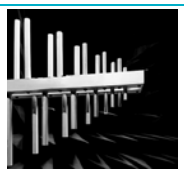
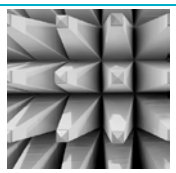

CTC advanced
member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

TEST REPORT

Test report no.: 1-2337/21-01-17

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Applicant

Sontheim Industrie Elektronik GmbH
Georg-Krug-Straße 2
87437 Kempten / GERMANY
Phone: +49 (0) 831 5759 0032
Contact: Roland Mader
e-mail: Roland.Mader@s-i-e.de

Manufacturer

Sontheim Industrie Elektronik GmbH
Georg-Krug-Straße 2
87437 Kempten / GERMANY

Test standard/s

FCC - Title 47 CFR Part 22	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 22 - Public mobile services
FCC - Title 47 CFR Part 24	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 24 - Personal communications services

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**Telematic Interface Gerät**
Model name:	**VERONA GEN4**
FCC ID:	**2AGFACOMHAWKXT04**
ISED certification number:	**20746-COMHAWKXT04**
Frequency:	WCDMA band 2; 4 and 5
Technology tested:	WCDMA
Antenna:	External antenna
Power supply:	12 V / 24 V DC by external power supply
Temperature range:	-40°C to +85°C

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

Test report authorized:

cn=Rene Oelmann, o=CTC advanced GmbH, ou=OEL-171123, email=rene.oelmann@ctcadvanced.com, c=DE
2022.04.11 12:26:44 +02'00'

René Oelmann
Lab Manager
Radio Communications

Test performed:

cn=Marco Bertolino, o=CTC advanced GmbH, ou=BTL-211209, email=marco.bertolino@ctcadvanced.com, c=DE
2022.04.11 13:20:07 +02'00'

Marco Bertolino
Lab Manager
Radio Communications

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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CTC advanced GmbH.
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In no case this test report can be considered as a Letter of Approval.

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

2.2 Application details

Date of receipt of order:	2021-12-09
Date of receipt of test item:	2022-02-15
Start of test:*	2022-02-15
End of test:*	2022-03-01
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

None

3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 22	-/-	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 22 - Public mobile services
FCC - Title 47 CFR Part 24	-/-	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 24 - Personal communications services
FCC - Title 47 CFR Part 27	-/-	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 27 - Miscellaneous wireless communications services
RSS - 132 Issue 3	January 2013	Spectrum Management and Telecommunications Radio Standards Specification - Cellular Telephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz
RSS - 133 Issue 6	January 2018	Spectrum Management and Telecommunications Policy - Radio Standards Specifications, 2 GHz Personal Communication Services
RSS – 139 Issue 3	July 2015	Advanced Wireless Services (AWS) Equipment Operating in the Bands 1710-1780 MHz and 2110-2180 MHz

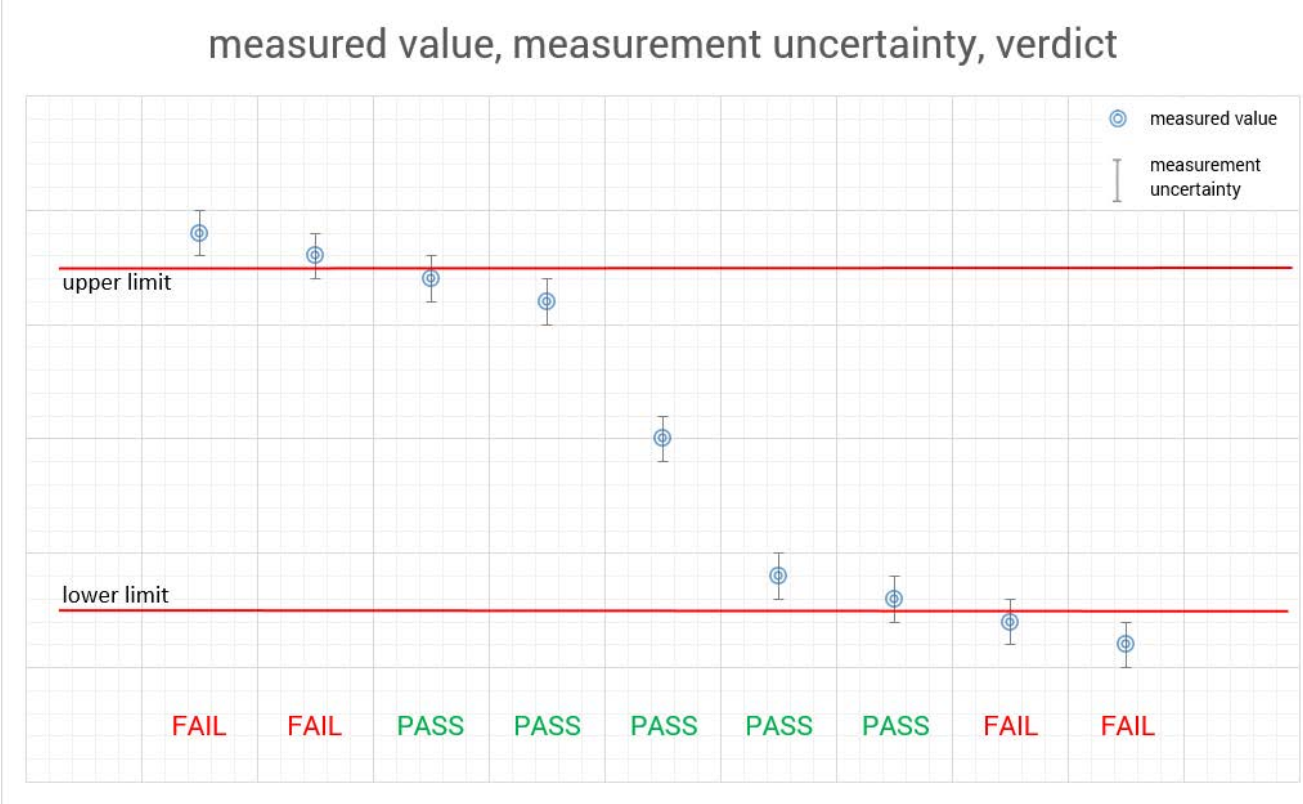
Guidance	Version	Description
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.26-2015	-/-	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
Power Meas License Systems: KDB 971168 D01	v03r01	Measurement Guidance for Certification of Licensed Digital Transmitters

Accreditation	Description
D-PL-12076-01-04	Telecommunication and EMC Canada https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf

ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



5 Test environment

Temperature :	T_{nom} T_{max} T_{min}	+20 °C during room temperature tests +85 °C during high temperature tests -40 °C during low temperature tests
Relative humidity content :		42 %
Barometric pressure :		1018 hpa
Power supply :	V_{nom} V_{max} V_{min}	24 V V DC by external power supply 32 V 6 V

6 Test item

6.1 General description

Kind of test item	:	Telematic Interface Gerät
Model name	:	VERONA GEN4
HMN	:	-/-
PMN	:	Verona Gen 4 / COMhawk xt
HVIN	:	Verona GEN4
FVIN	:	Verona-Gen4-512MB-Development-2022-01-10
S/N serial number	:	Radiated unit: 38 Conducted unit: 36
Hardware status	:	Revision 1
Software status	:	Linux Image Verona-Gen4-512MB-Development-2022-01-10
Firmware status	:	Boot Loader: U-Boot 2015.01 Linux-Kernel: Linux 4.19 (4.19.219) Linux Image: Verona-Gen4-512MB-Development-2022-01-10 IO Lib: 00.01.02 MSP430 Lib: 1.0.0 MSP430 FW: 1.0.0 STM32_1 BM: 00.00.03.00 STM32_1 FL: 00.00.02.02 STM32_1 Appl: 01.00.00.00 STM32_2 BM: 00.00.03.00 STM32_2 FL: 00.00.02.02 STM32_2 Appl: 01.00.00.00
Frequency band	:	WCDMA band 2; 4 and 5
Type of radio transmission Use of frequency spectrum	: :	modulated carrier
Type of modulation	:	QPSK
Antenna	:	External antenna
Power supply	:	24 V DC by external power supply
Temperature range	:	-40°C to +85°C

6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report: 1-2337/21-01-01_AnnexA
1-2337/21-01-01_AnnexB
1-2337/21-01-01_AnnexD

7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

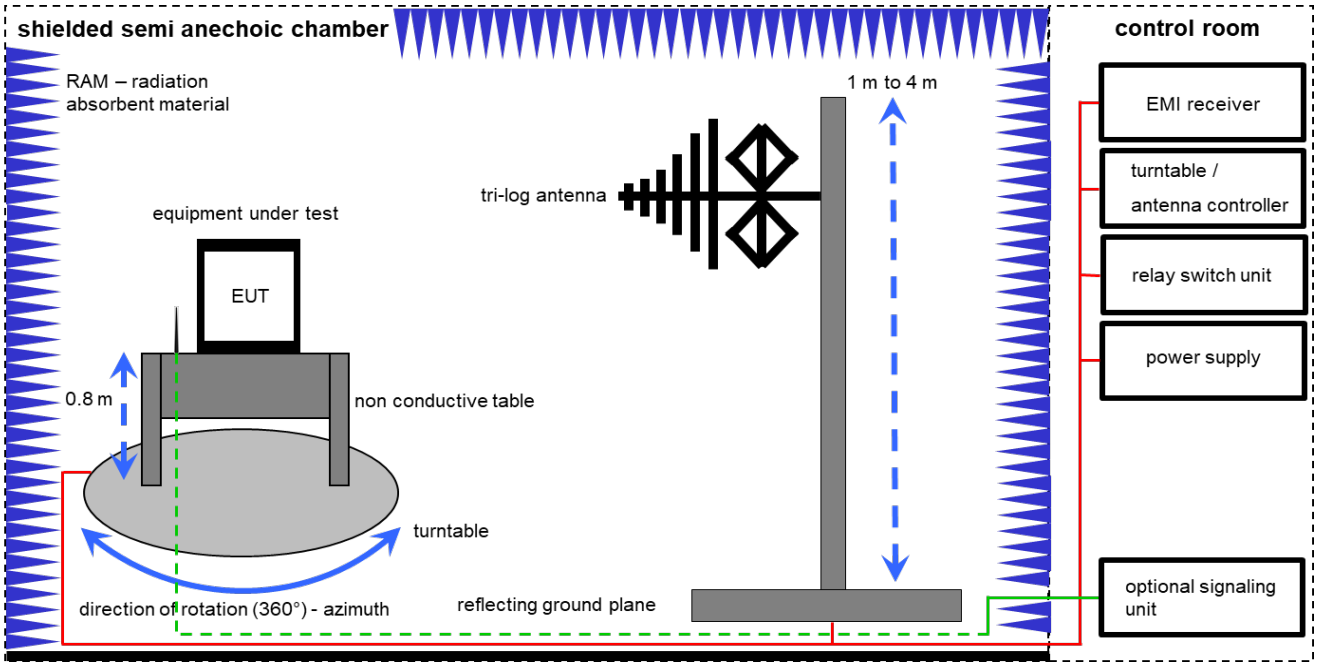
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter; EMC32 software version: 10.59.00

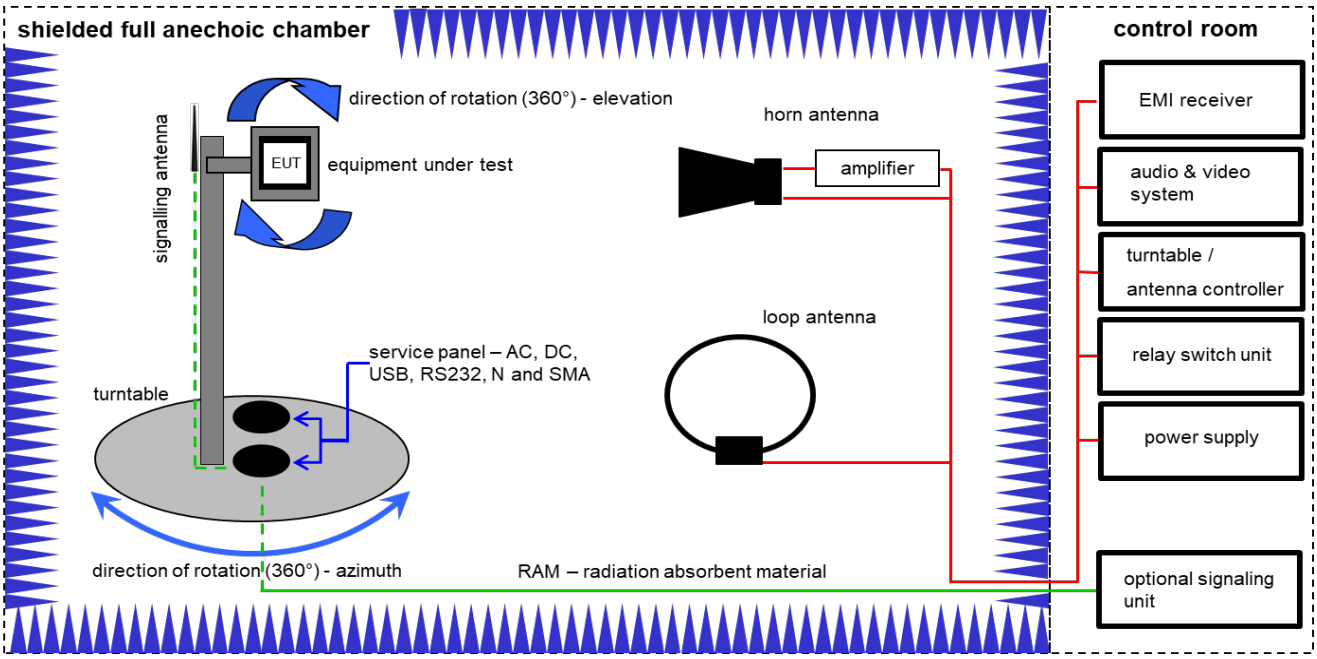
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	Semi anechoic chamber	3000023	MWB AG	-/-	300000551	ne	-/-	-/-
3	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	vlKl!	29.12.2021	28.12.2023
4	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
5	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
7	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	318	300003696	vlKl!	30.09.2021	29.09.2023
8	A	Turntable	2089-4.0	EMCO	-/-	300004394	ne	-/-	-/-
9	A	PC	TecLine	F+W	-/-	300004388	ne	-/-	-/-
10	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	08.12.2021	07.12.2022
11	A								

7.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter

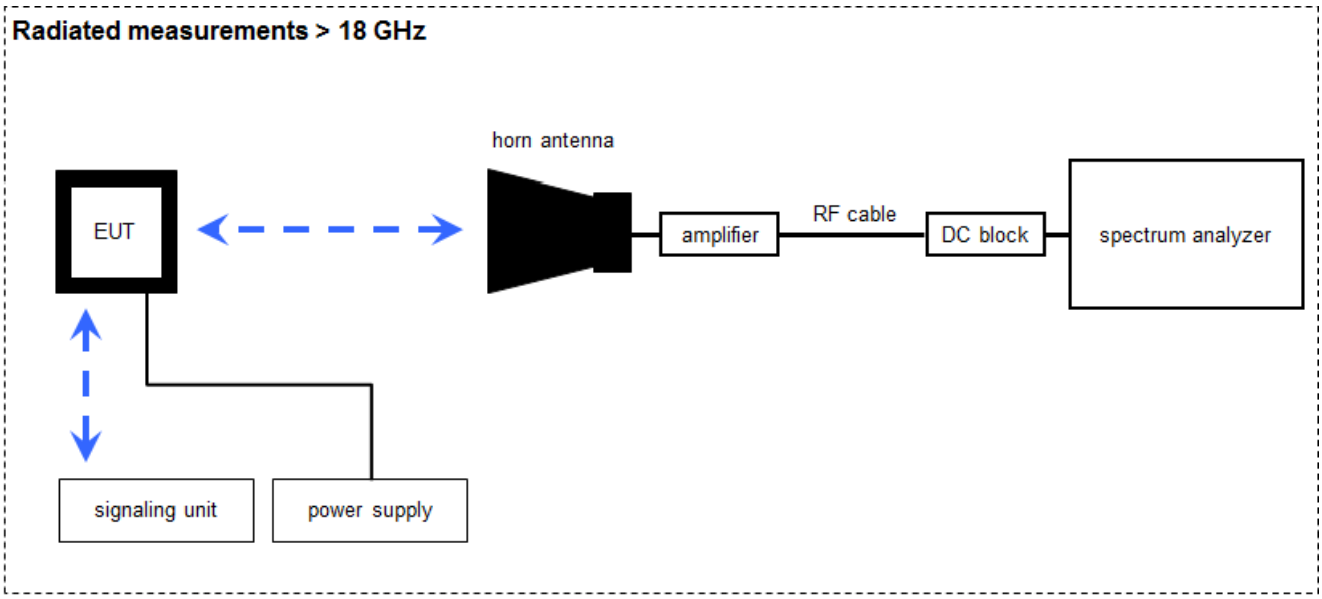
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -39.0 [dBm] + 57.0 [dB] - 12.0 [dBi] + (-36.0) [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1		Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3697	300001605	vlKl!	12.03.2021	11.03.2023
2		Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
3		Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	vlKl!	17.06.2021	16.06.2023
4		Band Reject filter	WRCG1850/1910-1835/1925-40/8SS	Wainwright	7	300003350	ev	-/-	-/-
5		EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	09.12.2021	31.12.2022
6		Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
7		Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
8		TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	318	300003696	vlKl!	30.09.2021	29.09.2023
9		4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
10		NEXIO EMV-Software	BAT EMC V3.21.0.27	EMCO	-/-	300004682	ne	-/-	-/-
11		RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-
12									

7.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

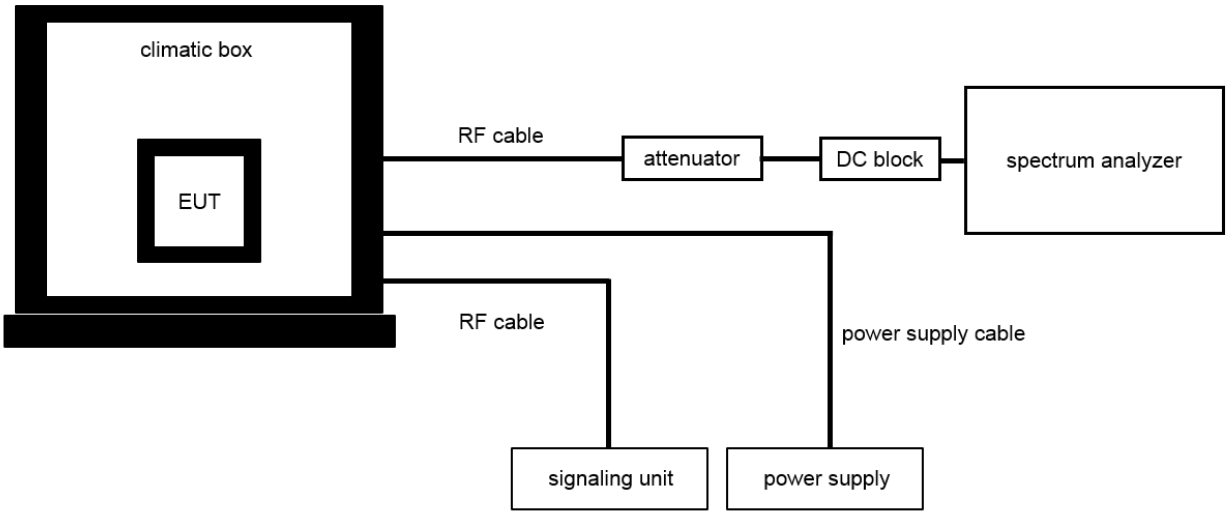
Example calculation:
OP [dBm] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-
2	A	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	01096	300000486	vlKl!	-/-	-/-
3	A	Signal analyzer	FSV40	Rohde&Schwarz	101042	300004517	k	25.01.2022	24.01.2023
4	A	RF-Cable	ST18/SMAm/SMAm /48	Huber & Suhner	Batch no. 127377	400001183	ev	-/-	-/-
5	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	-/-	400001185	ev	-/-	-/-
6	A								

7.4 Conducted measurements normal and extreme conditions

Conducted measurements normal & extreme conditions



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Temperature Test Chamber	VT 4002	Heraeus Voetsch	521/83761	300002326	g	-/-	-/-
2	A	Wideband Radio Communication Tester	CMW500	Rohde & Schwarz	170616	300006251	k	16.09.2021	15.09.2023
3	A	Hygro-Thermometer	-/-, 5-45°C, 20-100%rF	Thies Clima	-/-	400000108	ev	13.08.2020	12.08.2022
4	A	PC Tester R005	Intel Core i3 3220/3,3 GHz, Prozessor	-/-	2V2403033A4523	300004589	ne	-/-	-/-
5	A	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH	-/-	300004590	ne	-/-	-/-
6	A	Resistive Power Dividers, DC-40 GHz, 1W	1575	MRC COMPONENTS	-/-	300004671	ne	-/-	-/-
7	A	USB-GPIB-Adapter	GPIB-USB-HS	National Instruments	1829974	400001136	ne	-/-	-/-
8	A	RF-Cable	ST18/SMAm/SMAm/72	Huber & Suhner	Batch no. 699714	400001184	ev	-/-	-/-
9	A	Synchron Power Meter	SPM-4	CTC	1	300005580	ev	-/-	-/-
10	A	Signal analyzer	FSV40	Rohde&Schwarz	101042	300004517	k	25.01.2022	24.01.2023
11	A	RF-Cable	ST18/SMAm/SMAm/36	Huber & Suhner	Batch no. 601494	400001309	ev	-/-	-/-
12	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	-/-	400001185	ev	-/-	-/-

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

*)Note: The sequence will be repeated three times with different EUT orientations.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

8.4 Sequence of testing radiated spurious above 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

9 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
RF output power conducted	± 1 dB
RF output power radiated	± 3 dB
Frequency stability	± 20 Hz
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB
Spurious emissions conducted	± 3 dB
Block edge compliance	± 3 dB
Occupied bandwidth	± RBW

10 Summary of measurement results

☒	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☐	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC identifier	Description	verdict	date	Remark
RF-Testing	CFR Part 22, 24, 27 RSS 132, 133, 139	See table!	2022-04-11	-/-

10.1 UMTS band II

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	-/-
Frequency Stability	Nominal and extreme	Nominal and extreme	☒	☐	☐	☐	-/-
Spurious Emissions Radiated	Nominal	Nominal	☒	☐	☐	☐	-/-
Spurious Emissions Conducted	Nominal	Nominal	☒	☐	☐	☐	-/-
Block Edge Compliance	Nominal	Nominal	☒	☐	☐	☐	-/-
Occupied Bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

10.2 UMTS band IV

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	-/-
Frequency Stability	Nominal and extreme	Nominal and extreme	☒	☐	☐	☐	-/-
Spurious Emissions Radiated	Nominal	Nominal	☒	☐	☐	☐	-/-
Spurious Emissions Conducted	Nominal	Nominal	☒	☐	☐	☐	-/-
Block Edge Compliance	Nominal	Nominal	☒	☐	☐	☐	-/-
Occupied Bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

10.3 UMTS band V

Test Case	temperature conditions	power source voltages	C	NC	NA	NP	Remark
RF Output Power	Nominal	Nominal	☒	☐	☐	☐	-/-
Frequency Stability	Nominal and extreme	Nominal and extreme	☒	☐	☐	☐	-/-
Spurious Emissions Radiated	Nominal	Nominal	☒	☐	☐	☐	-/-
Spurious Emissions Conducted	Nominal	Nominal	☒	☐	☐	☐	-/-
Block Edge Compliance	Nominal	Nominal	☒	☐	☐	☐	-/-
Occupied Bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

11 Results UMTS band II

All UMTS-band measurements are done in WCDMA mode only.
The connection was established with the following setup: WCDMA CS-RMC, Max Power (All Bit up)

11.1 RF output power

Description:

This paragraph contains average power, peak output power and EIRP measurements for the mobile station. In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Detector:	Sample
AQT:	See plot
Resolution bandwidth:	1 MHz
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	see chapter 9

Limits:

FCC	ISED
CFR Part 24.232 CFR Part 2.1046	RSS 133
+33.00 dBm In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

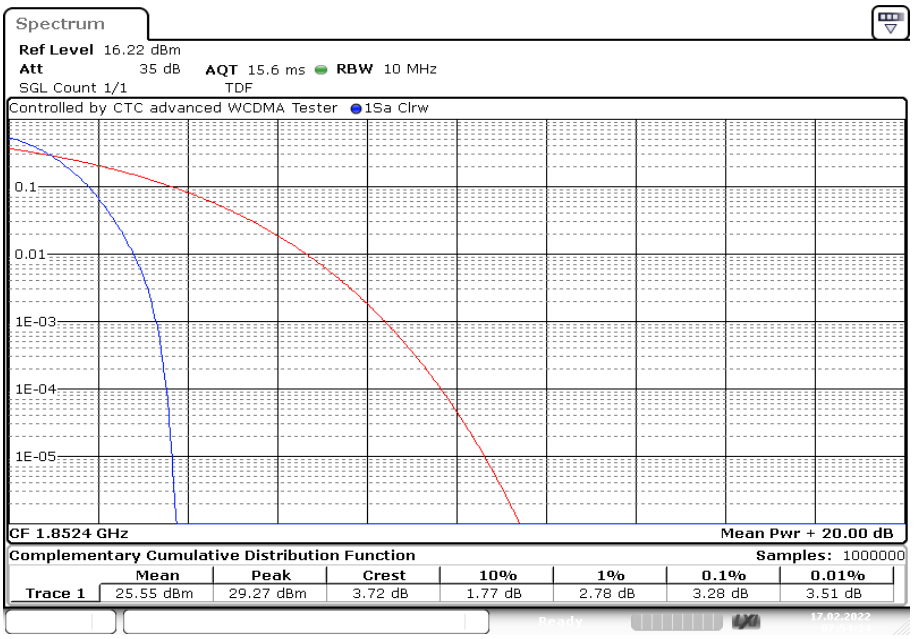
Results:

Output Power (conducted) WCDMA mode		
Frequency (MHz)	**Average Output Power (dBm)**	**Peak to Average Ratio (dB)**
1852.4	25.6	3.28
1880.0	26.0	3.19
1907.6	26.3	2.70

Output Power (radiated) WCDMA mode	
Frequency (MHz)	**Average Output Power (dBm) - EIRP**
1852.4	24.6
1880.0	25.2
1907.6	26.2

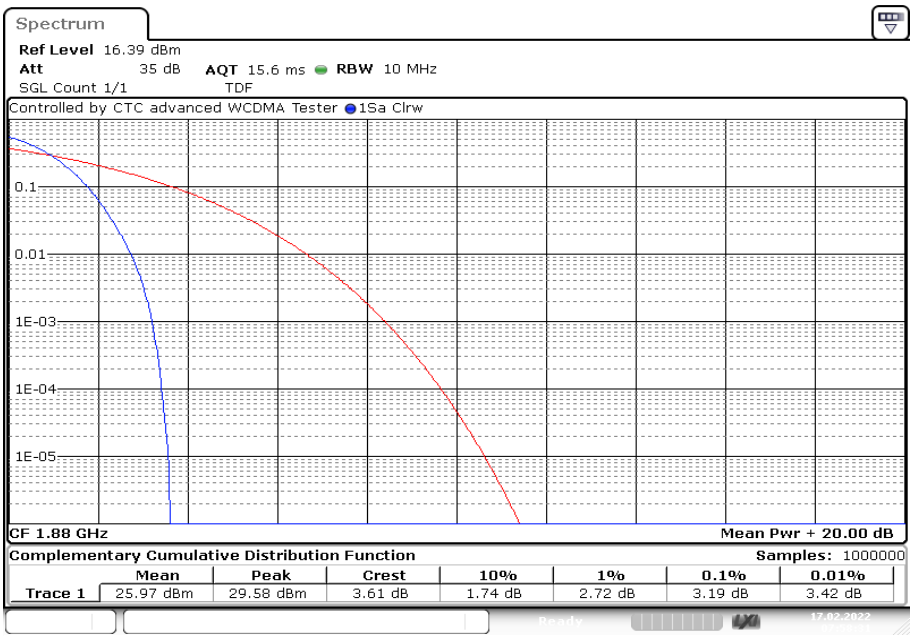
Plots:

Plot 1: CCDF, channel 9262



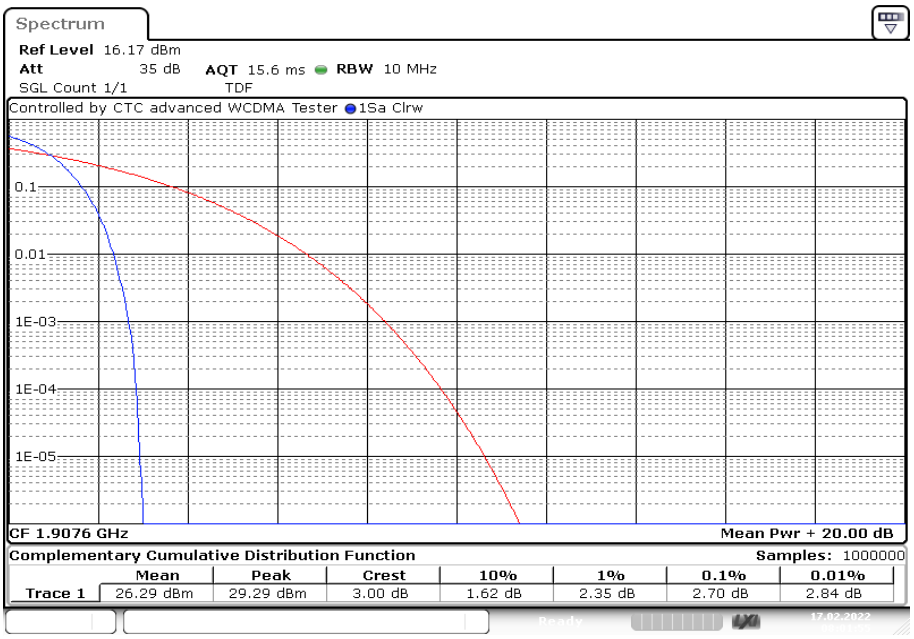
Date: 17.FEB.2022 07:54:35

Plot 2: CCDF, channel 9400



Date: 17.FEB.2022 07:58:32

Plot 3: CCDF, channel 9538



Date: 17.FEB.2022 08:01:56

11.2 Frequency stability

Description:

In order to measure the carrier frequency under normal conditions it is necessary to make measurements with the mobile station connected to a R&S CMU200 Wideband Radio Communication Tester.

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station powered with V_{nom} connected to the CMU200 on the center channel. Measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +50°C. Allow at least 15 minutes at each temperature unpowered before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage to V_{min} and measure the carrier frequency then setup V_{max} and repeat the measurement.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace mode:	
Test setup:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9

Limits:

FCC	ISED
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.	

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
6.0	10	0.0005	0.01
12.0	12	0.0006	0.01
24.0	12	0.0006	0.01
32.0	11	0.0006	0.01

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	10	0.0005	0.01
-20	10	0.0005	0.01
-10	12	0.0006	0.01
± 0	-9	-0.0005	-0.00
10	-11	-0.0006	-0.01
20	12	0.0006	0.01
30	-10	-0.0005	-0.01
40	-20	-0.0011	-0.01
50	-25	-0.0013	-0.01

11.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2014 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 1910 MHz. Measurement made up to 25 GHz. The resolution bandwidth is set as outlined in Part 24.238. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the UMTS band II.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 sec.
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	100 MHz Steps
Trace mode:	Max Hold
Used equipment:	See chapter
Measurement uncertainty:	See chapter 9

Limits:

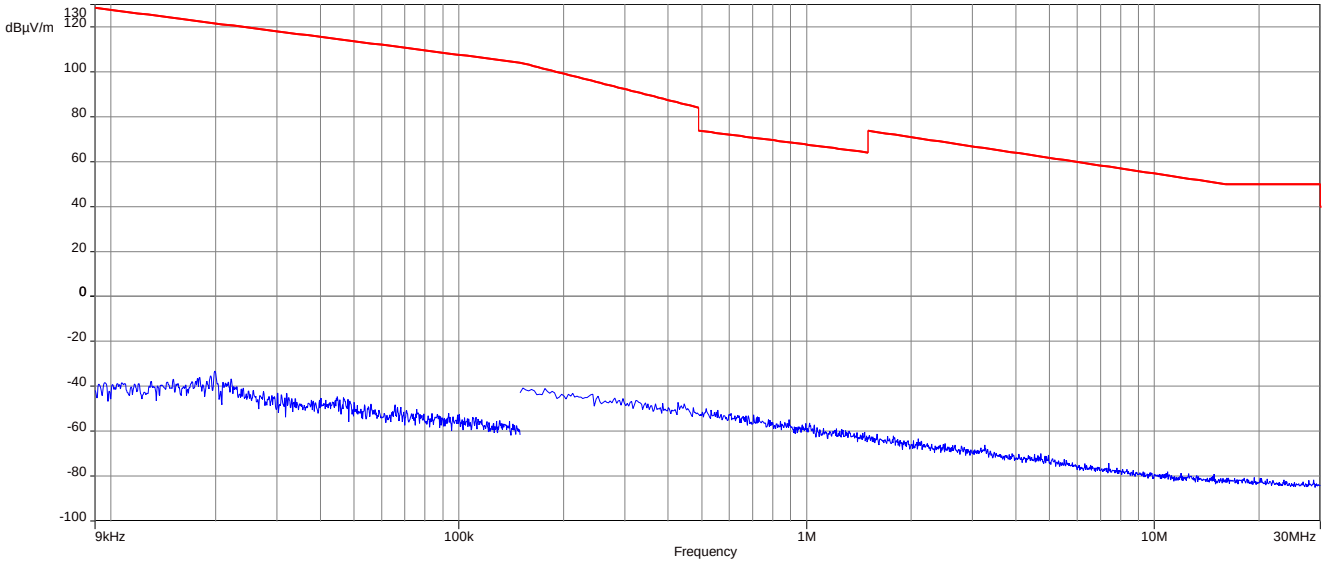
FCC	ISED
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm	

Results:

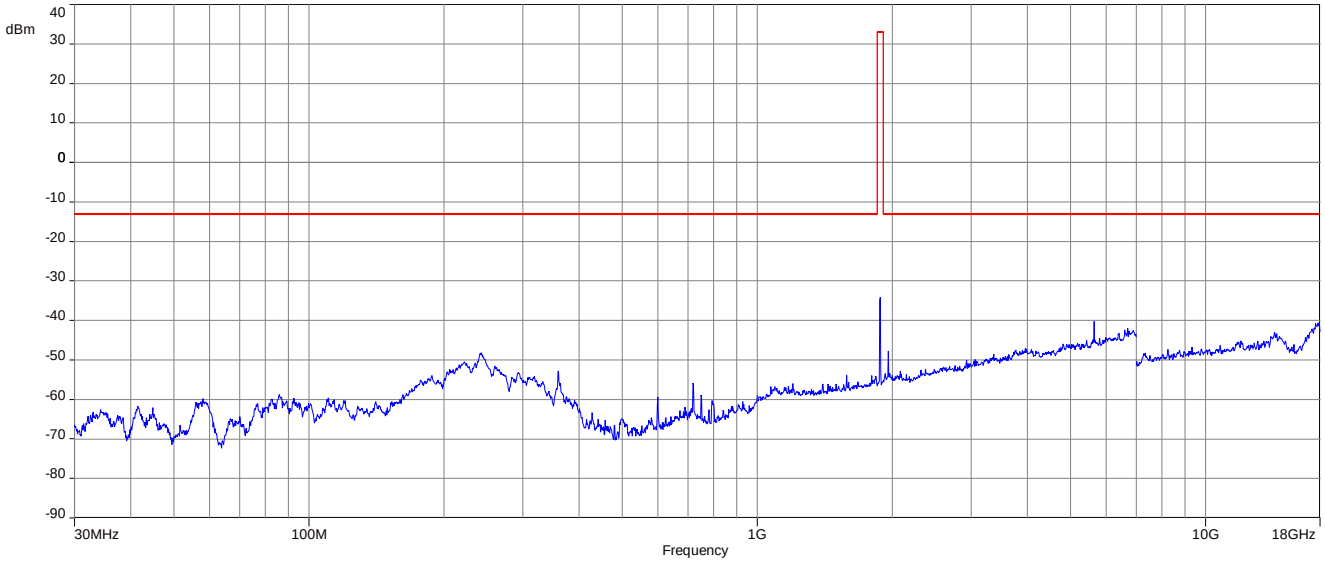
SPURIOUS EMISSION LEVEL								
Harmonic	Ch. 9262 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 9400 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 9538 Freq. (MHz)	Level [dBm]
2	3704.8	-	2	3760.0	-	2	3815.2	-
3	5557.2	-	3	5640.0	-	3	5722.8	-
4	7409.6	-	4	7520.0	-	4	7630.4	-
5	9262.0	-	5	9400.0	-	5	9538.0	-
6	11114.4	-	6	11280.0	-	6	11445.6	-
7	12966.8	-	7	13160.0	-	7	13353.2	-
8	14819.2	-	8	15040.0	-	8	15260.8	-
9	16671.6	-	9	16920.0	-	9	17168.4	-
10	18524.0	-	10	18800.0	-	10	19076.0	-

Plots:

Plot 1: Channel 9400 (Traffic mode up to 30 MHz)

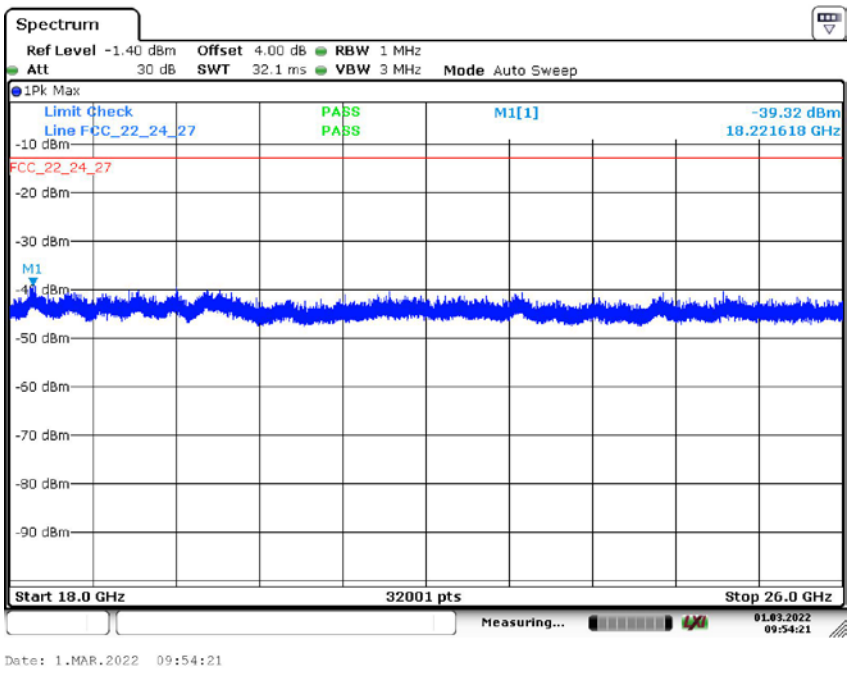


Plot 2: Channel 9400 (30 MHz – 18 GHz)



Carrier notched with 1.9 GHz rejection filter

Plot 3: Channel 9400 (18 GHz - 25 GHz)



11.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.
1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 19.1 GHz, data taken from 10 MHz to 20 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

UMTS band II Transmitter Channel Frequency
9262 1852.4 MHz
9400 1880.0 MHz
9538 1907.6 MHz

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	10 MHz – 9 GHz
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9

Limits:

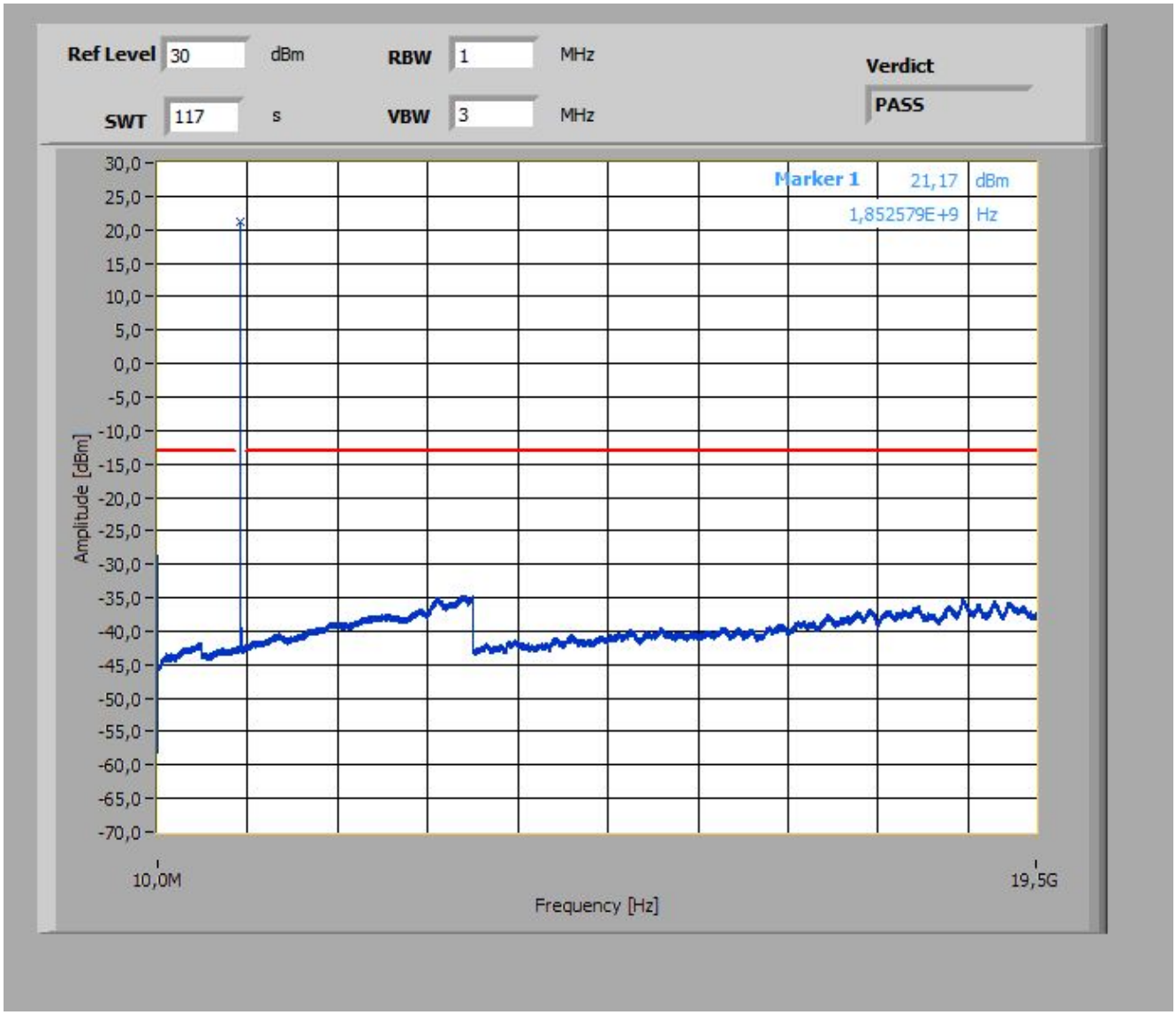
FCC	ISED
CFR Part 24.238 CFR Part 2.1051	RSS 133
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm	

Results:

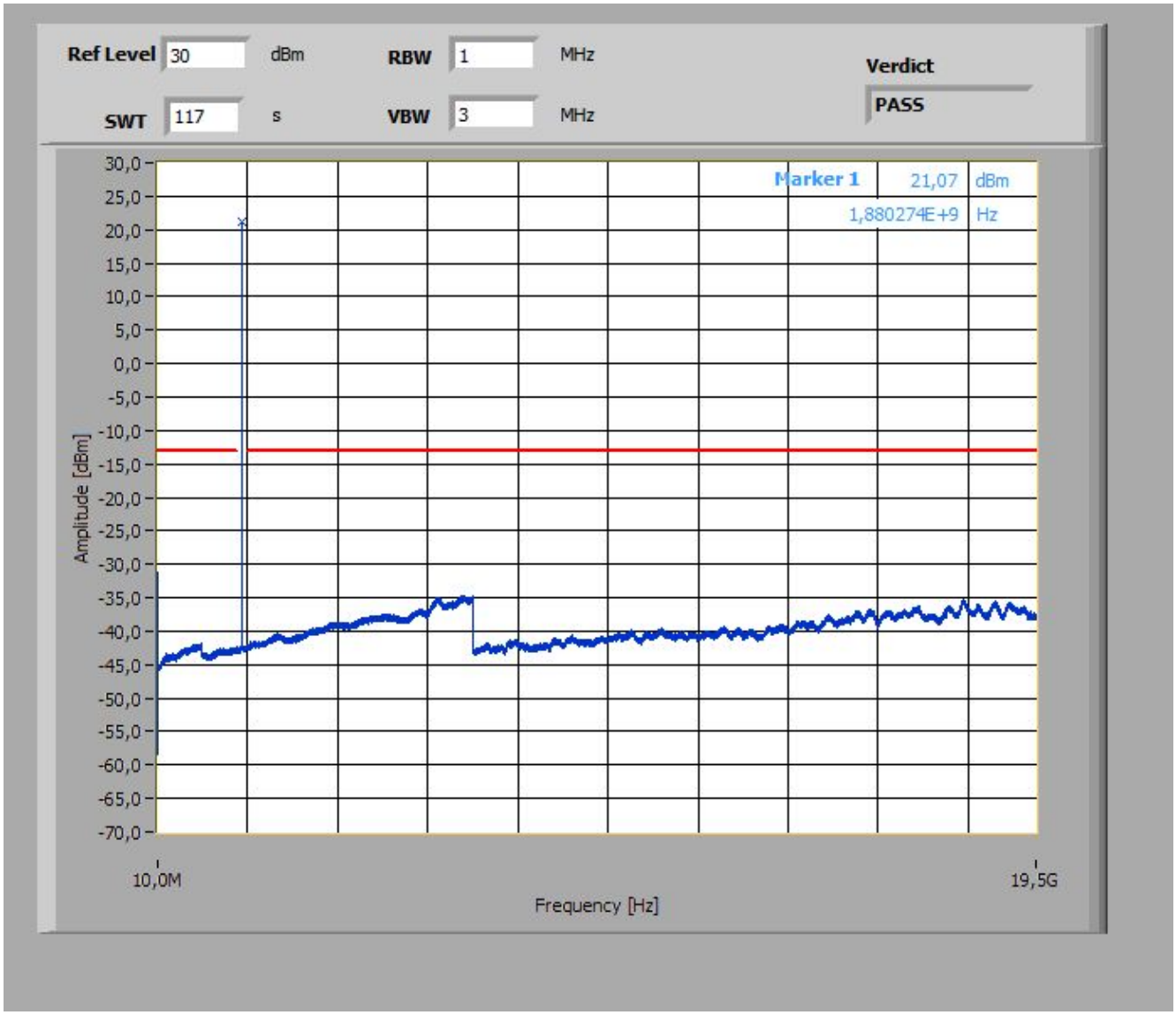
SPURIOUS EMISSION LEVEL								
Harmonic	Ch. 9262 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 9400 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 9538 Freq. (MHz)	Level [dBm]
2	3704.8	-	2	3760.0	-	2	3815.2	-
3	5557.2	-	3	5640.0	-	3	5722.8	-
4	7409.6	-	4	7520.0	-	4	7630.4	-
5	9262.0	-	5	9400.0	-	5	9538.0	-
6	11114.4	-	6	11280.0	-	6	11445.6	-
7	12966.8	-	7	13160.0	-	7	13353.2	-
8	14819.2	-	8	15040.0	-	8	15260.8	-
9	16671.6	-	9	16920.0	-	9	17168.4	-
10	18524.0	-	10	18800.0	-	10	19076.0	-

Plots:

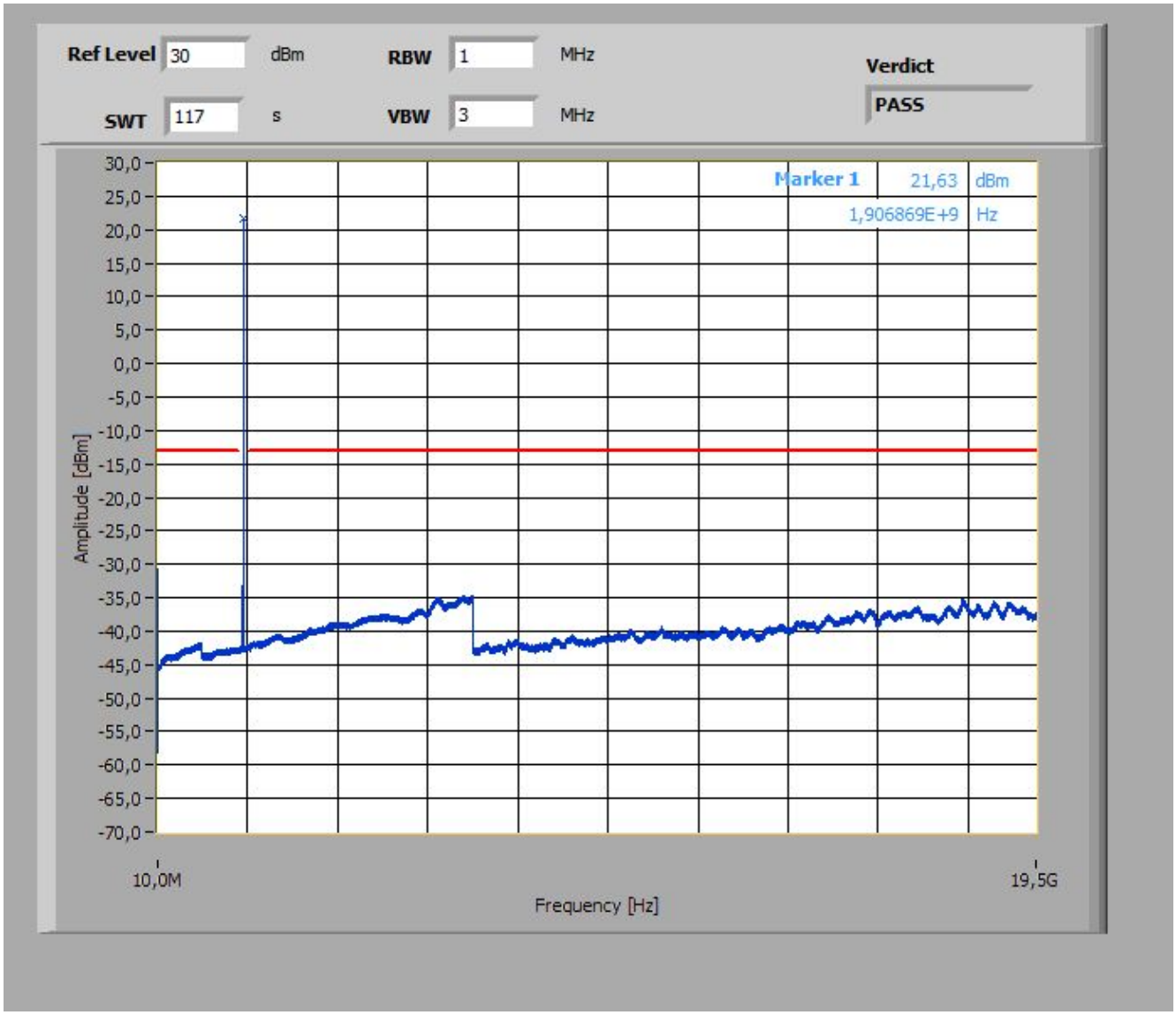
Plot 1: Channel 9262 (10 MHz – 19.5 GHz)



Plot 2: Channel 9400 (10 MHz – 19.5 GHz)



Plot 3: Channel 9538 (10 MHz – 19.5 GHz)



11.5 Block edge compliance

Description:

The spectrum at the band edges must comply with the spurious emissions limits.

Measurement:

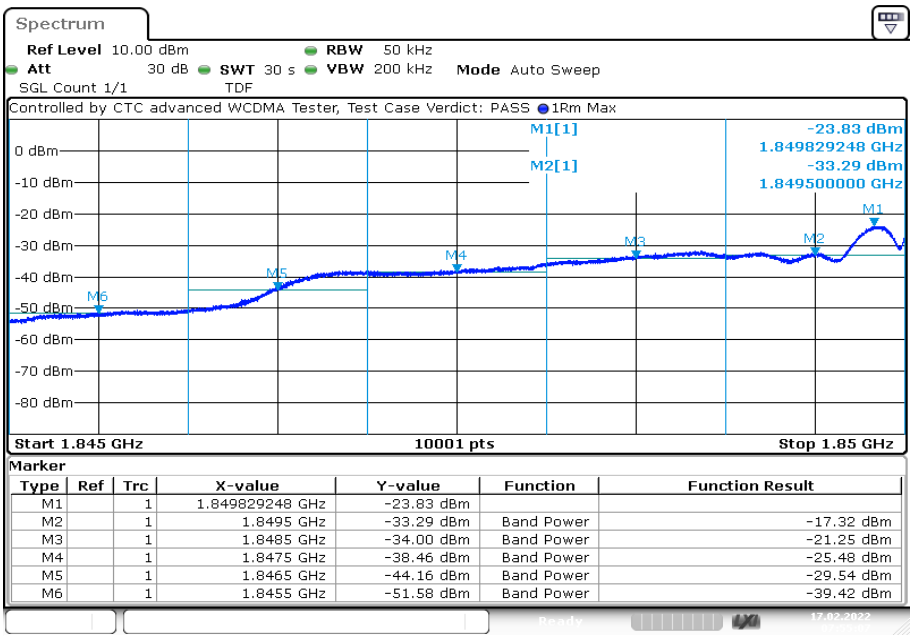
Measurement parameters	
Detector:	RMS
Sweep time:	30 sec.
Video bandwidth:	1% - 5% of the OBW
Resolution bandwidth:	≥ 3xRBW
Span:	5 MHz
Trace mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	See chapter 9

Limits:

FCC	ISED
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm	

Plots:

Plot 1: Channel 9262



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.849829248 GHz	-23.83 dBm		
M2		1	1.8495 GHz	-33.29 dBm	Band Power	-17.32 dBm
M3		1	1.8485 GHz	-34.00 dBm	Band Power	-21.25 dBm
M4		1	1.8475 GHz	-38.46 dBm	Band Power	-25.48 dBm
M5		1	1.8465 GHz	-44.16 dBm	Band Power	-29.54 dBm
M6		1	1.8455 GHz	-51.58 dBm	Band Power	-39.42 dBm

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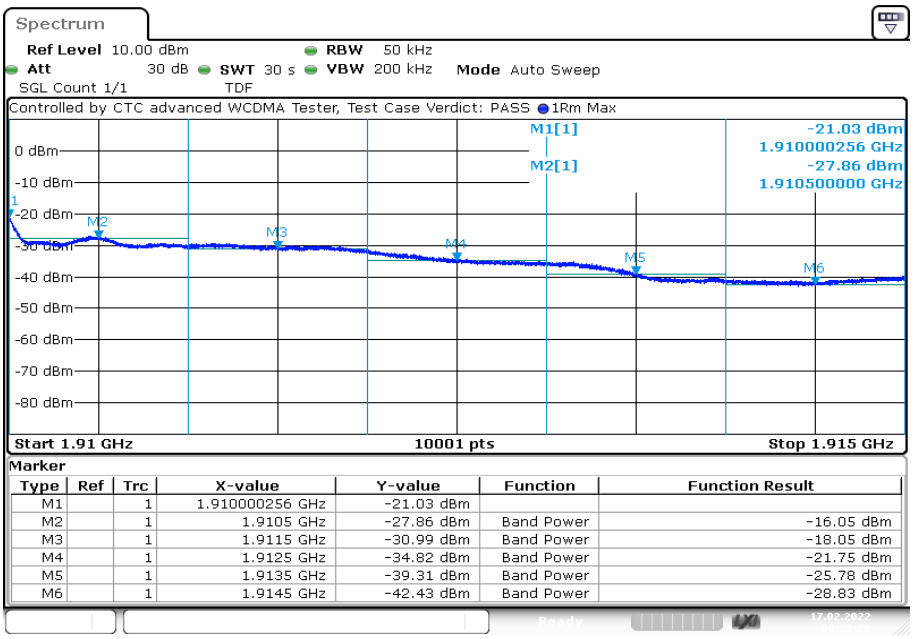
Plot 2: Channel 9538



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.910000256 GHz	-21.03 dBm		
M2		1	1.9105 GHz	-27.86 dBm	Band Power	-16.05 dBm
M3		1	1.9115 GHz	-30.99 dBm	Band Power	-18.05 dBm
M4		1	1.9125 GHz	-34.82 dBm	Band Power	-21.75 dBm
M5		1	1.9135 GHz	-39.31 dBm	Band Power	-25.78 dBm
M6		1	1.9145 GHz	-42.43 dBm	Band Power	-28.83 dBm

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11.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the UMTS band II frequency band. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Part 24.238 requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 4700 kHz, this equates to a resolution bandwidth of at least 50 kHz. For this testing, a resolution bandwidth 100 kHz was used.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	300 kHz
Resolution bandwidth:	100 kHz
Span:	6 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	see chapter 9

Limits:

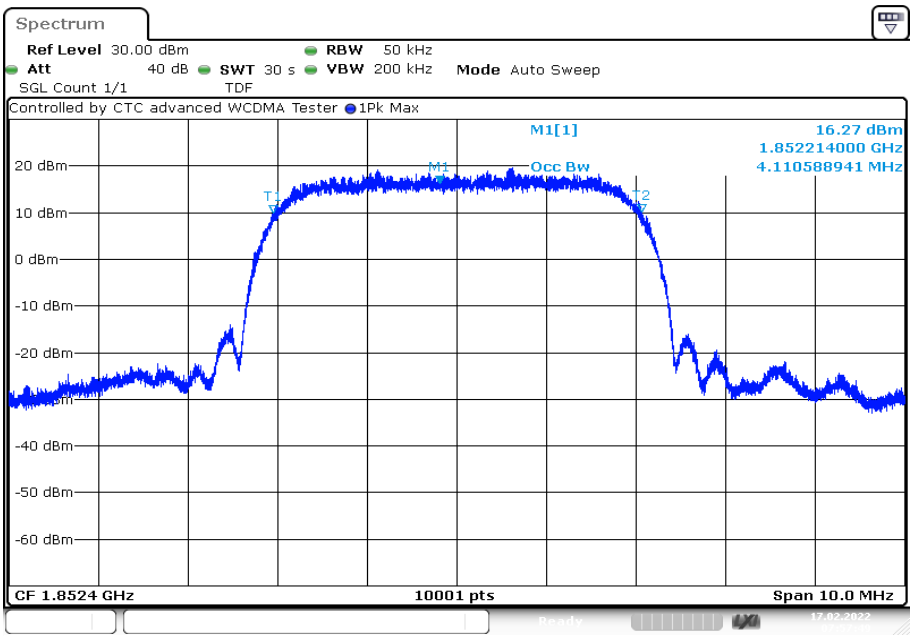
FCC	ISED
CFR Part 24.238 CFR Part 2.1049	RSS 133
Spectrum must fall completely in the specified band	

Results:

Occupied Bandwidth		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
1852.4	4111	4673
1880.0	4119	4678
1907.6	4121	4670

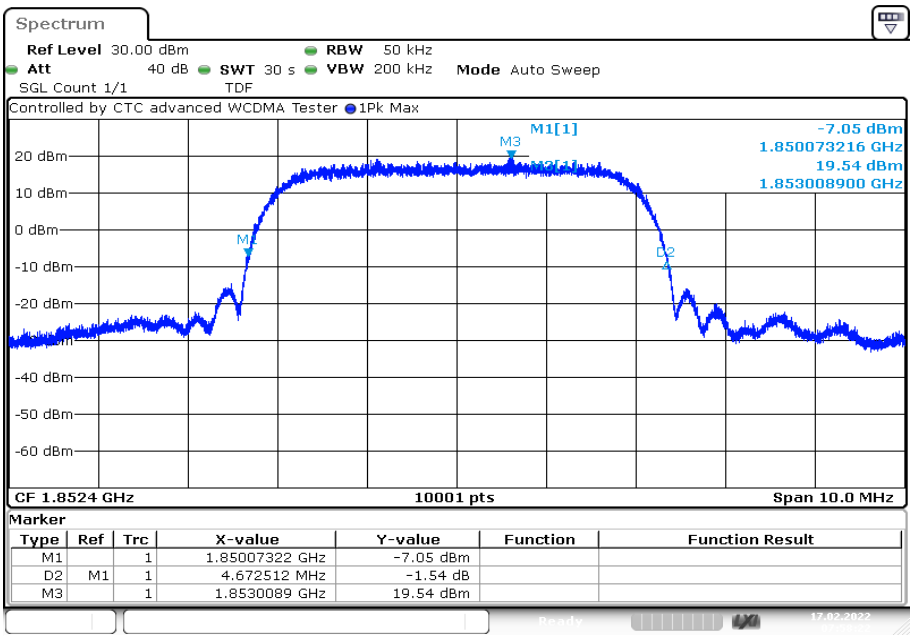
Plots:

Plot 1: Channel 9262 (99% - OBW)



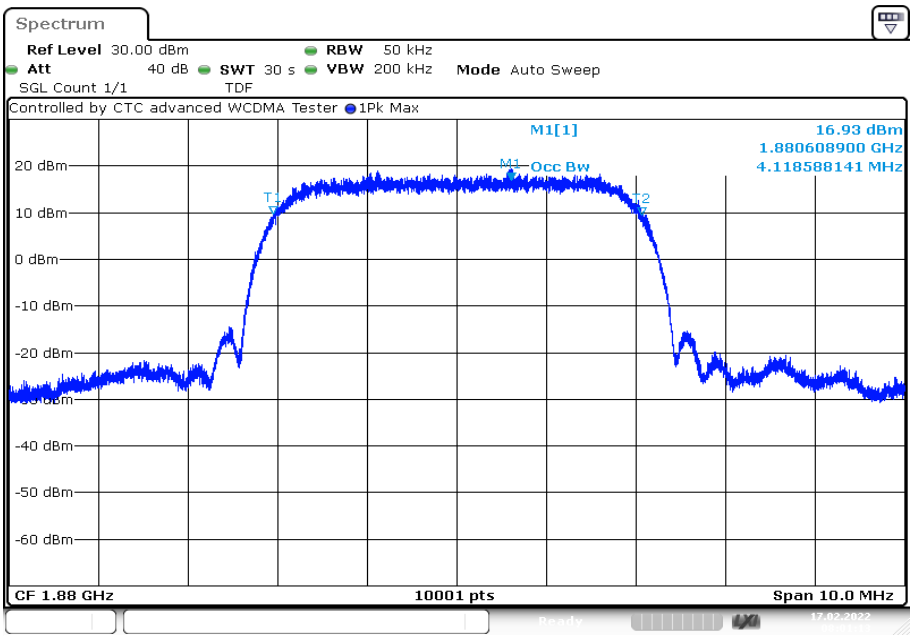
Date: 17.FEB.2022 07:57:50

Plot 2: Channel 9262 (-26 dBc BW)



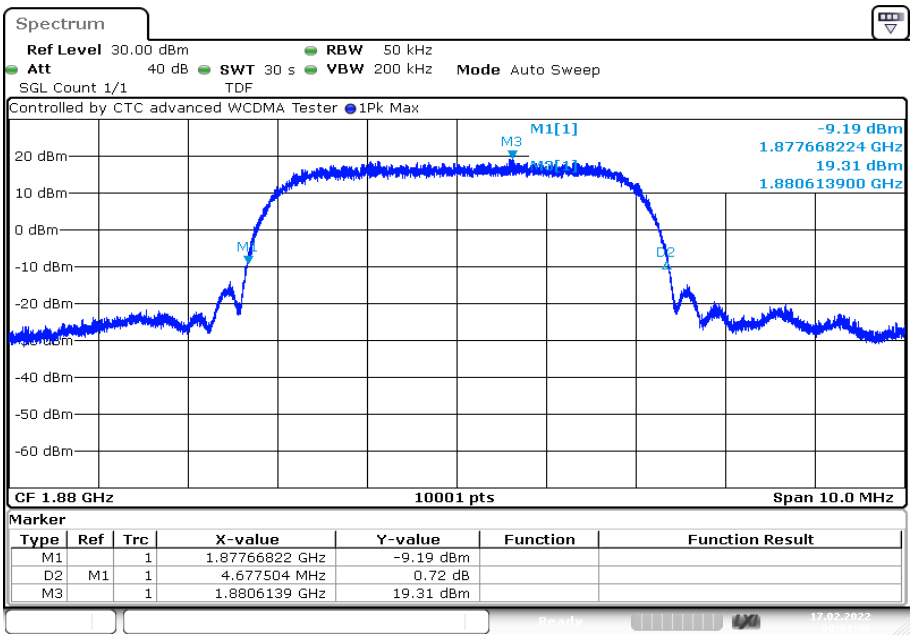
Date: 17.FEB.2022 07:58:23

Plot 3: Channel 9400 (99% - OBW)



Date: 17.FEB.2022 08:01:14

Plot 4: Channel 9400 (-26 dBc BW)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.87766822 GHz	-9.19 dBm		
D2	M1	1	4.677504 MHz	0.72 dB		
M3		1	1.8806139 GHz	19.31 dBm		

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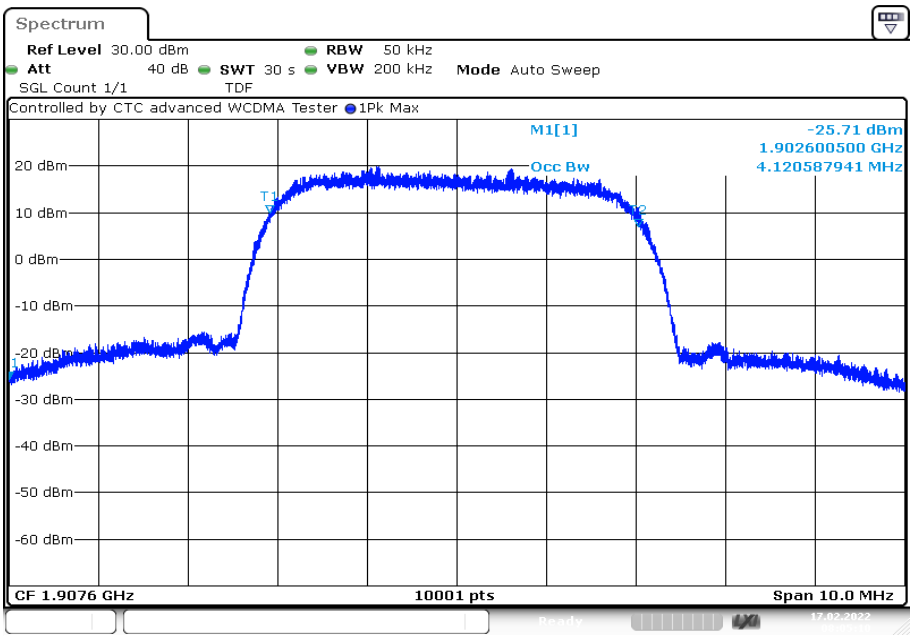
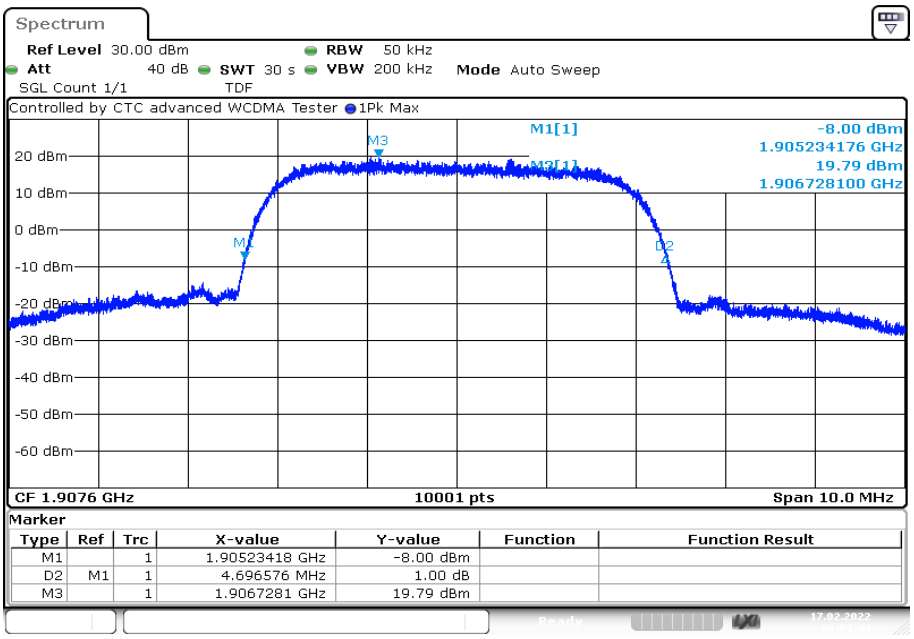
Plot 5: Channel 9538 (99% - OBW)



Date: 17.FEB.2022 08:05:11

Plot 6: Channel 9538 (-26 dBc BW)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.90523418 GHz	-8.00 dBm		
D2	M1	1	4.696576 MHz	1.00 dB		
M3		1	1.9067281 GHz	19.79 dBm		

Date: 17.FEB.2022 08:05:44

12 Results UMTS band IV

All UMTS-band measurements are done in WCDMA mode only.
The connection was established with the following setup: WCDMA CS-RMC, Max Power (All Bit up)

12.1 RF output power

Description:

This paragraph contains average power, peak output power and EIRP measurements for the mobile station. In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Detector:	Peak and RMS (Power in Burst)
Sweep time:	Auto
Video bandwidth:	10 MHz
Resolution bandwidth:	10 MHz
Span:	Zero Span
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	see chapter 9

Limits:

FCC	ISED
CFR Part 27.50 CFR Part 2.1046	RSS 139
+30.00 dBm In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

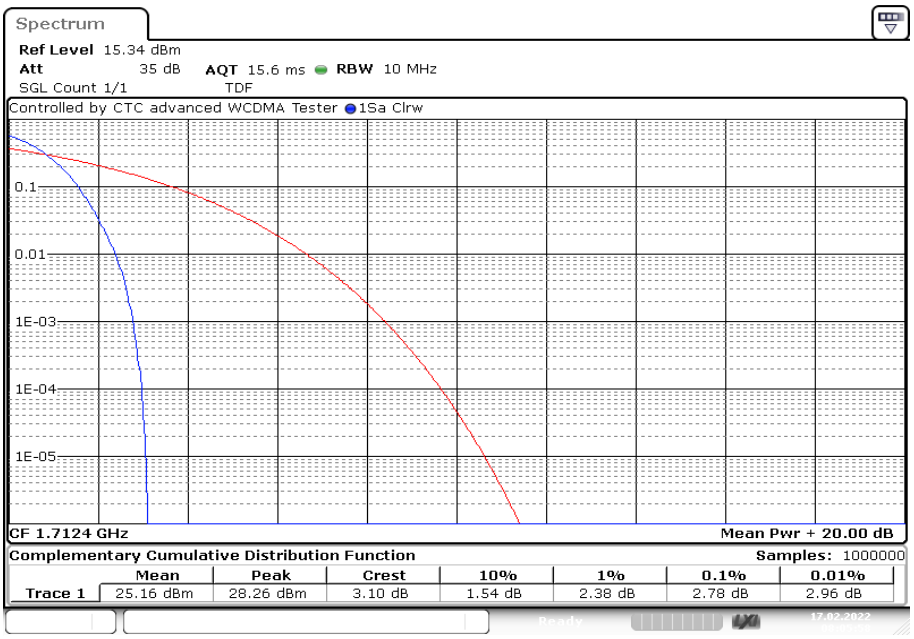
Results:

Output Power (conducted) WCDMA mode		
Frequency (MHz)	**Average Output Power (dBm)**	**Peak to Average Ratio (dB)**
1712.4	25.2	2.78
1732.4	24.2	2.96
1752.6	25.1	2.84

Output Power (radiated) WCDMA mode	
Frequency (MHz)	**Average Output Power (dBm) - EIRP**
1712.4	21.2
1732.4	21.1
1752.6	23.3

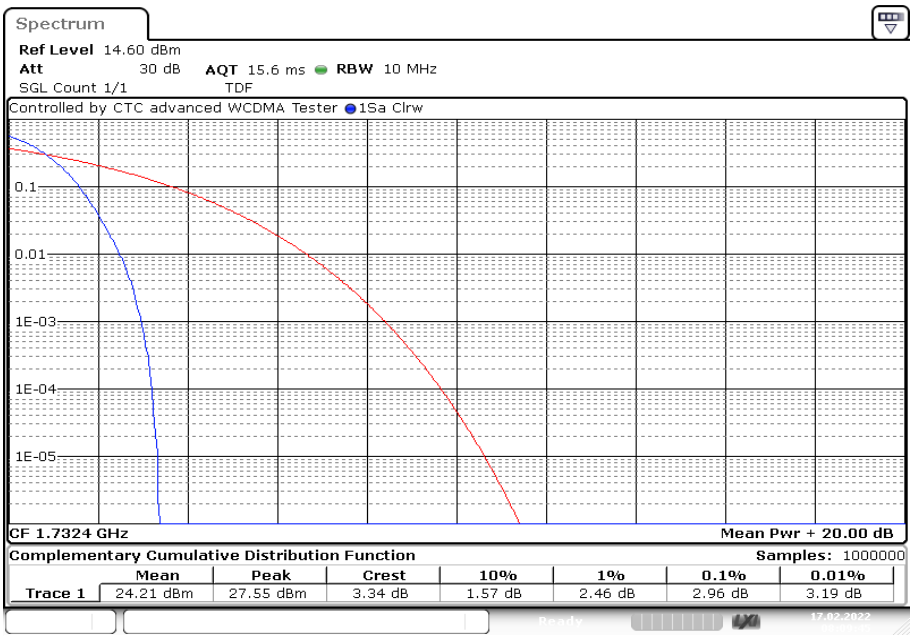
Plots:

Plot 1: CCDF, channel 1312



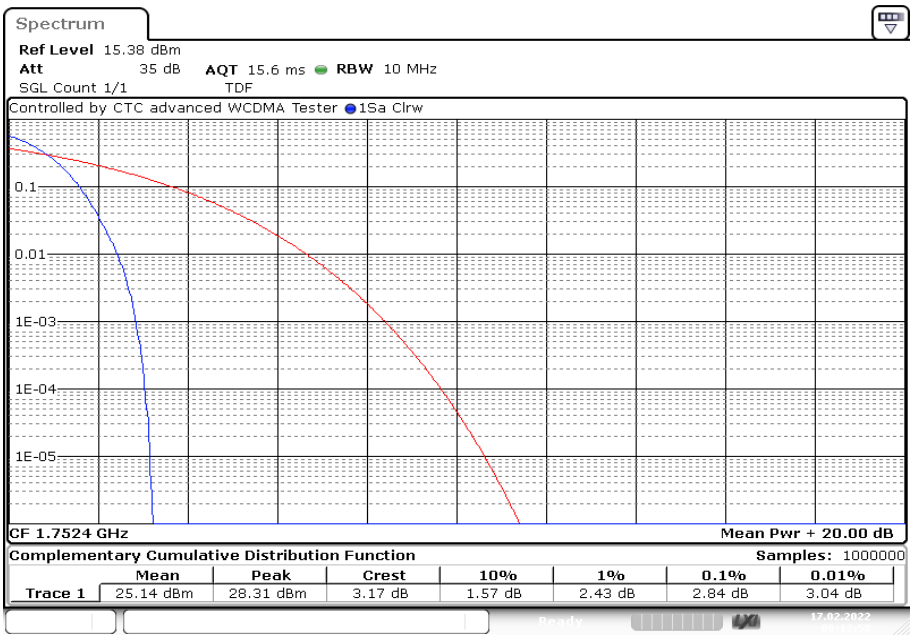
Date: 17.FEB.2022 08:05:58

Plot 2: CCDF, channel 1412



Date: 17.FEB.2022 08:09:45

Plot 3: CCDF, channel 1513



Date: 17.FEB.2022 08:12:59

12.2 Frequency stability

Description:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a "call mode". This is accomplished with the use of a R&S CMU200 DIGITAL RADIOCOMMUNICATION TESTER.
1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with V_{nom}, connected to the CMU200 and in a simulated call on channel 1412 (centre channel), measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station, to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +60°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage from V_{min} to V_{max}, in 0.1 Volt steps remeasuring carrier frequency at each voltage. Pause at V_{nom} for 1.5 hours unpowered, to allow any self heating to stabilize, before continuing.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMW500
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	see chapter 9

Limits:

FCC	ISED
CFR Part 27.54 CFR Part 2.1055	RSS 139
± 2.5 ppm	

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
6.0	-14	-0.0008	-0.01
12.0	-17	-0.0010	-0.01
24.0	-17	-0.0010	-0.01
32.0	-13	-0.0008	-0.01

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	-14	-0.0008	-0.01
-20	-13	-0.0008	-0.01
-10	11	0.0006	0.01
± 0	-38	-0.0022	-0.02
10	-18	-0.0010	-0.01
20	-17	-0.0010	-0.01
30	-14	-0.0008	-0.01
40	-7	-0.0004	0.00
50	-13	-0.0008	-0.01

12.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2009 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 1755 MHz. Measurement made up to 25 GHz. The resolution bandwidth is set as outlined in Part 27.53. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the UMTS band IV.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 sec.
Video bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span:	100 MHz Steps
Trace-Mode:	Max Hold
Used equipment:	See chapter
Measurement uncertainty:	see chapter 9

Limits:

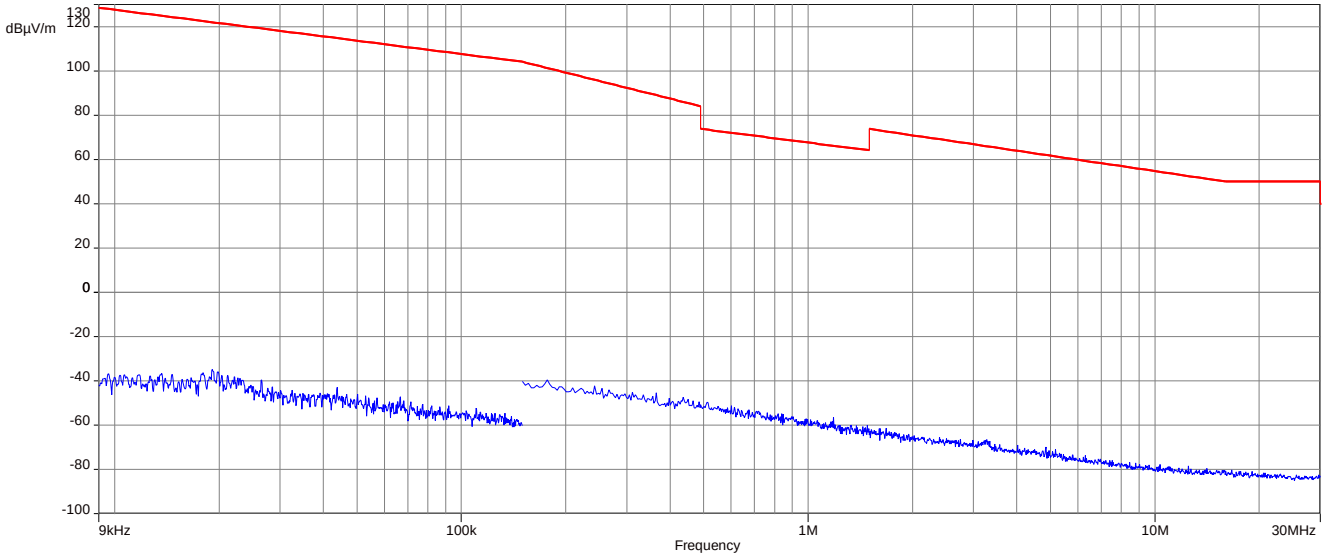
FCC	ISED
CFR Part 27.53(g) CFR Part 2.1053	RSS 139
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm	

Results:

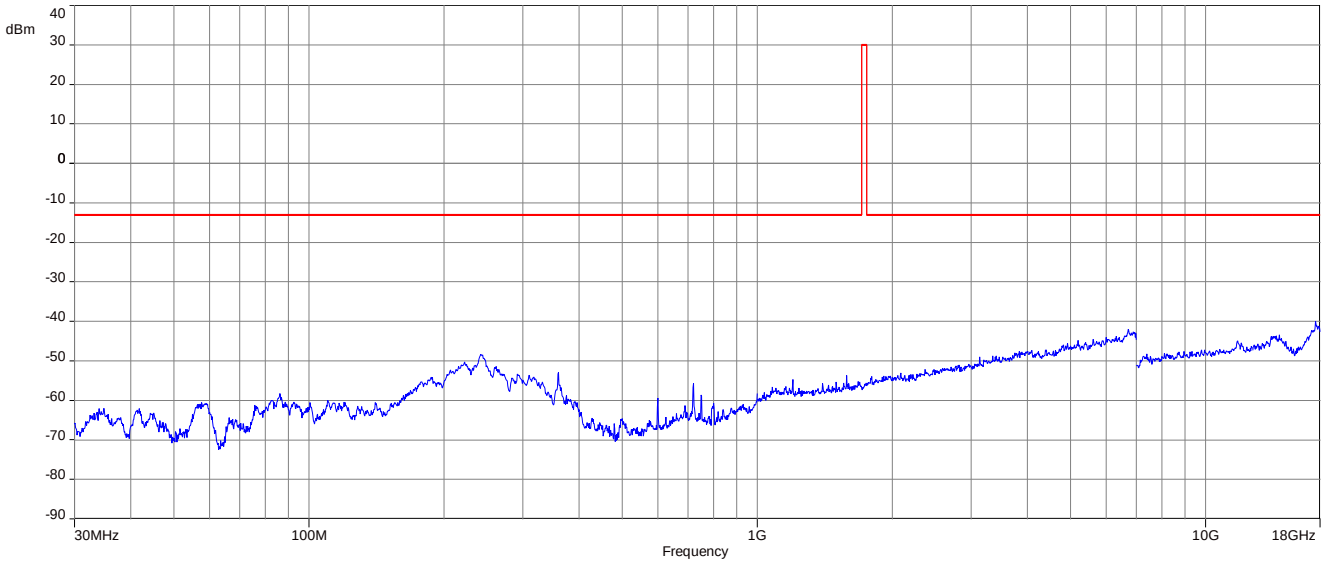
SPURIOUS EMISSION LEVEL								
Harmonic	Ch. 1312 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 1412 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 1513 Freq. (MHz)	Level [dBm]
2	3424.8	-	2	3464.8	-	2	3505.2	-
3	5137.2	-	3	5197.2	-	3	5257.8	-
4	6849.6	-	4	6929.6	-	4	7010.4	-
5	8562.0	-	5	8662.0	-	5	8763.0	-
6	10274.4	-	6	10394.4	-	6	10515.6	-
7	11986.8	-	7	12126.8	-	7	12268.2	-
8	13699.2	-	8	13859.2	-	8	14020.8	-
9	15411.6	-	9	15591.6	-	9	15773.4	-
10	17124.0	-	10	17324.0	-	10	17526.0	-

Plots:

Plot 1: Channel 1412 (Traffic mode up to 30 MHz)

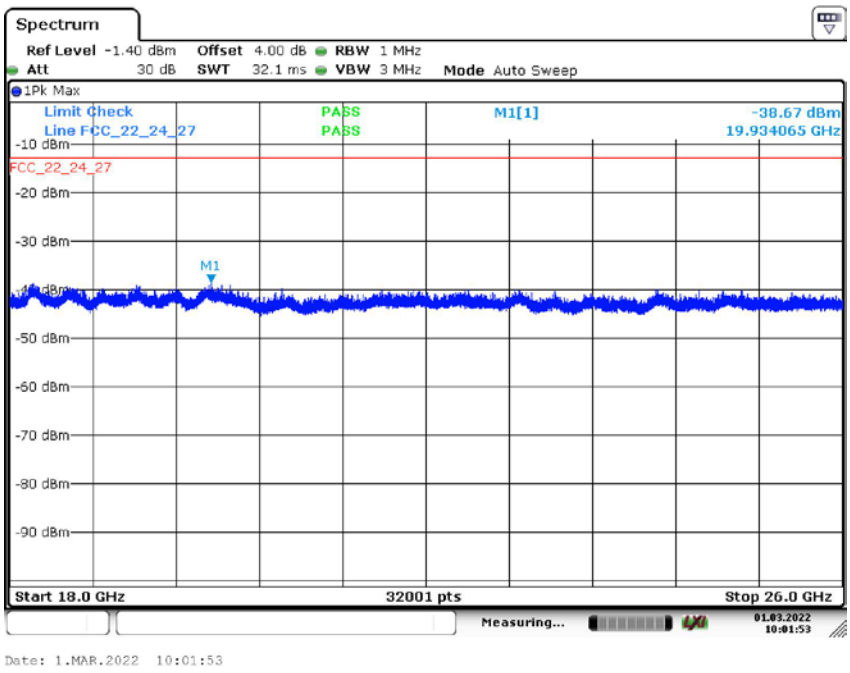


Plot 2: Channel 1412 (30 MHz – 18 GHz)



Carrier notched with 1.7 GHz rejection filter

Plot 3: Channel 1412 (12 GHz – 25 GHz)



12.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.
1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency. For the mobile station equipment tested, this equates to a frequency range of 13 MHz to 17.6 GHz, data taken from 10 MHz to 25 GHz.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

UMTS band IV Transmitter Channel Frequency
1312 1712.4 MHz
1412 1732.4 MHz
1513 1752.6 MHz

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Resolution bandwidth:	Pre-measurement with 1 MHz On spurious detection re-measurement below 1 GHz with 100 kHz Above 1 GHz with 1 MHz
Span:	10 MHz – 18 GHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	see chapter 9

Limits:

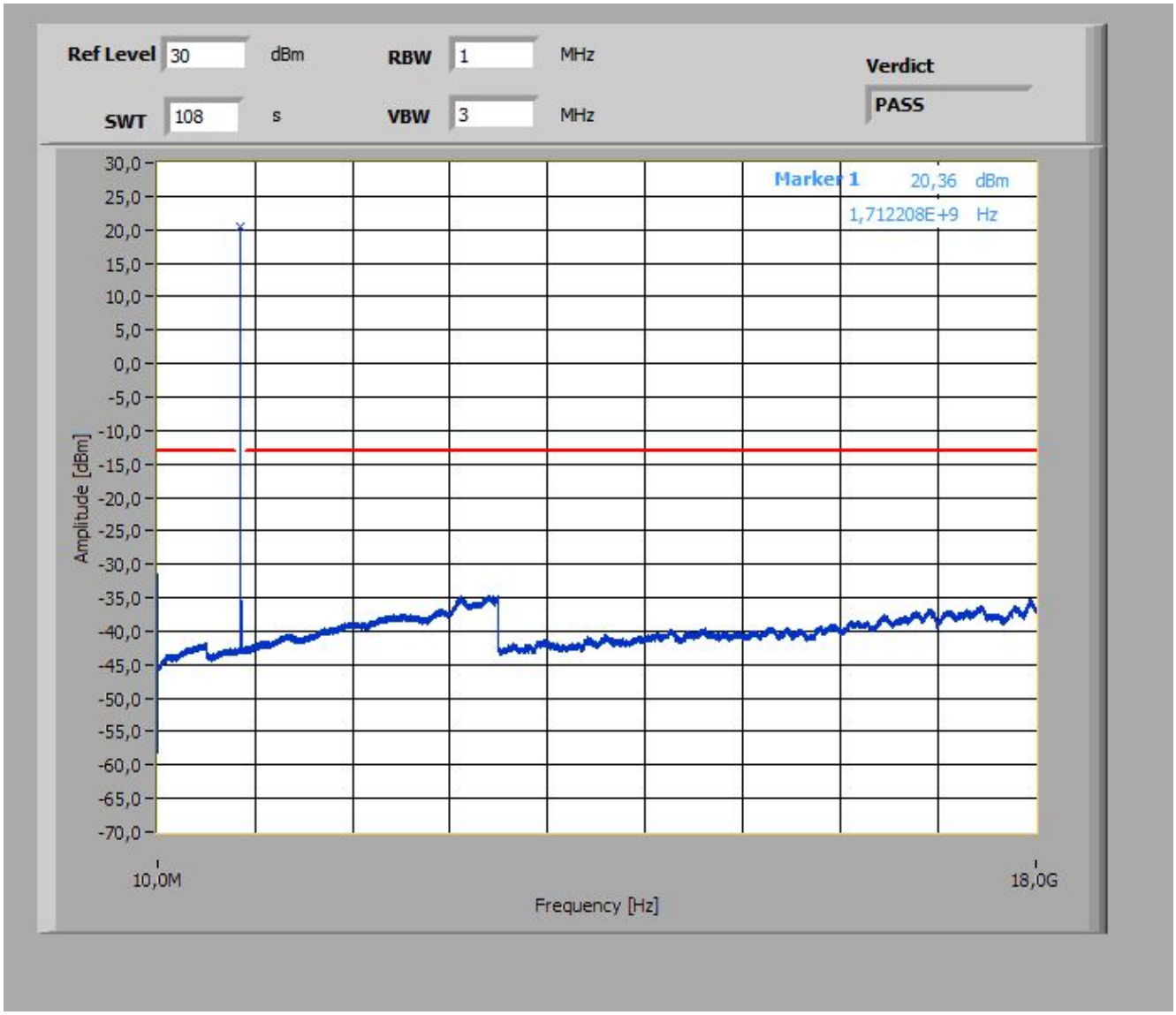
FCC	ISED
CFR Part 27.53(g) CFR Part 2.1053	RSS 139
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm	

Results:

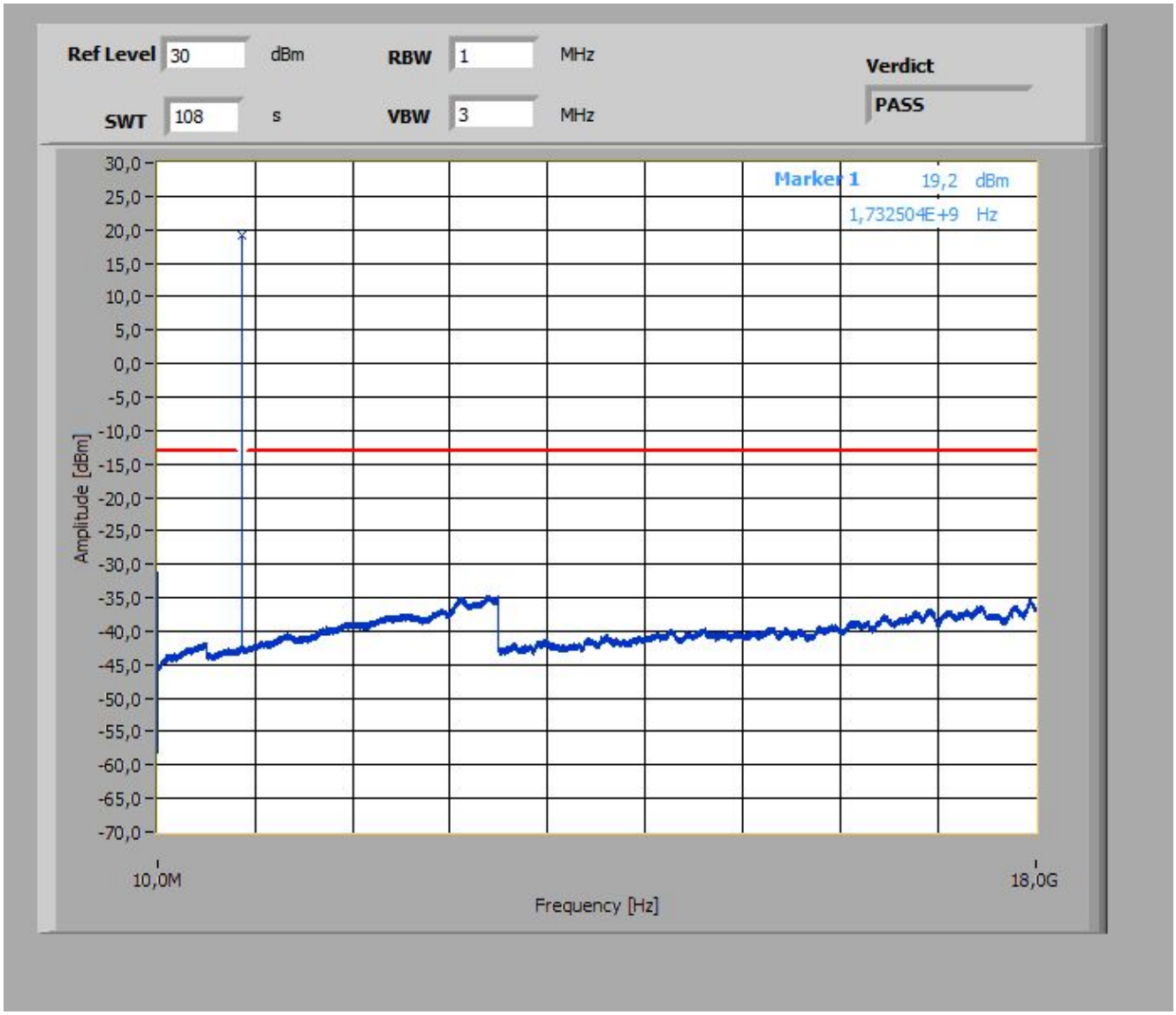
SPURIOUS EMISSION LEVEL								
Harmonic	Ch. 1312 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 1412 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 1513 Freq. (MHz)	Level [dBm]
2	3424.8	-	2	3464.8	-	2	3505.2	-
3	5137.2	-	3	5197.2	-	3	5257.8	-
4	6849.6	-	4	6929.6	-	4	7010.4	-
5	8562.0	-	5	8662.0	-	5	8763.0	-
6	10274.4	-	6	10394.4	-	6	10515.6	-
7	11986.8	-	7	12126.8	-	7	12268.2	-
8	13699.2	-	8	13859.2	-	8	14020.8	-
9	15411.6	-	9	15591.6	-	9	15773.4	-
10	17124.0	-	10	17324.0	-	10	17526.0	-

Plots:

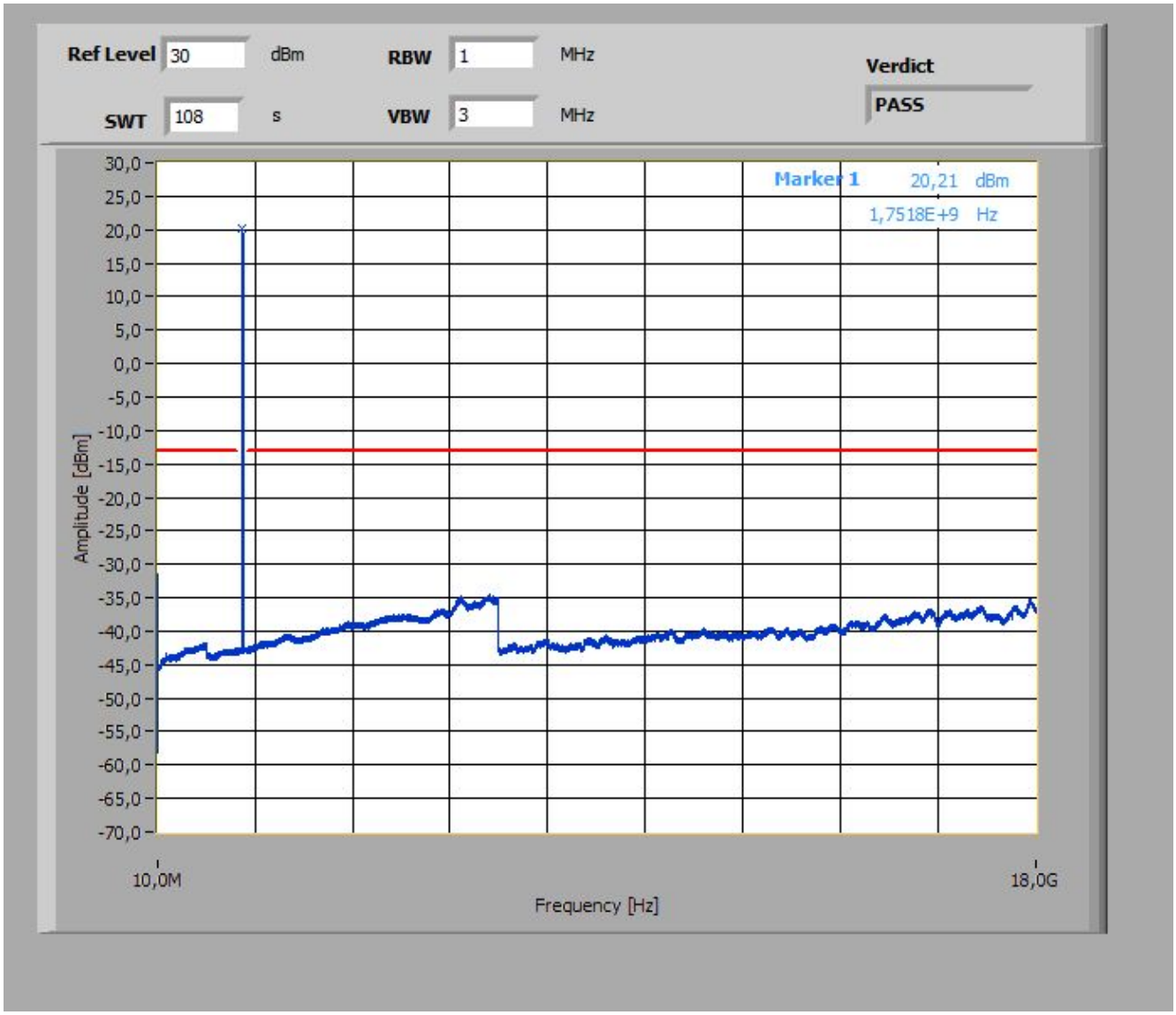
Plot 1: Channel 1312 (10 MHz - 18 GHz)



Plot 2: Channel 1412 (10 MHz - 18 GHz)



Plot 3: Channel 1513 (10 MHz - 18 GHz)



12.5 Block edge compliance

Description:

The spectrum at the band edges must comply with the spurious emissions limits.

Measurement:

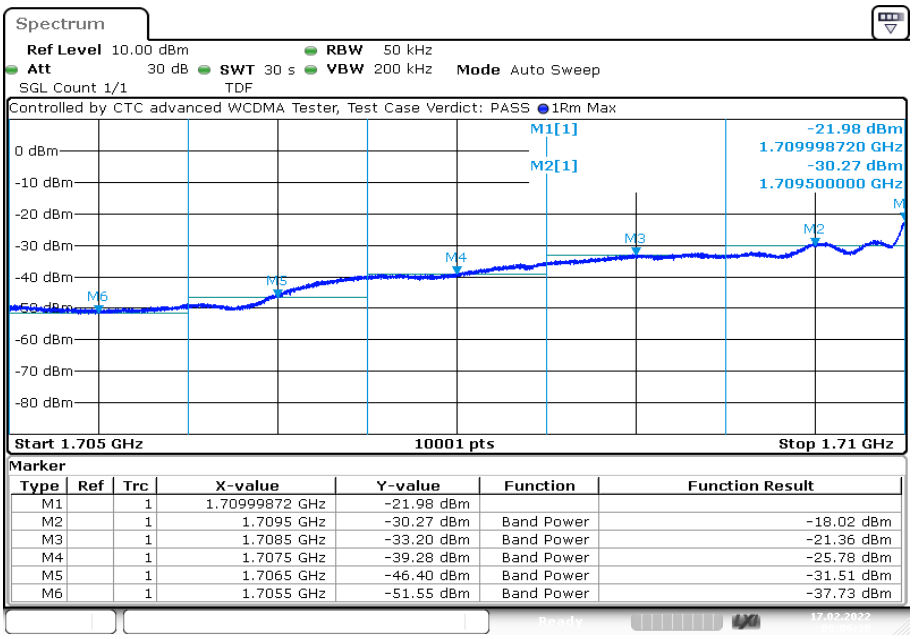
Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	see chapter 9

Limits:

FCC	ISED
CFR Part 27.53(g) CFR Part 2.1053	RSS 139
-13 dBm	

Plots:

Plot 1: Channel 1312

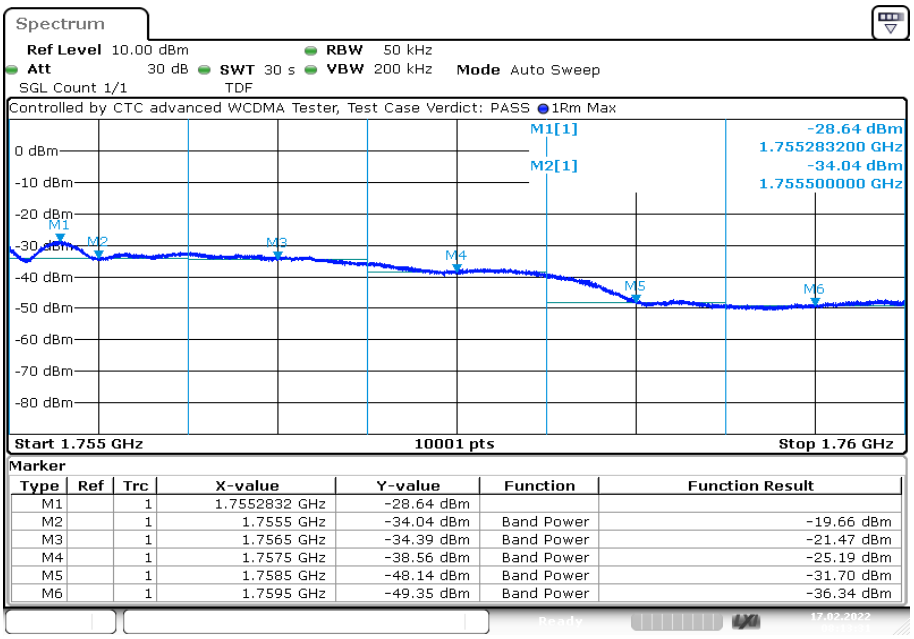


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.70999872 GHz	-21.98 dBm		
M2		1	1.7095 GHz	-30.27 dBm	Band Power	-18.02 dBm
M3		1	1.7085 GHz	-33.20 dBm	Band Power	-21.36 dBm
M4		1	1.7075 GHz	-39.28 dBm	Band Power	-25.78 dBm
M5		1	1.7065 GHz	-46.40 dBm	Band Power	-31.51 dBm
M6		1	1.7055 GHz	-51.55 dBm	Band Power	-37.73 dBm

Date: 17.FEB.2022 08:06:31

Plot 2: Channel 1513



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.7552832 GHz	-28.64 dBm		
M2		1	1.7555 GHz	-34.04 dBm	Band Power	-19.66 dBm
M3		1	1.7565 GHz	-34.39 dBm	Band Power	-21.47 dBm
M4		1	1.7575 GHz	-38.56 dBm	Band Power	-25.19 dBm
M5		1	1.7585 GHz	-48.14 dBm	Band Power	-31.70 dBm
M6		1	1.7595 GHz	-49.35 dBm	Band Power	-36.34 dBm

Date: 17.FEB.2022 08:13:32

12.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the UMTS band IV frequency band. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Part 27.53 requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 4700 kHz, this equates to a resolution bandwidth of at least 50 kHz. For this testing, a resolution bandwidth 100 kHz was used.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	300 kHz
Resolution bandwidth:	100 kHz
Span:	6 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.4 setup A
Measurement uncertainty:	see chapter 9

Limits:

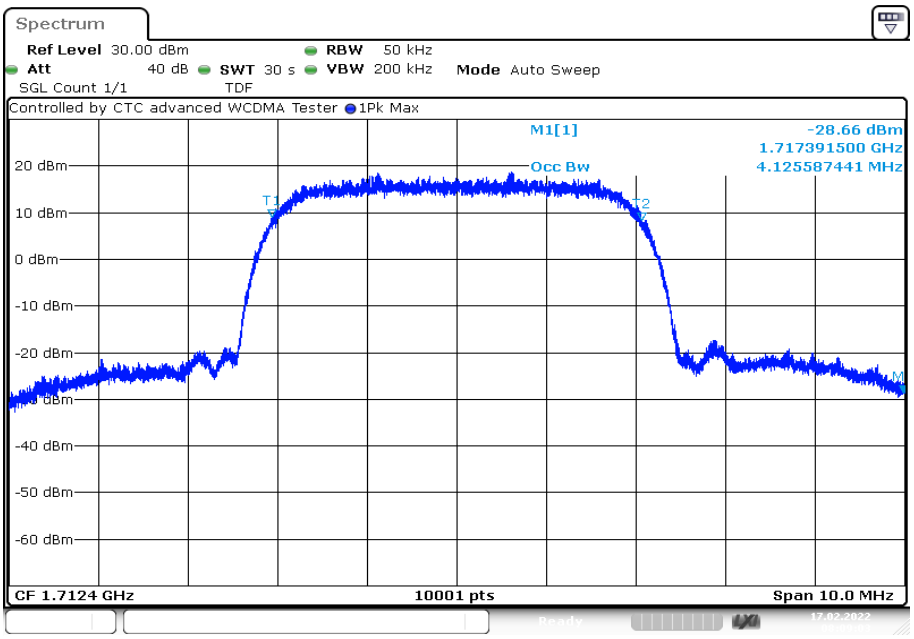
FCC	ISED
CFR Part 27.53(g) CFR Part 2.1049	RSS 139
Spectrum must fall completely in the specified band	

Results:

Occupied Bandwidth		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
1712.4	4126	4709
1732.4	4132	4710
1752.6	4128	4700

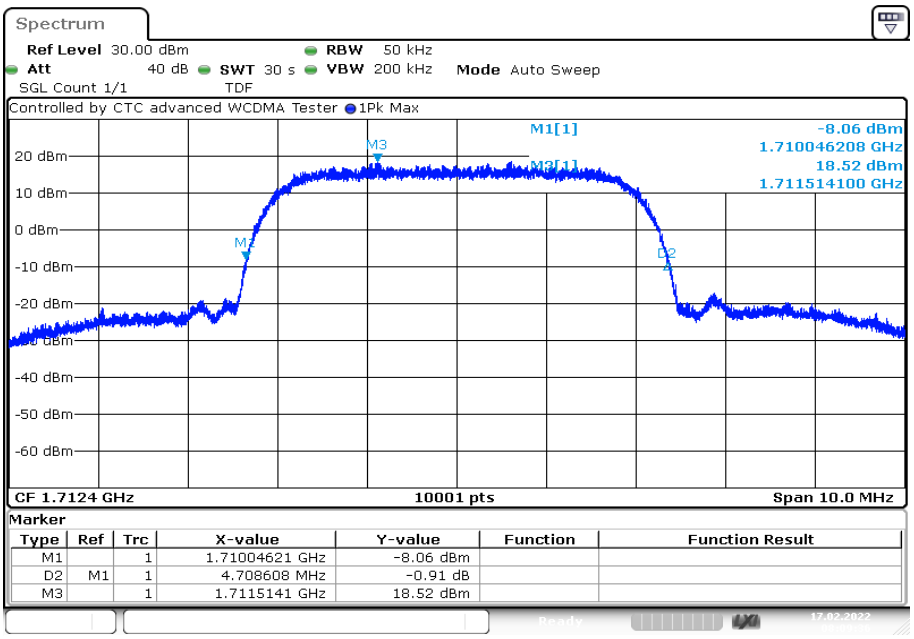
Plots:

Plot 1: Channel 1312 (99% - OBW)



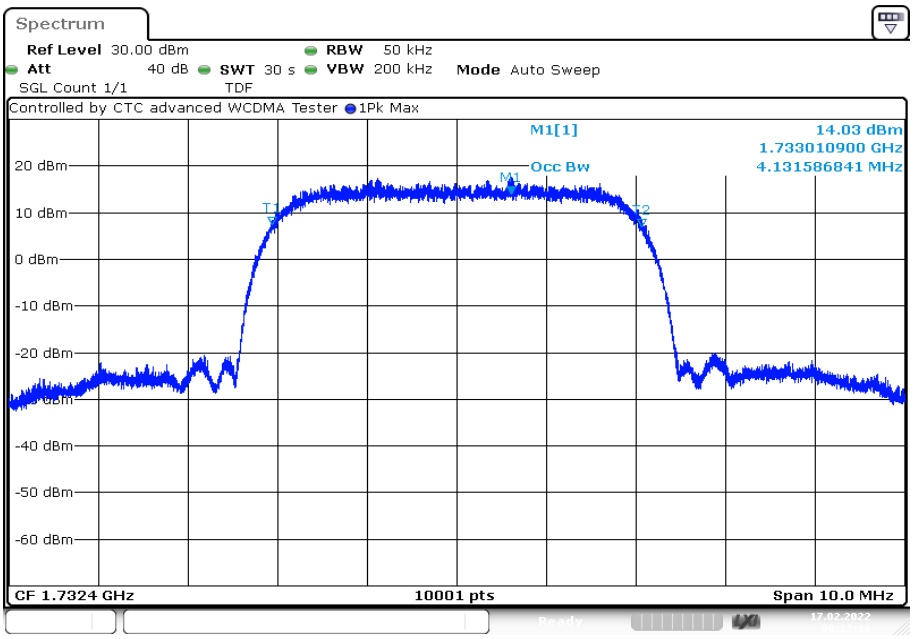
Date: 17.FEB.2022 08:09:04

Plot 2: Channel 1312 (-26 dBc BW)



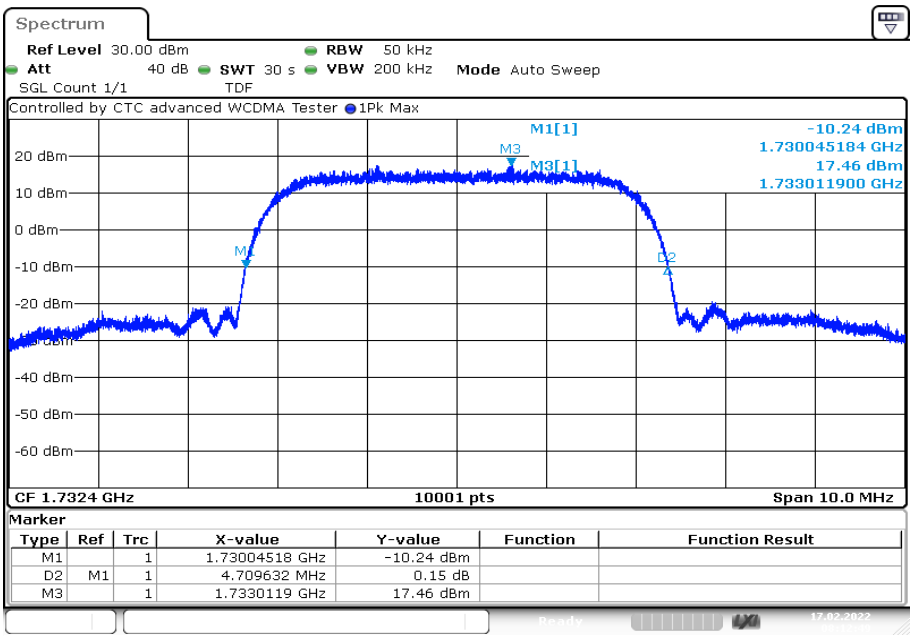
Date: 17.FEB.2022 08:09:37

Plot 3: Channel 1412 (99% - OBW)



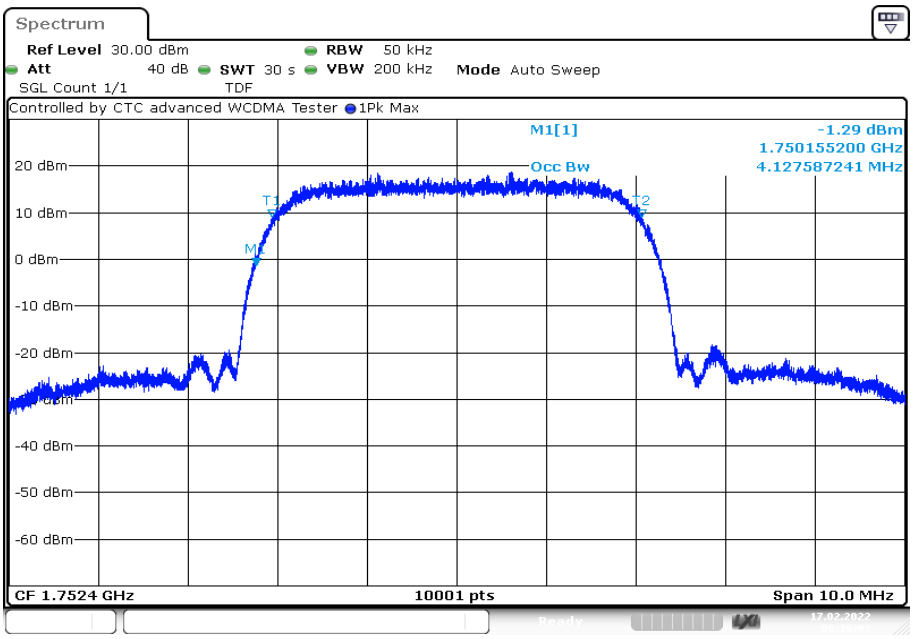
Date: 17.FEB.2022 08:12:17

Plot 4: Channel 1412 (-26 dBc BW)



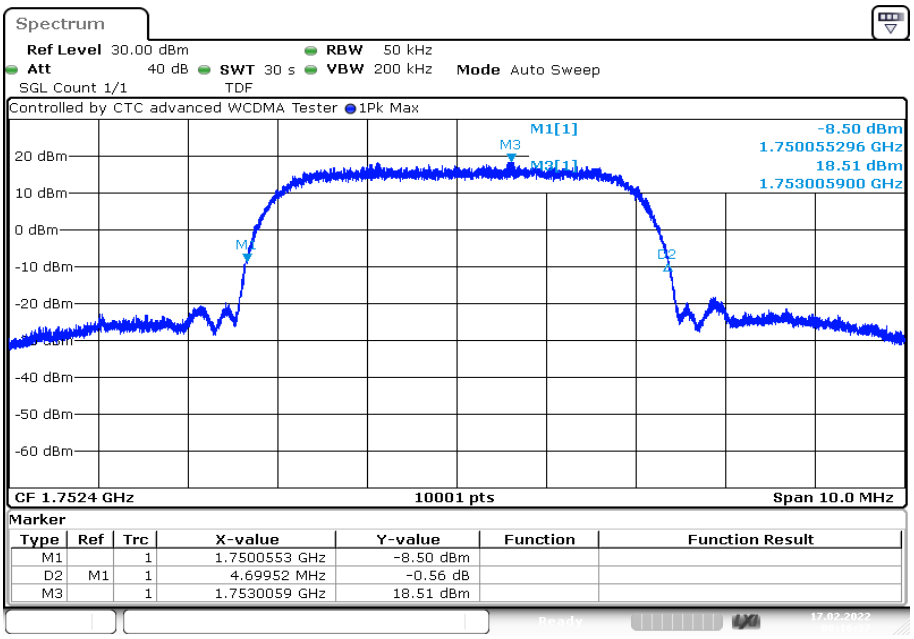
Date: 17.FEB.2022 08:12:50

Plot 5: Channel 1513 (99% - OBW)



Date: 17.FEB.2022 08:16:04

Plot 6: Channel 1513 (-26 dBc BW)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	1.7500553 GHz	-8.50 dBm		
D2	M1	1	4.69952 MHz	-0.56 dB		
M3		1	1.7530059 GHz	18.51 dBm		

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13 Results UMTS band V

All UMTS-band measurements are done in WCDMA mode only.
The connection was established with the following setup: WCDMA CS-RMC, Max Power (All Bit up)

13.1 RF output power

Description:

This paragraph contains average power, peak output power and ERP measurements for the mobile station. In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

Measurement:

The mobile was set up for the maximum output power with pseudo random data modulation.

To determine the Peak-To-Average Power Ratio (PAPR) the measurement was performed with the Power Complementary Cumulative Distribution Function (CCDF).

Measurement parameters	
Detector:	Peak and RMS (Power in Burst)
Sweep time:	Auto
Video bandwidth:	10 MHz
Resolution bandwidth:	10 MHz
Span:	Zero Span
Trace-Mode:	Max Hold
Used equipment:	See chapter
Measurement uncertainty:	see chapter 9

Limits:

FCC	ISED
CFR Part 22.913 CFR Part 2.1046	RSS 132
+38.45 dBm In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.	

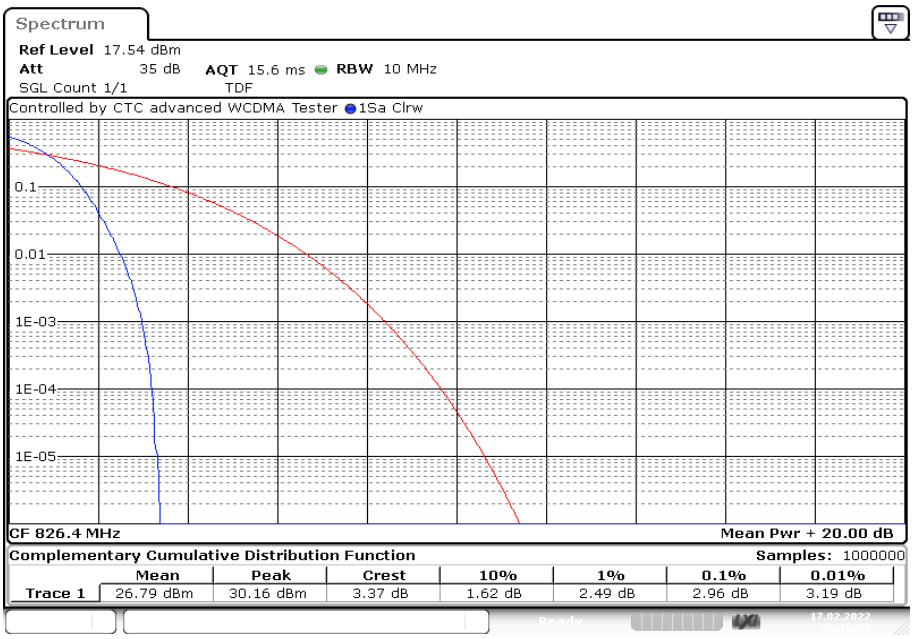
Results:

Output Power (conducted) WCDMA mode		
Frequency (MHz)	**Average Output Power (dBm)**	**Peak to Average Ratio (dB)**
826.4	26.8	2.96
836.0	26.9	2.87
846.6	26.7	2.78

Output Power (radiated) WCDMA mode	
Frequency (MHz)	**Average Output Power (dBm) - ERP**
826.4	23.7
836.0	22.5
846.6	24.2

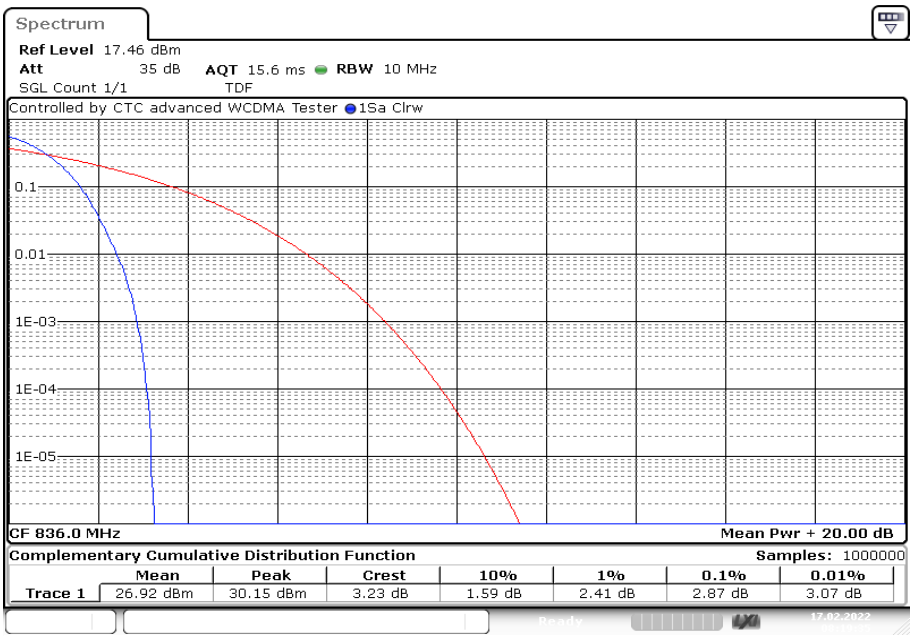
Plots:

Plot 1: CCDF, channel 4132



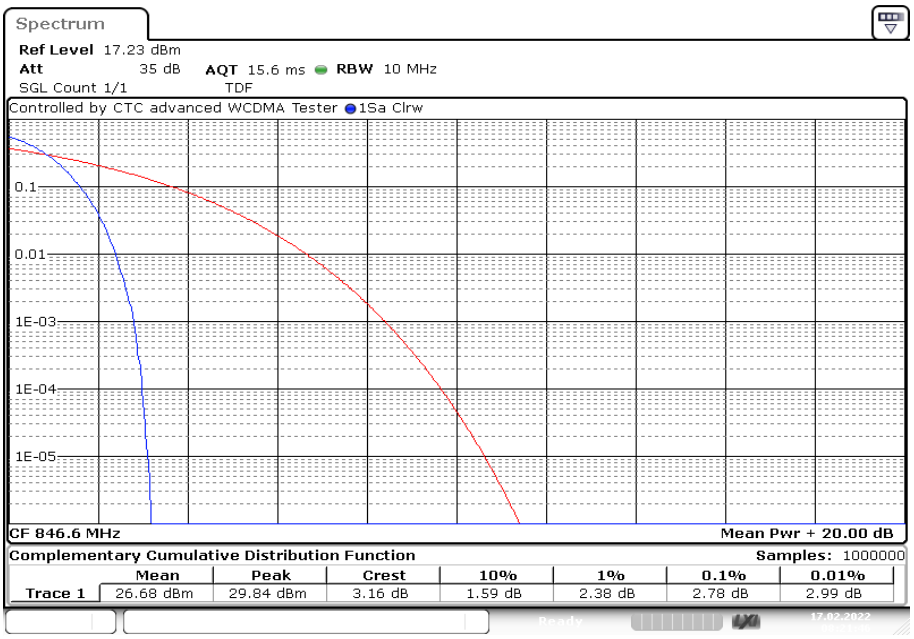
Date: 17.FEB.2022 08:16:51

Plot 2: CCDF, channel 4180



Date: 17.FEB.2022 08:19:36

Plot 3: CCDF, channel 4233



Date: 17.FEB.2022 08:21:47

13.2 Frequency stability

Description:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a "call mode". This is accomplished with the use of a R&S CMU200 DIGITAL RADIOCOMMUNICATION TESTER.
1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with V_{nom}, connected to the CMU200 and in a simulated call on channel 4180 (centre channel), measure the carrier frequency. These measurements should be made within two minutes of powering up the mobile station, to prevent significant self warming.
4. Repeat the above measurements at 10°C increments from -30°C to +60°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with V_{nom}. Vary supply voltage from V_{min} to V_{max}, in 0.1 Volt steps remeasuring carrier frequency at each voltage. Pause at V_{nom} for 1.5 hours unpowered, to allow any self heating to stabilize, before continuing.
6. At all temperature levels hold the temperature to +/- 0.5°C during the measurement procedure.

Measurement:

Measurement parameters	
Detector:	Measured with CMU200
Sweep time:	
Video bandwidth:	
Resolution bandwidth:	
Span:	
Trace-Mode:	
Used equipment:	See chapter
Measurement uncertainty:	see chapter 9

Limits:

FCC	ISED
CFR Part 22.355 CFR Part 2.1055	RSS 132
± 0.1 ppm	

Results:

AFC FREQ ERROR versus VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
6.0	12	0.0014	0.01
12.0	14	0.0017	0.02
24.0	14	0.0017	0.02
32.0	13	0.0016	0.02

AFC FREQ ERROR versus TEMPERATURE

Temperature (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	14	0.0017	0.02
-20	12	0.0014	0.01
-10	8	0.0010	0.01
± 0	-9	-0.0011	-0.01
10	-15	-0.0018	-0.02
20	14	0.0017	0.02
30	11	0.0013	0.01
40	10	0.0012	0.01
50	8	0.0010	0.01

13.3 Spurious emissions radiated

Description:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2009 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 846.6 MHz. This was rounded up to 12 GHz. The resolution bandwidth is set as outlined in Part 22.917. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the UMTS band V.

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	2 sec.
Video bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Resolution bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Span:	100 MHz Steps
Trace-Mode:	Max Hold
Used equipment:	See chapter
Measurement uncertainty:	see chapter 9

Limits:

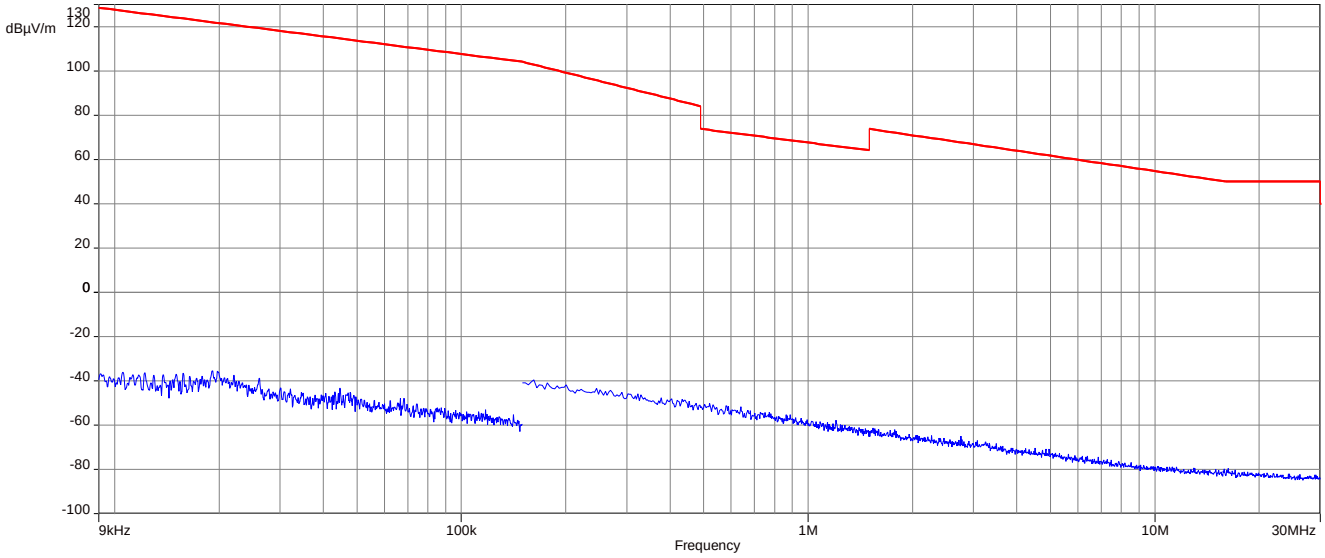
FCC	ISED
CFR Part 22.917 CFR Part 2.1053	RSS 132
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm	

Results:

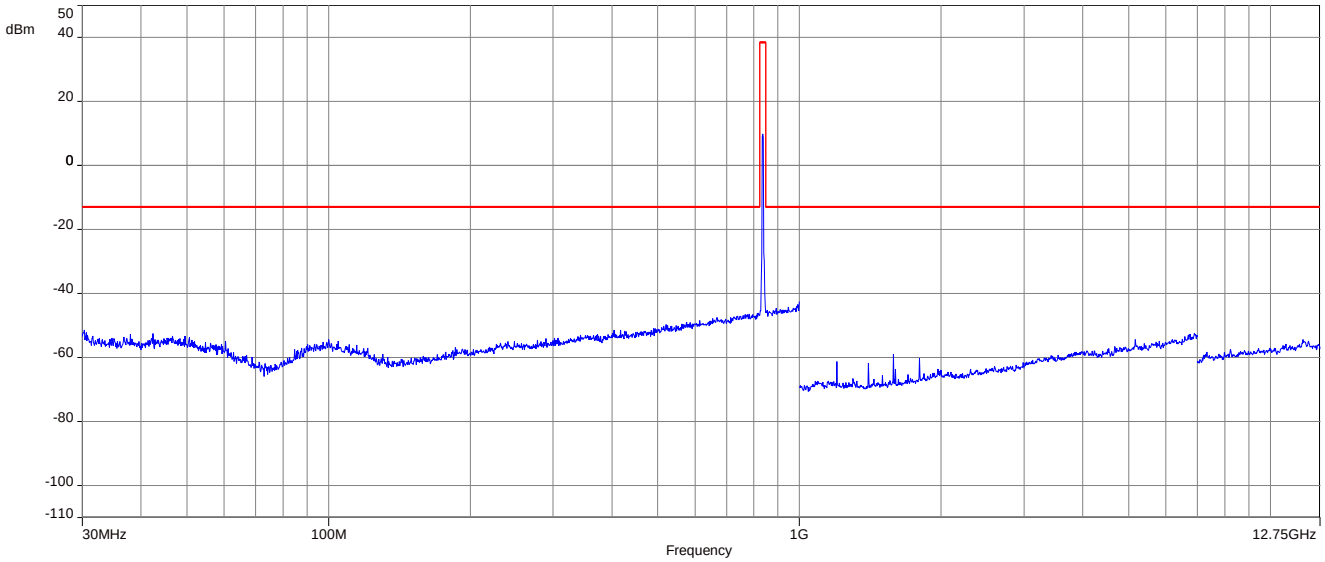
SPURIOUS EMISSION LEVEL								
Harmonic	Ch. 4132 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4180 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4233 Freq. (MHz)	Level [dBm]
2	1652.8	-	2	1672.0	-	2	1693.2	-
3	2479.2	-	3	2508.0	-	3	2539.8	-
4	3305.6	-	4	3344.0	-	4	3386.4	-
5	4132.0	-	5	4180.0	-	5	4233.0	-
6	4958.4	-	6	5016.0	-	6	5079.6	-
7	5784.8	-	7	5852.0	-	7	5926.2	-
8	6611.2	-	8	6688.0	-	8	6772.8	-
9	7437.6	-	9	7524.0	-	9	7619.4	-
10	8264.0	-	10	8360.0	-	10	8466.0	-

Plots:

Plot 1: Channel 4180 (Traffic mode up to 30 MHz)



Plot 2: Channel 4180 (30 MHz – 12.75 GHz)



13.4 Spurious emissions conducted

Description:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.
1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency.
2. Determine mobile station transmits frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

UMTS band V Transmitter Channel Frequency
4132 826.4 MHz
4180 836.0 MHz
4233 846.6 MHz

Measurement:

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	10 MHz – 8.5 GHz
Trace-Mode:	Max Hold
Used equipment:	See chapter
Measurement uncertainty:	see chapter 9

Limits:

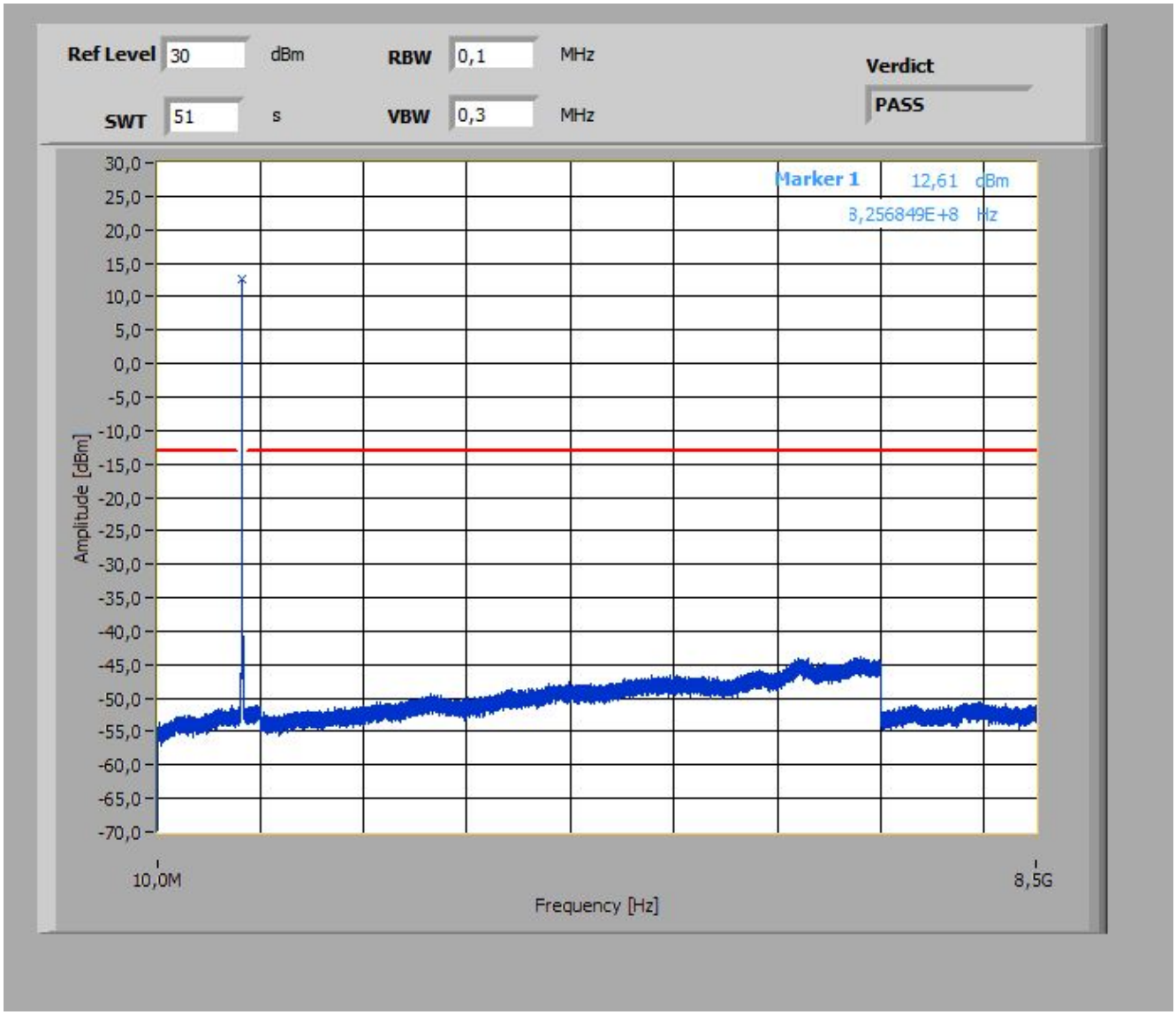
FCC	ISED
CFR Part 22.917 CFR Part 2.1051	RSS 132
Attenuation ≥ 43 + 10log(P) (P, Power in Watts)	
-13 dBm	

Results:

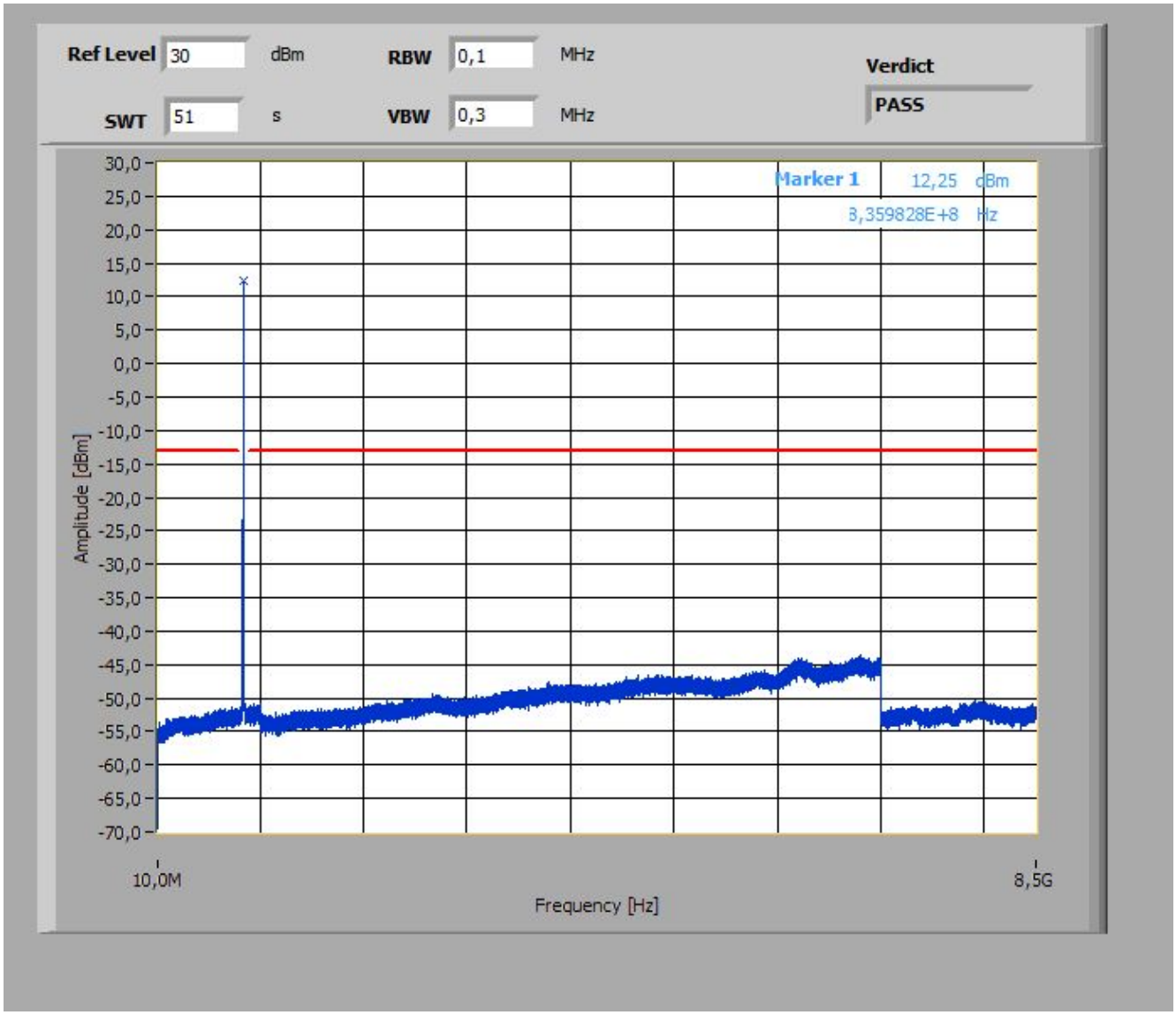
SPURIOUS EMISSION LEVEL								
Harmonic	Ch. 4132 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4180 Freq. (MHz)	Level [dBm]	Harmonic	Ch. 4233 Freq. (MHz)	Level [dBm]
2	1652.8	-	2	1672.0	-	2	1693.2	-
3	2479.2	-	3	2508.0	-	3	2539.8	-
4	3305.6	-	4	3344.0	-	4	3386.4	-
5	4132.0	-	5	4180.0	-	5	4233.0	-
6	4958.4	-	6	5016.0	-	6	5079.6	-
7	5784.8	-	7	5852.0	-	7	5926.2	-
8	6611.2	-	8	6688.0	-	8	6772.8	-
9	7437.6	-	9	7524.0	-	9	7619.4	-
10	8264.0	-	10	8360.0	-	10	8466.0	-

Plots:

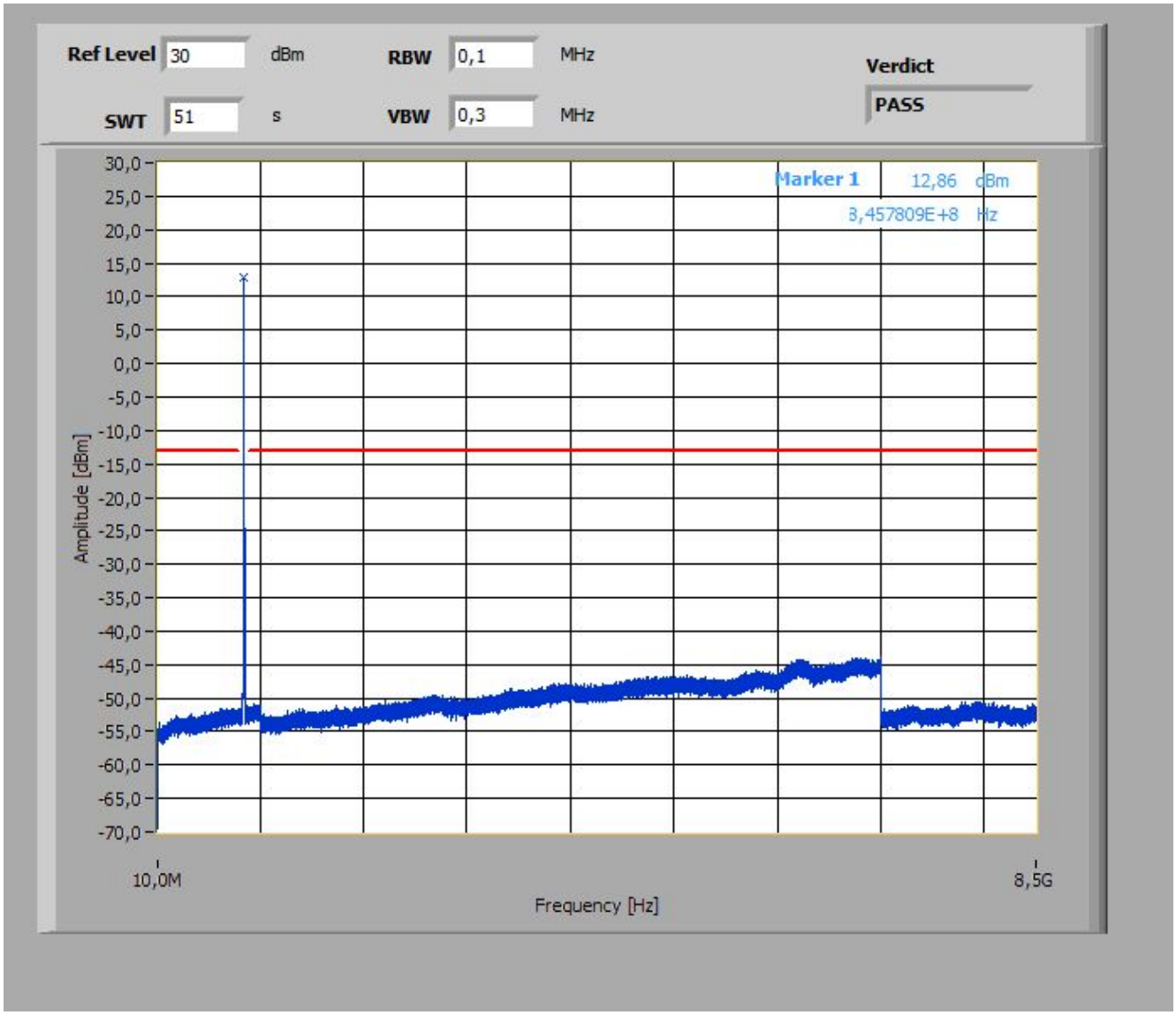
Plot 1: Channel 4132 (10 MHz – 8.5 GHz)



Plot 2: Channel 4180 (10 MHz – 8.5 GHz)



Plot 3: Channel 4233 (10 MHz – 8.5 GHz)



13.5 Block edge compliance

Description:

The spectrum at the band edges must comply with the spurious emissions limits.

Measurement:

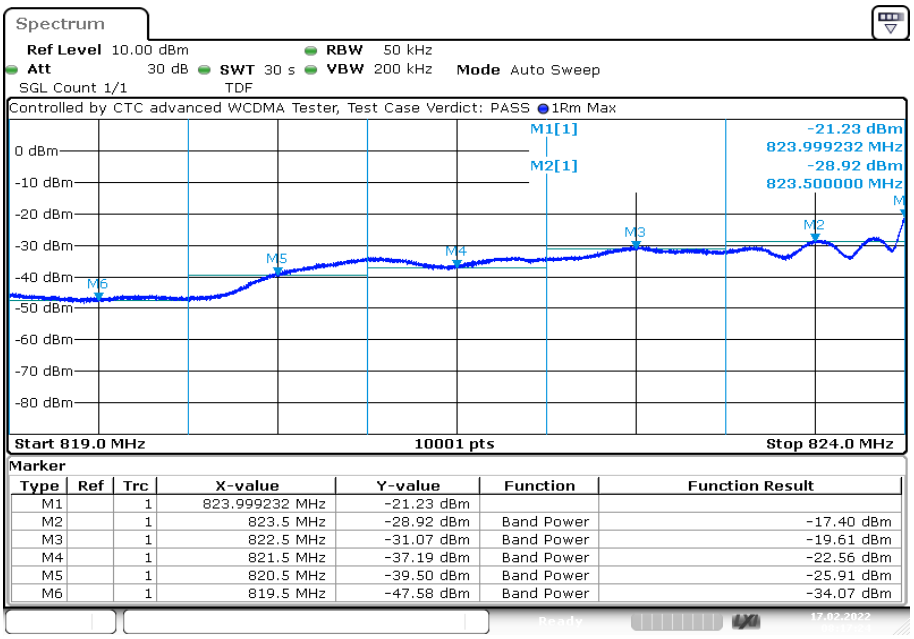
Measurement parameters	
Detector:	RMS
Sweep time:	20 sec.
Video bandwidth:	30 kHz
Resolution bandwidth:	30 kHz
Span:	1 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter
Measurement uncertainty:	See chapter 9

Limits:

FCC	ISED
CFR Part 22.917 CFR Part 2.1051	RSS 132
-13 dBm	

Plots:

Plot 1: Channel 4132



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	823.999232 MHz	-21.23 dBm		
M2		1	823.5 MHz	-28.92 dBm	Band Power	-17.40 dBm
M3		1	822.5 MHz	-31.07 dBm	Band Power	-19.61 dBm
M4		1	821.5 MHz	-37.19 dBm	Band Power	-22.56 dBm
M5		1	820.5 MHz	-39.50 dBm	Band Power	-25.91 dBm
M6		1	819.5 MHz	-47.58 dBm	Band Power	-34.07 dBm

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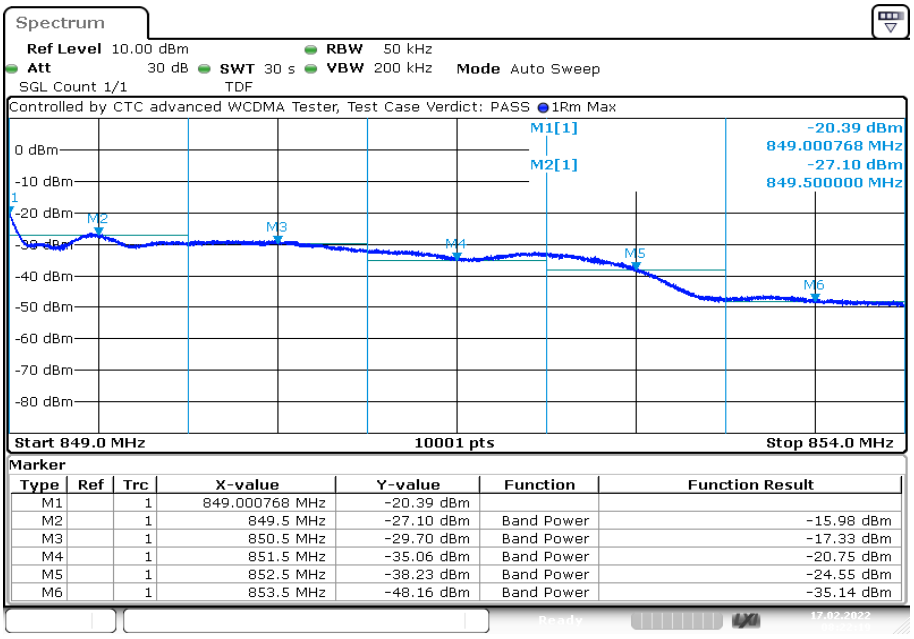
Plot 2: Channel 4233



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	849.000768 MHz	-20.39 dBm		
M2		1	849.5 MHz	-27.10 dBm	Band Power	-15.98 dBm
M3		1	850.5 MHz	-29.70 dBm	Band Power	-17.33 dBm
M4		1	851.5 MHz	-35.06 dBm	Band Power	-20.75 dBm
M5		1	852.5 MHz	-38.23 dBm	Band Power	-24.55 dBm
M6		1	853.5 MHz	-48.16 dBm	Band Power	-35.14 dBm

Date: 17.FEB.2022 08:22:19

13.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the UMTS band V. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Part 22.917 requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 4700 kHz, this equates to a resolution bandwidth of at least 50 kHz. For this testing, a resolution bandwidth 100 kHz was used.

Measurement parameters	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	300 kHz
Resolution bandwidth:	100 kHz
Span:	6 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter
Measurement uncertainty:	see chapter 9

Limits:

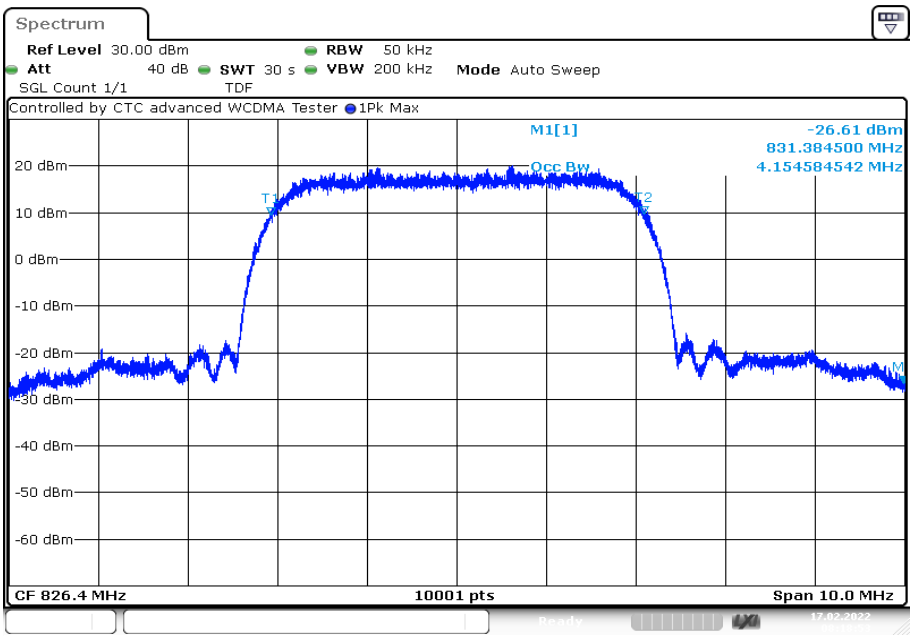
FCC	ISED
CFR Part 22.917 CFR Part 2.1049	RSS 132
Spectrum must fall completely in the specified band	

Results:

Occupied Bandwidth		
Frequency (MHz)	99% OBW (kHz)	-26 dBc BW (kHz)
826.4	4155	4716
836.0	4158	4719
846.6	4139	4725

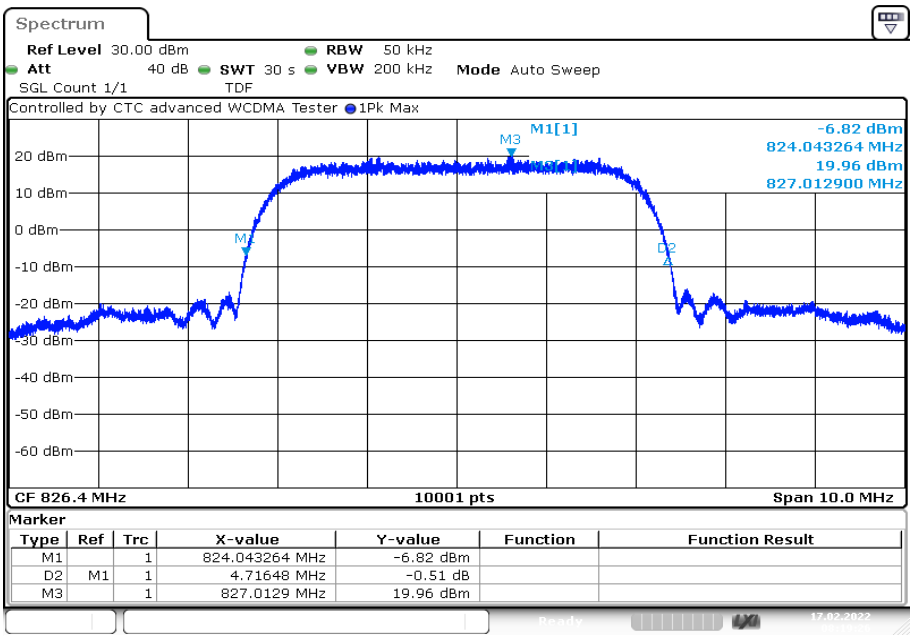
Plots:

Plot 1: Channel 4132 (99% - OBW)



Date: 17.FEB.2022 08:18:54

Plot 2: Channel 4132 (-26 dBc BW)

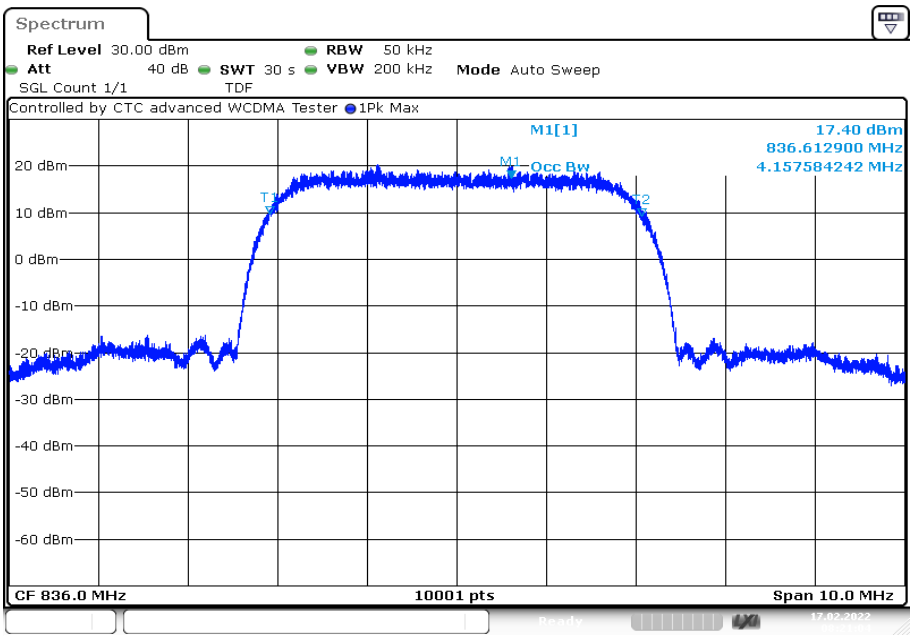


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	824.043264 MHz	-6.82 dBm		
D2	M1	1	4.71648 MHz	-0.51 dB		
M3		1	827.0129 MHz	19.96 dBm		

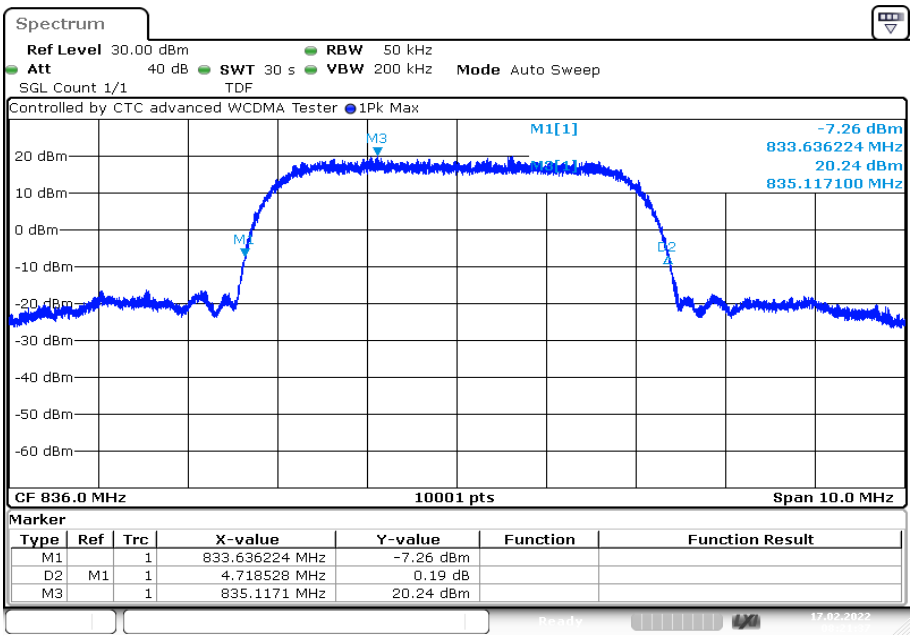
Date: 17.FEB.2022 08:19:27

Plot 3: Channel 4180 (99% - OBW)



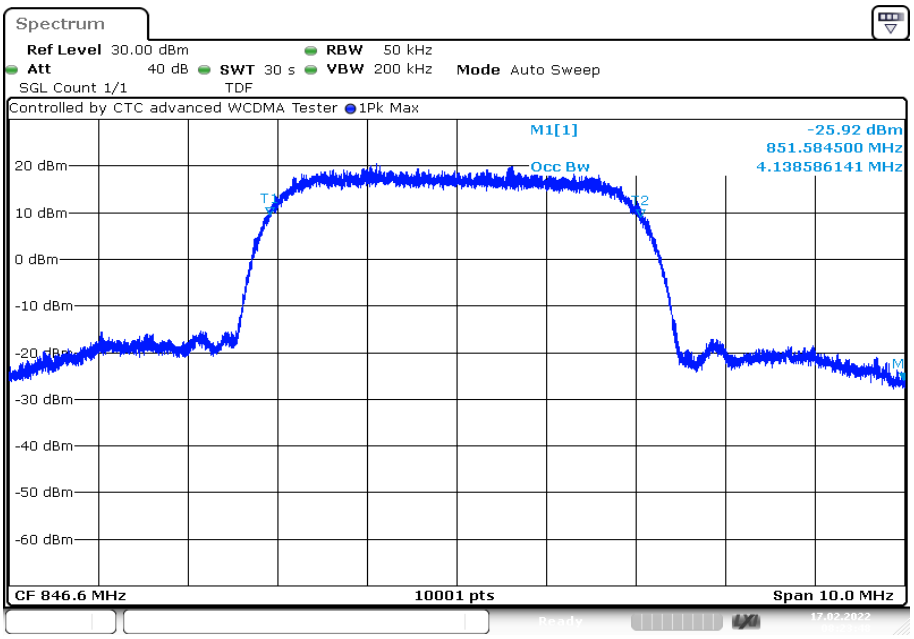
Date: 17.FEB.2022 08:21:05

Plot 4: Channel 4180 (-26 dBc BW)



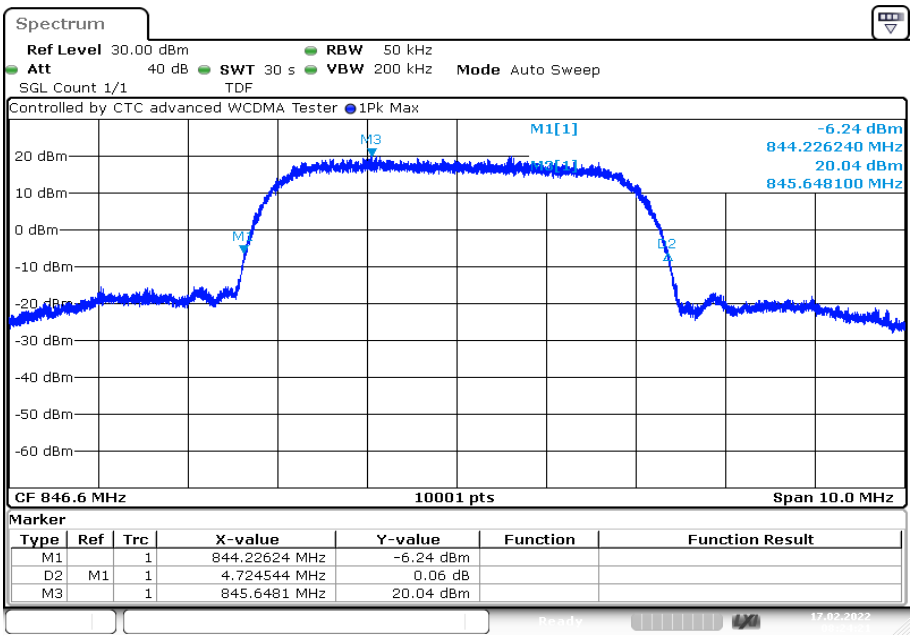
Date: 17.FEB.2022 08:21:38

Plot 5: Channel 4233 (99% - OBW)



Date: 17.FEB.2022 08:23:49

Plot 6: Channel 4233 (-26 dBc BW)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	844.22624 MHz	-6.24 dBm		
D2	M1	1	4.724544 MHz	0.06 dB		
M3		1	845.6481 MHz	20.04 dBm		

Date: 17.FEB.2022 08:24:22

14 Observations

No observations except those reported with the single test cases have been made.

15 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz

16 Document history

Version	Applied changes	Date of release
-/-	Initial release	2022-04-11

17 Accreditation Certificate – D-PL-12076-01-04

first page	last page

DAkkS Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory

CTC advanced GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields:

Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards

The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 07 pages.

Registration number of the certificate: **D-PL-12076-01-04**

Frankfurt am Main, 09.06.2020

by order Dipl.-Ing. (FH) Ralf Egner
Head of Division

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.
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See notes overleaf.

Deutsche Akkreditierungsstelle GmbH

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ILAC: www.ilac.org
IAF: www.iaf.nu

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https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-04e.pdf

or
https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-04_Canada_TCEMC.pdf

18 Accreditation Certificate – D-PL-12076-01-05

first page	last page

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Untertürkheimer Straße 6-10, 66117 Saarbrücken

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Telecommunication (FCC Requirements)

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Registration number of the certificate: **D-PL-12076-01-05**

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https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05e.pdf

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https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf

################################ END OF TEST REPORT ################################