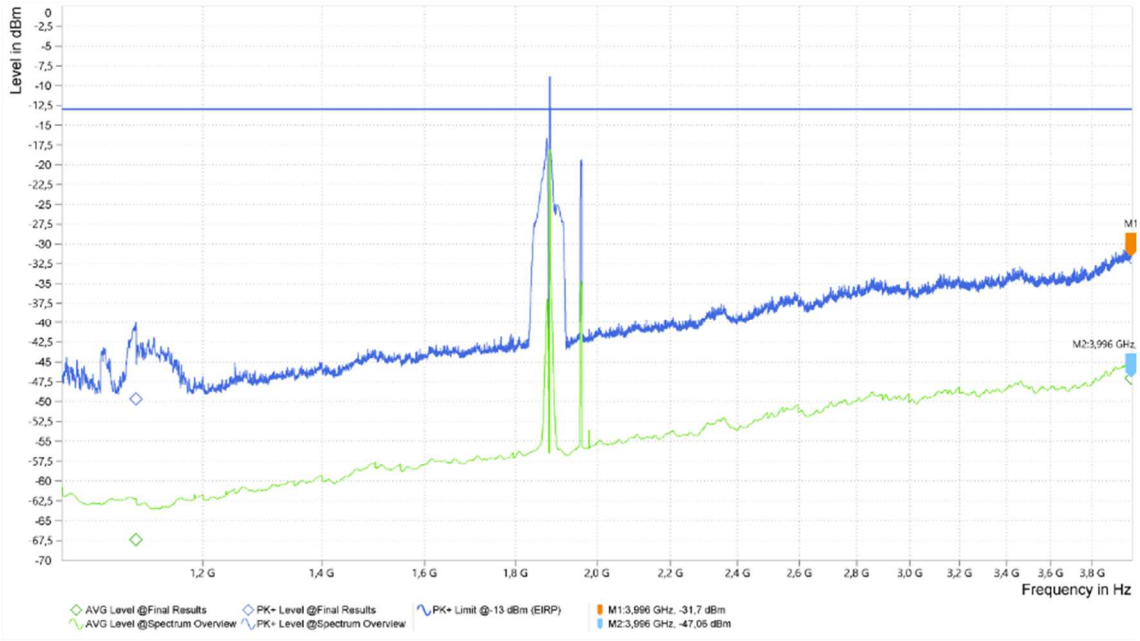
The measurement plots are shown in the following:



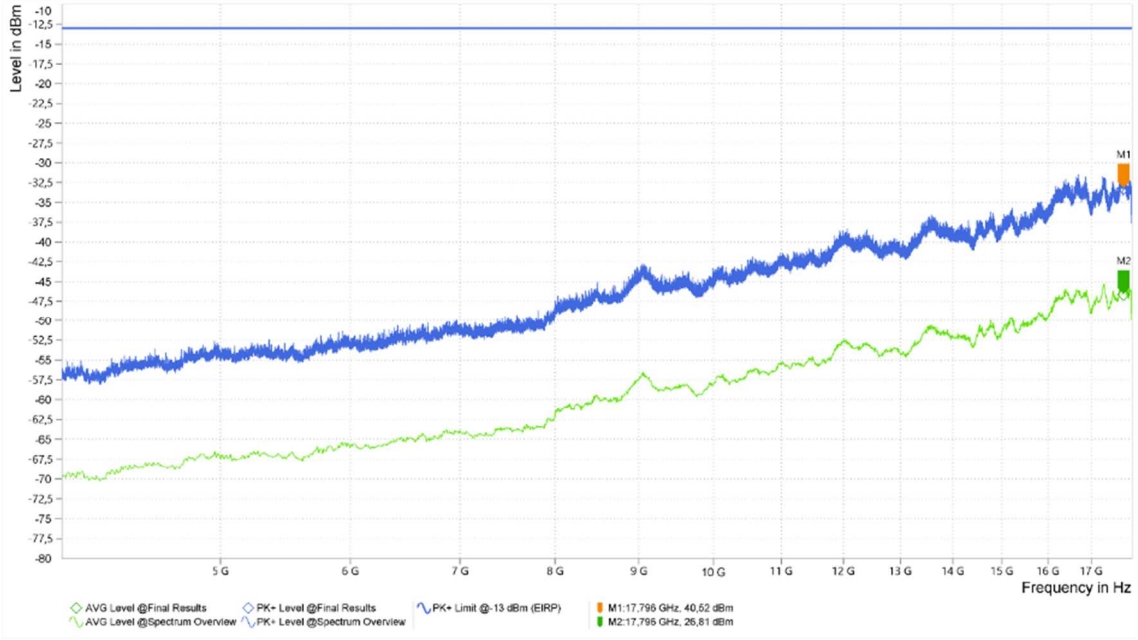
Results 30 MHz to 200 MHz



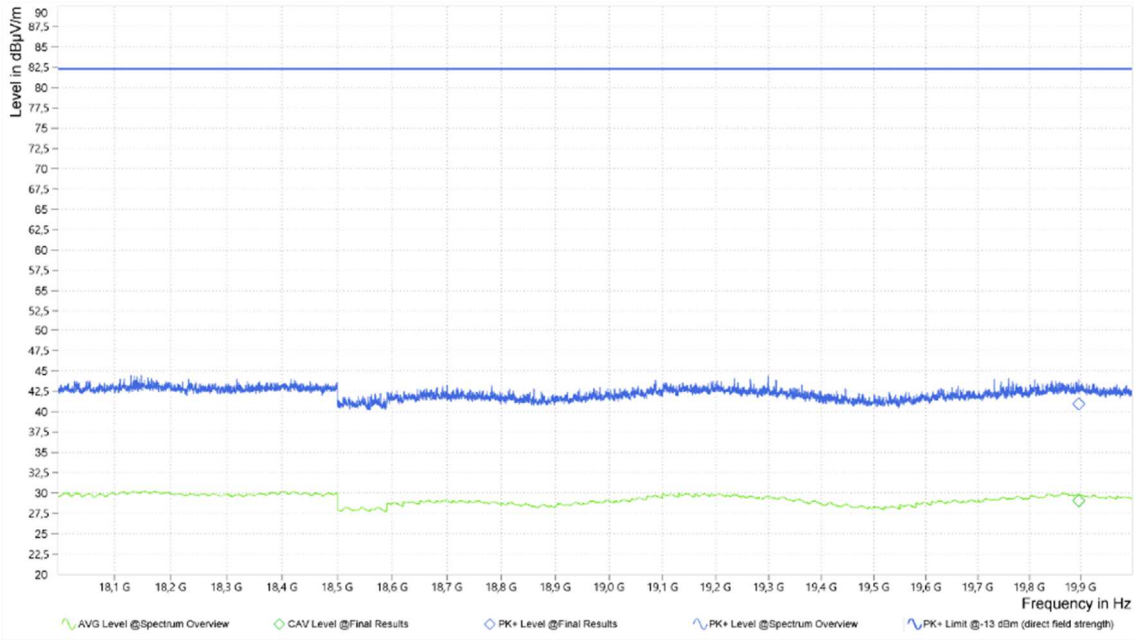
Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 18 GHz



Results 18 to 20 GHz

6.1.3 Radiated emissions - UE in traffic mode (UMTS band 4)

Ambient temperature:	23 °C
Relative humidity:	40 %

Date:	22.05-31.05.23
Tested by:	Y. KHALEK

Measurement at uplink channel 1413:

Frequency [MHz]	PK+ Level [dBm]	PK+ Limit [dBm]	PK+ Margin [dB]	AVG Level [dBm]	Correction [dB]	Elevation [deg]	Azimuth [deg]	Antenna Height [m]	Meas. BW [kHz]	Meas. Time [ms]
1732.600	Uplink channel, no spurious									
2132.600	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.

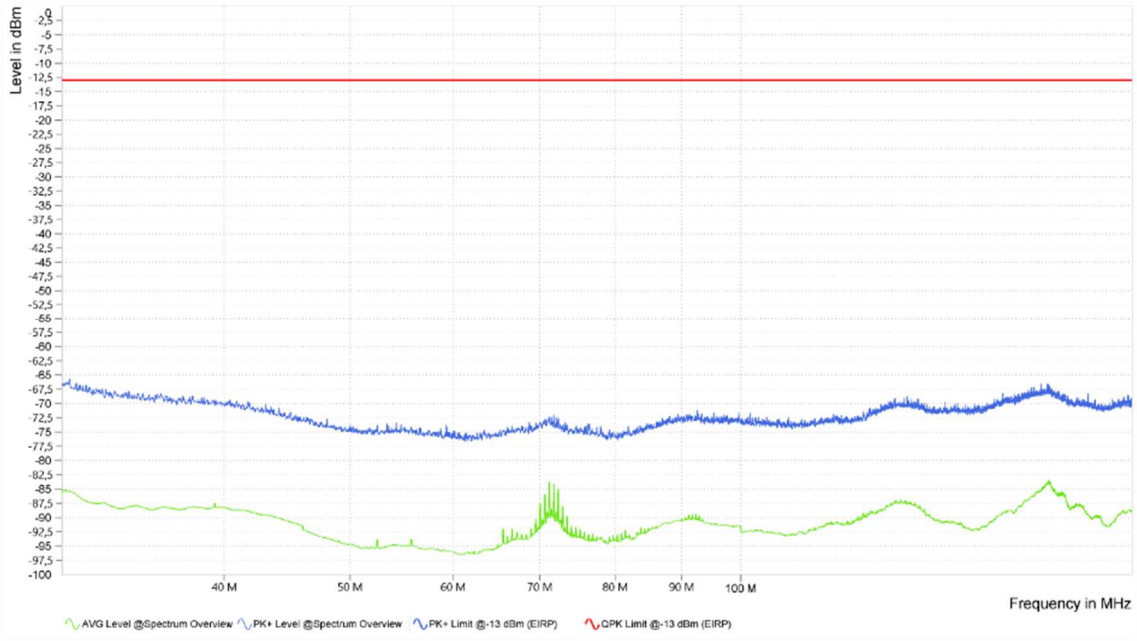
This results into a limit of -13 dBm for all power levels of the UE.

No significant frequencies were found during the spurious emission measurement.

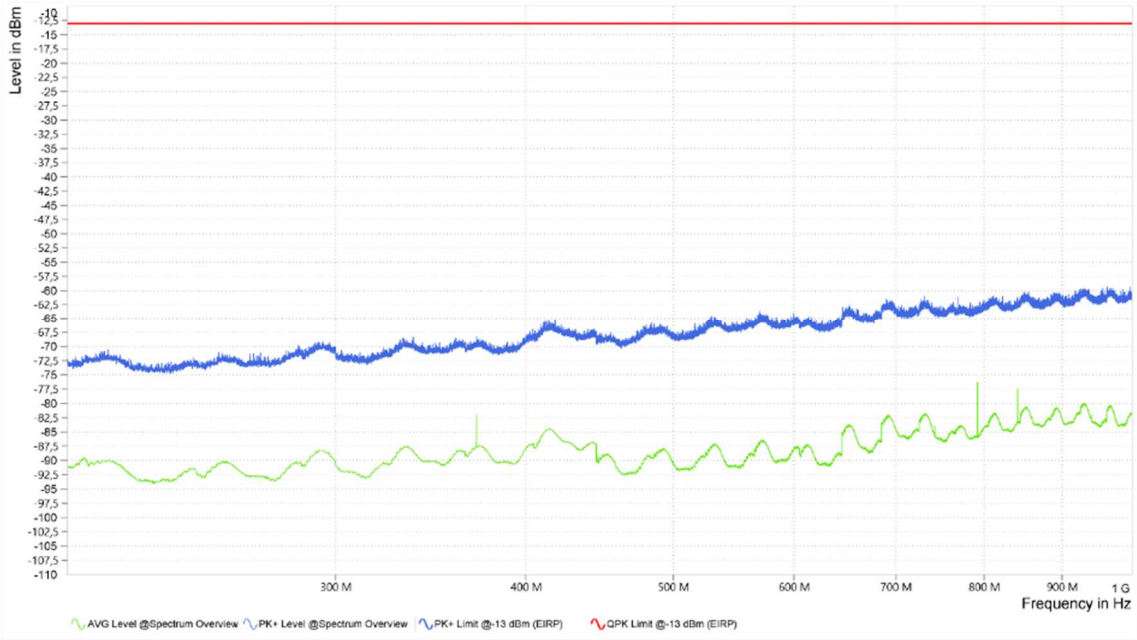
Test equipment used (see chapter 6 for details):

1 – 10, 14, 17-27

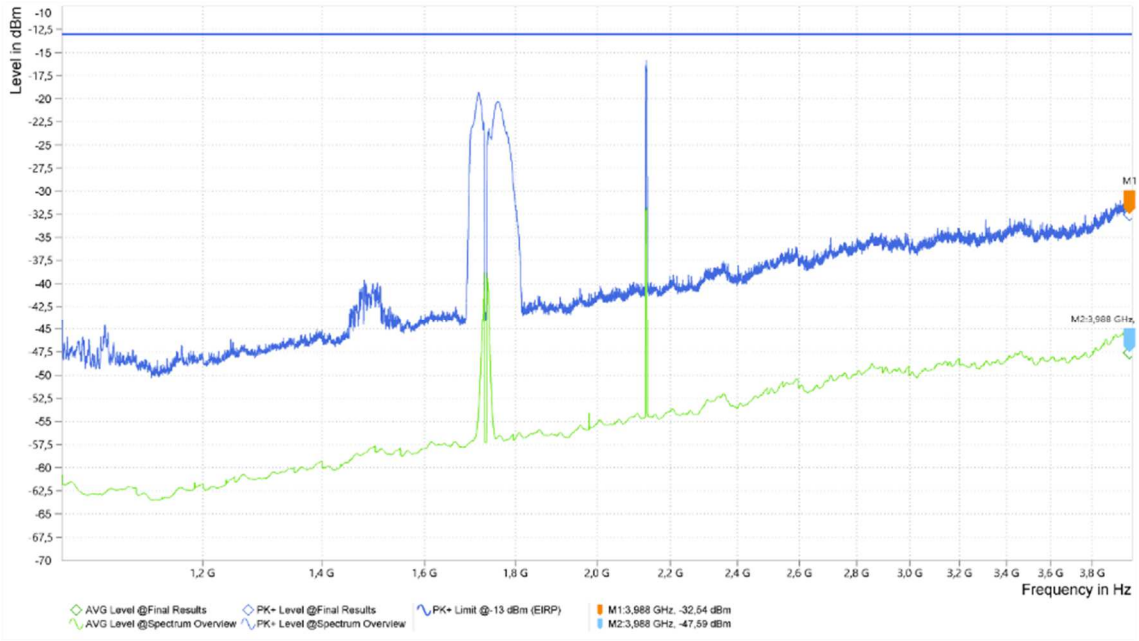
The measurement plots are shown in the following:



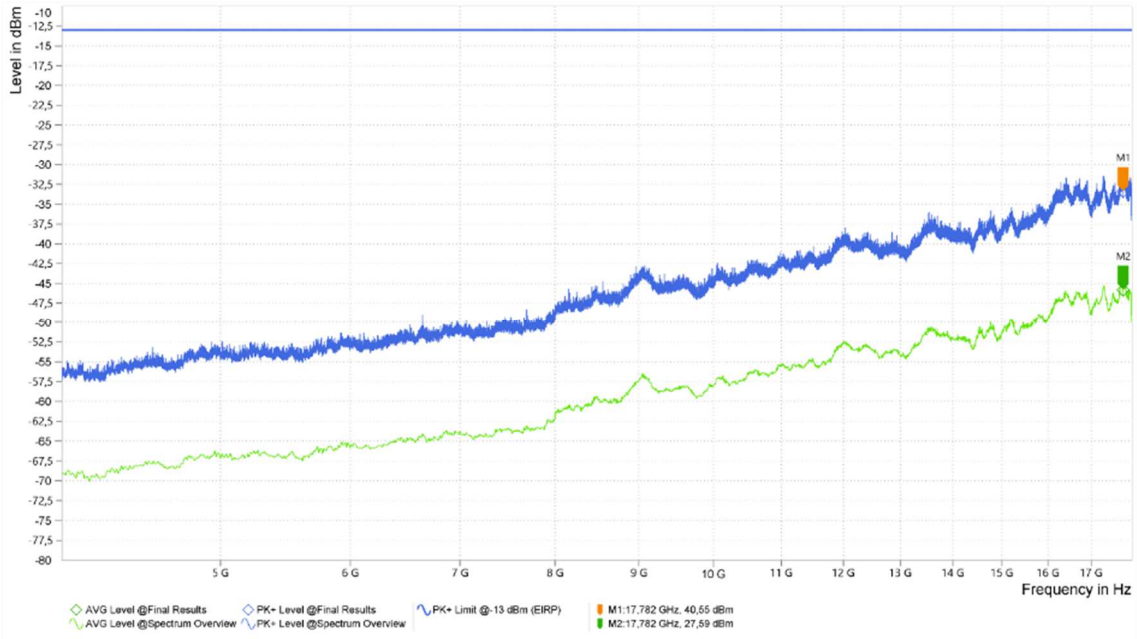
Results 30 MHz to 200 MHz



Results 200 MHz to 1 GHz



Results 1 GHz to 4 GHz



Results 4 GHz to 18 GHz

6.1.4 Radiated emissions - UE in traffic mode (LTE band 2)

Ambient temperature:	23 °C
Relative humidity:	40 %

Date:	22.05-31.05.23
Tested by:	Y. KHALEK

Measurement at uplink channel 18900:

Spurious emissions level								
Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1880.000	Uplink channel, no spurious							
1960.000	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.

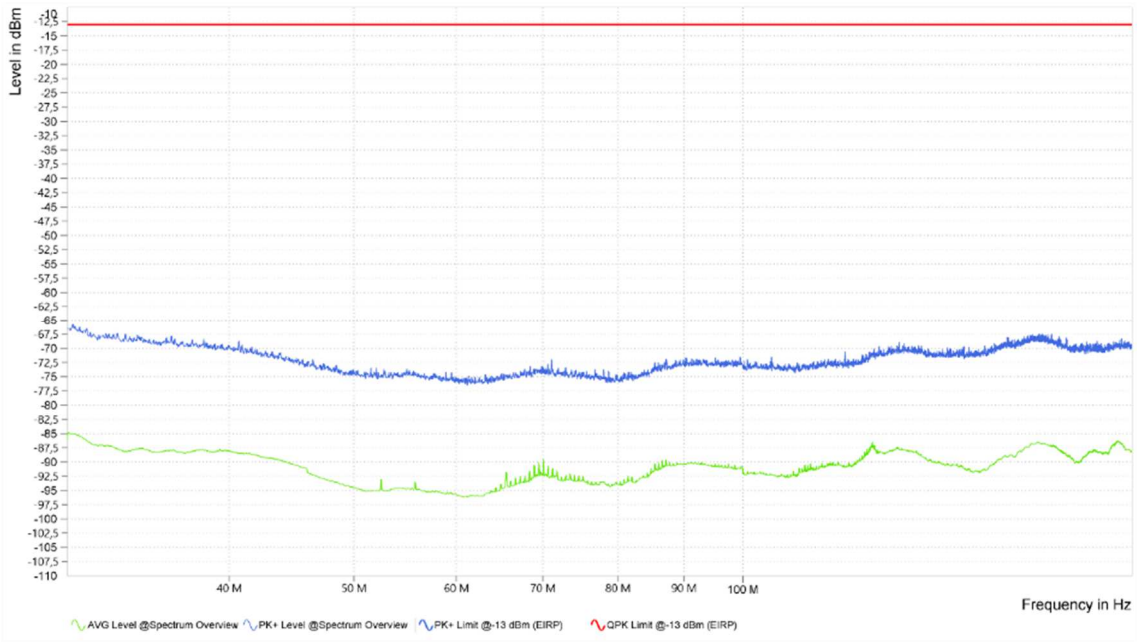
This results into a limit of -13 dBm for all power levels of the UE.

No significant frequencies were found during the spurious emission measurement.

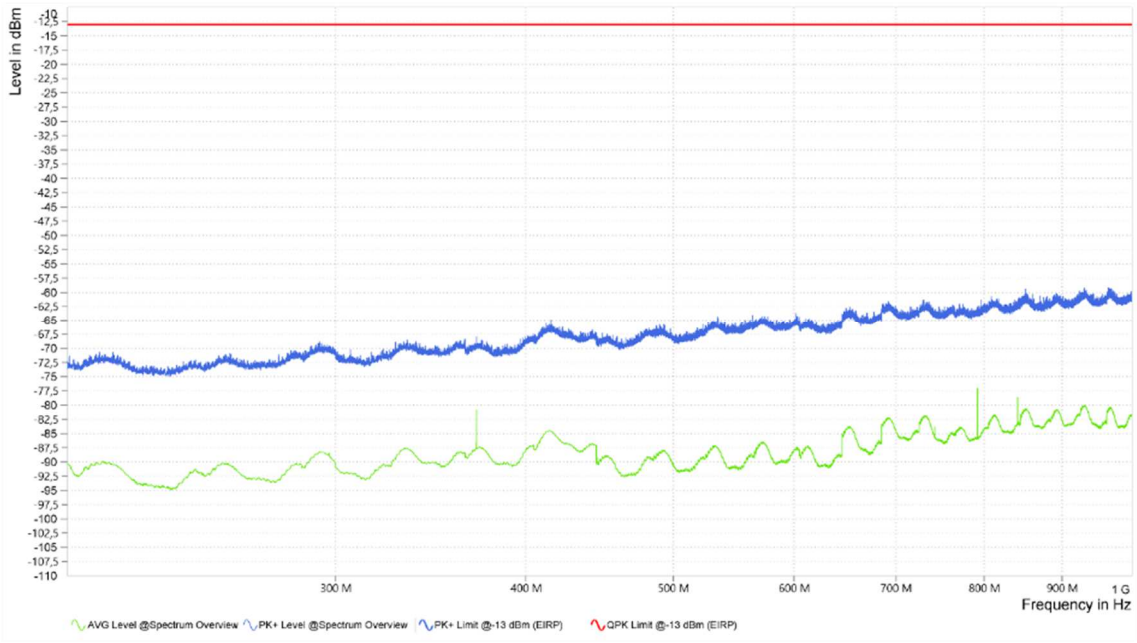
Test equipment used (see chapter 6 for details):

1 – 10, 14, 17-27

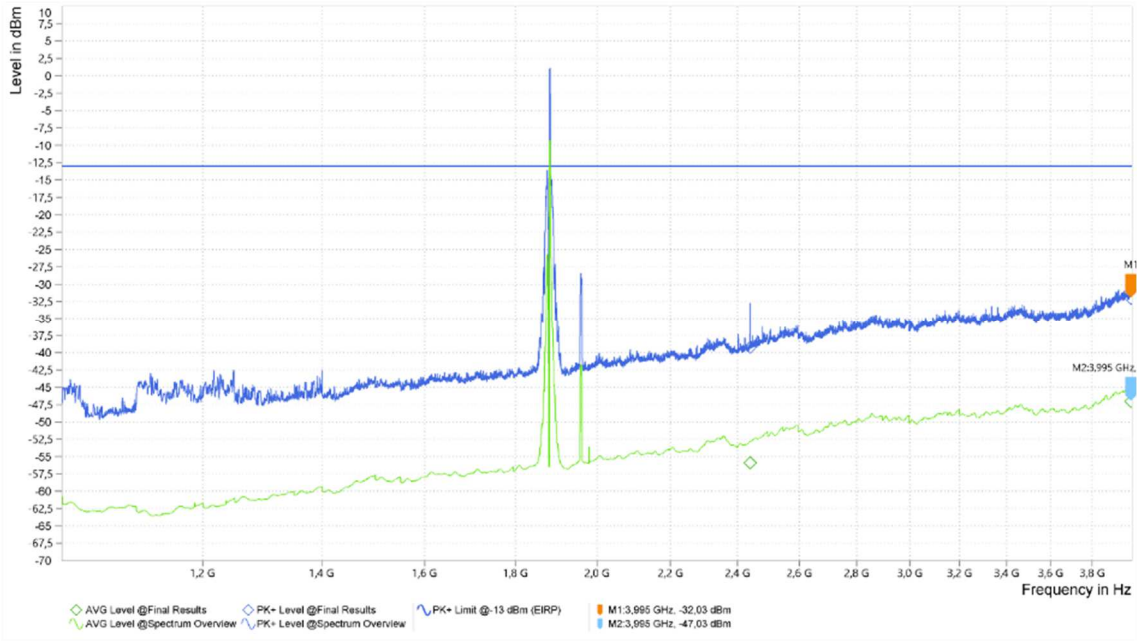
The measurement plots are shown in the following:



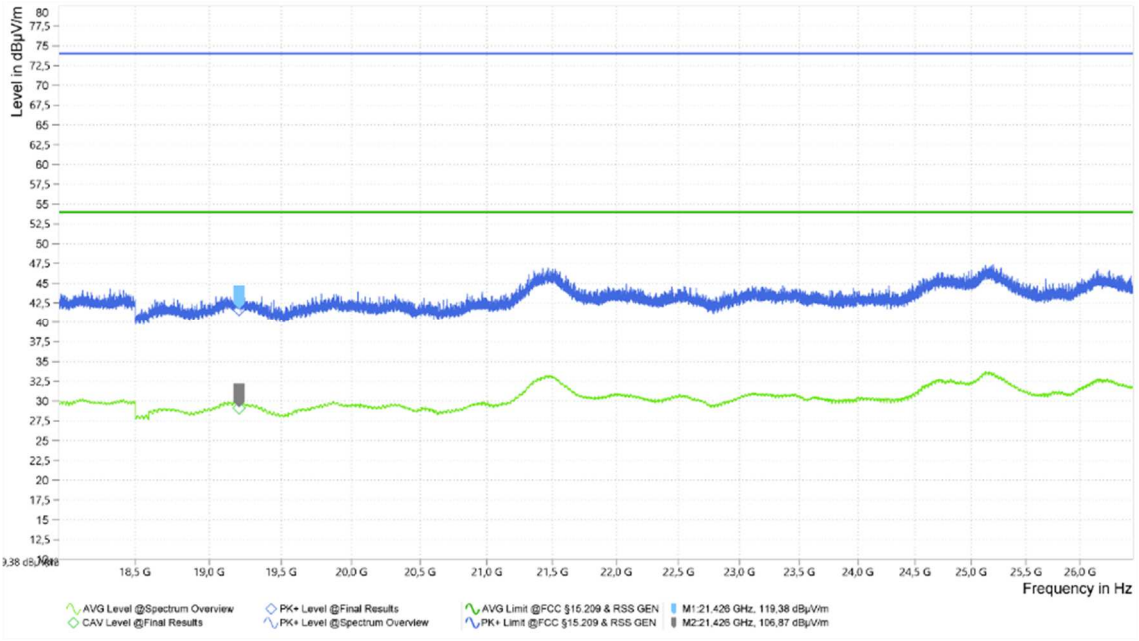
Results 30 MHz to 200 MHz



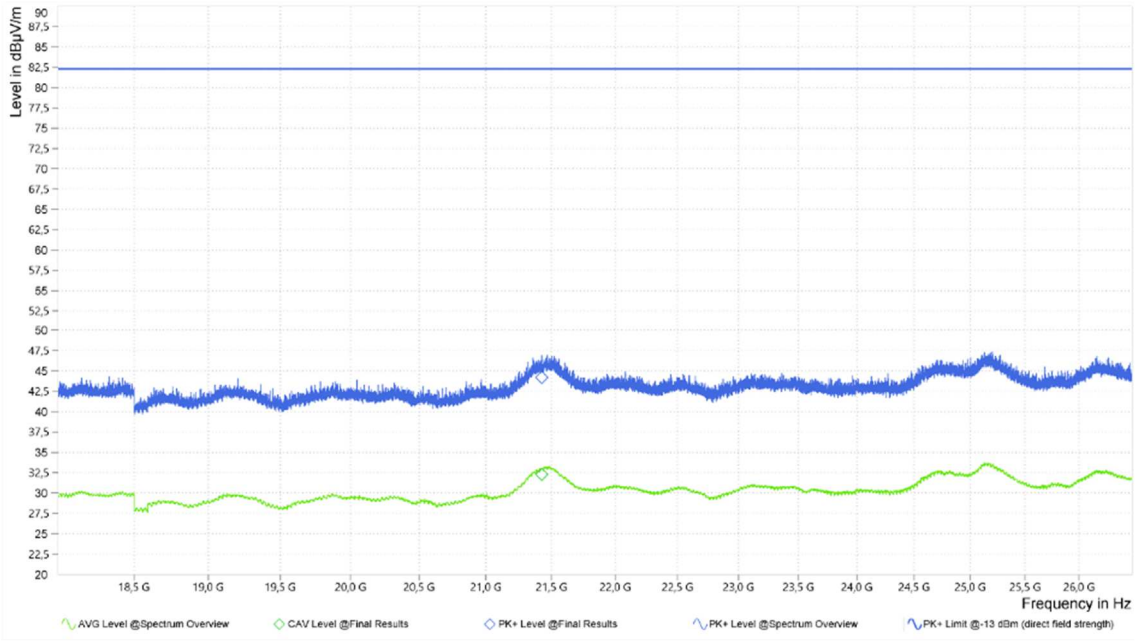
Results 200 MHz to 1 GHz



Results 1 GHz to 4 GHz



Results 4 GHz to 18 GHz



Results 4 GHz to 26.5 GHz

6.1.5 Radiated emissions - UE in traffic mode (LTE band 4)

Ambient temperature:	23 °C
Relative humidity:	37 %

Date:	17.05 – 26.05.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 20175:

Spurious emissions level								
Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1732.5	Uplink channel, no spurious							
2132.5	Downlink channel, no spurious							

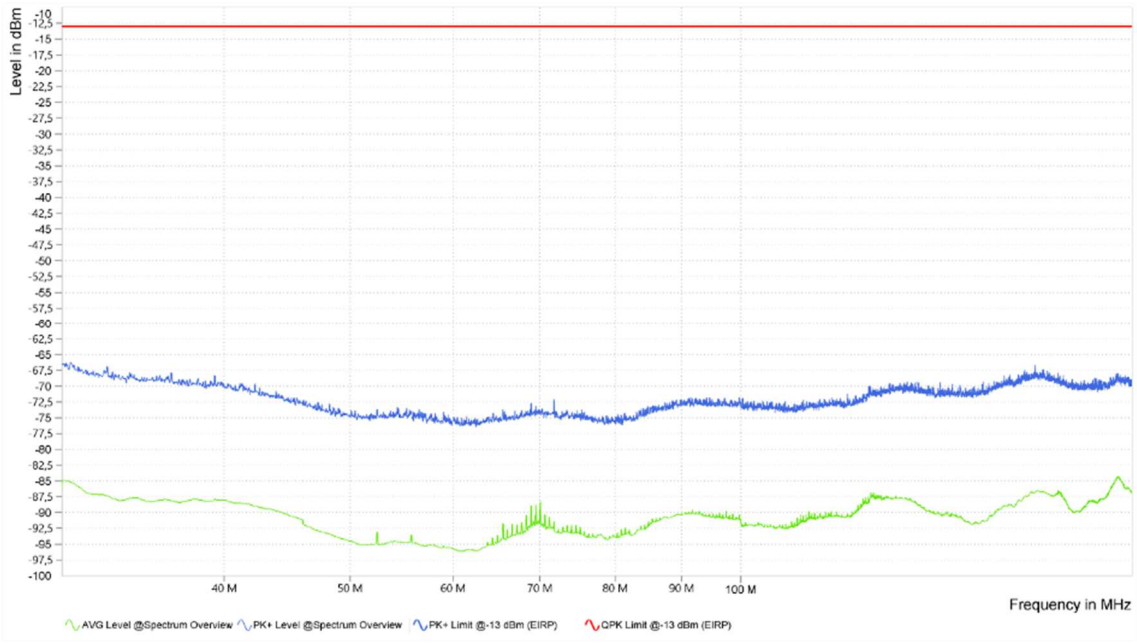
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

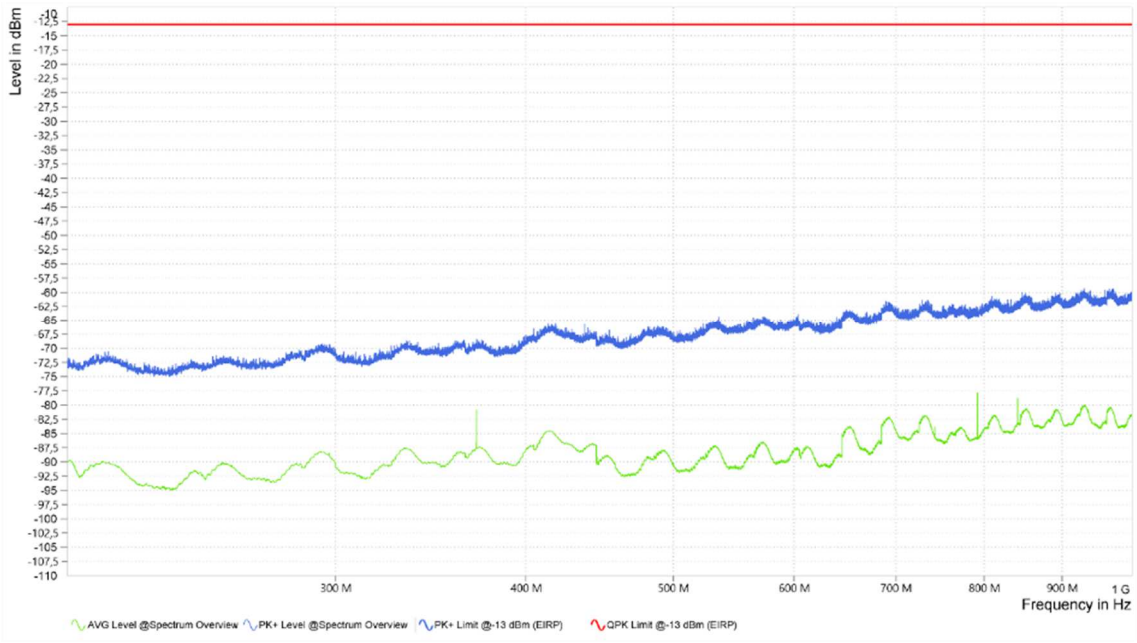
Test equipment used (see chapter 6 for details):

1 – 10, 14, 17-27

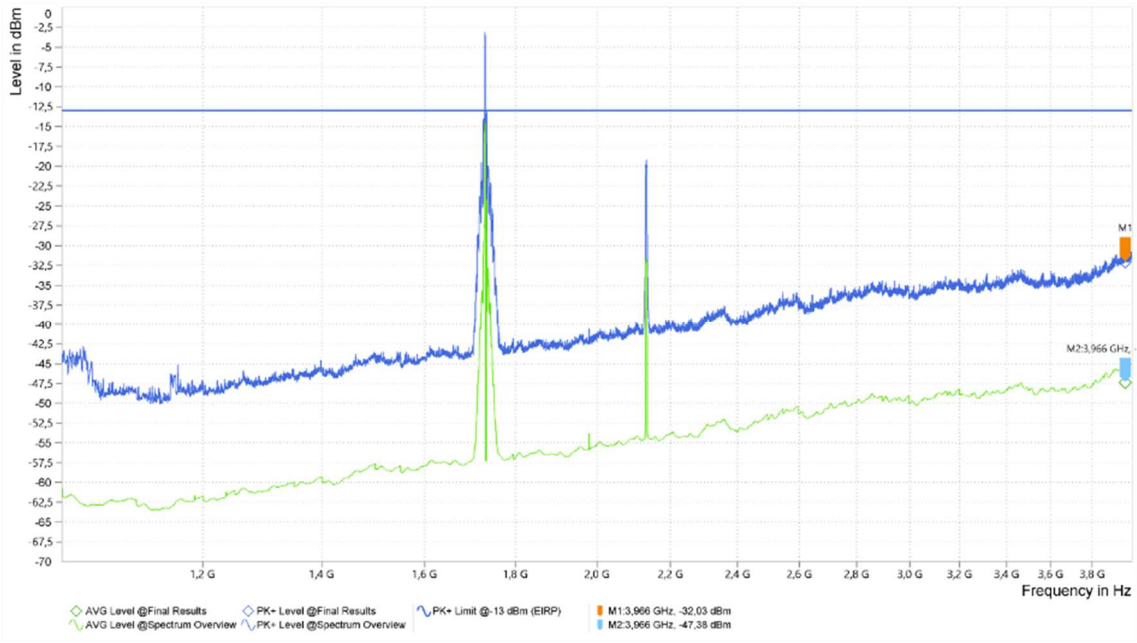
The measurement plots are shown in the following:



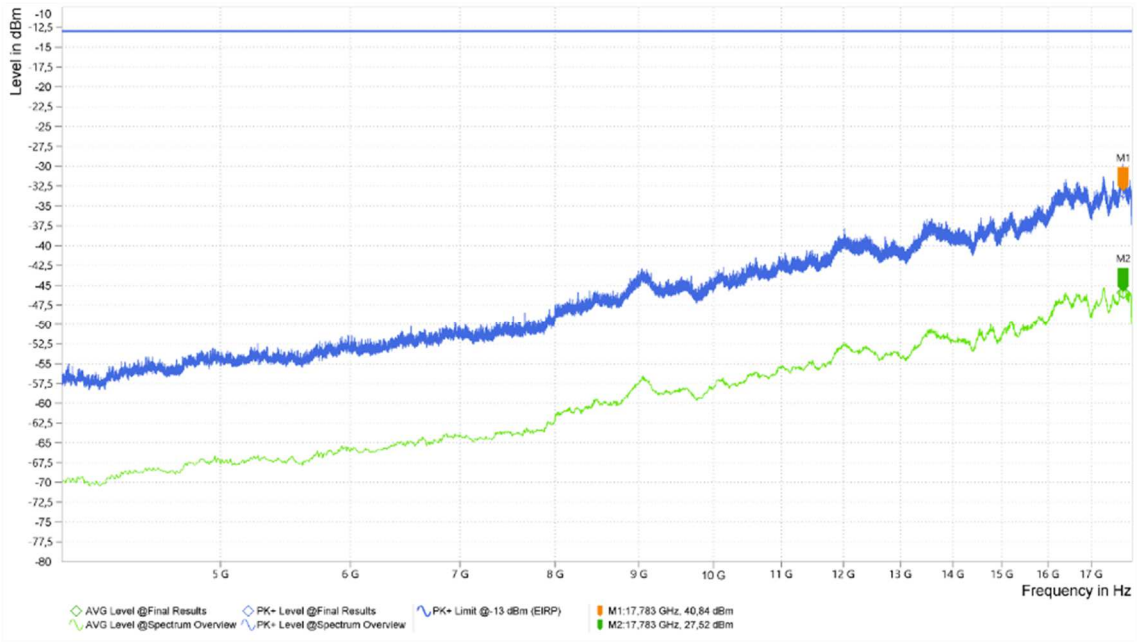
Results 30 MHz to 200 MHz



Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 18 GHz

6.1.6 Radiated emissions - UE in traffic mode (LTE band 7)

Ambient temperature:	22 °C
Relative humidity:	28 %

Date:	17.05.2023
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
2535.000	Uplink channel, no spurious							
2655.000	Downlink channel, no spurious							

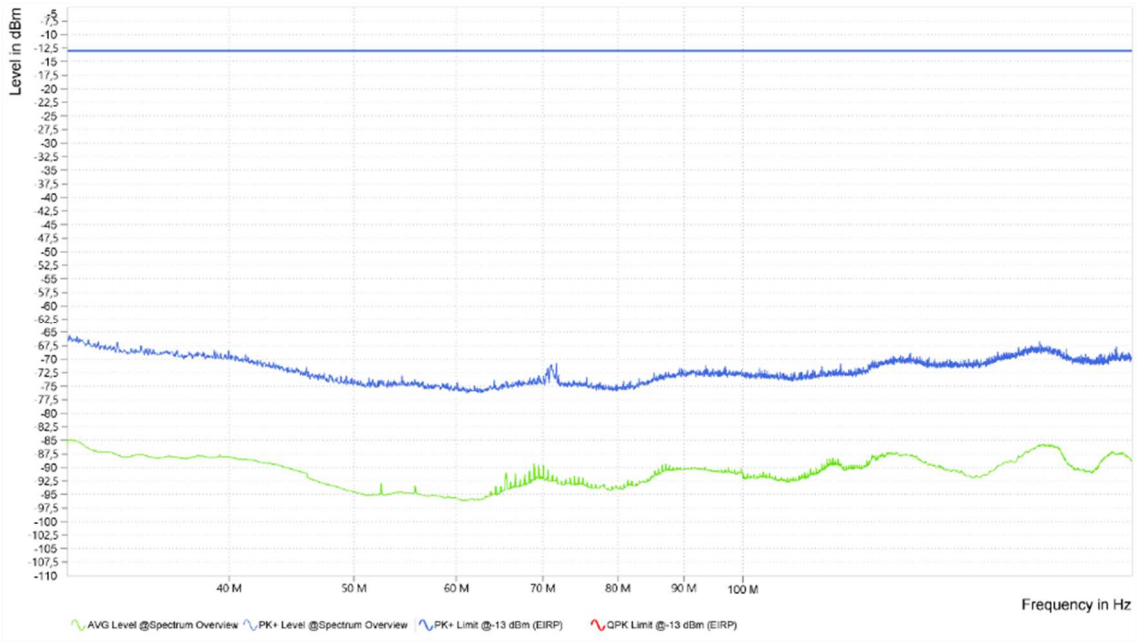
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

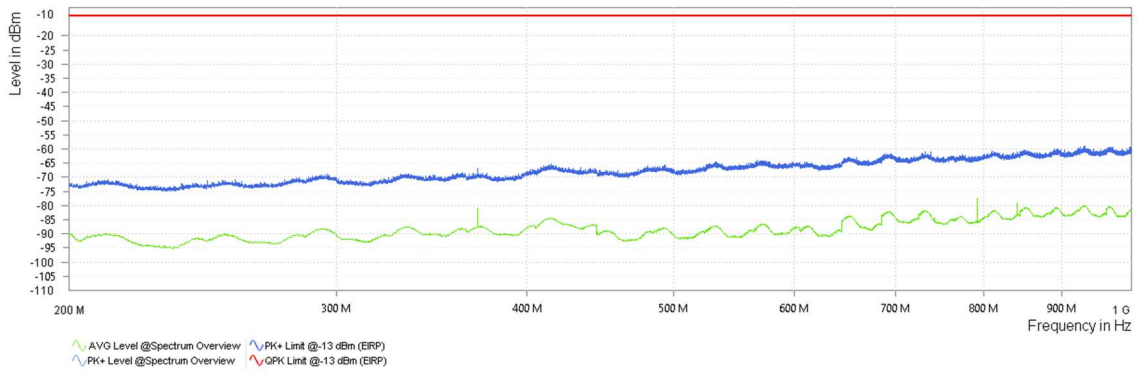
Test equipment used (see chapter 6 for details):

1 – 10, 12-15, 17-27

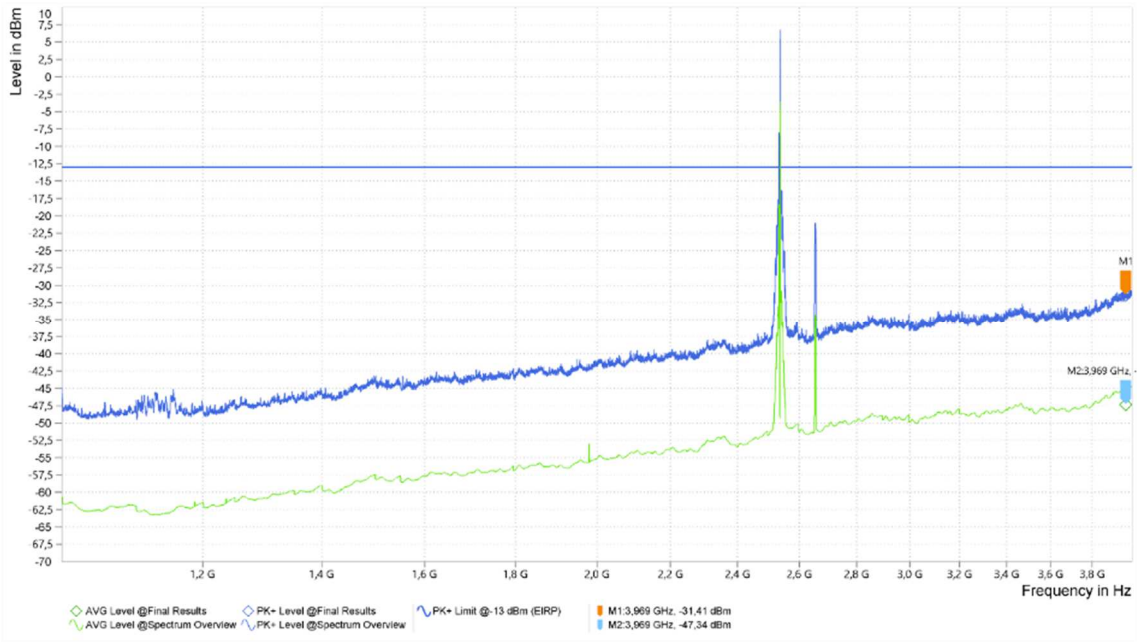
The measurement plots are shown in the following:



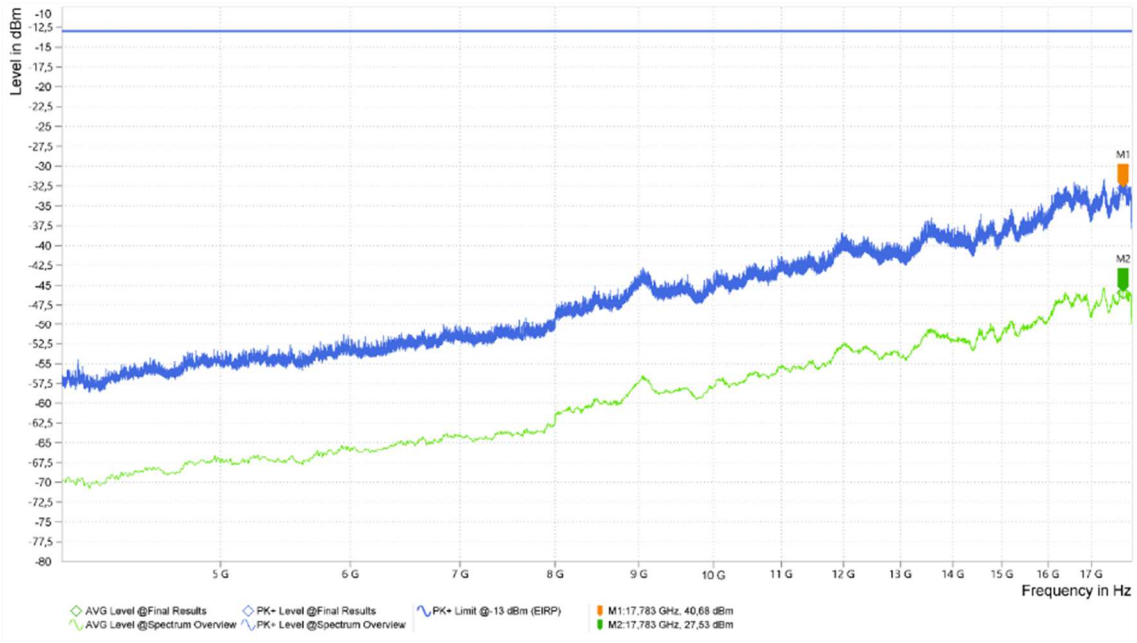
Results 30M to 200 MHz



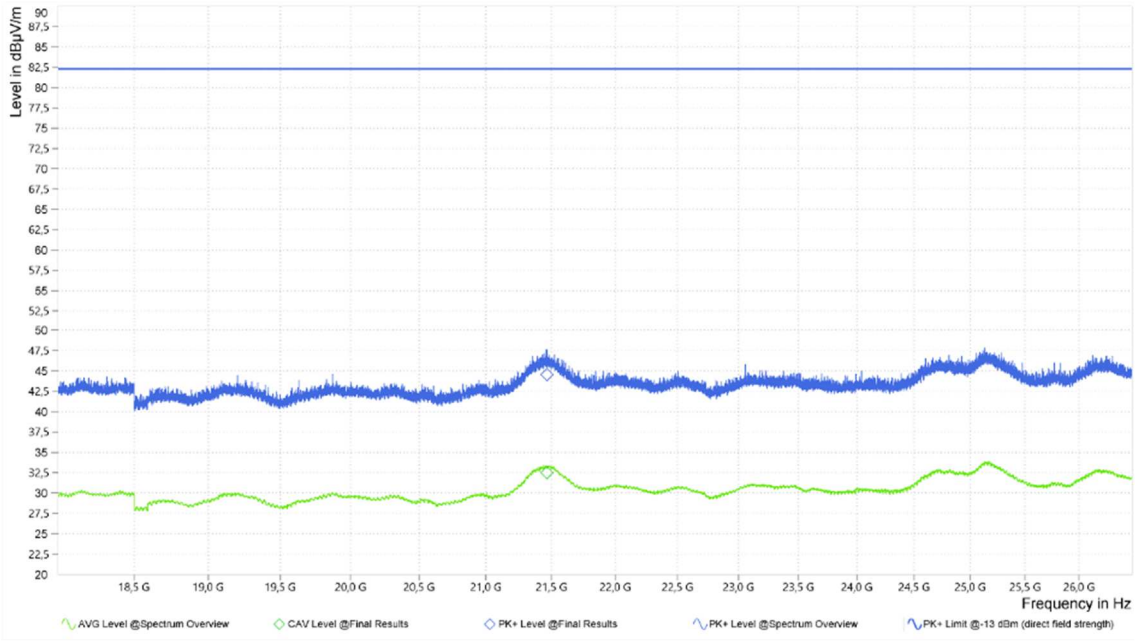
Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 18 GHz



Results 18 to 26.5 GHz

6.1.7 Radiated emissions - UE in traffic mode (LTE band 12)

Ambient temperature:	22 °C
Relative humidity:	28 %

Date:	17.05.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 23095:

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

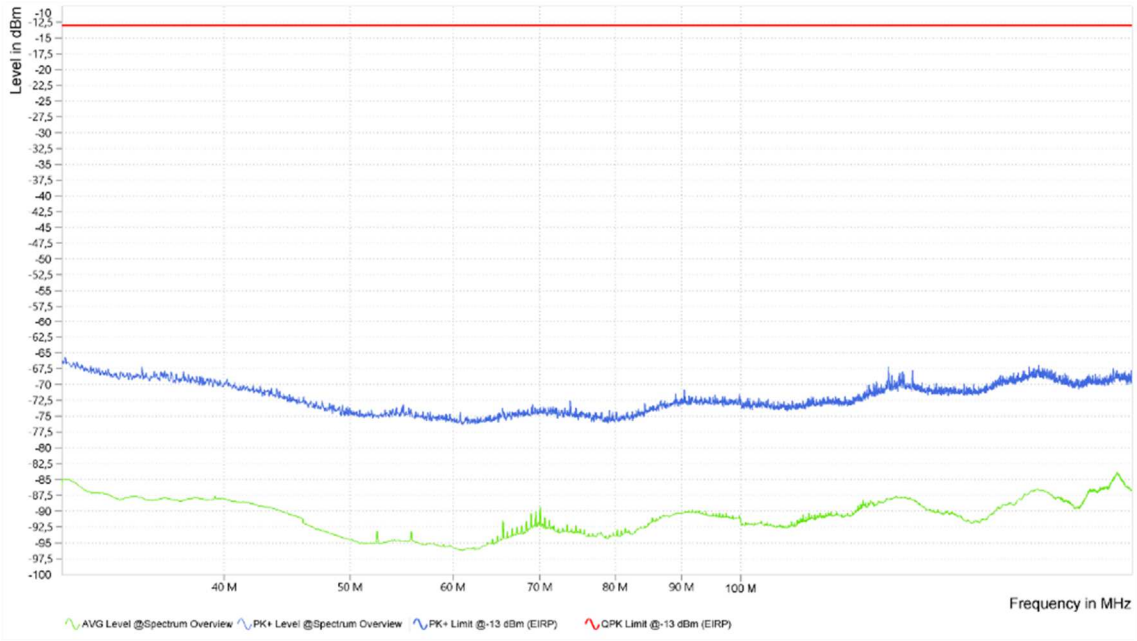
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

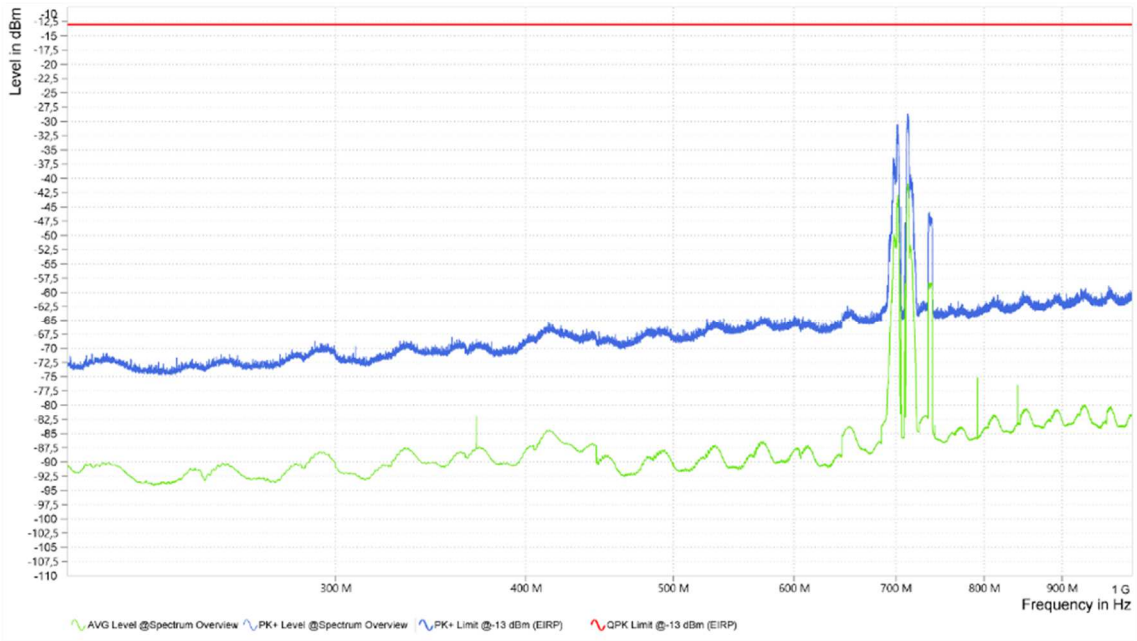
Test equipment used (see chapter 6 for details):

1 – 11, 14, 18-28

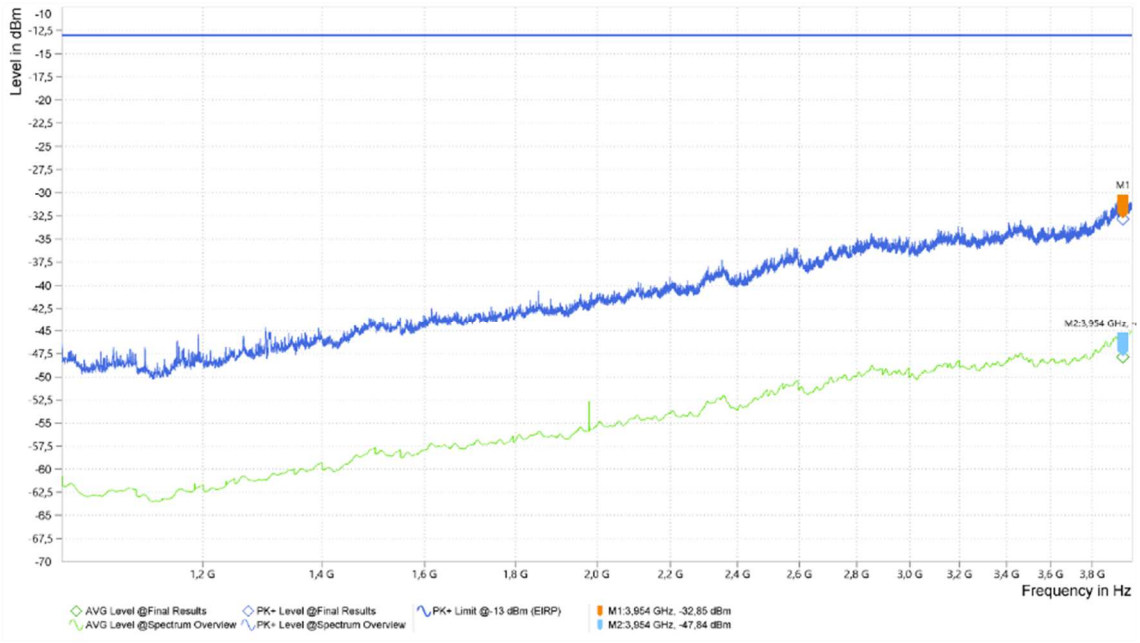
The measurement plots are shown in the following:



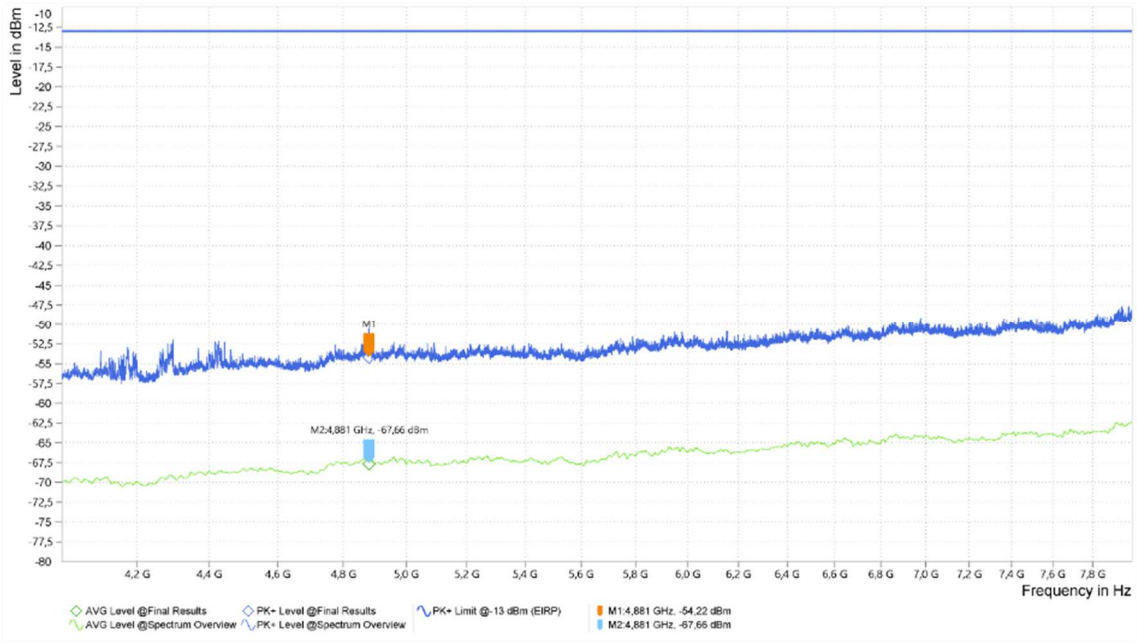
Results 30 to 200 MHz



Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 18 GHz

6.1.8 Radiated emissions - UE in traffic mode (LTE band 13)

Ambient temperature:	22 °C
Relative humidity:	28 %

Date:	17.05- 30.05.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 5230:

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

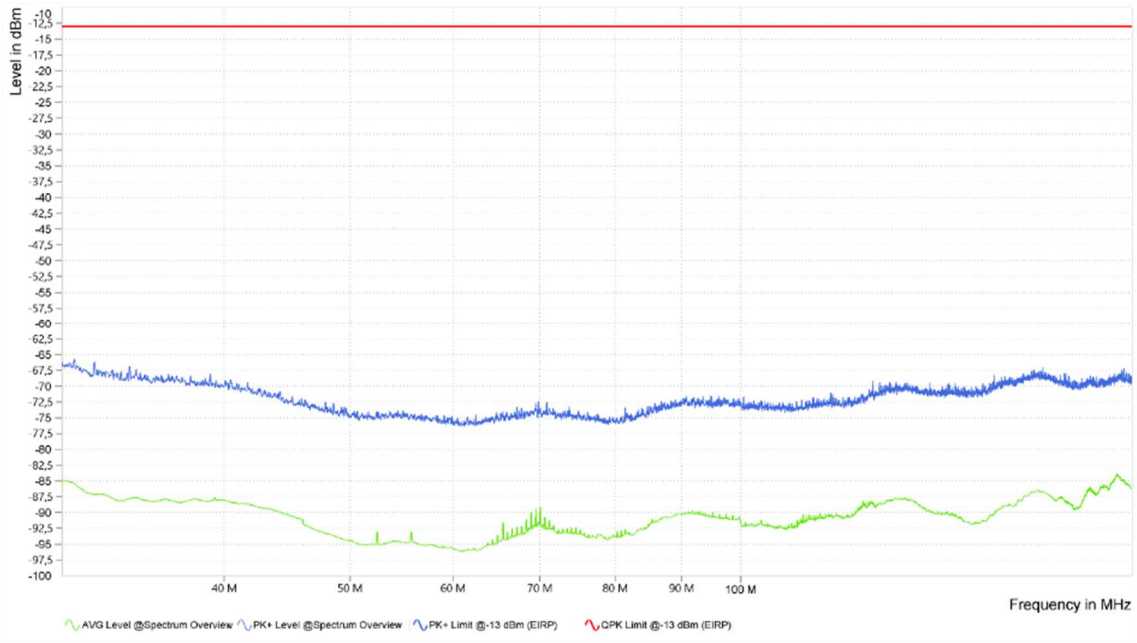
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

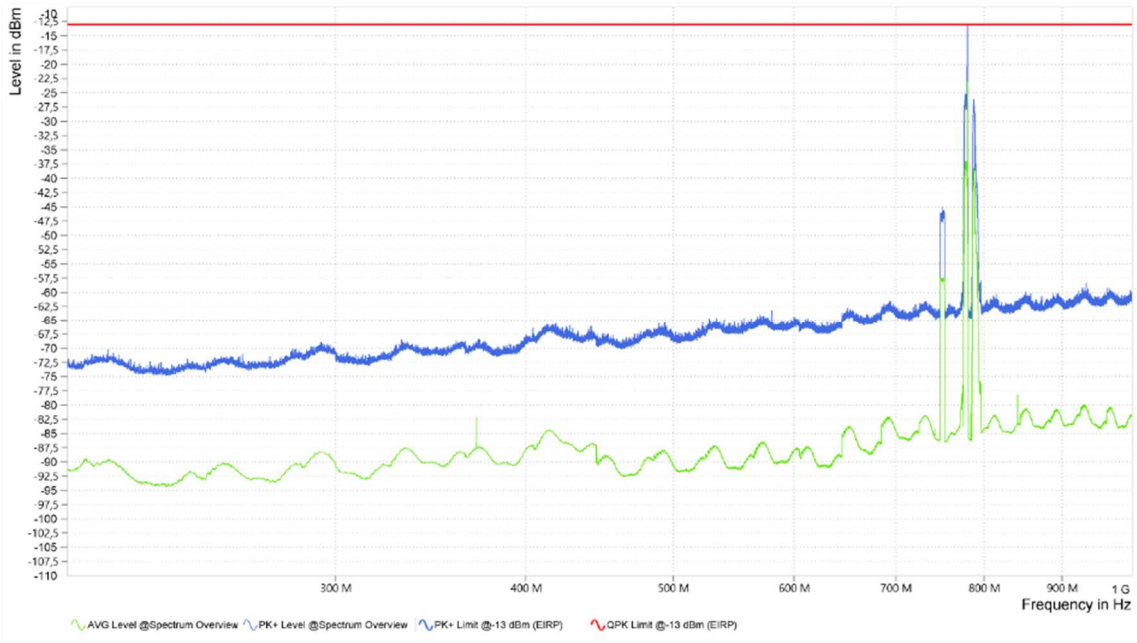
Test equipment used (see chapter 6 for details):

1 – 11, 14, 18-28

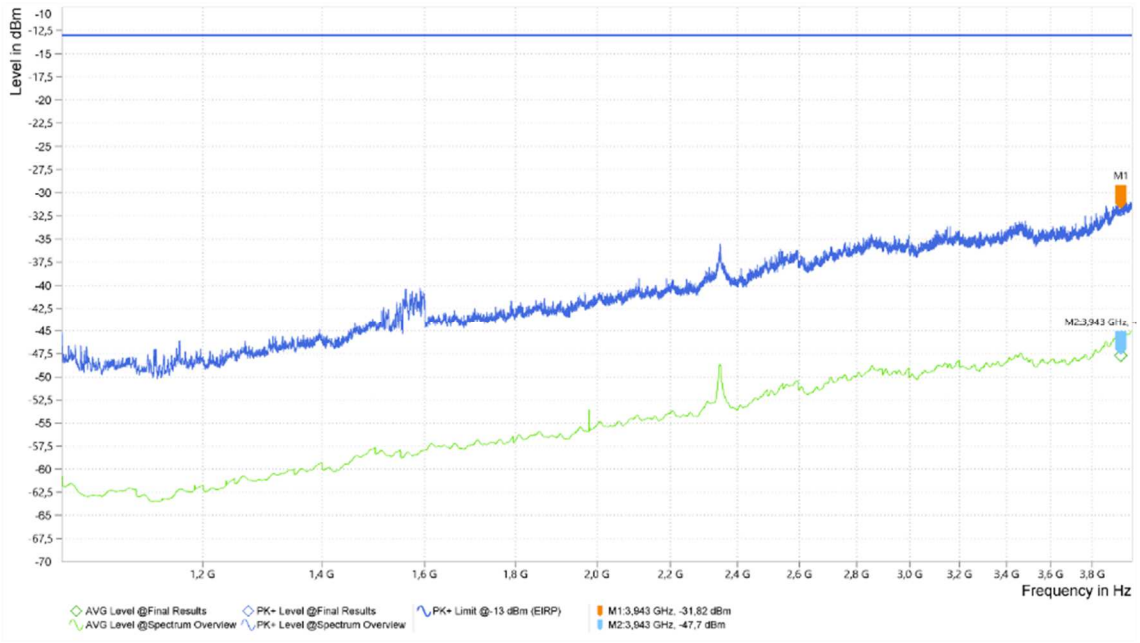
The measurement plots are shown in the following:



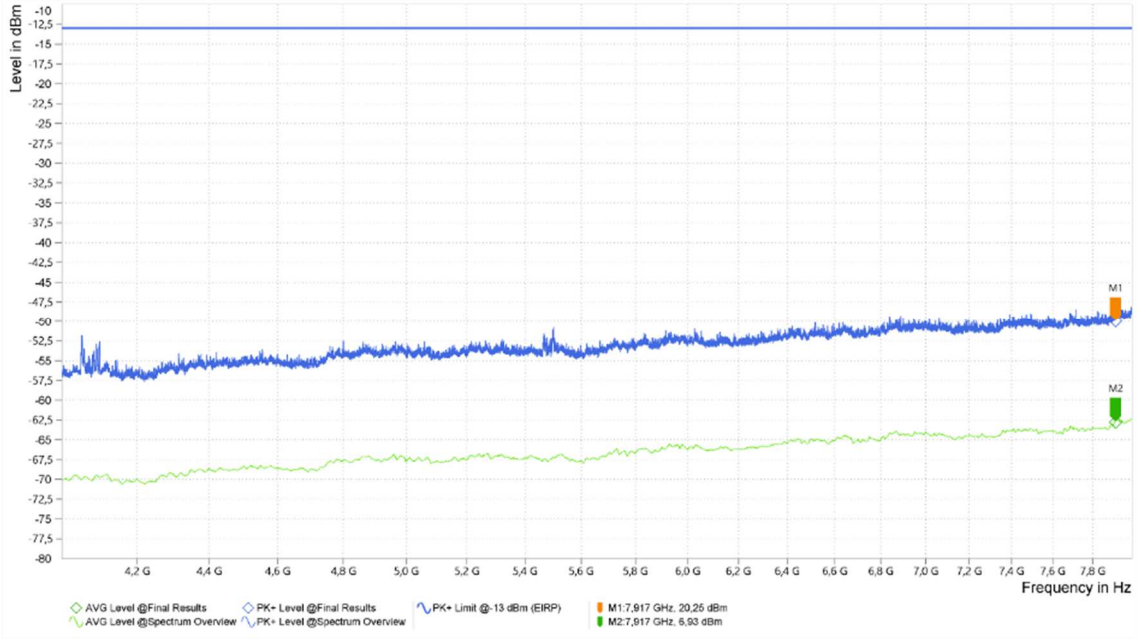
Results 30 to 200 MHz



Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 8 GHz

6.1.9 Radiated emissions - UE in traffic mode (LTE band 41)

Ambient temperature:	22 °C
Relative humidity:	28 %

Date:	17.05 – 31.05.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 40620:

Spurious emissions level								
Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2593.000	Uplink channel, no spurious							
2593.000	Downlink channel, no spurious							

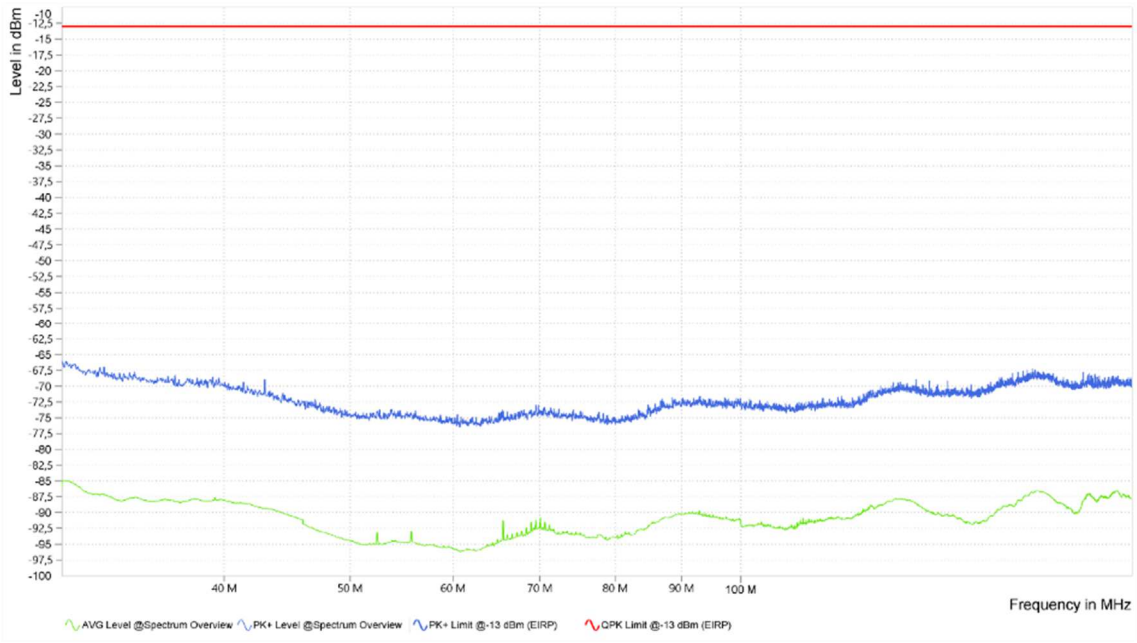
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

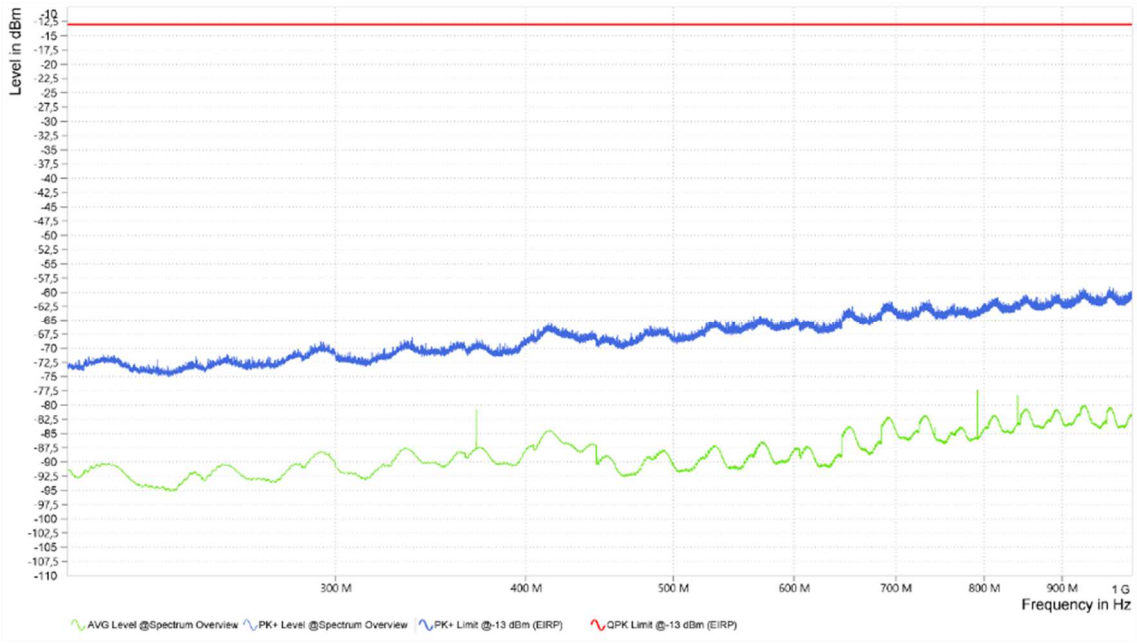
Test equipment used (see chapter 6 for details):

1 – 10, 12-15, 17-27

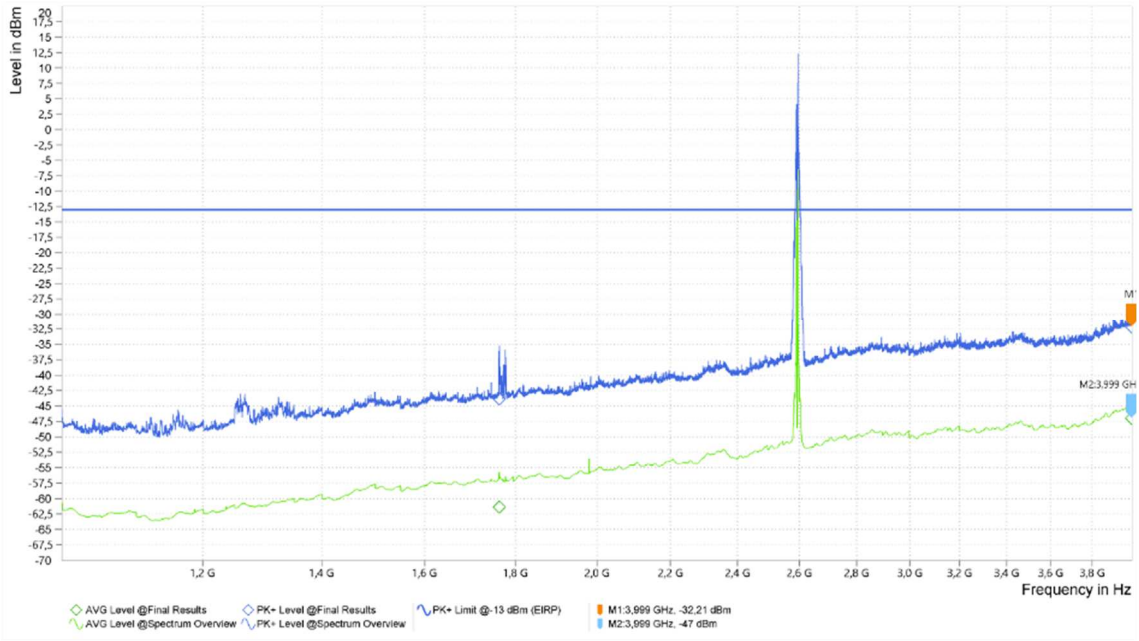
The measurement plots are shown in the following:



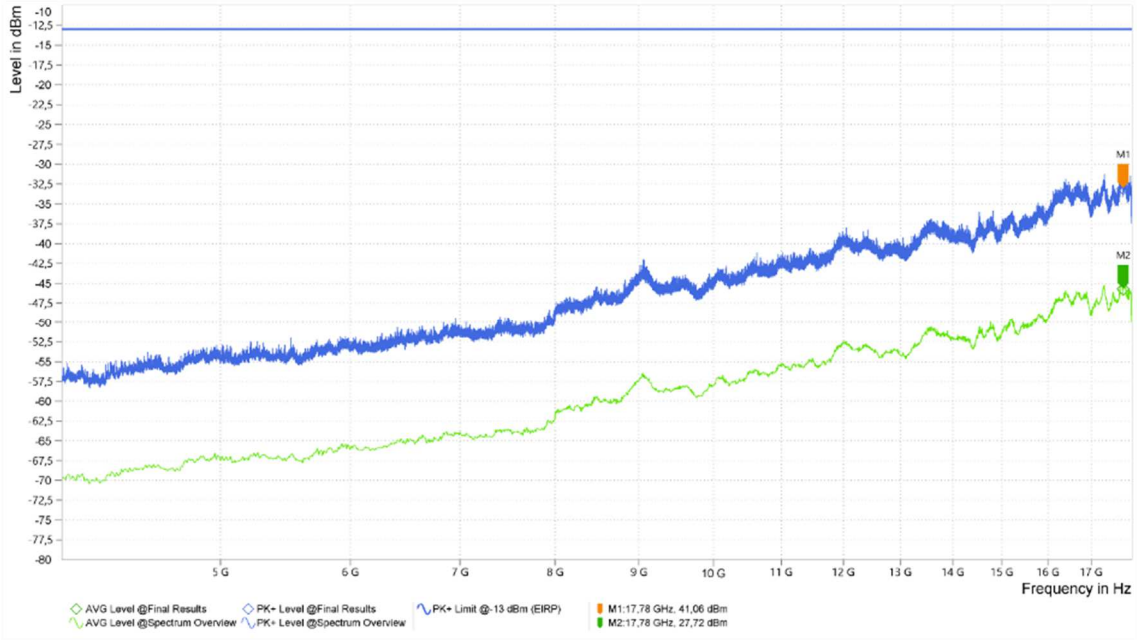
Results 30 to 200 MHz



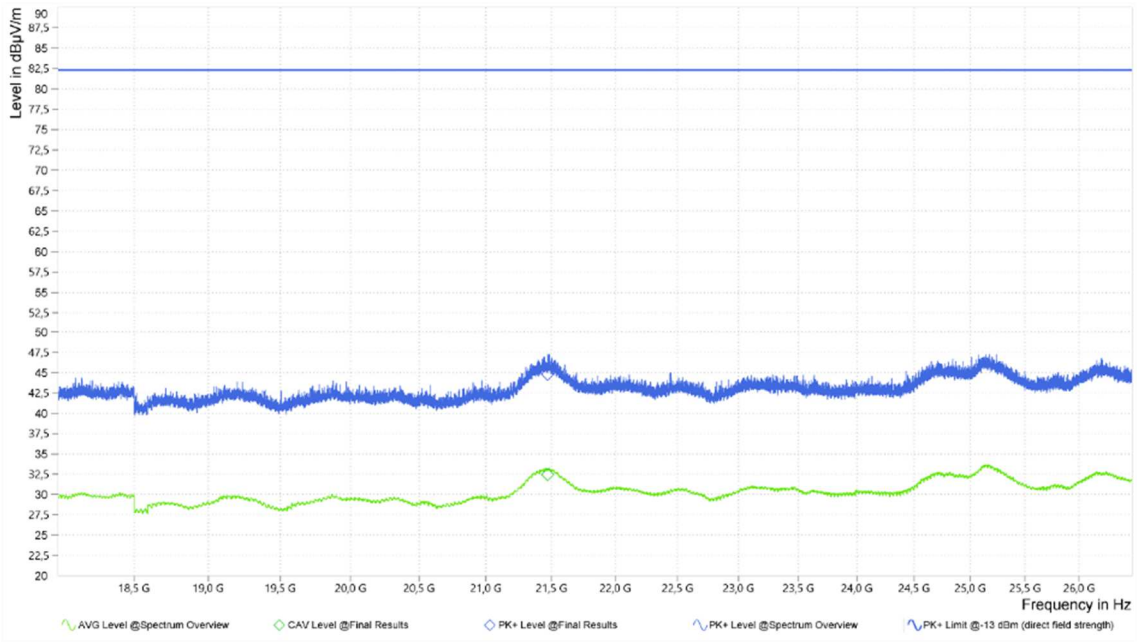
Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 18 GHz



Results 18 to 26.5 GHz

6.1.10 Radiated emissions - UE in traffic mode (LTE band 66)

Ambient temperature:	22 °C
Relative humidity:	37 %

Date:	17.05 – 26.05.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 132322:

Spurious emissions level								
Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1745.000	Uplink channel, no spurious							
2145.000	Downlink channel, no spurious							

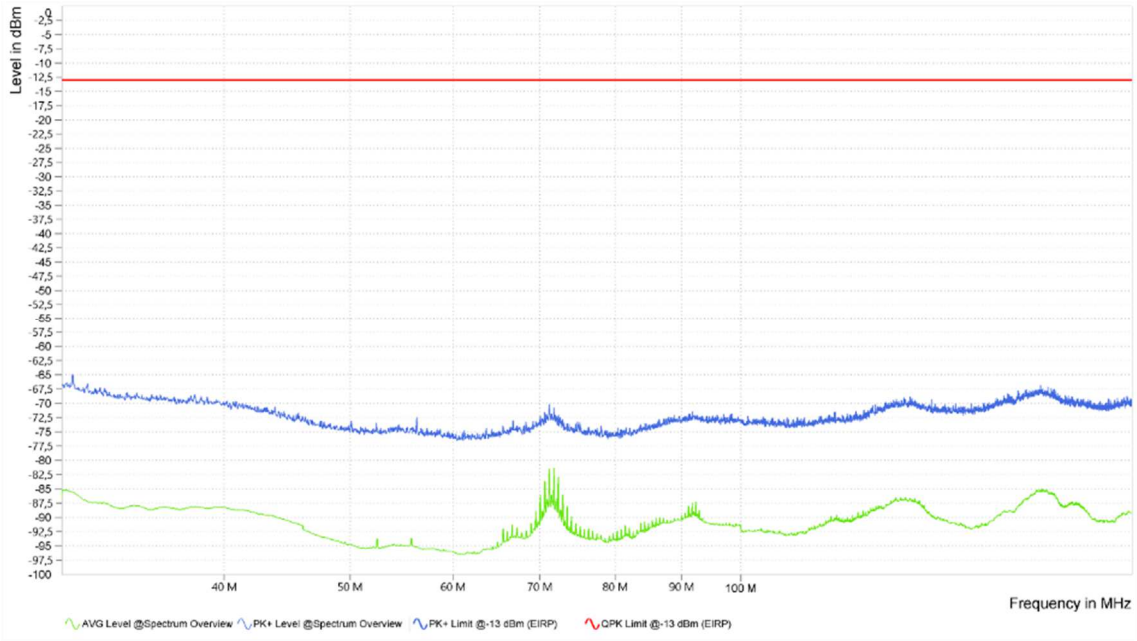
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

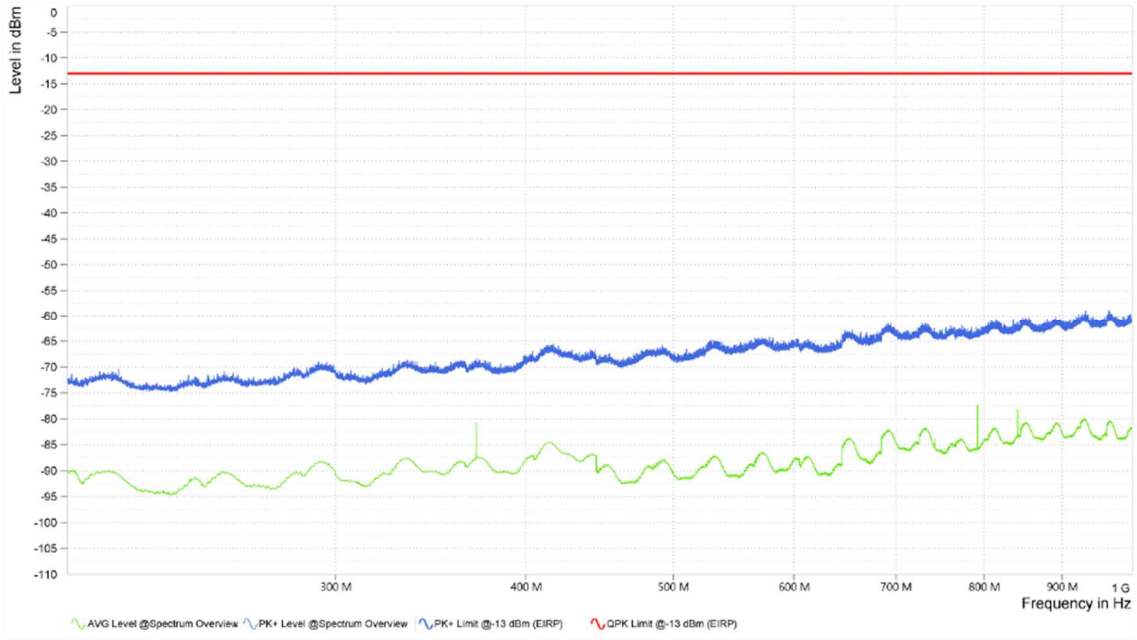
Test equipment used (see chapter 6 for details):

1 – 10, 14, 17-27

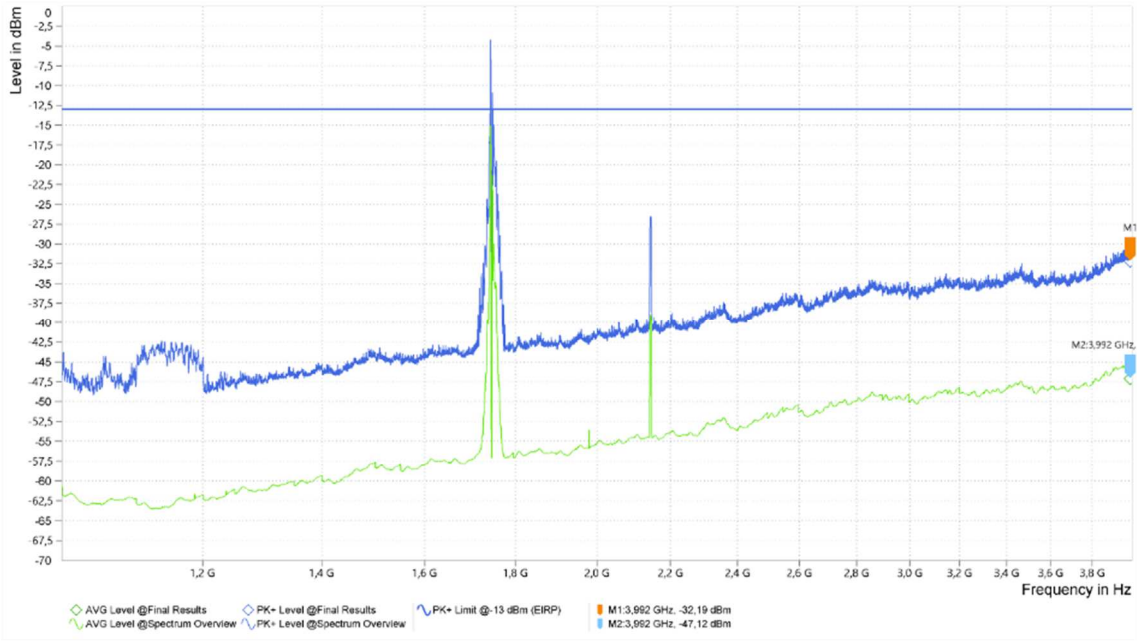
The measurement plots are shown in the following:



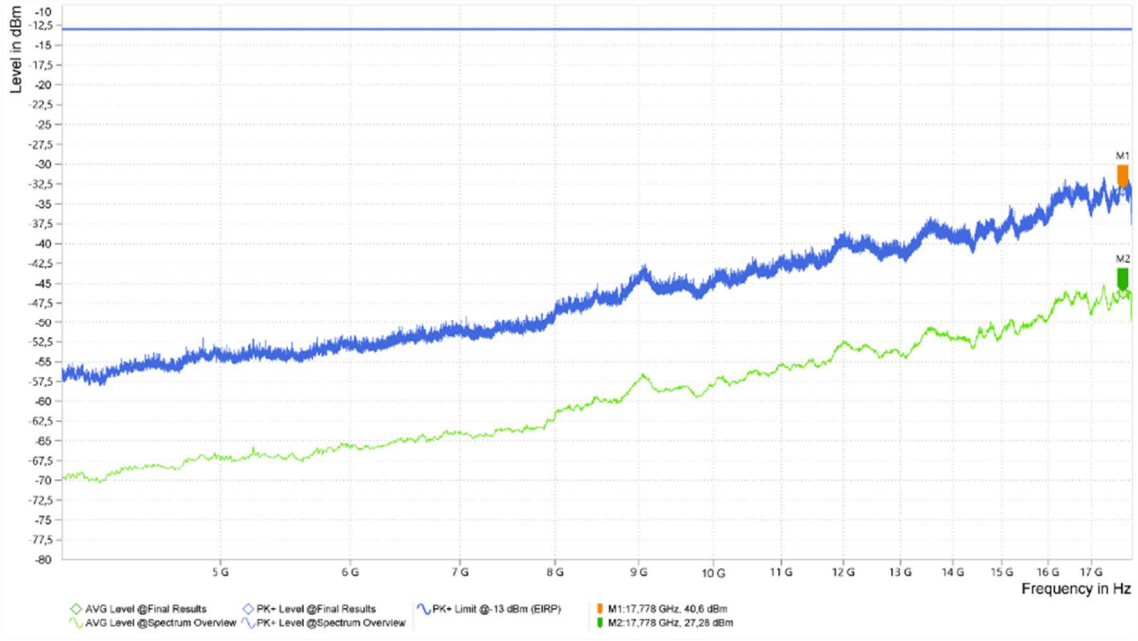
Results 30 to 200 MHz



Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 18 GHz

6.1.11 Radiated emissions - UE in traffic mode (LTE band 71)

Ambient temperature:	22 °C

Date:	17.05 – 30.05.2023

Relative humidity:	39 %	Tested by:	Y. KHALEK

Measurement at uplink channel 133297:

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

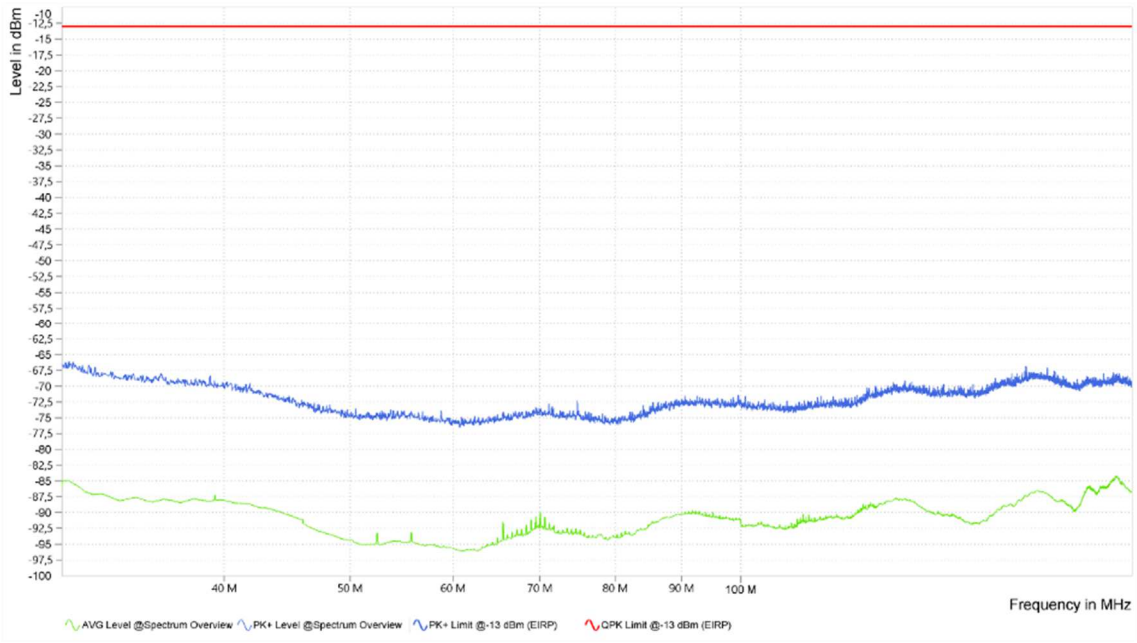
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

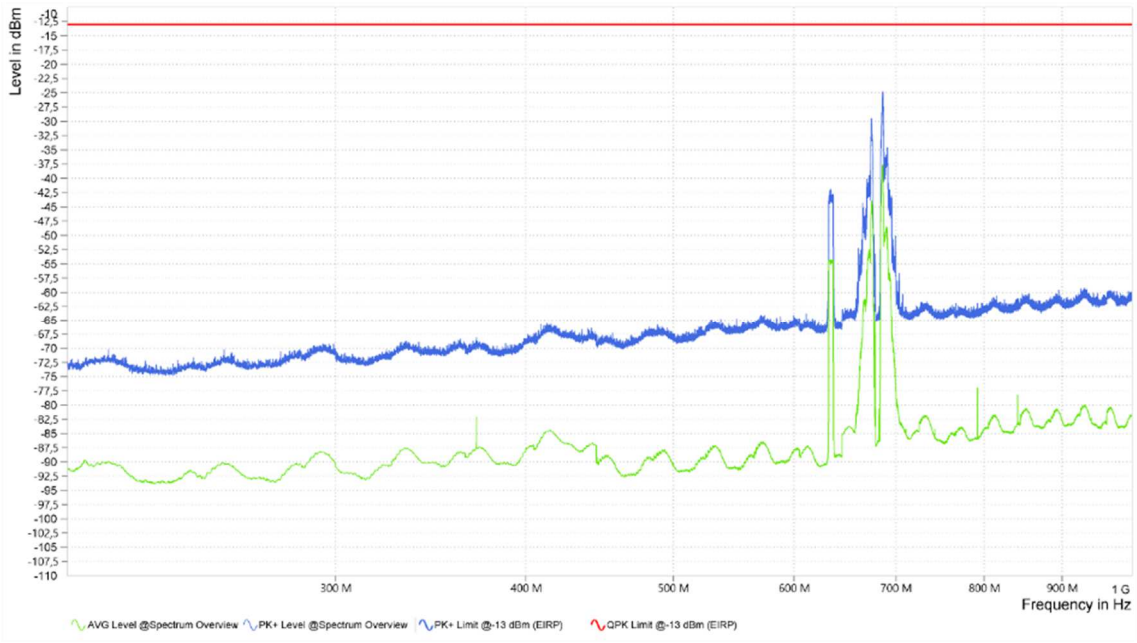
Test equipment used (see chapter 6 for details):

1 – 11, 14, 18-28

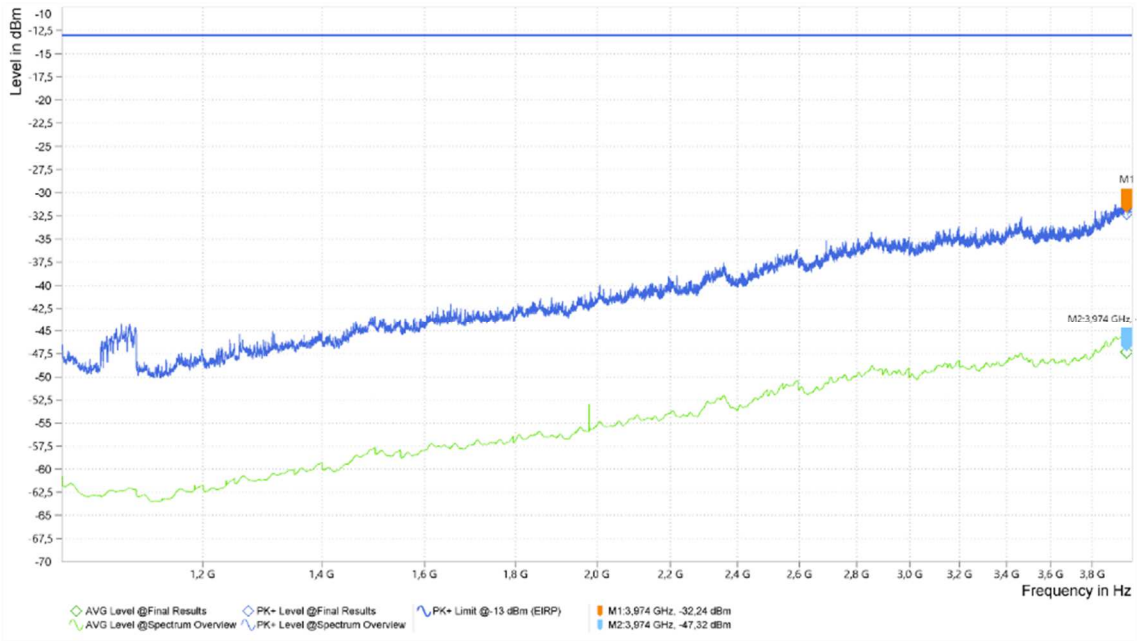
The measurement plots are shown in the following:



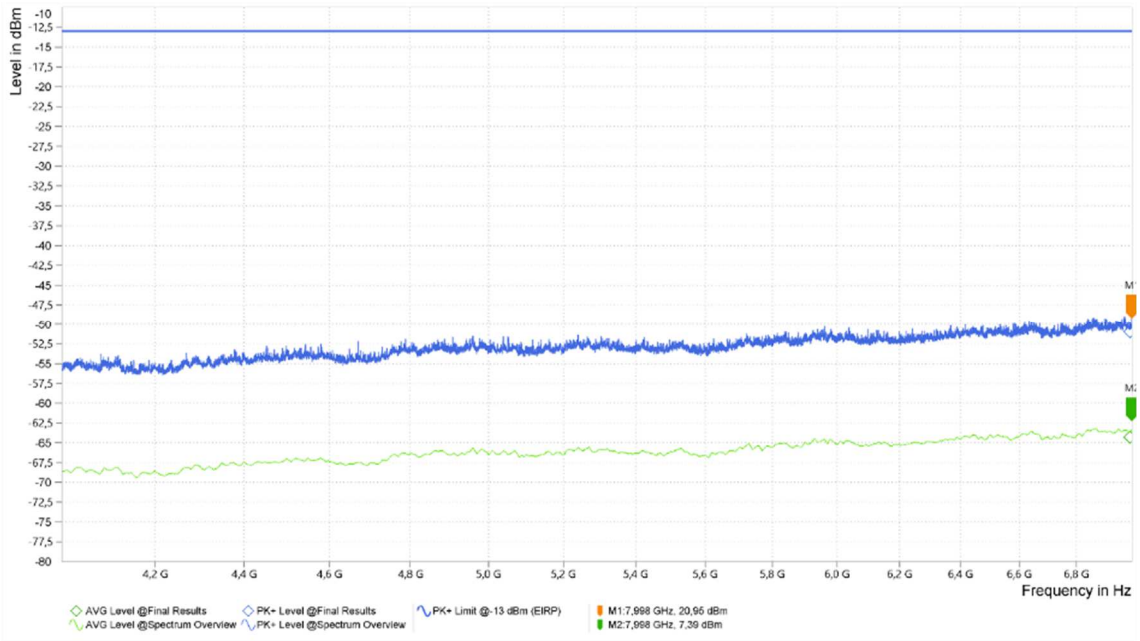
Results 30 MHz to 200 MHz



Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 GHz to 8 GHz

6.1.12 Simultaneous Transmission measurement

6.1.12.1 Radiated emissions – UE in traffic mode (PCS1900) and WLAN

Ambient temperature:	22 °C
Relative humidity:	67 %

Date:	24.07-26.07.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 18900 and WLAN Ch. 1 mode b:

Spurious emissions level								
Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1880.000	Uplink channel, no spurious							
1960.000	Downlink channel, no spurious							
2412.000	WLAN channel, no spurious							

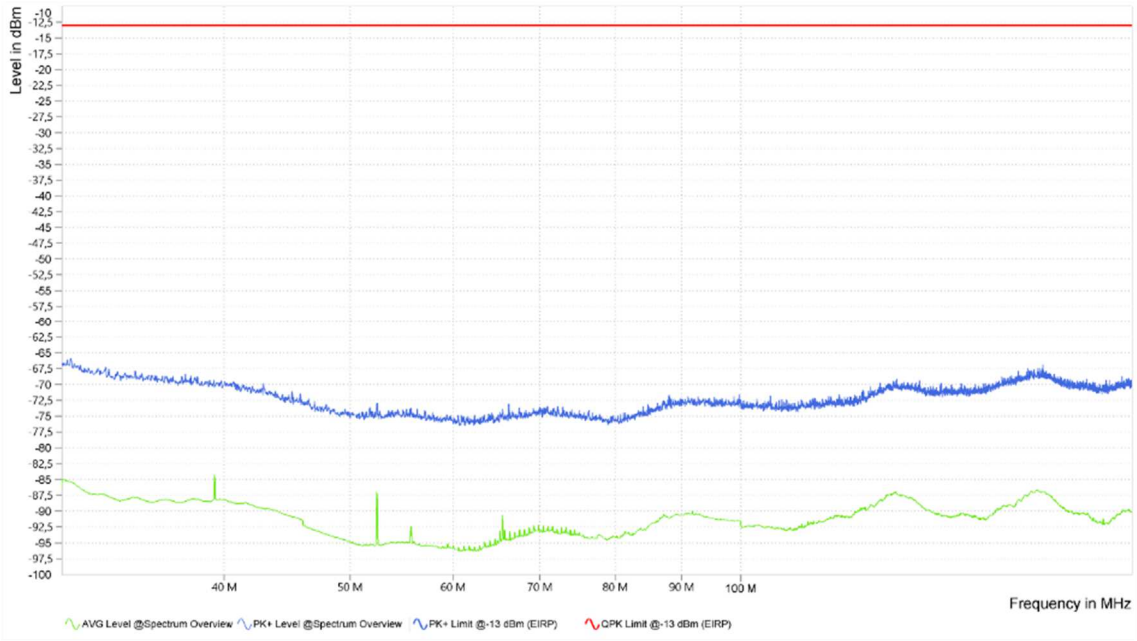
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

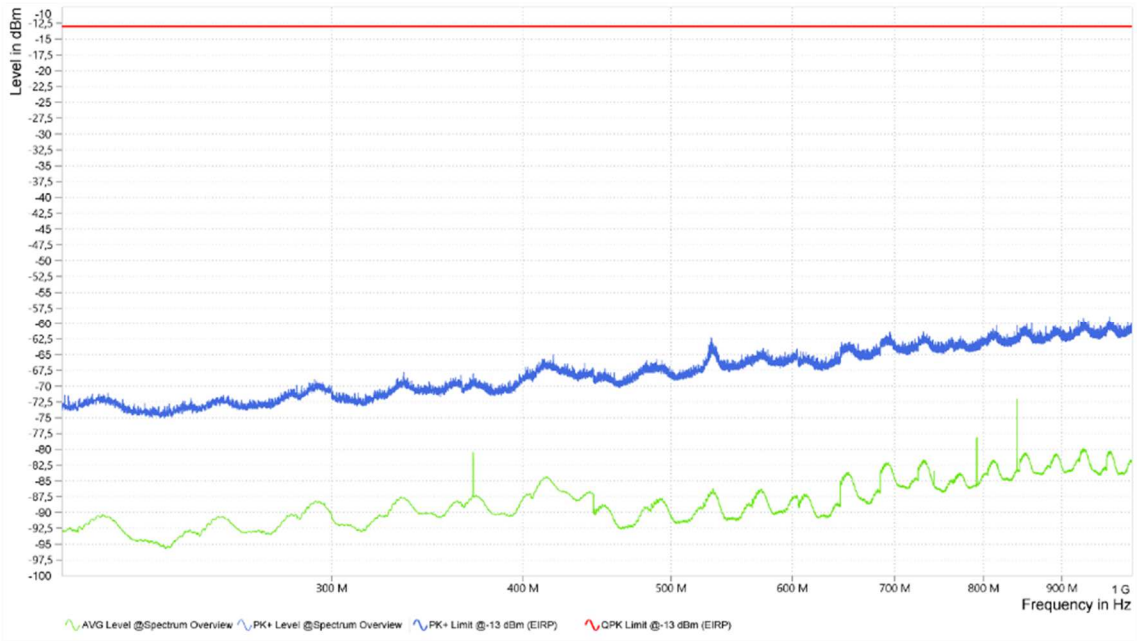
Test equipment used (see chapter 6 for details):

1 – 10, 12-14, 16, 18-27

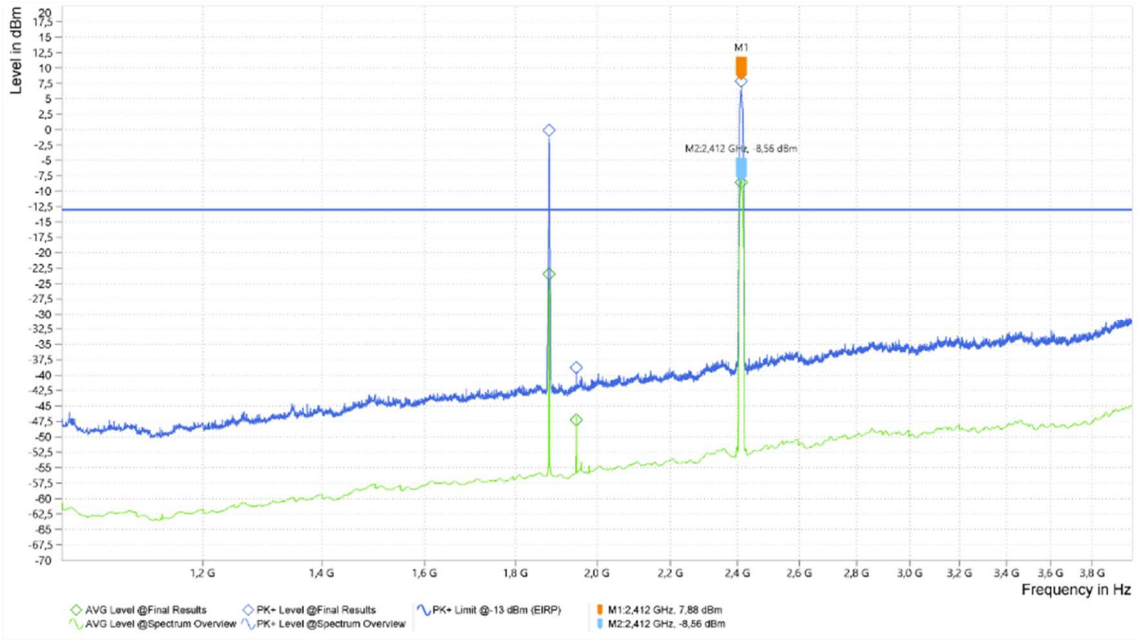
The measurement plots are shown in the following:



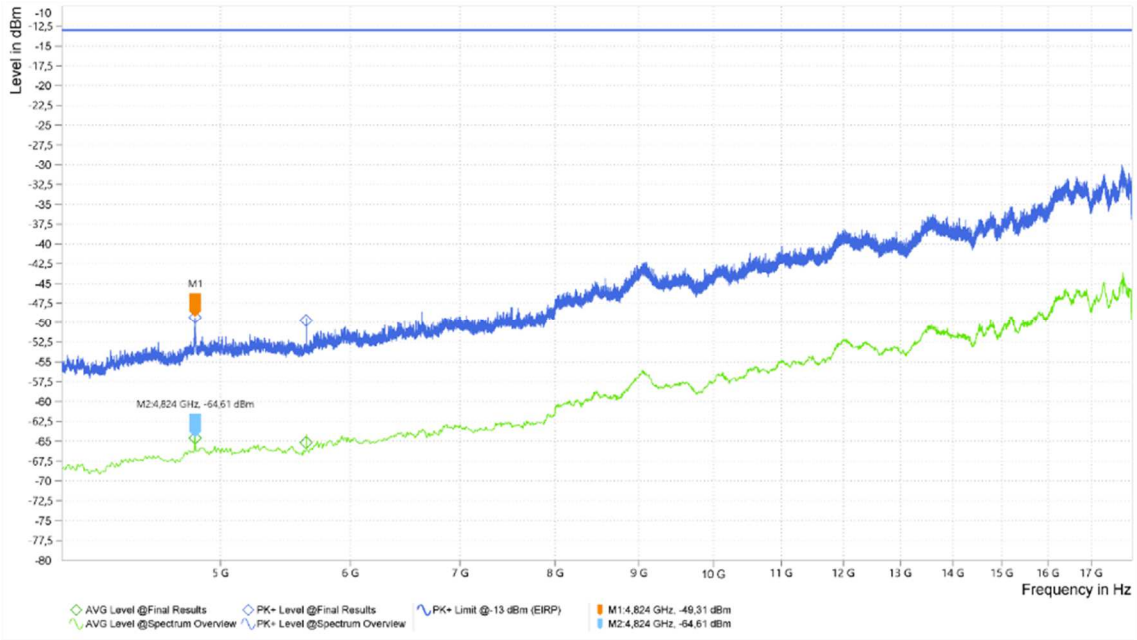
Results 30 MHz to 200 MHz



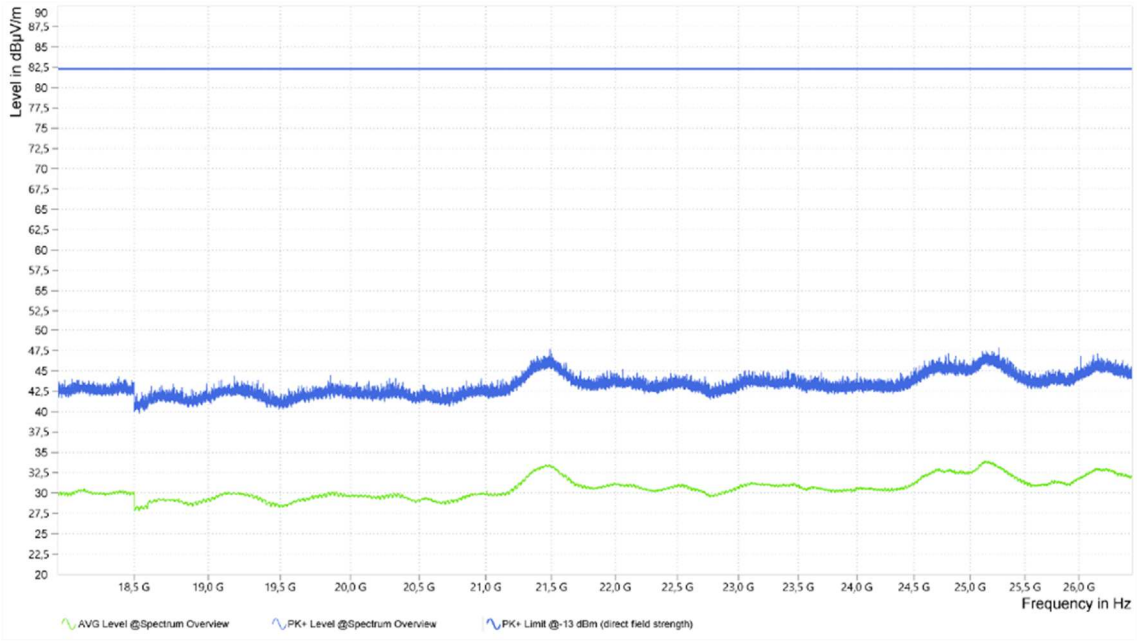
Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 18 GHz



Results 18 to 26.5 GHz

6.1.12.2 Radiated emissions - UE in traffic mode (LTE Bd 7) and WLAN

Ambient temperature:	22 °C
Relative humidity:	67 %

Date:	24.07-26.07.2023
Tested by:	Y. KHALEK

Measurement at uplink channel 21100 and WLAN Ch. 1 mode b:

Spurious emissions level								
Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
2535.000	Uplink channel, no spurious							
2655.000	Downlink channel, no spurious							
2412.000	WLAN channel, no spurious							

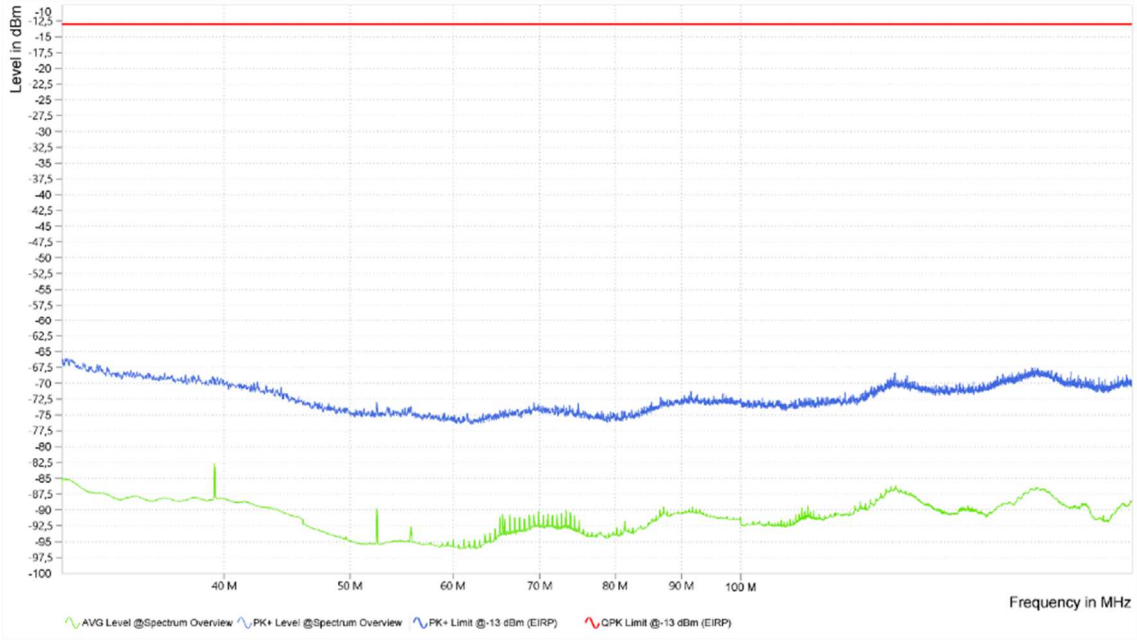
Limit: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

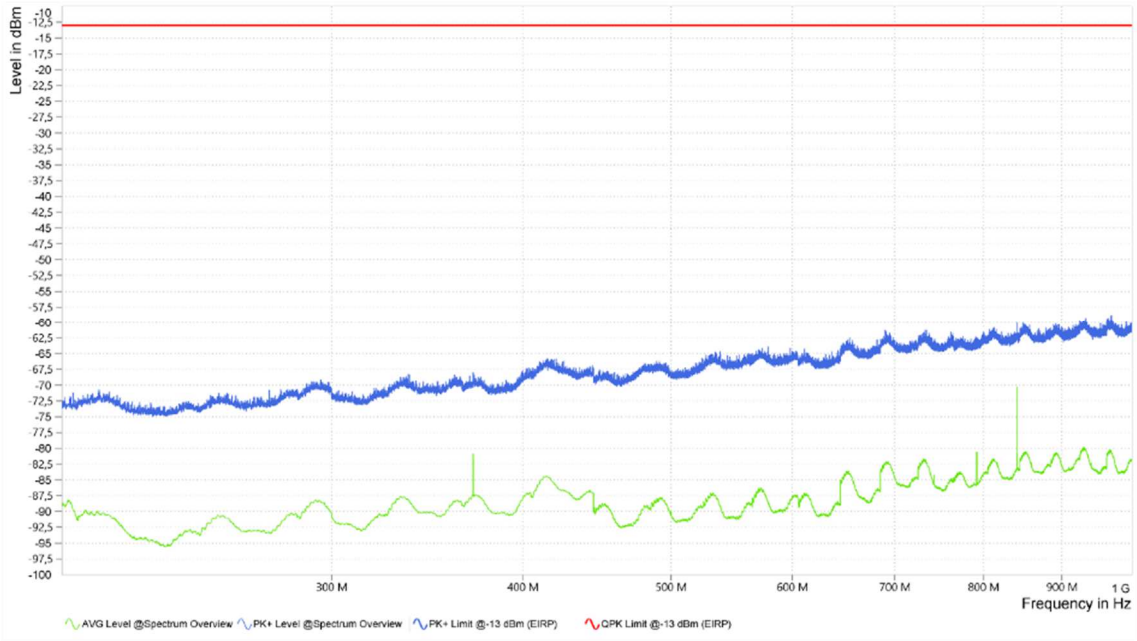
Test equipment used (see chapter 6 for details):

1 – 10, 12-15, 17-27

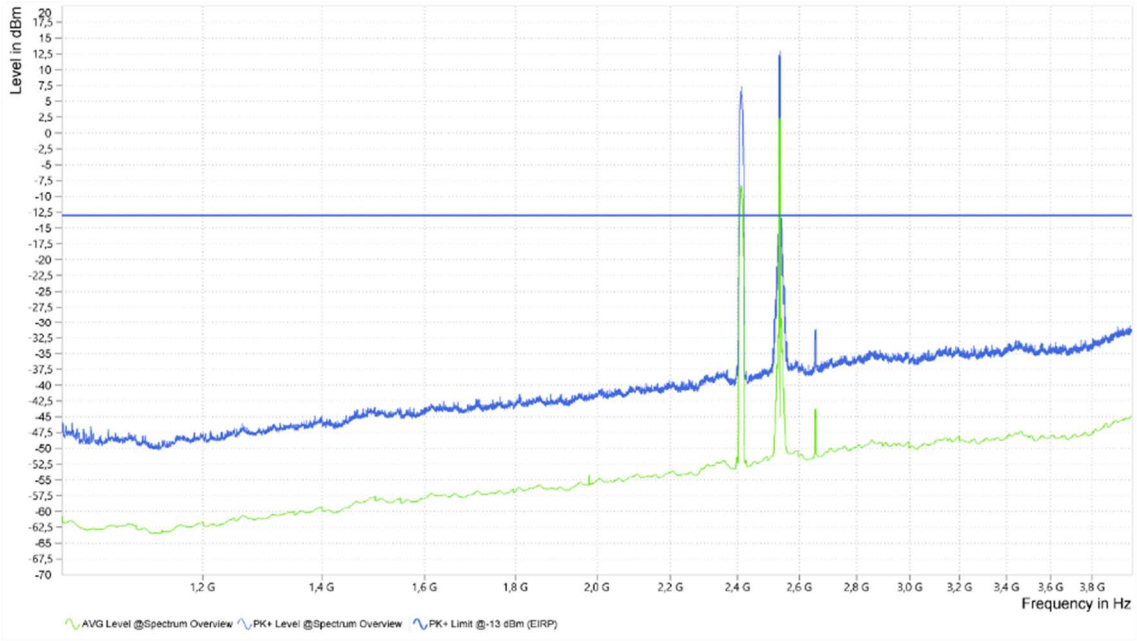
The measurement plots are shown in the following:



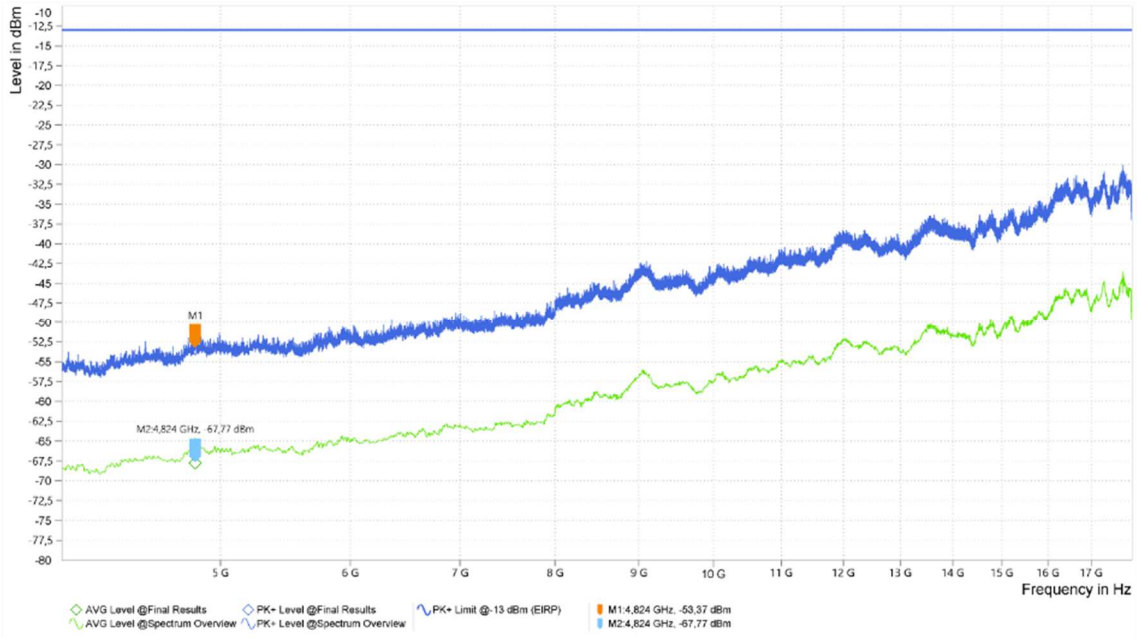
Results 30M to 200 MHz



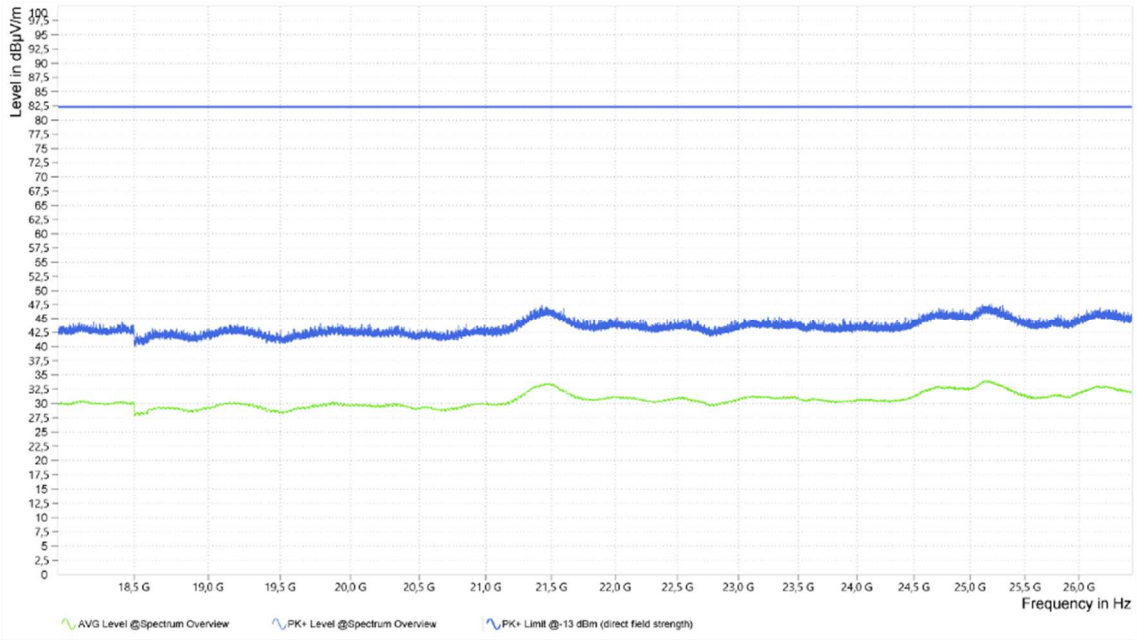
Results 200 MHz to 1 GHz



Results 1 to 4 GHz



Results 4 to 18 GHz



Results 18 to 26.5 GHz

7 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

8 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 GmbH	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 GmbH	-	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	ZVA 40	Rohde & Schwarz	100298	481538	17.02.2022	02.2024
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 GmbH	-	482012	Calibration not necessary	
29	Tunable Band Reject Filter	WRCT 1850/2170-5/40-10EESD	Wainwright Instruments GmbH	1	480715	Calibration not necessary	

9 Test site Verification

Test equipment	PM. No.	Frequency range	Type of validation	According to	Val. Date	Val Due
Semi anechoic chamber M276	483227	30 – 1000 MHz	NSA/RSM	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	01.03.2023	01.03.2025
Semi anechoic chamber M276	483227	1 -18 GHz	SVSWR	CISPR 16-1-4 + Cor1:2010 + A1:2012 +A2:2017	28.02.2023	28.02.2025

10 Report History

Report Number	Date	Comment
F222063E1	30.01.2024	Initial Test Report
F222063E1 2nd version	14.02.2024	Minor changes: - Editorial changes and correction of typing errors in pages.2, 7, 12, 24 of 62 - Added additional antenna gain information in page 7 - Added correct PMN and HMN
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11 List of Annexes

Annex A	Test Setup Photos	5 pages
Annex B	EUT Photos	3 pages