TEST REPORT

No. I21N03607-RF-GSM

for

TCL Communication Ltd.

GSM Quad Band Mobile Phone

Model Name: 2057D,2057X

FCC ID: 2ACCJB169

with

Hardware Version: F109_MB_V1.0

Software Version: 2057D_ALW8_2SIM_V1_1_20211129_UNLOCK

Issued Date: 2022-01-12

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of SAICT.

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I21N03607-RF-GSM	Rev.0	1st edition	2022-01-12

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1. SUMMARY OF TEST REPORT

1.1. Test Items

Description	GSM Quad Band Mobile Phone
Model Name	2057D,2057X
Applicant's name	TCL Communication Ltd.
Manufacturer's Name	TCL Communication Ltd.

1.2. Test Standards

FCC Part 2/22/24	10-1-19 Edition
ANSI C63.26	2015
KDB971168 D01	v03r01

1.3. Test Result

All test items are pass. Please refer to "6 Summary of Test Results" for detail.

1.4. Testing Location

Address: Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen, Guangdong, P. R. China 518000

1.5. Project Data

Testing Start Date: 2021-12-02 Testing End Date: 2022-01-11

1.6. Signature

Tan Pei
(Prepared this test report)

Huang Qiuqin
(Reviewed this test report)

Zhang Hao
(Approved this test report)

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2. CLIENT INFORMATION

2.1. Applicant Information

Company Name:	TCL Communication Ltd.
Address /Post:	5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong
Contact Person:	Peter yang
Contact Email	peter.yang@tcl.com
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2.2. Manufacturer Information

Company Name:	TCL Communication Ltd.
Address /Post:	5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong
Contact Person:	Peter yang
Contact Email	peter.yang@tcl.com
Telephone:	+86 755 3664 5759
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3. EQUIPMENT UNDER TEST (EUT) AND ANCILLARY EQUIPMENT (AE)

3.1. About EUT

Description	GSM Quad Band Mobile Phone
Model Name	2057D,2057X
FCC ID	2ACCJB169
Frequency Bands	GSM850; GSM1900
Antenna	Integrated
Extreme vol. Limits	3.6V to 4.2V (nominal: 3.8V)
Extreme temp. Tolerance	-10°C to +55°C
Condition of EUT as received	No abnormality in appearance

Noe: The test sample was 2057D; 2057X is a variant product of 2057D, 2057X: Single SIM; 2057D: Dual SIM.

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version	Sample Arrival Date
UT01aa	350306070002990	F109_MB_V1.0	2057D_ALW8_2SIM_V1_1_20211129_UNLOCK	2021-12-02
UT07aa	350306070004830	F109_MB_V1.0	2057D_ALW8_2SIM_V1_1_20211129_UNLOCK	2021-12-08

*EUT ID: is used to identify the test sample in the lab internally.

UT01aa is used for conduction test, UT07aa is used for radiation test.

3.3. Internal Identification of AE used during the test

AE ID*	Description
AE1	Battery

AE1

Model	TLi009AA
Manufacturer	TIANMAO
Capacity	950mAh
Nominal Voltage	3.7V

*AE ID: is used to identify the test sample in the lab internally.

3.4. General Description

The Equipment Under Test (EUT) is a model GSM Quad Band Mobile Phone with integrated antenna. It consists of normal options: lithium battery, charger. Manual and specifications of the EUT were provided to fulfil the test. Samples undergoing test were selected by the Client.

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4. REFERENCE DOCUMENTS

4.1. Reference Documents for testing

The following documents listed in this section are referred for testing.

Reference	Title	Version
FCC Part 22	PUBLIC MOBILE SERVICES	10-1-19 Edition
FCC Part 2	FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS	10-1-19 Edition
FCC Part 24	PERSONAL COMMUNICATIONS SERVICES	10-1-19 Edition
ANSI C63.26	American National Standard of Procedures for Compliance Testing of Licensed Transmitters Used in Licensed Radio Service	2015
KDB971168 D01	Power Meas License Digital Systems	v03r01

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5. LABORATORY ENVIRONMENT

Shielded room did not exceed following limits along the RF testing:

Temperature	Min. = 15 ˚C, Max. = 35 ˚C
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz>60 dB; 1MHz-18000MHz>90 dB
Electrical insulation	>2 MΩ
Ground system resistance	< 4 Ω

Fully-anechoic chamber did not exceed following limits along the EMC testing

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz> 60 dB; 1MHz-18000MHz>90 dB
Electrical insulation	> 2MΩ
Ground system resistance	< 4 Ω
Voltage Standing Wave Ratio （VSWR）	≤ 6 dB, from 1 to 18 GHz，3 m distance
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz

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6. SUMMARY OF TEST RESULTS

Abbreviations used in this clause:		
Verdict Column	P	Pass
	F	Fail
	NA	Not applicable
	NM	Not measured
Location Column	A/B/C/D	The test is performed in test location A, B, C or D which are described in section 1.1 of this report

GSM850

Items	List	Clause in FCC rules	Section in this report	Verdict
1	Output Power	2.1046/22.913	A.1	P
2	Field Strength of Spurious Radiation	2.1053/22.917	A.2	P
3	Frequency Stability	2.1055/22.355	A.3	P
4	Occupied Bandwidth	2.1049/22.917	A.4	P
5	Emission Bandwidth	2.1049/22.917	A.5	P
6	Band Edge Compliance	2.1051/22.917	A.6	P
7	Conducted Spurious Emission	2.1051/22.917	A.7	P
8	Peak-to-Average Power Ratio	KDB971168 D01	A.8	P

PCS1900

Items	List	Clause in FCC rules	Section in this report	Verdict
1	Output Power	2.1046/24.232	A.1	P
2	Field Strength of Spurious Radiation	2.1053/24.238	A.2	P
3	Frequency Stability	2.1055/24.235	A.3	P
4	Occupied Bandwidth	2.1049/24.238	A.4	P
5	Emission Bandwidth	2.1049/24.238	A.5	P
6	Band Edge Compliance	2.1051/24.238	A.6	P
7	Conducted Spurious Emission	2.1051/24.238	A.7	P
8	Peak-to-Average Power Ratio	24.232/KDB971168 D01	A.8	P

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7. STATEMENT

Since the information of samples in this report is provided by the client, the laboratory is not respo nsible for the authenticity of sample information.
This report takes measured values as criterion of test conclusion. The test conlusion meets the li mit requirements.

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8. TEST EQUIPMENTS UTILIZED

NO.	Description	TYPE	Manufacture	series number	CAL DUE DATE
1	Test Receiver	ESR7	R&S	101676	2022-11-24
2	BiLog Antenna	3142E	ETS-Lindgren	0224831	2024-05-27
3	Horn Antenna	3117	ETS-Lindgren	00066577	2022-04-02
4	Horn Antenna	QSH-SL-18 -26-S-20	Q-par	17013	2023-01-06
5	Antenna	BBHA 9120D	Schwarzbeck	1593	2022-12-05
6	Antenna	VUBA 9117	Schwarzbeck	207	2023-07-15
7	Antenna	QWH-SL-18 -40-K-SG	Q-par	15979	2023-01-06
8	preamplifier	83017A	Agilent	MY39501110	/
9	Signal Generator	SMB100A	R&S	179725	2022-11-24
10	Fully Anechoic Chamber	FACT3-2.0	ETS-Lindgren	1285	2023-05-29
11	Spectrum Analyzer	FSV40	R&S	101192	2022-01-13
12	Universal Radio Communication Tester	CMU200	R&S	114545	2022-01-13
13	Universal Radio Communication Tester	CMU200	R&S	123210	2022-12-13
14	Spectrum Analyzer	FSU	R&S	101506	2022-12-13
15	Temperature Chamber	SH-241	ESPEC	92007516	2022-10-15
16	DC Power Supply	U3606A	Agilent Technologies	MY50450012	2022-11-13

Test software

Item	Name	Vesion
Radiated	EMC32	V10.50.40

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ANNEX A: MEASUREMENT RESULTS

A.1 OUTPUT POWER

Reference

FCC: CFR Part 2.1046, 22.913, 24.232.

A.1.1 Summary

During the process of testing, the EUT was controlled via Rhode & Schwarz Digital Radio Communication tester (CMU-200) to ensure max power transmission and proper modulation.

This result contains max output power and EIRP measurements for the EUT. In all cases, output power is within the specified limits.

A.1.2 Conducted

A.1.2.1 Method of Measurements

The EUT was set up for the max output power with pseudo random data modulation.

These measurements were done at 3 frequencies, 1850.2 MHz, 1880.0MHz and 1909.8MHz for PCS1900 band; 824.2MHz, 836.6MHz and 848.8MHz for GSM850 band. (bottom, middle and top of operational frequency range).

GSM850

	Power step	Nominal Peak output power (dBm)
GSM	5	33dBm(2W)
GPRS	NA	NA
EGPRS	NA	NA

Measurement result

GSM(GMSK)

Frequency(MHz)	Power Step	Output power(dBm)
824.2	5	32.58
836.6	5	32.45
848.8	5	32.33

Note: Expanded measurement uncertainty is U = 0.49dB, k = 1.96

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PCS1900

	Power step	Nominal Peak output power (dBm)
GSM	0	30dBm(1W)
GPRS	NA	NA
EGPRS	NA	NA

Measurement result

GSM(GMSK)

Frequency(MHz)	Power Step	Output power(dBm)
1850.2	0	29.65
1880.0	0	29.63
1909.8	0	29.68

Note: Expanded measurement uncertainty is U = 0.49dB, k = 1.96

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A.1.3 Radiated

A.1.3.1 Description

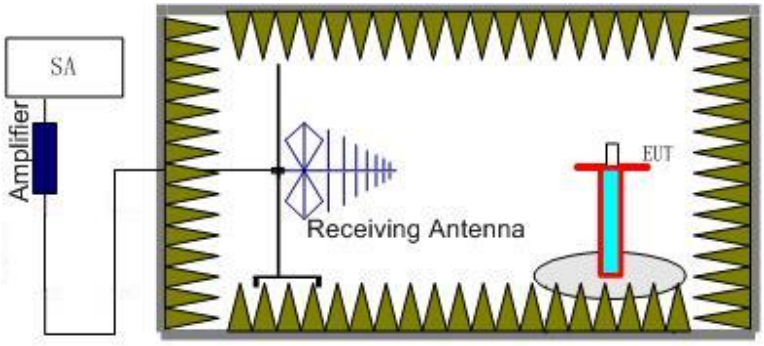
This is the test for the maximum radiated power from the EUT.

Rule Part 24.232(c) specifies, "Mobile/portable stations are limited to 2 watts e.i.r.p. Peak power" and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."

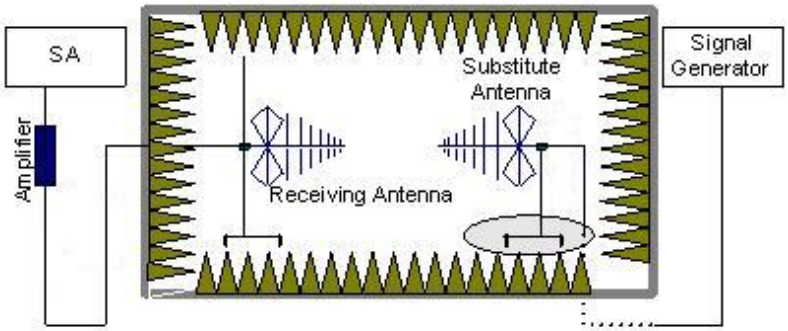
Rule Part 22.913(a) specifies" The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts."

A.1.3.2 Method of Measurement

1. EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in three channels (High, Middle, Low) were measured with peak detector.



2. The EUT is then put into continuously transmitting mode at its maximum power level during the test. And the maximum value of the receiver should be recorded as (Pr).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



In the chamber, a substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the

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receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

4. A amplifier should be connected to the Signal Source output port. And the cable should be connected between the Amplifier and the Substitution Antenna.
   The cable loss (P_{cl}) ,the Substitution Antenna Gain(dBi) (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test.
   The measurement results are obtained as described below:
   Power(EIRP)=P_{Mea}- P_{Ag} - P_{cl} + G_a
5. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
6. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.15dB.

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GSM 850-ERP 22.913(a)

Limits

	Power Step	Burst Peak ERP (dBm)
GSM	5	≤38.45dBm (7W)

Measurement result

GSM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	Correction (dB)	ERP(dBm)	Limit(dBm)	Polarization
824.20	-3.23	-33.60	-0.79	2.15	27.43	38.45	V
836.60	**-3.02**	**-33.50**	**-0.74**	**2.15**	**27.59**	**38.45**	**V**
848.80	-3.41	-33.50	-0.73	2.15	27.21	38.45	V

Frequency: 836.60MHz

Peak ERP(dBm)=PMea(-3.02dBm)-(Pcl+PAg)(-33.50dB)+Ga(-0.74dB)-2.15dB=27.59dBm

ANALYZER SETTINGS: RBW = VBW = 3MHz

Note: The maximum value of expanded measurement uncertainty for this test item is U = 2.87dB(30MHz-3GHz)/3.35dB(3GHz-18GHz)/2.68dB(18GHz-40GHz), k = 2

Note: Both of Vertical and Horizontal polarizations are evaluated, but only the worst case is recorded in this report.

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PCS1900-EIRP 24.232(c)

Limits

	Power Step	Burst Peak EIRP (dBm)
GSM	0	≤33dBm (2W)

Measurement result

GSM

Frequency(MHz)	P_{Mea}(dBm)	P_{cl}(dB)+ P_{Ag}(dB)	Ga Antenna Gain(dBi)	EIRP(dBm)	Limit(dBm)	Polarization
1850.20	-8.90	-29.30	8.10	28.50	33.00	V
1880.00	**-8.48**	**-29.40**	**8.10**	**29.02**	**33.00**	**V**
1909.80	-8.70	-29.30	8.10	28.70	33.00	V

Frequency**:** 1880.00MHz

Peak EIRP(dBm)= PMea(-8.48dBm) –(Pcl+PAg)(-29.40dB)+Ga (8.10dB) =29.02dBm

ANALYZER SETTINGS: RBW = VBW = 3MHz

Note: The maximum value of expanded measurement uncertainty for this test item is U = 2.87dB(30MHz-3GHz)/3.35dB(3GHz-18GHz)/2.68dB(18GHz-40GHz), k = 2

Note: Both of Vertical and Horizontal polarizations are evaluated, but only the worst case is recorded in this report.

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A.2 FIELD STRENGTH OF SPURIOUS RADIATION

Reference

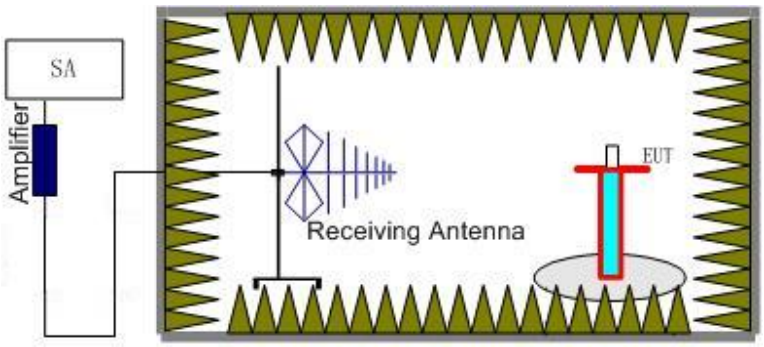
FCC: CFR 2.1053, 22.917, 24.238.

A.2.1 Measurement Method

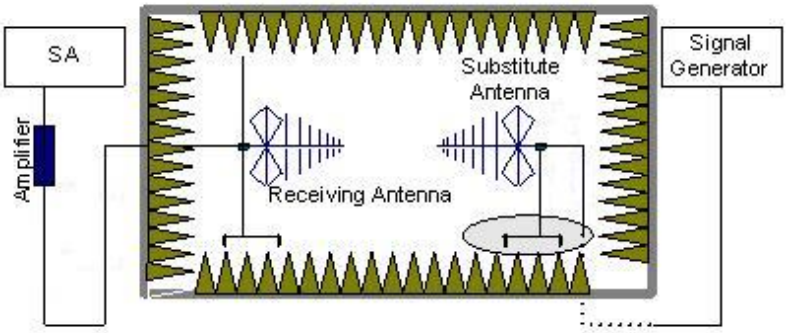
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 1910MHz. The resolution bandwidth is set 1MHz as outlined in Part 24.238 and Part 22.917. The spectrum is scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of PCS1900 and GSM850.

The procedure of radiated spurious emissions is as follows:

1. EUT was placed on a 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all non-harmonic and harmonics of the transmit frequency through the 10th harmonic were measured with peak detector.



2. The EUT is then put into continuously transmitting mode at its maximum power level during the test. And the maximum value of the receiver should be recorded as (Pr).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere

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with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

4. The Path loss (P_{pl}) between the Signal Source with the Substitution Antenna and the Substitution Antenna Gain(dBi) (G_a) should be recorded after test.
   A amplifier should be connected in for the test.
   The Path loss (P_{pl}) is the summation of the cable loss and the gain of the amplifier.
   The measurement results are obtained as described below:
   Power(EIRP)=P_{Mea} - P_{pl} + G_a
5. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
6. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.15dB.

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A.2.2 Measurement Limit

Part 24.238 and Part 22.917 specify that 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.

The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

A.2.3 Measurement Results

Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of the PCS1900 band (1850.2 MHz, 1880 MHz and 1909.8 MHz) and GSM850 band (824.2MHz, 836.6MHz, 848.8MHz) . It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the PCS1900, GSM850 into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

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A.2.4 Measurement Results Table

Frequency	Channel	Frequency Range	Result
GSM 850MHz	Low	30MHz-10GHz	Pass
	Middle	30MHz-10GHz	Pass
	High	30MHz-10GHz	Pass
GSM 1900MHz	Low	30MHz-20GHz	Pass
	Middle	30MHz-20GHz	Pass
	High	30MHz-20GHz	Pass

A.2.5 Sweep Table

Working Frequency	Subrange (GHz)	RBW	VBW	Sweep time (s)
850MHz	0.03~1	100KHz	300KHz	10
	1-2	1 MHz	3 MHz	2
	2~5	1 MHz	3 MHz	3
	5~8	1 MHz	3 MHz	3
	8~10	1 MHz	3 MHz	3
1900MHz	0.03~1	100KHz	300KHz	10
	1-2	1 MHz	3 MHz	2
	2~5	1 MHz	3 MHz	3
	5~8	1 MHz	3 MHz	3
	8~11	1 MHz	3 MHz	3
	11~14	1 MHz	3 MHz	3
	14~18	1 MHz	3 MHz	3
	18~20	1 MHz	3 MHz	2

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GSM Mode Channel 128/824.2MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit （dBm）	Polarization
1648.55	-39.36	0.80	8.10	-34.21	-13.00	V
2472.50	-42.87	0.90	9.80	-36.12	-13.00	H
4120.88	-35.62	1.20	12.40	-26.57	-13.00	V
9101.00	-47.55	2.20	11.60	-40.30	-13.00	H
9300.50	-47.00	2.00	11.60	-39.55	-13.00	H
9420.50	-47.67	2.10	11.60	-40.32	-13.00	H

GSM Mode Channel 190/836.6MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit （dBm）	Polarization
1673.33	-32.03	0.80	8.10	-26.88	-13.00	V
2509.58	-43.16	0.90	10.70	-35.51	-13.00	H
4182.75	-37.68	1.20	12.40	-28.63	-13.00	V
8393.00	-47.97	1.80	11.30	-40.62	-13.00	H
9301.50	-46.76	2.00	11.60	-39.31	-13.00	H
9476.00	-47.41	2.10	11.60	-40.06	-13.00	V

GSM Mode Channel 251/848.8MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak ERP(dBm)	Limit （dBm）	Polarization
1697.26	-28.80	0.80	8.10	-23.65	-13.00	V
2546.67	-43.22	0.90	10.70	-35.57	-13.00	H
4243.88	-46.32	1.20	12.40	-37.27	-13.00	H
9293.00	-46.68	2.00	11.60	-39.23	-13.00	H
9473.00	-47.32	2.10	11.60	-39.97	-13.00	V
9800.50	-47.40	2.30	11.20	-40.65	-13.00	H

Note: The maximum value of expanded measurement uncertainty for this test item is U = 2.87dB(30MHz-3GHz)/3.35dB(3GHz-18GHz)/2.68dB(18GHz-40GHz), k = 2

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GSM Mode Channel 512/1850.2MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit （dBm）	Polarization
17003.33	-42.33	2.90	14.50	-30.73	-13.00	H
17344.76	-42.88	3.20	14.50	-31.58	-13.00	H
17464.76	-41.83	2.90	14.50	-30.23	-13.00	H
17630.95	-40.10	3.30	12.80	-30.60	-13.00	H
17828.10	-40.00	3.60	12.80	-30.80	-13.00	H
17983.33	-37.54	3.20	12.80	-27.94	-13.00	H

GSM Mode Channel 661/1880.0MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit （dBm）	Polarization
16957.62	-44.62	2.90	16.50	-31.02	-13.00	H
17212.38	-43.62	2.90	14.50	-32.02	-13.00	H
17523.33	-40.52	2.90	12.80	-30.62	-13.00	H
17531.43	-40.14	2.90	12.80	-30.24	-13.00	H
17821.43	-40.51	3.60	12.80	-31.31	-13.00	H
17996.19	-37.76	3.20	12.80	-28.16	-13.00	H

GSM Mode Channel 810/1909.8MHz

Frequency(MHz)	P_{Mea}(dBm)	Path loss	Antenna Gain(dBi)	Peak EIRP(dBm)	Limit （dBm）	Polarization
17171.90	-43.65	2.90	14.50	-32.05	-13.00	H
17284.29	-43.37	3.20	14.50	-32.07	-13.00	H
17449.05	-41.54	2.90	14.50	-29.94	-13.00	H
17584.76	-39.94	3.30	12.80	-30.44	-13.00	H
17834.76	-39.76	3.60	12.80	-30.56	-13.00	H
17948.57	-37.68	3.20	12.80	-28.08	-13.00	H

Note: The maximum value of expanded measurement uncertainty for this test item is U = 2.87dB(30MHz-3GHz)/3.35dB(3GHz-18GHz)/2.68dB(18GHz-40GHz), k = 2

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A.3 FREQUENCY STABILITY

Reference

FCC: CFR Part 2.1055, 22.355, 24.235.

A.3.1 Method of Measurement

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of R&S CMU200 DIGITAL RADIO COMMUNICATION TESTER.

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -30℃.
3. With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on mid channel of PCS 1900 and GSM850, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
4. Repeat the above measurements at 10℃ increments from -30℃ to +50℃. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments remeasuring carrier frequency at each voltage. Pause at nominal voltage for 1.5 hours unpowered, to allow any self-heating to stabilize, before continuing.
6. Subject the EUT to overnight soak at +50℃.
7. With the EUT, powered via nominal voltage, connected to the CMU200 and in a simulated call on the centre channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
8. Repeat the above measurements at 10℃ increments from -30℃ to +50℃. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

A.3.2 Measurement Limit

A.3.2.1 For Hand carried battery powered equipment

According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. As this transceiver is considered "Hand carried, battery powered equipment" Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of between 3.6V and 4.2V, with a nominal voltage of 3.8V. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress. These voltages represent a tolerance of -5.3 % and +10.5 %. For the purposes of measuring frequency stability these voltage limits are to be used.

A.3.2.2 For equipment powered by primary supply voltage

According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec.

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24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. For this EUT section 2.1055(d)(1) applies. This requires varying primary supply voltage from 95 to 110 percent of the nominal value for other than hand carried battery equipment.

A.3.3 Measurement results

GSM 850

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.6	-26	0.030
3.8	-27	0.032
4.2	-29	0.035

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	-26	0.031
-20	-26	0.031
-10	-22	0.026
0	-23	0.027
10	-24	0.029
20	-21	0.025
30	-26	0.032
40	-25	0.030
50	-25	0.030

Expanded measurement uncertainty is 10Hz, k = 2

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PCS 1900

Frequency Error vs Voltage

Voltage(V)	Frequency error(Hz)	Frequency error(ppm)
3.6	-37	0.020
3.8	-41	0.022
4.2	-41	0.022

Frequency Error vs Temperature

temperature(℃)	Frequency error(Hz)	Frequency error(ppm)
-30	-36	0.019
-20	-32	0.017
-10	-38	0.020
0	-38	0.020
10	-41	0.022
20	-46	0.025
30	-37	0.020
40	-38	0.020
50	-46	0.025

Expanded measurement uncertainty is 10Hz, k = 2

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A.4 OCCUPIED BANDWIDTH

Reference

FCC: CFR Part 2.1049, 22.917, 24.238.

A.4.1 Measurement Procedure

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (i.e., two to five times the OBW).

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.

c) Set the reference level of the instrument as required to keep the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope must be at least 10log (OBW / RBW) below the reference level.

d) Set the detection mode to peak, and the trace mode to max hold.

e) Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.

A.4.2 Occupied Bandwidth Results

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 US Cellular/PCS frequency bands. The table below lists the measured 99% BW. Spectrum analyzer plots are included on the following pages.

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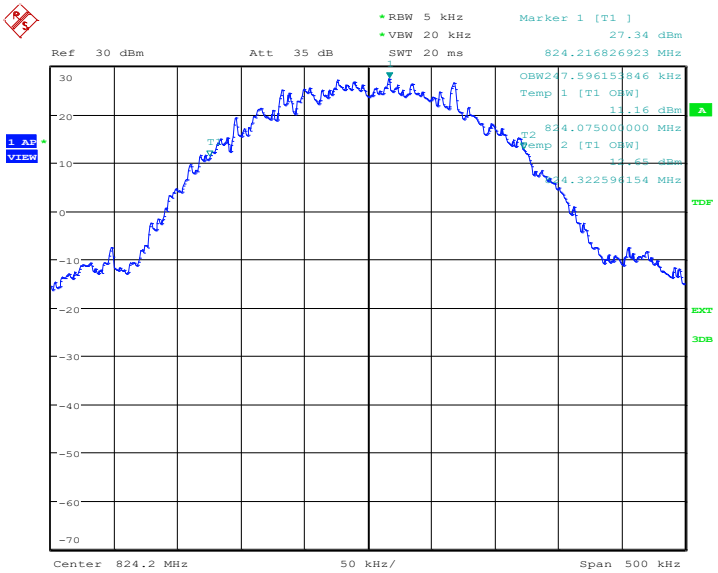
GSM 850(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
824.2	247.60
836.6	245.99
848.8	245.99

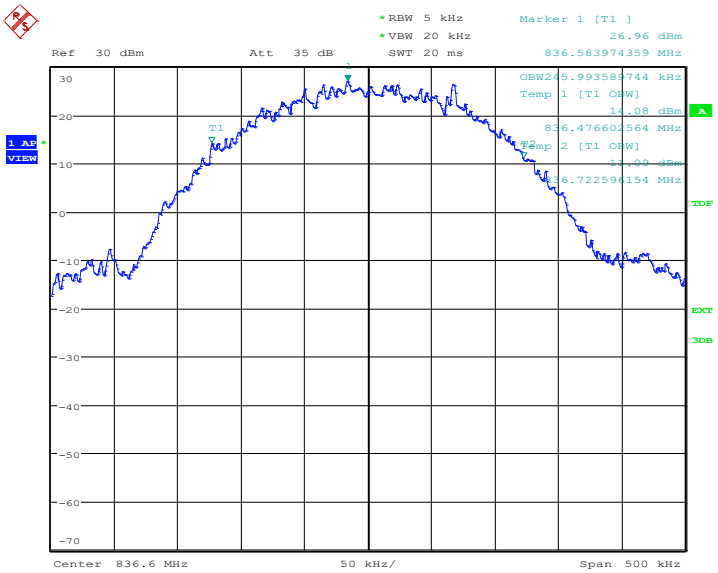
GSM 850

Channel 128-Occupied Bandwidth (99% BW)



Date: 13.DEC.2021 08:50:33

Channel 190-Occupied Bandwidth (99% BW)



Date: 13.DEC.2021 08:51:05

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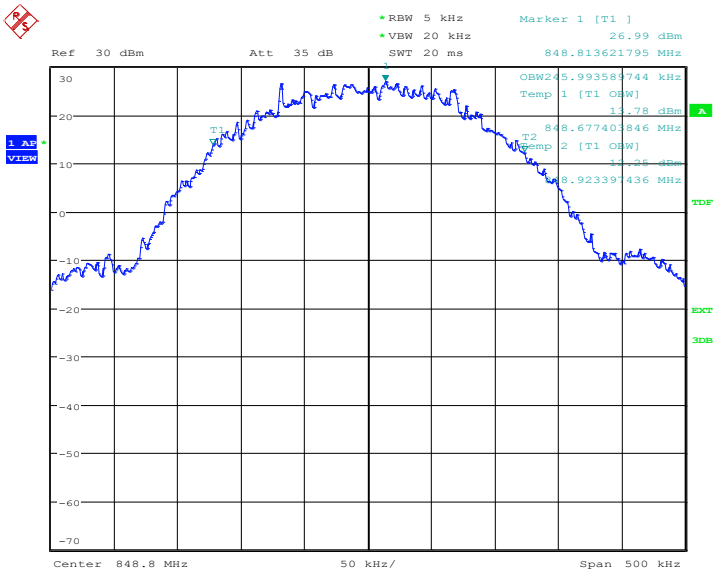
Channel 251-Occupied Bandwidth (99% BW)



Date: 13.DEC.2021 08:51:36

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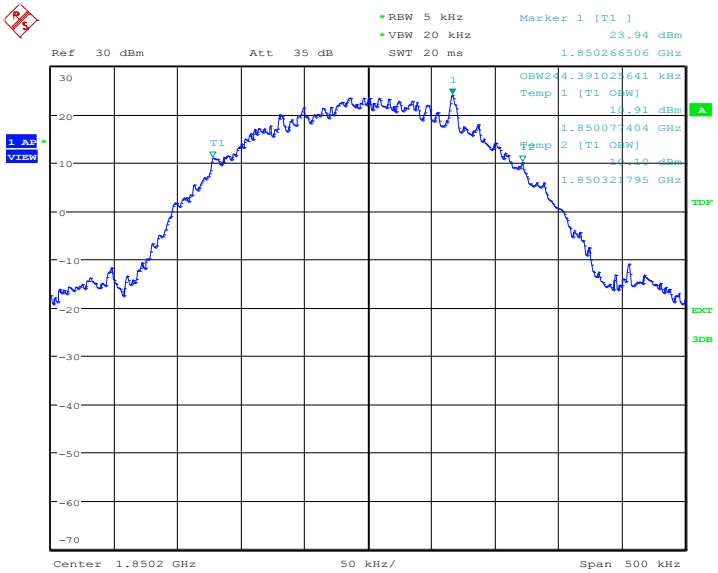
PCS 1900(99% BW)

Frequency(MHz)	Occupied Bandwidth (99% BW)(kHz)
1850.2	244.39
1880.0	246.80
1909.8	247.60

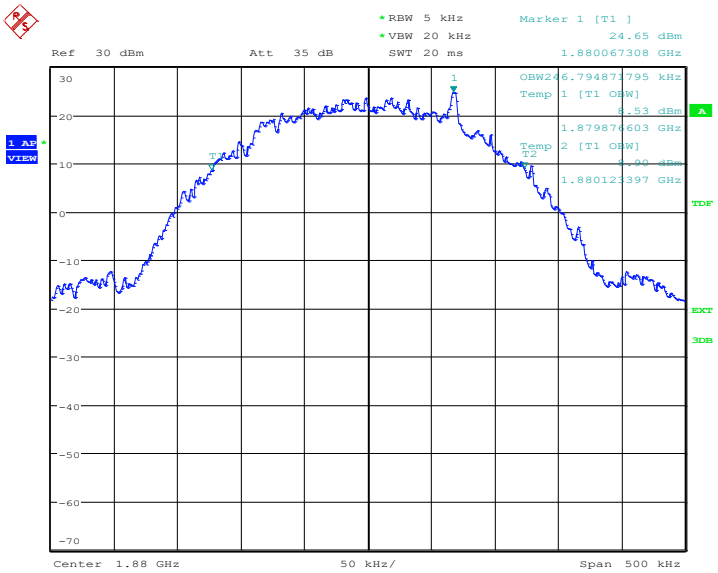
PCS 1900

Channel 512-Occupied Bandwidth (99% BW)



Date: 13.DEC.2021 09:23:51

Channel 661-Occupied Bandwidth (99% BW)



Date: 13.DEC.2021 09:24:22

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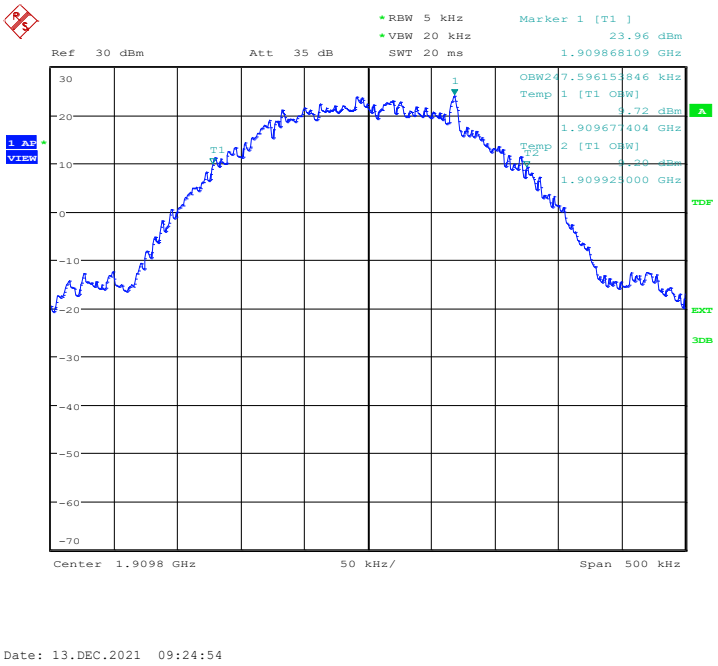
Channel 810-Occupied Bandwidth (99% BW)



Note: Expanded measurement uncertainty is U = 3428Hz, k = 2

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A.5 EMISSION BANDWIDTH

Reference

FCC: CFR Part 2.1049, 22.917, 24.238

A.5.1 Measurement Procedure

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (i.e., two to five times the OBW).

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.

c) Set the reference level of the instrument as required to keep the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope must be at least 10log (OBW / RBW) below the reference level.

d) Set the detection mode to peak, and the trace mode to max hold.

e) Use the 26dB bandwidth function of the spectrum analyzer and report the measured bandwidth.

A.5.2Emission Bandwidth Results

Similar to conducted emissions; Emission 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 PCS1900 band and GSM850 band. Table below lists the measured -26dBc BW. Spectrum analyzer plots are included on the following pages.

GSM 850(-26dBc BW)

Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)
824.2	315.71
836.6	312.50
848.8	315.71

GSM 850

Channel 128-Emission Bandwidth (-26dBc BW)

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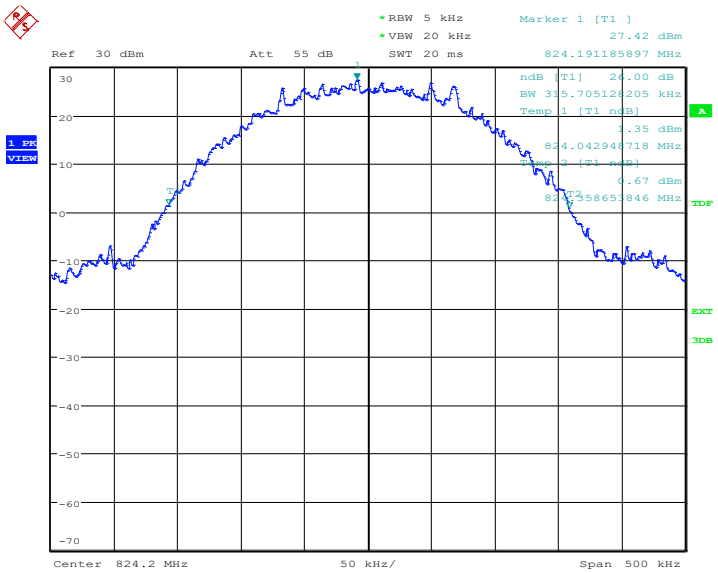

Date: 13.DEC.2021 08:52:44

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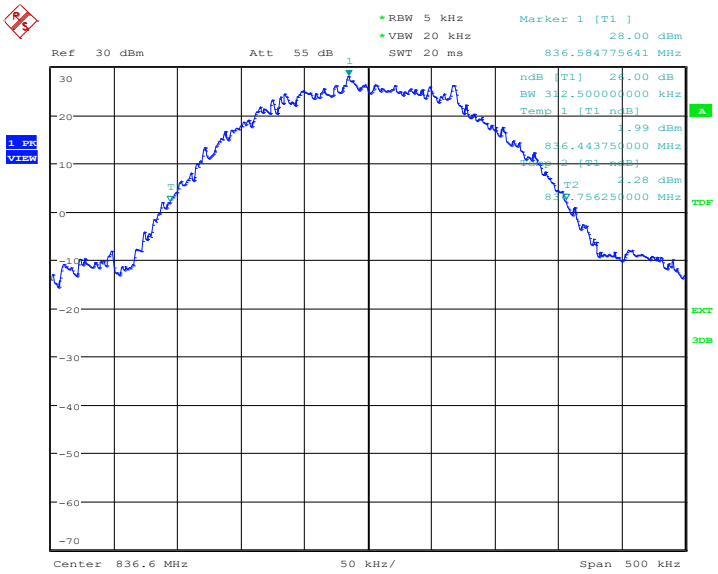
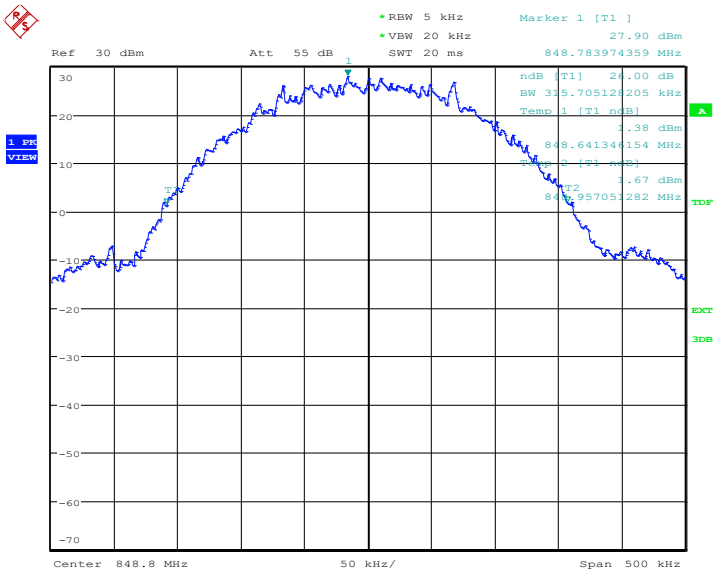
Channel 190-Emission Bandwidth (-26dBc BW)



Date: 13.DEC.2021 08:53:50

Channel 251-Emission Bandwidth (-26dBc BW)



Date: 13.DEC.2021 08:54:57

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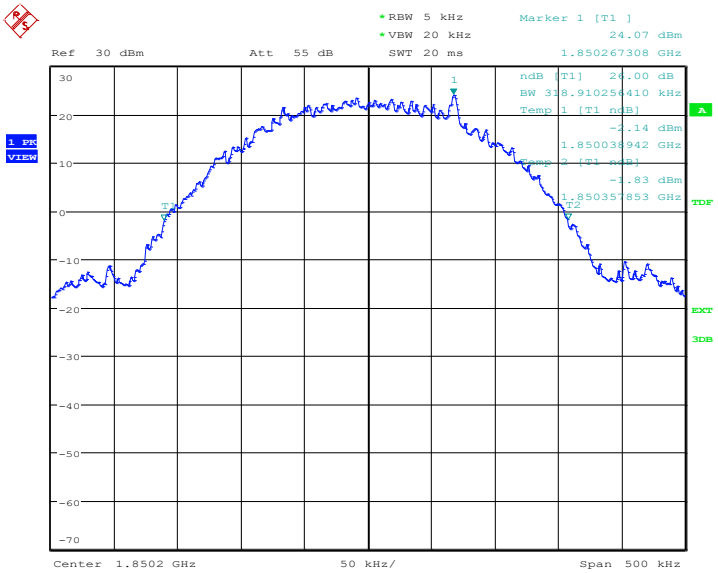
PCS 1900(-26dBc BW)

Frequency(MHz)	Emission Bandwidth (-26dBc BW)(kHz)
1850.2	318.91
1880.0	314.90
1909.8	312.50

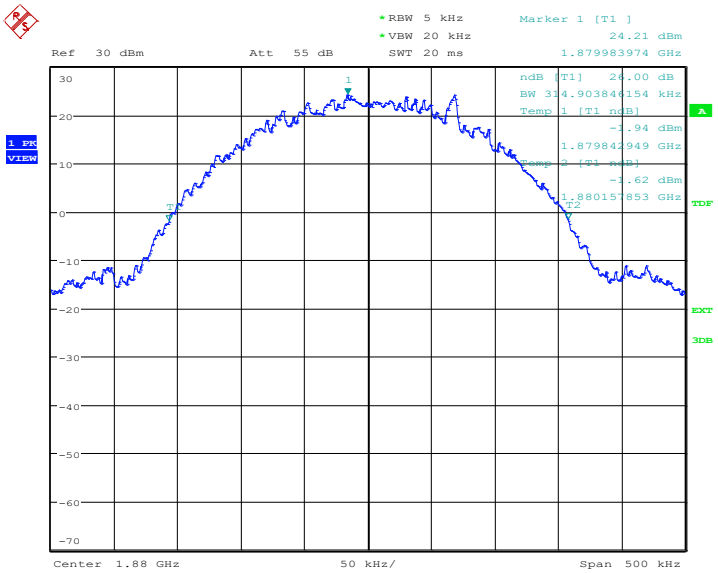
PCS 1900

Channel 512-Emission Bandwidth (-26dBc BW)



Date: 13.DEC.2021 09:26:01

Channel 661-Emission Bandwidth (-26dBc BW)



Date: 13.DEC.2021 09:27:08

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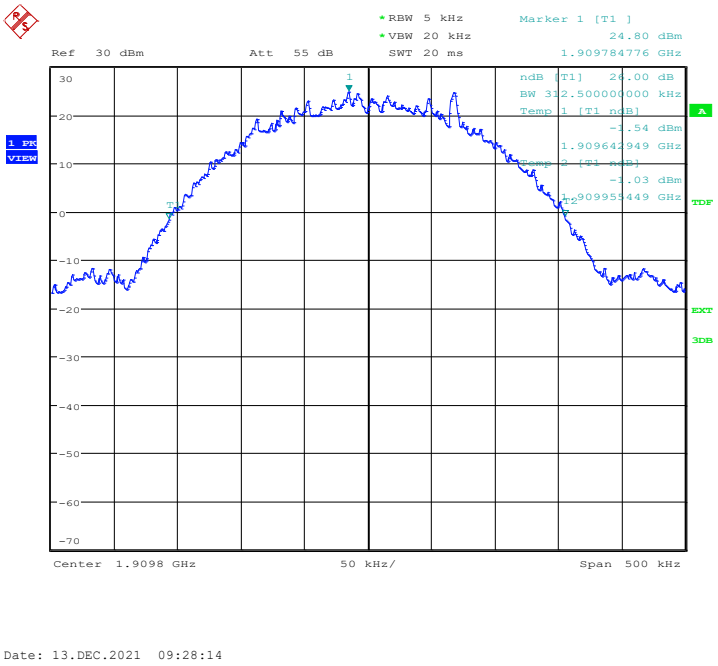
Channel 810-Emission Bandwidth (-26dBc BW)



Note: Expanded measurement uncertainty is *U* = 3428Hz, *k* = 2

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A.6 BAND EDGE COMPLIANCE

Reference

FCC: CFR Part 2.1051, 22.917, 24.238

Measurement limit

On any frequency outside frequency band of the US Cellular/PCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log (P) dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm. A relaxation of the reference bandwidth is often provided for measurements within a specified frequency range at the edge of the authorized frequency block/band. This is often implemented by permitting the use of a narrower RBW (typically limited to a minimum RBW of 1% of the OBW) for measuring the out-of-band emissions without a requirement to integrate the result over the full reference bandwidth.

Measurement Procedure

The testing follows ANSI C63.26

a) The EUT was connected to spectrum analyzer and system simulator via a power divider.

b) The band edges of low and high channels for the highest RF powers were measured.

c) Set RBW >= 1% EBW in the 1MHz band immediately outside and adjacent to the band edge.

d) Set spectrum analyzer with RMS detector.

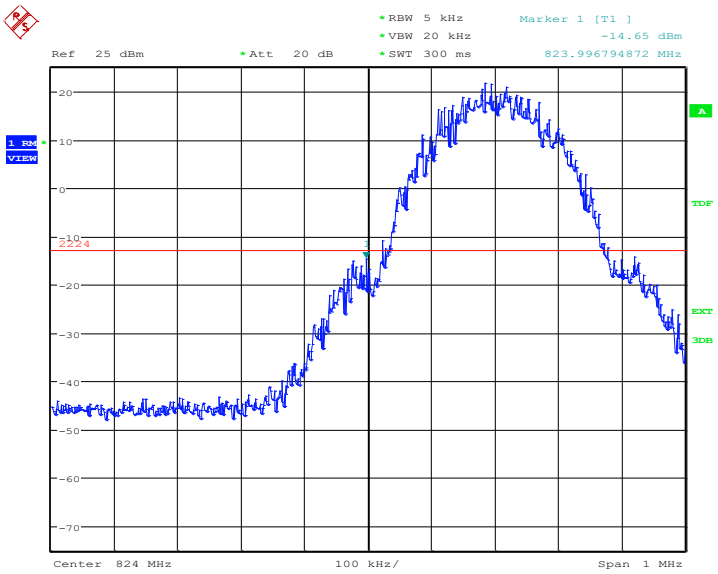
e) The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

f) Checked that all the results comply with the emission limit line.

Only worst case result is given below

GSM 850

LOW BAND EDGE BLOCK-A-Channel 128



Date: 13.DEC.2021 08:55:04

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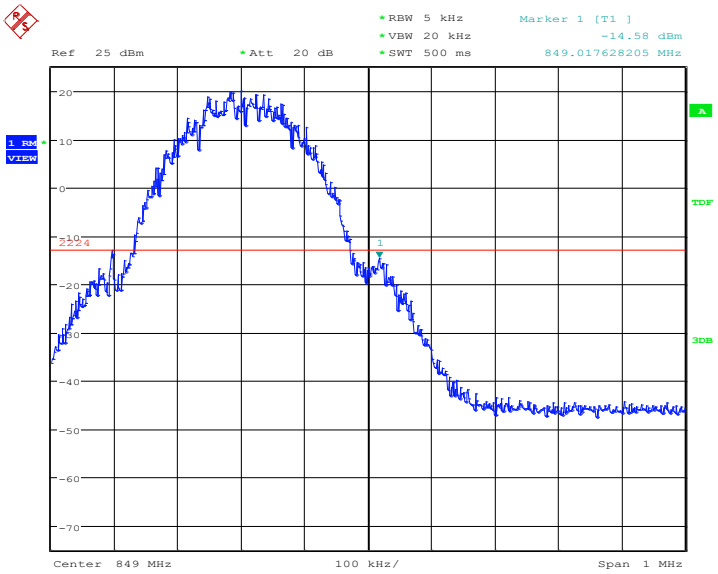
HIGH BAND EDGE BLOCK-C –Channel 251



Date: 27.DEC.2021 10:43:31

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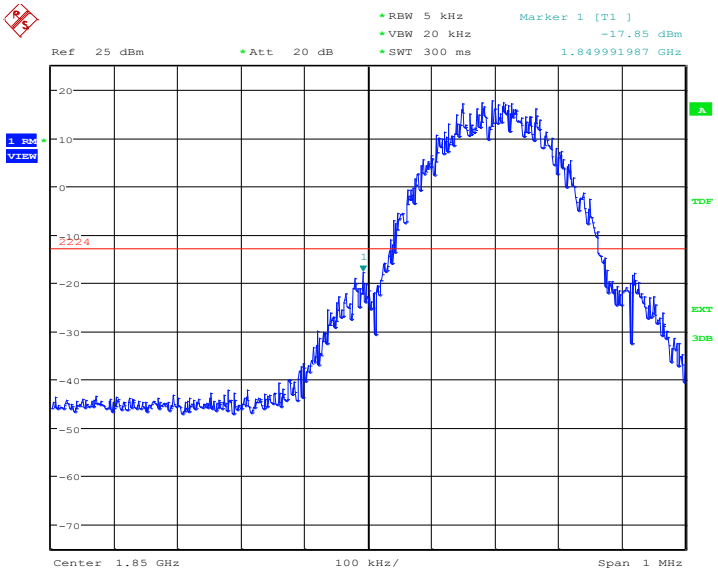
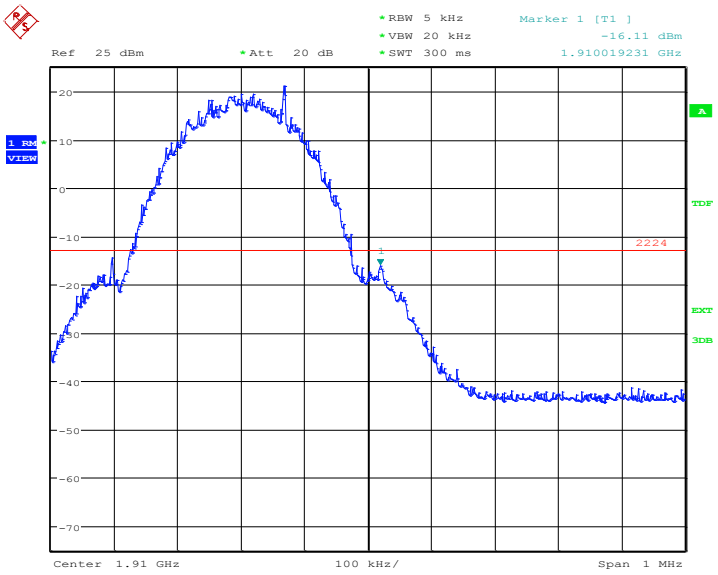
PCS 1900

LOW BAND EDGE BLOCK-A-Channel 512



Date: 13.DEC.2021 09:28:22

HIGH BAND EDGE BLOCK-C–Channel 810



Date: 13.DEC.2021 09:30:25

Note: Expanded measurement uncertainty is *U* = 0.49dB(100KHz-2GHz)/1.21dB(2GHz-26.5GHz), *k* = 1.96

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A.7 CONDUCTED SPURIOUS EMISSION

Reference

FCC: CFR Part 2.1051, 22.917, 24.238

A.7.1 Measurement Method

The following steps outline the procedure used to measure the conducted emissions from the EUT.

1. Determine frequency range for measurements: From CFR 2.1051 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 9 GHz, data taken from 10 MHz to 25 GHz.
2. Determine EUT transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

GSM850 Transmitter

Channel	Frequency (MHz)
128	824.2
190	836.6
251	848.8

PCS1900 Transmitter

Channel	Frequency (MHz)
512	1850.2
661	1880.0
810	1909.8

A. 7.2 Measurement Limit

Part 24.238 and Part 22.917 specify that 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.

The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB, which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

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A.7.3 Measurement result

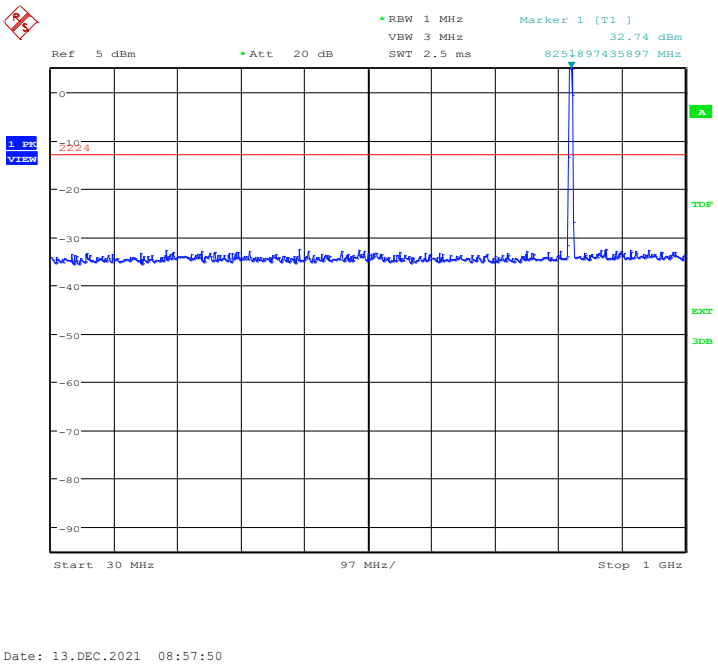
Only worst case result is given below

GSM850

Channel 128: 30MHz – 1GHz

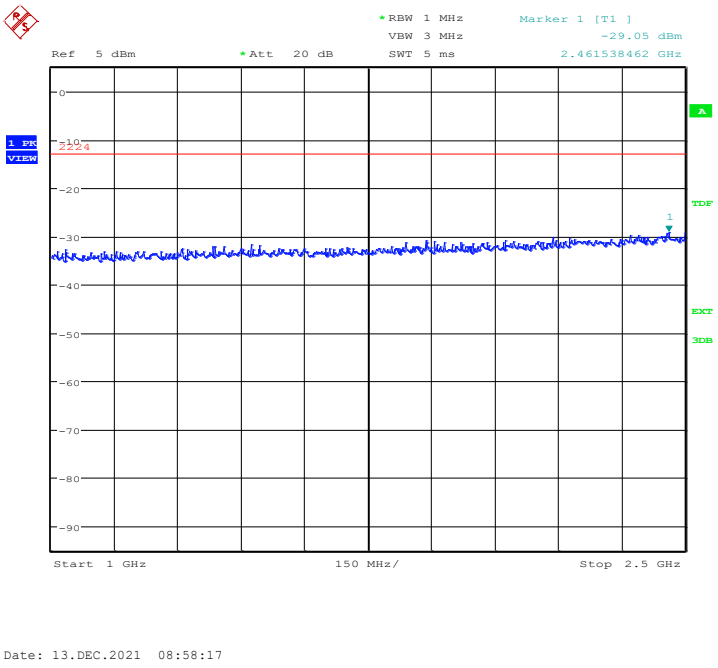
Spurious emission limit –13dBm.

NOTE: peak above the limit line is the carrier frequency.



Channel 128: 1GHz – 2.5GHz

Spurious emission limit –13dBm.



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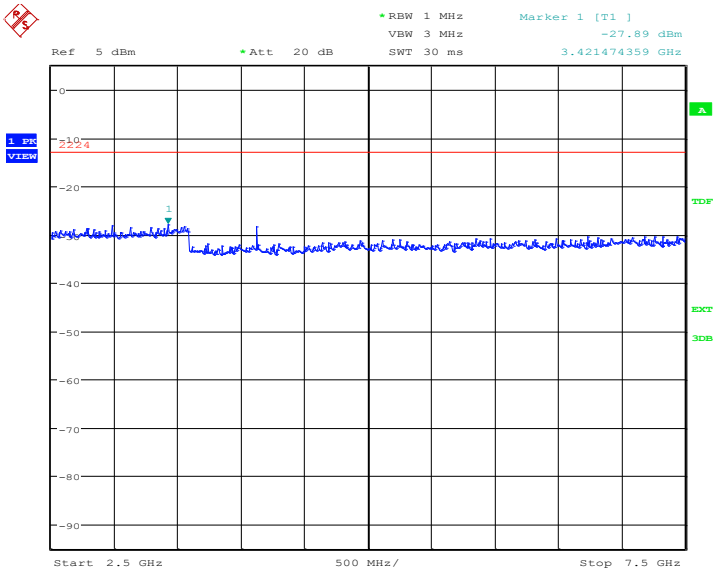
Channel 128: 2.5GHz – 7.5GHz

Spurious emission limit –13dBm.



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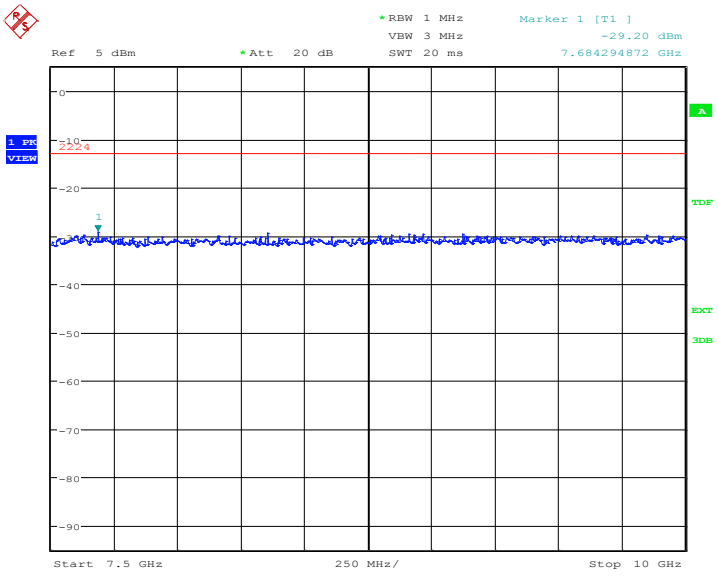
Channel 128: 7.5GHz –10GHz

Spurious emission limit –13dBm.



Date: 13.DEC.2021 08:59:10

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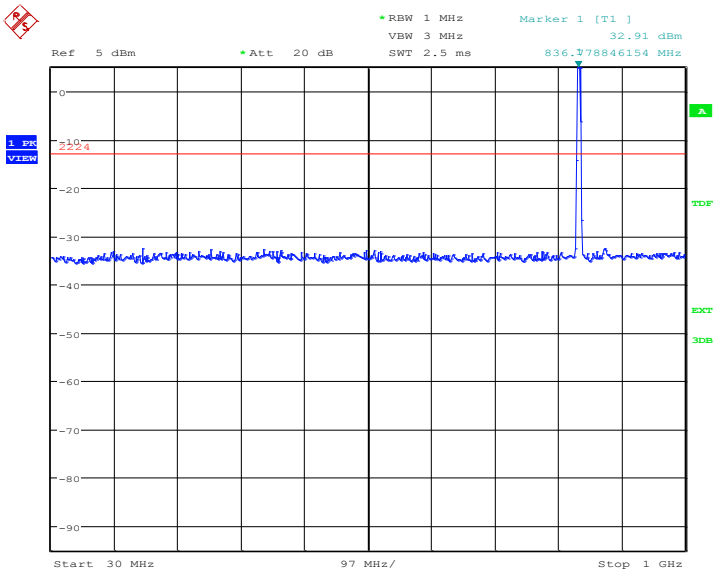
Channel 190: 30MHz – 1GHz

Spurious emission limit –13dBm

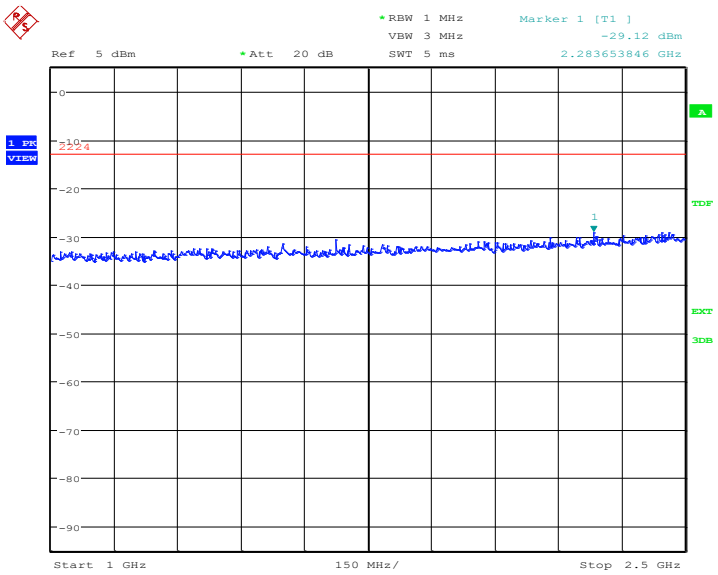
NOTE: peak above the limit line is the carrier frequency.



Date: 13.DEC.2021 08:59:38

Channel 190: 1GHz –2.5GHz

Spurious emission limit –13dBm



Date: 13.DEC.2021 09:00:05

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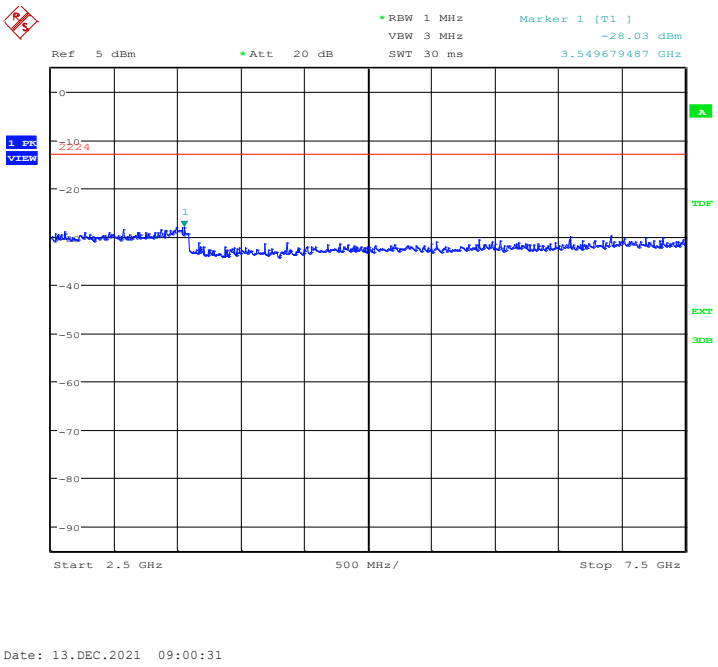
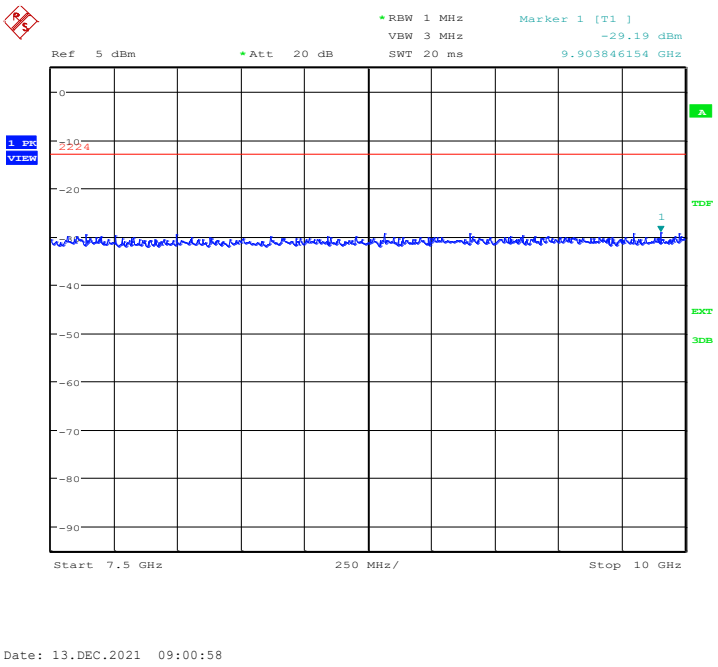
Channel 190: 2.5GHz –7.5GHz

Spurious emission limit –13dBm



Channel 190: 7.5GHz –10GHz

Spurious emission limit –13dBm



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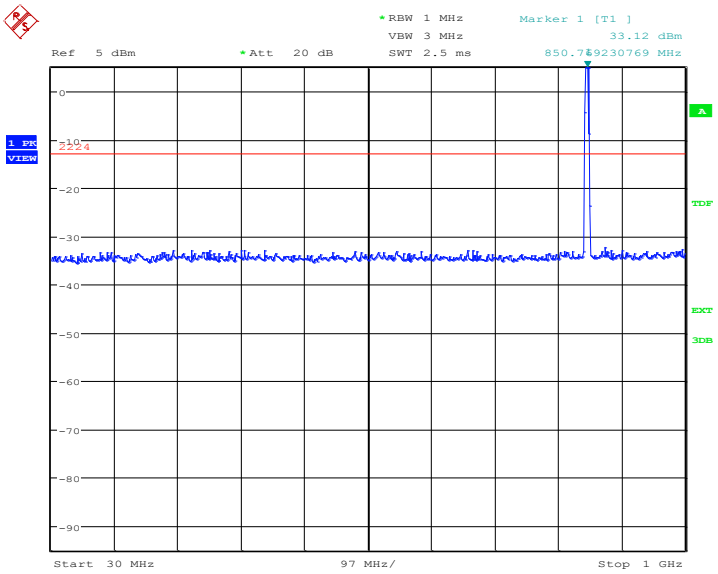
Channel 251: 30MHz – 1GHz

Spurious emission limit –13dBm.

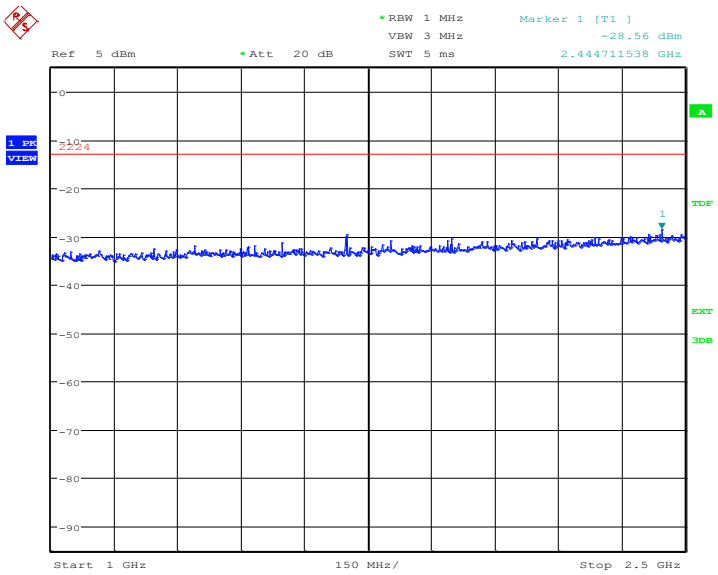
NOTE: peak above the limit line is the carrier frequency.



Date: 13.DEC.2021 09:01:26

Channel 251: 1GHz – 2.5GHz

Spurious emission limit –13dBm.



Date: 13.DEC.2021 09:01:52

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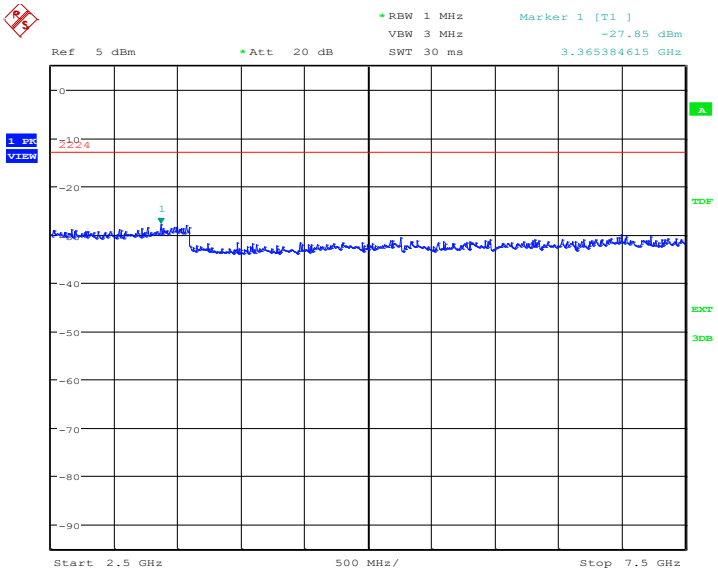
Channel 251:2.5GHz – 7.5GHz

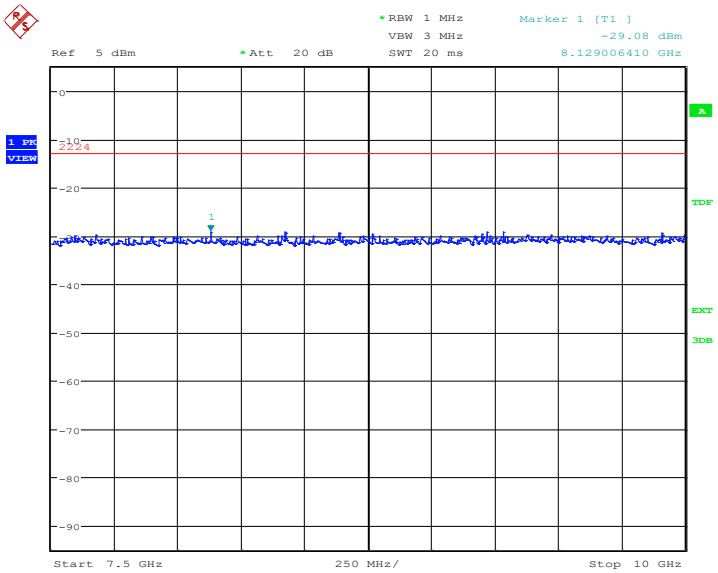
Spurious emission limit –13dBm.



Date: 13.DEC.2021 09:02:19

Channel 251: 7.5GHz – 10GHz

Spurious emission limit –13dBm.



Date: 13.DEC.2021 09:02:46

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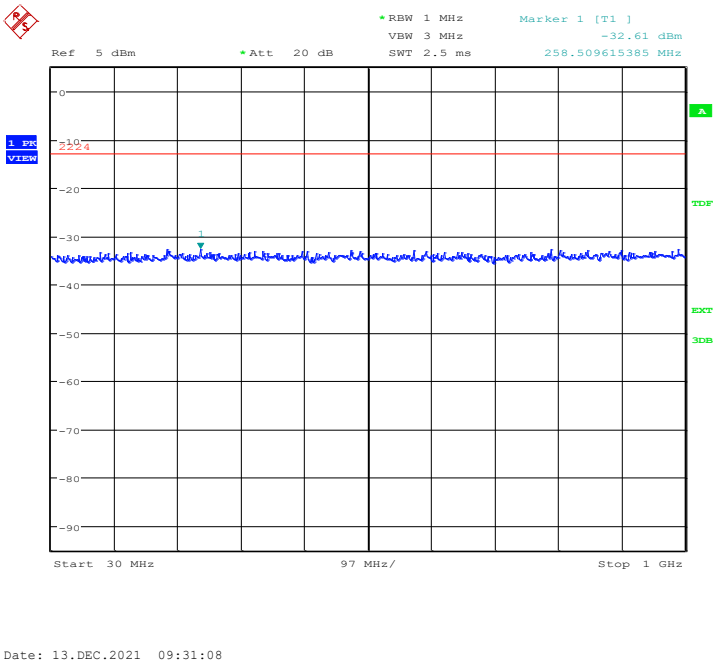
PCS1900

Channel 512: 30MHz – 1GHz

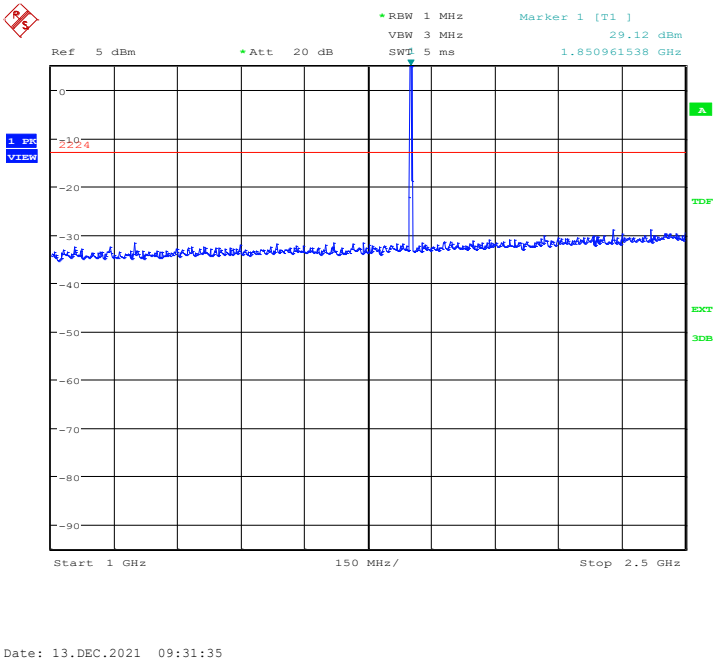
Spurious emission limit –13dBm.



Channel 512: 1GHz – 2.5GHz

Spurious emission limit –13dBm.

NOTE: peak above the limit line is the carrier frequency.



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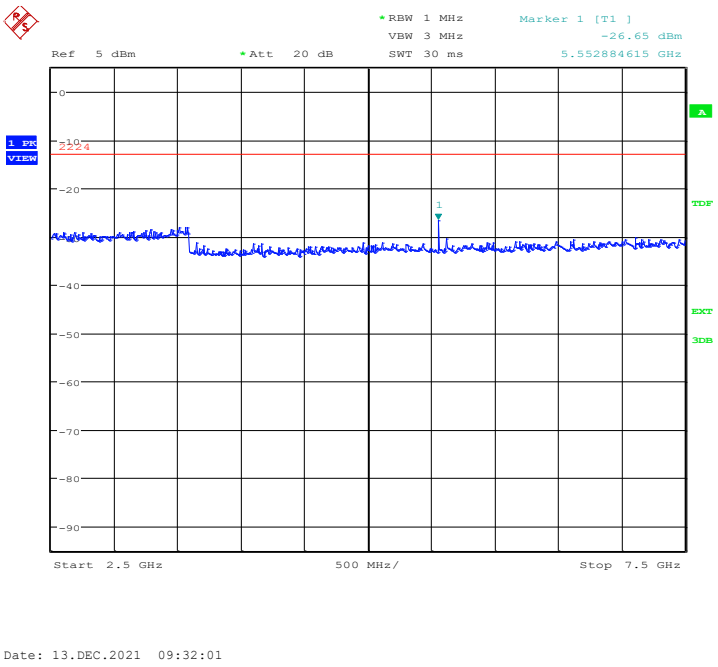
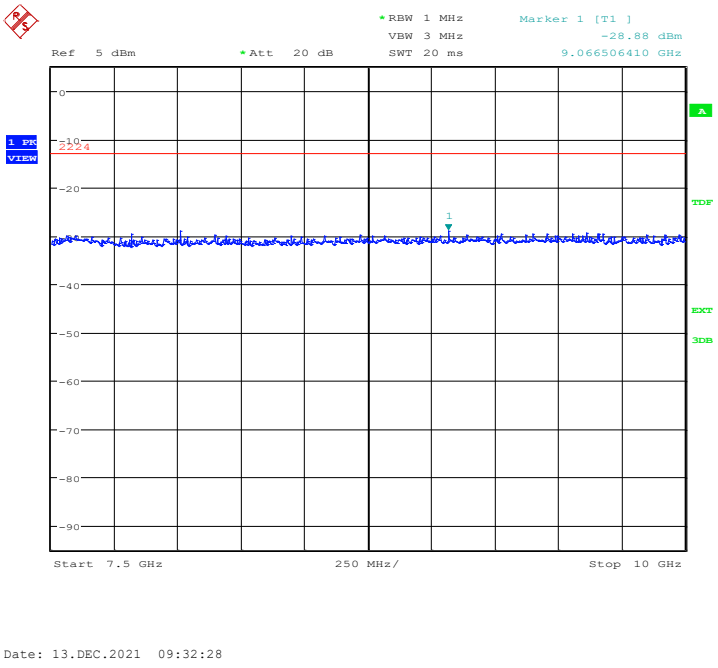
Channel 512: 2.5GHz – 7.5GHz

Spurious emission limit –13dBm.



Channel 512: 7.5GHz –10GHz

Spurious emission limit –13dBm.



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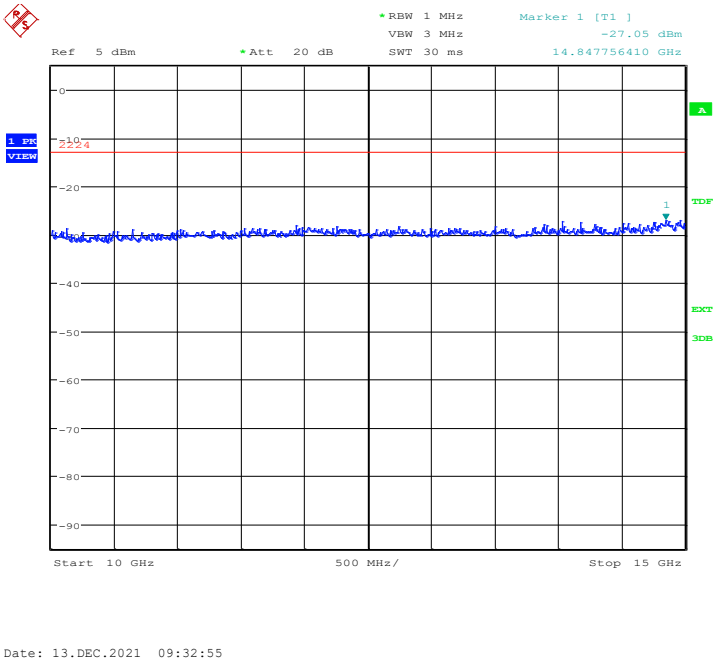
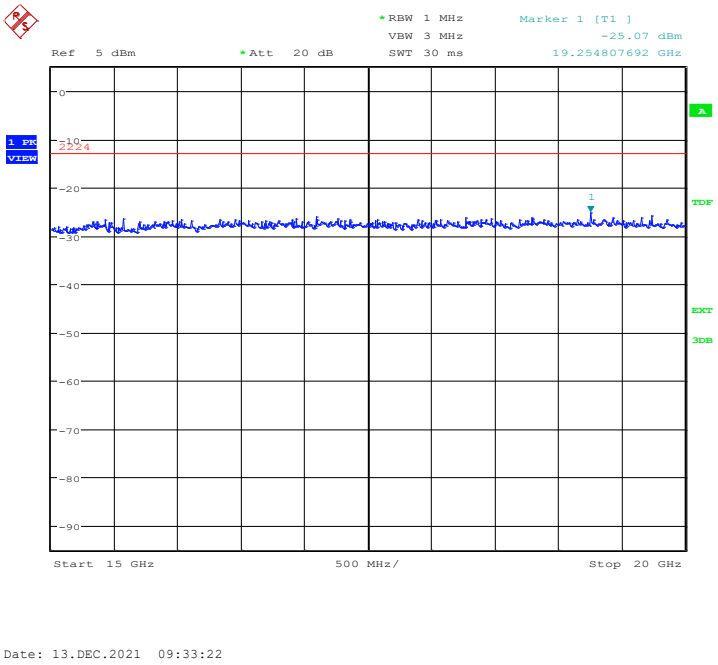
Channel 512: 10GHz –15GHz

Spurious emission limit –13dBm.



Channel 512: 15GHz –20GHz

Spurious emission limit –13dBm.



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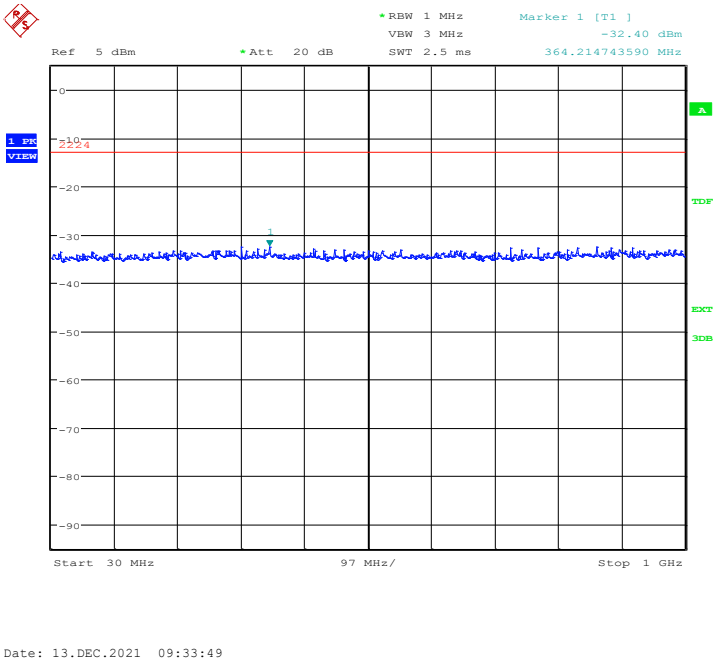
Channel 661: 30MHz – 1GHz

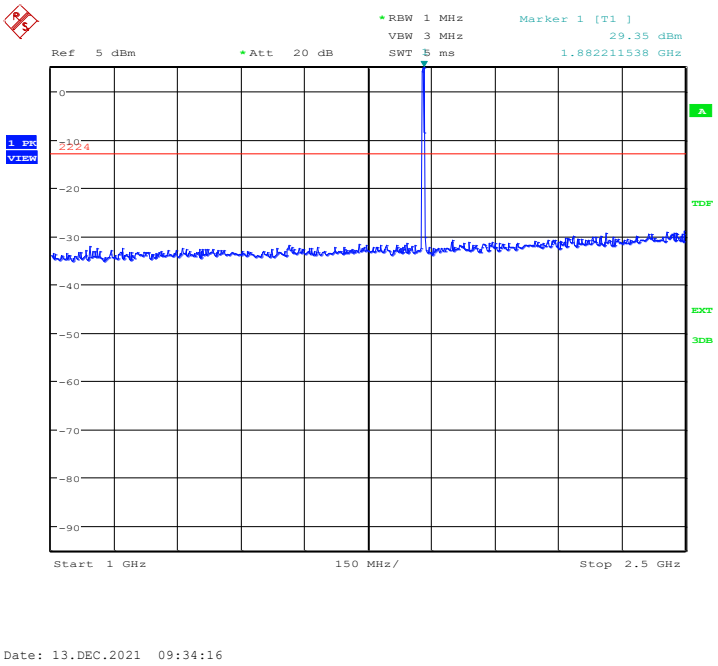
Spurious emission limit –13dBm



Channel 661: 1GHz –2.5GHz

Spurious emission limit –13dBm

NOTE: peak above the limit line is the carrier frequency.



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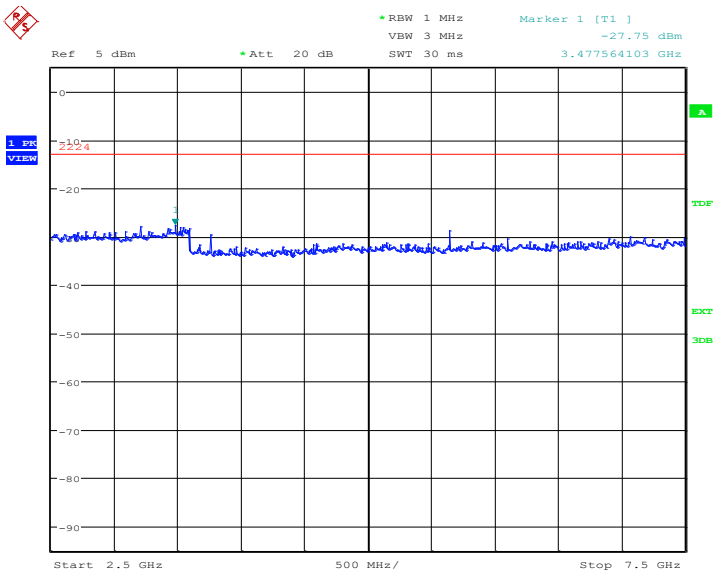
Channel 661: 2.5GHz –7.5GHz

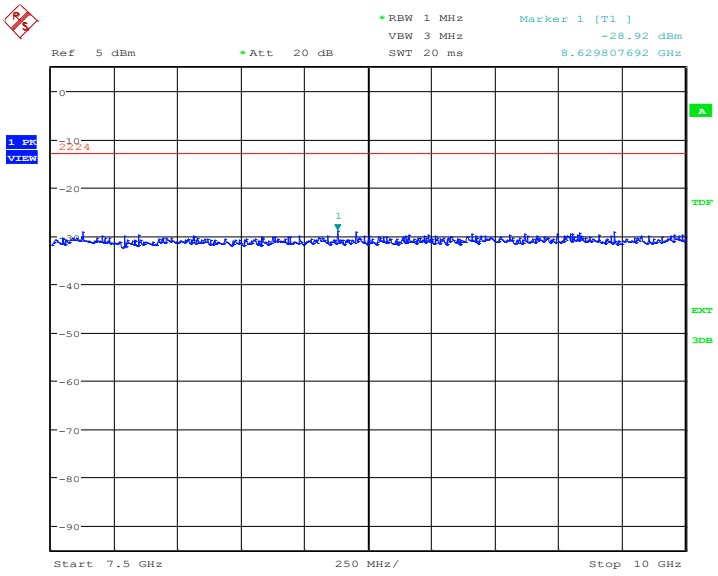
Spurious emission limit –13dBm



Date: 13.DEC.2021 09:34:43

Channel 661: 7.5GHz –10GHz

Spurious emission limit –13dBm



Date: 13.DEC.2021 09:35:10

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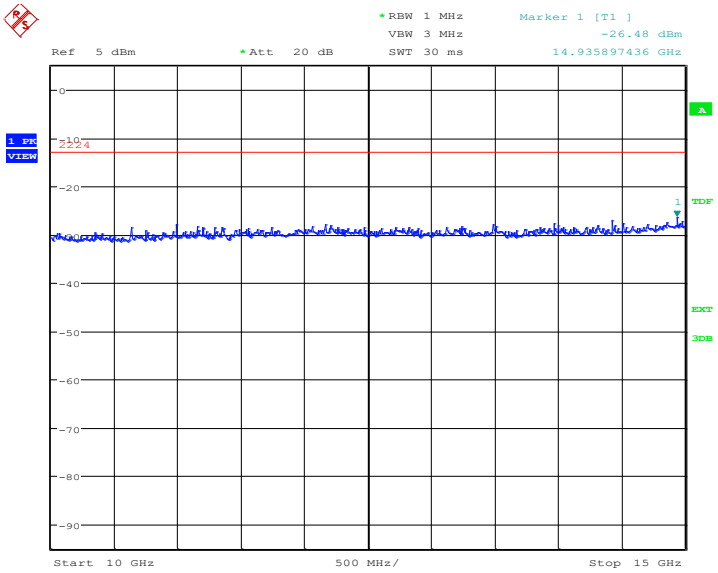
Channel 661: 10GHz –15GHz

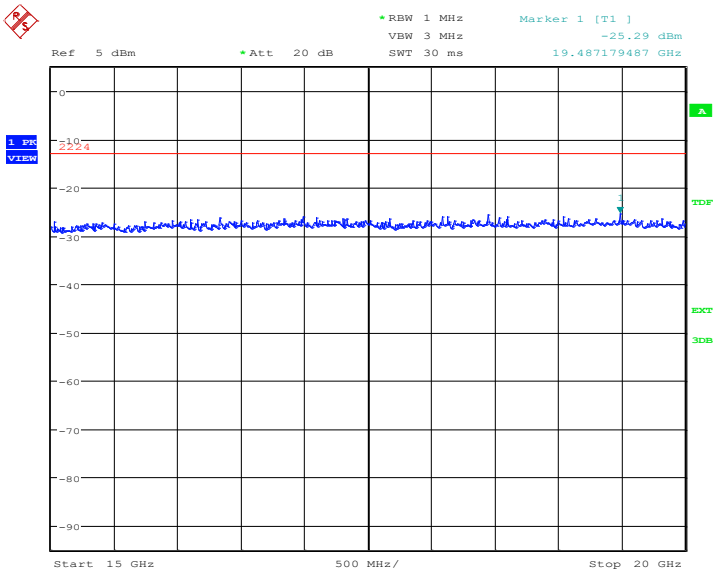
Spurious emission limit –13dBm.



Date: 13.DEC.2021 09:35:37

Channel 661: 15GHz –20GHz

Spurious emission limit –13dBm.



Date: 13.DEC.2021 09:36:04

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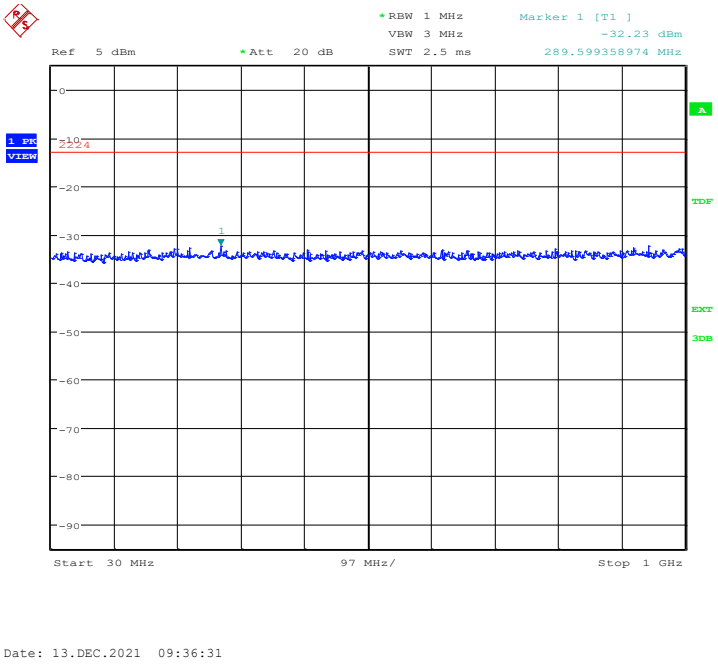
Channel 810: 30MHz – 1GHz

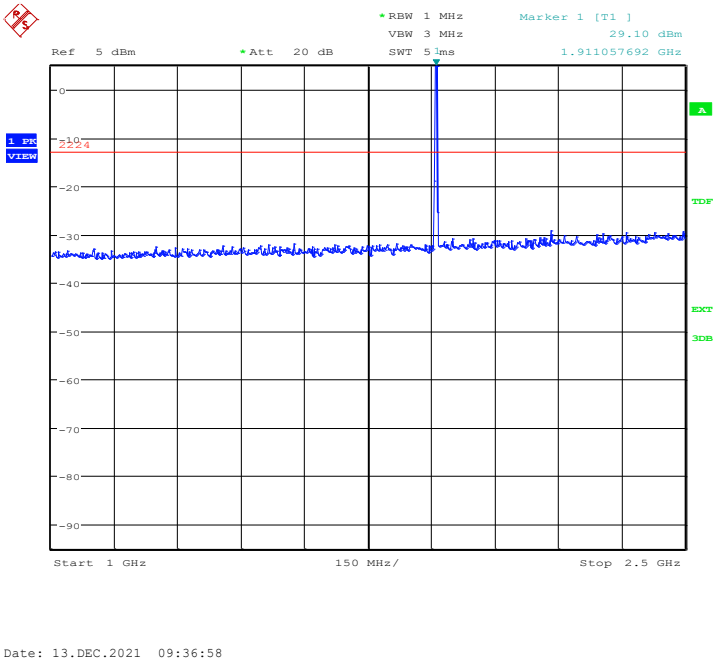
Spurious emission limit –13dBm.



Channel 810: 1GHz – 2.5GHz

Spurious emission limit –13dBm.

NOTE: peak above the limit line is the carrier frequency.



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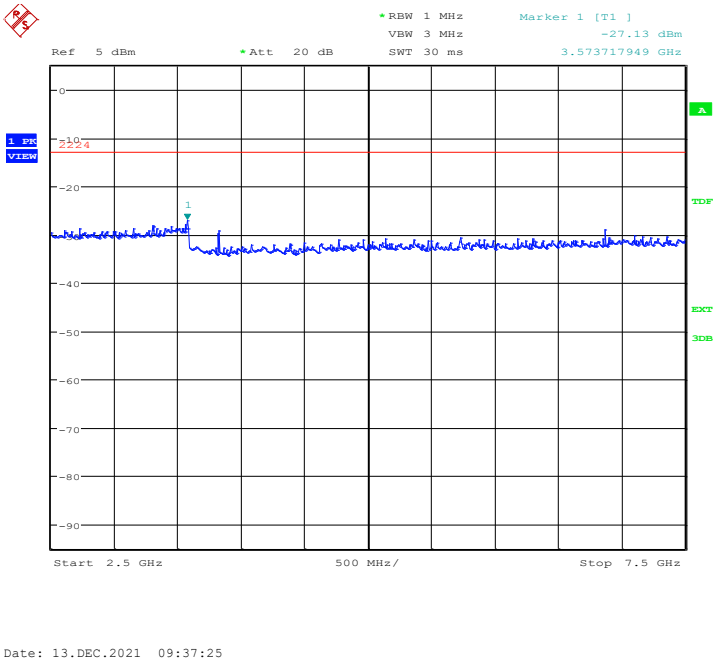
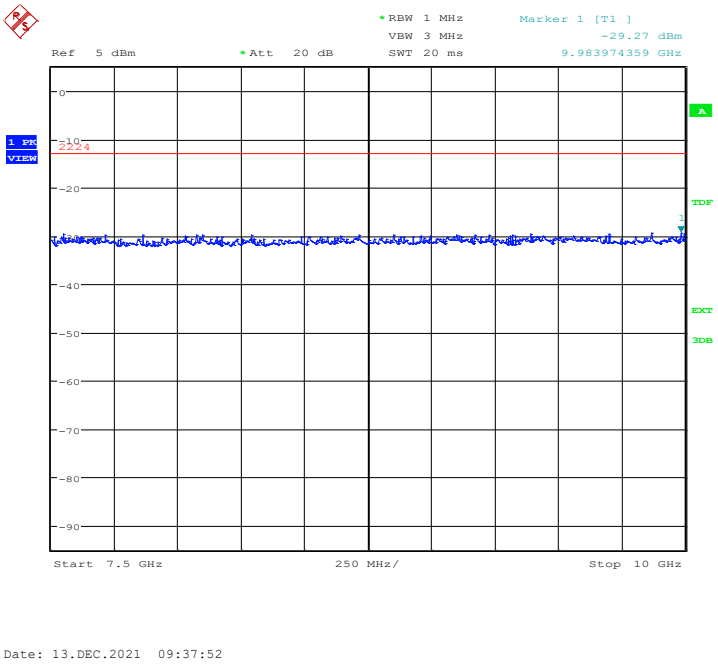
Channel 810:2.5GHz – 7.5GHz

Spurious emission limit –13dBm.



Channel 810: 7.5GHz – 10GHz

Spurious emission limit –13dBm.



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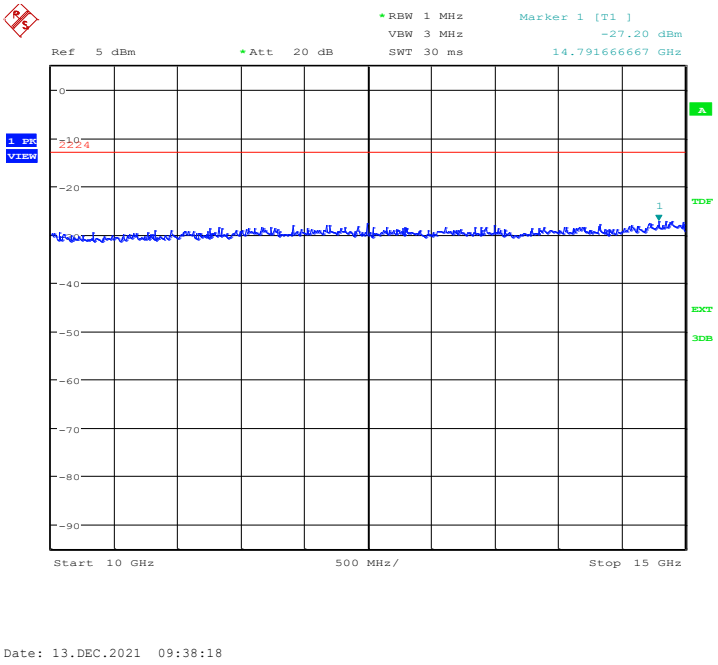
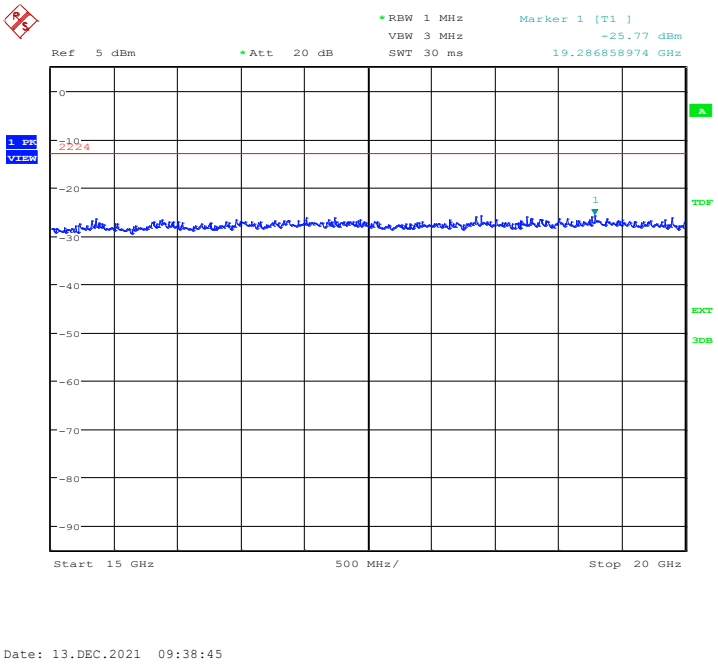
Channel 810: 10GHz –15GHz

Spurious emission limit –13dBm.



Channel 810: 15GHz –20GHz

Spurious emission limit –13dBm.



Note: Expanded measurement uncertainty is U = 0.49dB(100KHz-2GHz)/1.21dB(2GHz-26.5GHz), k = 1.96

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A.8 PEAK-TO-AVERAGE POWER RATIO

Reference

FCC: CFR Part 24.232, KDB971168 D01.

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

a)Refer to instrument's analyzer instruction manual for details on how to use the power statistics/CCDF function;

b) Set resolution/measurement bandwidth ≥ signal' s occupied bandwidth;

c) Set the number of counts to a value that stabilizes the measured CCDF curve;

d) Set the measurement interval to 1 ms

e)Record the maximum PAPR level associated with a probability of 0.1%

A.8.1 Measurement limit

not exceed 13 dB

A.8.2 Measurement results

Only worst case result is given below

GSM850

Frequency(MHz)	Peak-To-Average Power Ratio(PAPR)(dB)
824.2	7.66
836.6	7.63
848.8	7.66

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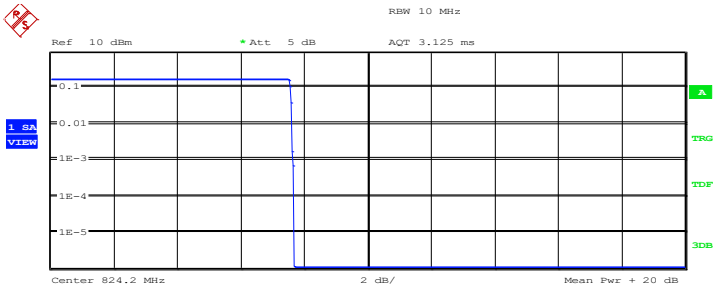
GSM 850

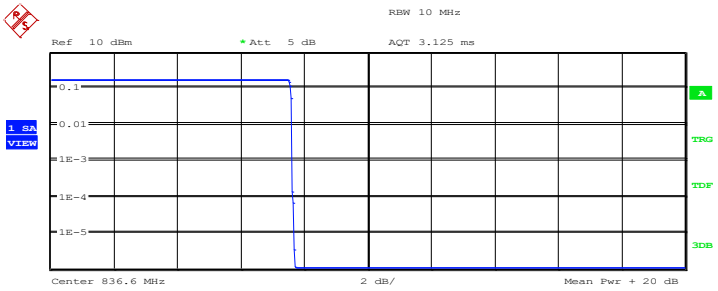
Channel 128- Peak-to-average Power Ratio



	Trace 1
Mean	24.33 dBm
Peak	32.00 dBm
Crest	7.67 dB
10 %	7.56 dB
1 %	7.63 dB
.1 %	7.66 dB
.01 %	7.69 dB

Date: 13.DEC.2021 08:57:12

Channel 190- Peak-to-average Power Ratio



	Trace 1
Mean	24.46 dBm
Peak	32.14 dBm
Crest	7.68 dB
10 %	7.56 dB
1 %	7.63 dB
.1 %	7.63 dB
.01 %	7.63 dB

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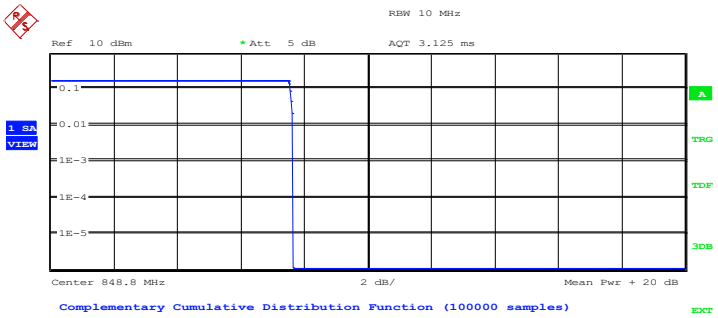
Channel 251- Peak-to-average Power Ratio



	Trace 1
Mean	24.51 dBm
Peak	32.15 dBm
Crest	7.64 dB
10 %	7.56 dB
1 %	7.66 dB
.1 %	7.66 dB
.01 %	7.66 dB

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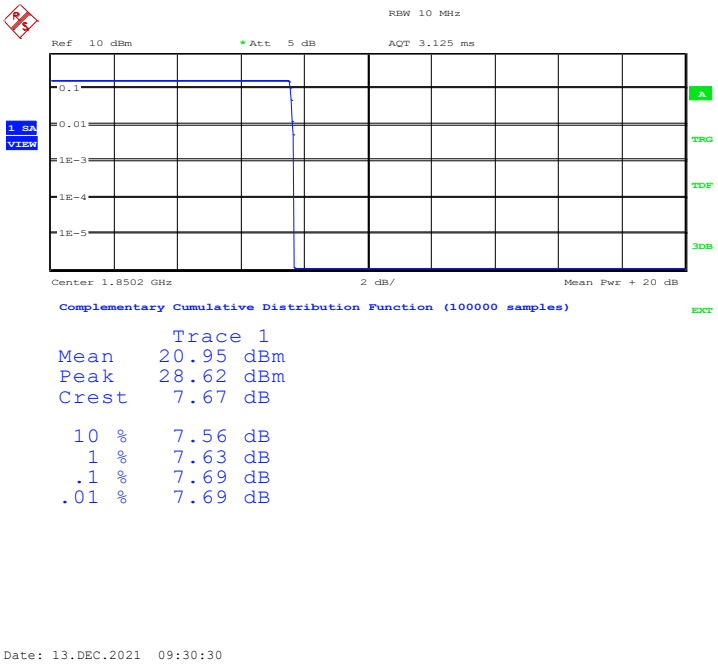
PCS1900 (PAPR)

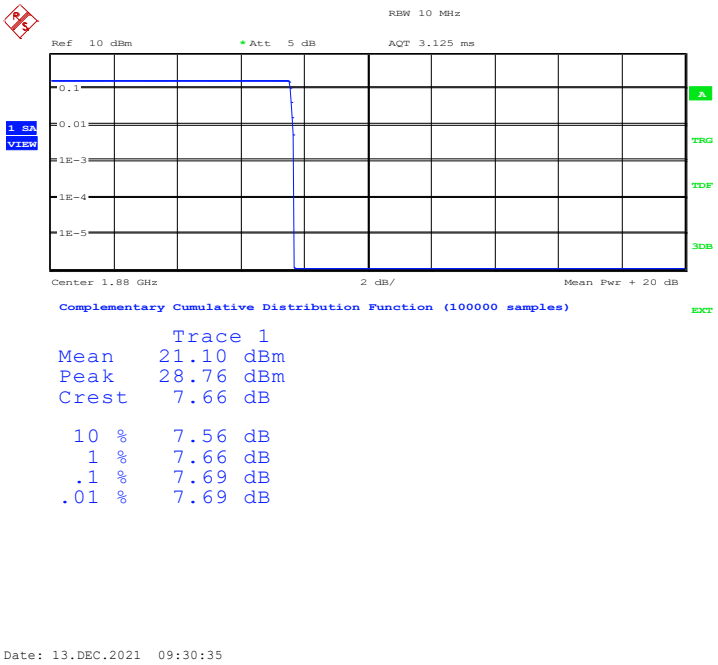
Frequency(MHz)	Peak-To-Average Power Ratio(PAPR)(dB)
1852.4	7.69
1880.0	7.69
1909.7	7.69

PCS 1900

Channel 512- Peak-To-Average Power Ratio(PAPR)



Channel 661- Peak-To-Average Power Ratio(PAPR)



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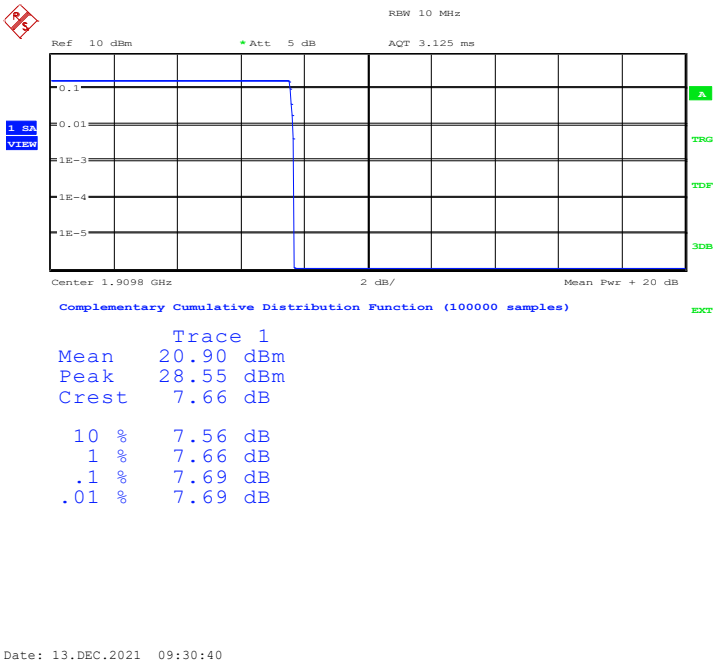
Channel 810- Peak-To-Average Power Ratio(PAPR)



Note: Expanded measurement uncertainty is U = 0.49 dB, k = 2

*****END OF REPORT*****

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