REPORT

issued by an Accredited Testing Laboratory

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Date	Reference	Page
2024-03-19	P119088-F2	1 (67)

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Torshamnsgatan 21
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Radio measurements on Radio 4490HP 44B5 44B13 C with FCC ID TA8AKRC161985 and IC 287AB-AS161985

Product name: Radio 4490HP 44B5 44B13 C
Product number: KRC 161 985/3

RISE Research Institutes of Sweden AB
Vehicles and Automation – EMC-IKT

Performed by

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Examined by

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SWEDAC ACKREDITERING
Accred. No. 1002
Testing
ISO/IEC 17025

Summary

Standard Listed part of		Compliant
FCC CFR 47 part 22 / RSS-132 and RSS-Gen		
2.1046/ RSS-132 5.4	RF power output	Yes
2.1049/ RSS-Gen 6.7	Occupied bandwidth	Yes
2.1051/ RSS-132 5.5	Band edge	Yes
2.1051/ RSS-132 5.5	Spurious emission at antenna terminals	Yes
2.1053/ RSS-132 5.5	Field strength of spurious radiation	Yes
2.1055/ RSS-132 5.3	Frequency stability	Yes

Description of the test object

Equipment:	Radio 4490HP 44B5 44B13 C Product number KRC 161 985/3 and KRC 161 985/31* FCC ID: TA8AKRC161985 IC: 287AB-AS161985 * The hardware and software (except for the security software) are identical for both types of Radios, KRC 161 985/3 (Security unlocked) and KRC 161 985/31 (Security locked). The tests were performed on KRC 161 985/3 with security unlocked software for testing purpose.
HVIN:	AS161985
FVIN:	CXP 202 1113/1, rev. R20A103
Hardware revision state:	R1B
Radio Access Technology, RAT and Frequency range:	3GPP Band 5/n5 (B5): Single RAT: **WCDMA**, LTE, NR, NB IoT (IB, GB) Multi RAT: **WCDMA**, NR, LTE, ESS, NB IoT (IB, GB) TX: 869 – 894 MHz RX: 824 – 849 MHz 3GPP Band 13/n13 (B13): Single RAT: LTE, NR, NB IoT (IB, GB) Multi RAT: NR, LTE, ESS, NB IoT (IB, GB) TX: 746 – 756 MHz RX: 777 – 787 MHz
IBW:	B5: 25 MHz B13: 10 MHz
Output power:	Maximum nominal output power per band, carrier and port **B5 WCDMA: 5 MHz: 40 W** B5 LTE: 5, 10 MHz: 60 W B5 NR: 5, 10, 15, 20, 25 MHz: 60 W B5 ESS 10 MHz: 60 W B13 LTE: 5, 10 MHz: 60 W B13 NR: 5, 10 MHz: 60 W B13 ESS 10 MHz: 60 W Multi band: LTE/NR: (B5/n5): 60W+(B13/n13): 60W, Total: 120W. **Multi band: NR(n5)+WCDMA(B5): 40W+LTE/NR(B13/n13): 60W, Total 100W** **Multi band: LTE(B5)+WCDMA(B5): 40W+LTE/NR(B13/n13): 60W, Total 100W** Max total power per Radio (Multi band): 480W

Antenna ports B5:	A-D: 4 TX / 4 RX ports
Antenna ports B13:	A-D: 4 TX / 4 RX ports
Antenna:	50 Ohm Impedance, No dedicated antenna, handled during licensing.
RF configuration B5:	Single and multi-carrier, 5 carriers per port, Non-Contiguous Spectrum (NCS), Contiguous Spectrum (CS) TX Diversity, 2x2 MIMO, 4x4 MIMO, Carrier Aggregation (CA) intra-band and inter-band supported. LTE with NB IoT IB/GB: 1 Anchor PRB + 1 Non-Anchor PRB NR with NB IoT IB: Max 2 Boosted PRB for 5 and 10 MHz BW Max 4 Boosted for 15MHz BW Max 6 Boosted PRB for 20 MHz BW Max 2 Boosted PRB for 25MHz BW
RF configuration B13:	Single and multi-carrier, 2 carriers per port, Non-Contiguous Spectrum (NCS), Contiguous Spectrum (CS) TX Diversity, 2x2 MIMO, 4x4 MIMO, Carrier Aggregation (CA) intra-band and inter-band supported. LTE with NB IoT IB/GB: 1 Anchor PRB + 1 Non-Anchor PRB NR with NB IoT IB: Max 2 Boosted PRB for 5 and 10 MHz BW
Channel bandwidths:	B5 WCDMA: 5 MHz LTE: 5 MHz and 10 MHz NR: 5 MHz, 10 MHz 15 MHz, 20 MHz and 25 MHz B13 LTE: 5 MHz and 10 MHz NR: 5 MHz and 10 MHz
Sub-carrier spacing:	LTE: 15 kHz NR: 15 kHz and 30 kHz (30 kHz for 10 MHz BW and wider)
Modulations:	LTE: QPSK, 16QAM, 64QAM and 256QAM NR: QPSK, 16QAM, 64QAM and 256QAM NB IoT GB/ IB: QPSK
Emission designators:	**B5 WCDMA: 5 MHz, BW: 4M17F9W** LTE with and without NB IoT IB 5 MHz, BW: 4M49W7D 10 MHz, BW: 8M96W7D 20MHz, BW: 18M8W7D (10+10 MHz, Carrier aggregation)

LTE with NB IoT GB:
10 MHz,BW: 9M33W7D

NR with and without NB IoT IB: SCS 15kHz :
5 MHz, BW: 4M51W7D
10 MHz, BW: 9M40W7D
15 MHz, BW: 14M4W7D
20 MHz, BW: 19M2W7D
25 MHz BW: 24M0W7D
20 MHz, BW: 19M2W7D (10+10, 15+5 MHz, Carrier aggregation)
25 MHz, BW 24M1W7D (5+20, Carrier aggregation)

NR SCS 30kHz :
10 MHz, BW: 8M64W7D
15 MHz, BW: 13M6W7D
20 MHz, BW: 18M3W7D
25 MHz BW: 23M2W7D

B13:
LTE with and without NB IoT IB
5 MHz, BW: 4M48W7D
10 MHz, BW: 8M96W7D

LTE with NB IoT GB:
10 MHz, BW: 9M34W7D

NR with and without NB IoT IB: SCS 15kHz :
5 MHz, BW: 4M51W7D
10 MHz, BW: 9M41W7D

NR SCS 30kHz:
10 MHz, BW: 8M63W7D

RF power Tolerance:	+0.6/ -2.5 dB
CPRI Speed	Up to 25.8 Gbps
Nominal supply voltage:	-48VDC

The information above is supplied by the manufacturer.

Purpose of test

The purpose of the test is to support a C2PC/ C3PC of the product, with the Radio Access Technology WCDMA functionality added with software upgrade.

No modifications of the test object was made during the testing.

Operation modes during measurements

WCDMA measurements were performed with the test object transmitting the Test models defined in 3GPP TS 25.141. Test model 1 (TM1) represent QPSK modulation. Test model 5 (TM5) includes the 16QAM modulation and Test model 6 (TM6) includes the 64QAM modulation.

LTE measurements were performed with the test object transmitting test models as defined in 3GPP TS 36.141. Test model E-TM1.1 was used to represent QPSK, test model E-TM3.2 to represent 16QAM, test model E-TM3.1 to represent 64QAM modulation and E-TM3.1A to represent 256QAM modulation. Test model E-TM1.1 was used for all measurements representing worst case if not otherwise stated.

NR measurements were performed with the test object transmitting test models as defined in 3GPP TS 38.141-1. Test model NR: FR1-TM1.1 is used to represent QPSK, test model NR: FR1-TM3.2 to represent 16QAM, test model NR: FR1-TM3.1 to represent 64QAM modulation and test model NR: FR1-TM3.1a to represent 256QAM modulation. Test model NR: FR1-TM1.1 was used for all measurements representing worst case.

Conducted measurements

The test object was supplied with -48 VDC by an external power supply. Additional connections are documented in the set-up drawings for conducted measurements.

The signal path of the measurement chain was calibrated with a network analyzer and the correction stored as a transducer factor in the measurement equipment.

Radiated measurements

The test object was powered with -48 VDC by an external power supply. Additional connections are documented in the set-up drawings for radiated measurements.

EUT Emission= SA reading + (CableLosses – Antenna gain(dBi) + TheoreticalPathloss + FilterLoss – LNAgain)

The correction factors are stored in R&S Electra software as separate files and activated as applicable in the Hardware setup, for each measurement configuration. Emissions close or above the limit is verified with the substitution method where the EUT is replaced by a signal generator and an Antenna with known gain.

Test facility

The used semi-anechoic chamber is compliant with ANSI C63.4. RISE is an ISO 17025 accredited test facility for Electromagnetic Compatibility (EMC) and Radio testing. RISE is a Recognized Lab by FCC (Designation number: SE0001) and ISED (CAB identifier: SE0002) for the scope of standards and methods used in this test report.

References

Measurements were done according to applicable parts of the following standards:
ANSI C63.4-2014+ C63.4a-2017
ANSI C63.5-2017
ANSI C63.26-2015
e-CFR 47 part 2, February 2024
e-CFR 47 part 27, February 2024
e-CFR 47 part 22, February 2024
KDB 662911 D01 Multiple Transmitter Output v02r02
KDB 971168 D01 Power Meas License Digital Systems v03r01
KDB 971168 D03 IM Emission Repeater Amp v01
3GPP TS 36.141, version 15.3.0
3GPP TS 38.141-1, version 15.4.0
3GPP TS 25.141, version 17.0.0
RSS-130 Issue 2
RSS-132 Issue 4
RSS-Gen Issue 5

Measurement equipment

Item	Name	Inv.no	Cal. due date
Semi Anechoic Chamber	Tesla	503881	-
	NSA	BX90699	2025-11-04
	SVSWR	BX90702	2024-09-20
Spectrum Analyzer	Rohde & Schwarz ESU40	901385	2024-07-24
Software	Rohde & Schwarz EMC32	BX62351	-
RF cable	Huber & Suhner Eacon 4C	BX91490	2024-06-30
RF Cable	Rosenberger UFB311A	503508	2024-09-08
RF Cable	Rosenberger UFB311A	503509	2024-09-08
Antenna, Bilog	Teseq CBL6143A	BX92331	2025-09-16
Preamplifier	MicroComp Nordic MCN-JS42-00101800-28-10P	901545	2025-01-25
HP filter	Wainwright WHKX1.0/18G-10SS	901373	2024-07-08
Antenna, Horn	Emco 3115	502175	2024-07-02
Spectrum analyzer	R&S FSQ 40	504143	2024-07-21
Spectrum analyzer	R&S FSW 43	902073	2024-07-21
RF attenuator	Weinschel 40dB	902282	2024-09-09
HP filter	Wainwright WHKY1.0/15G-12SS	504199	2024-06-08
RF cable	Sucoflex 102EA	BX50236	2024-09-09
RF Cable	Sucoflex 102EA	BX50237	2024-09-09
Thermohygrometer	Testo 635	504203	2024-06-30
Thermohygrometer	Testo 625	504117	2024-06-30

Uncertainties

Measurement and test instrument uncertainties are described in the quality assurance documentation ”RISE – 3936”. The uncertainties are calculated with a coverage factor k=2 (95% level of confidence).

Reservation

The test results in this report apply only to the particular test object as declared in the report.

Delivery of test object

The test object was delivered: 2024-02-15.

Manufacturer’s representative

Patrik Hellström, Ericsson AB.

Test engineers

Tomas Lennhager and Björn Skönvall, RISE.

Test participant(-s)

None.

Test frequencies used for conducted and radiated measurements

B5 WCDMA:

Frequency [MHz]	Symbolic name	Comment
871.4	B	TX bottom frequency in 5 MHz BW configuration
881.6	M	TX middle frequency in 5 MHz BW configuration
891.6	T	TX top frequency in 5 MHz BW configuration.
871.4 876.6 891.6	Bim	TX constellation for Bim with 5 MHz BW (B= Bottom frequency, im= Intermodulation)
871.4 886.4 891.6	Tim	TX constellation for Tim with 5 MHz BW (T= Top frequency, im= Intermodulation)
871.4 878.2 884.8 891.6	M4	TX constellation for maximum number of carriers with 5 MHz bandwidth configuration.

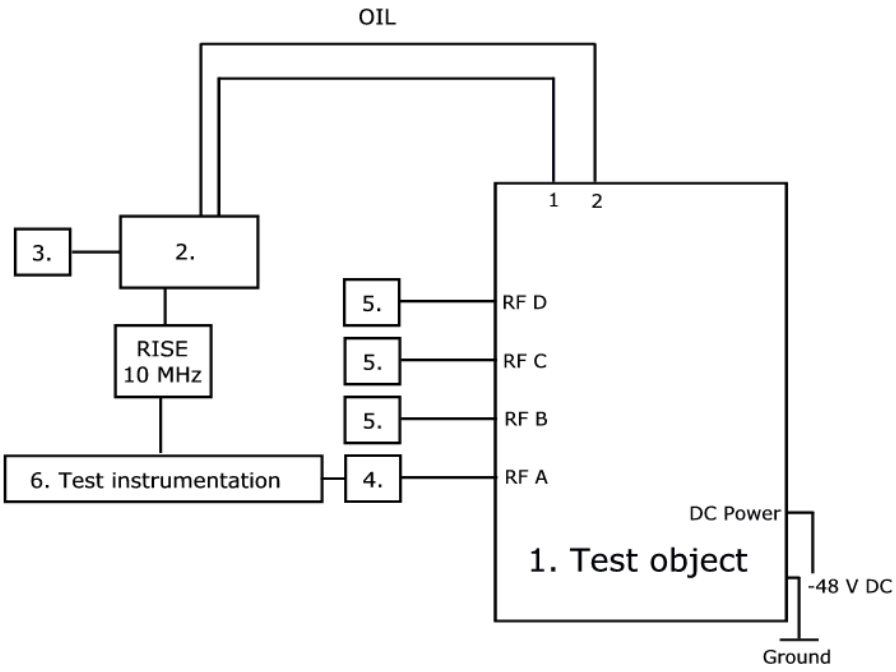
The RX frequency was configured 45 MHz below the corresponding TX frequency according to the applicable duplex offset for the operating band.

B5 Multi RAT

Frequency [MHz]	Symbolic name	Comment
WCDMA=871.4 NR=881.5 LTE=891.5	W+N+L	TX constellation With WCDMA, NR and LTE carrier with 5 MHz carrier bandwidth.

The test object was simultaneously transmitting in both bands at maximum output power settings during all measurements. In Band 13 one carrier with 5 MHz BW NR FR1-TM 1.1 on the frequency 751 MHz was used.

Test setup: conducted measurements



Test object:

1.	Radio 4490HP 44B5 44B13 C, KRC 161 985/3, rev. R1B, s/n: E23E499389 With Radio Software: CXP 202 1113/1, rev. R20A103. FCC ID: TA8AKRC161985, IC: 287AB-AS161985

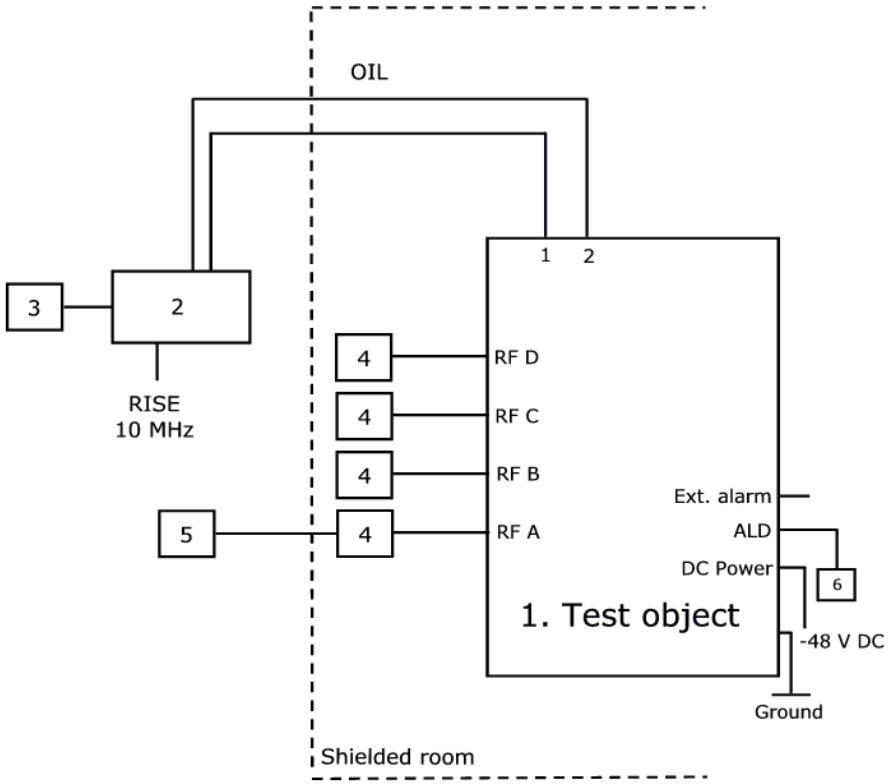
Associated equipment:

2.	Testing Equipment: CT-DU25, LPC 102 500/1, rev. R3B, s/n: T01G520908 with software Ruma R50B02

Functional test equipment:

3.	Computer, Mac book pro, BAMS – 1002122807
4.	RF Attenuator: RISE number: 902 282
5.	Terminator, 50 ohm
6.	RISE Test Instrumentation according to measurement equipment list for each test. The signal analyzer was connected to the RISE 10 MHz reference standard during all measurements.

Test setup: radiated measurements



1.	Radio 4490HP 44B5 44B13 C, KRC 161 985/3, rev. R1B, s/n: E23E499389 With Radio Software: CXP 202 1113/1, rev. R20A103. FCC ID: TA8AKRC161985, IC: 287AB-AS161985

Associated equipment:

2.	Testing Equipment: CT-DU25, LPC 102 500/1, rev. R3B, s/n: T01G520908 with software Ruma R50B02

Functional test equipment:

3.	Computer, Mac book pro, BAMS – 1002122807
4.	Attenuator/ Terminator
5.	R&S ESIB 26, SP no: 503 885 for supervision purpose only
6.	Remote Control Unit, ANDREW Model: ATM200-A20, Serial: DESA101412073

Interfaces:

Power input configuration DC: -48 VDC	Power
RF A-D, 4.3-10 connector, combined TX/RX	Antenna
1, Optical Interface Link, single mode opto fibre	Signal
2, Optical Interface Link, single mode opto fibre	Signal
ALD Control, shielded multi-wire	Signal
EXT Alarm, shielded multi-wire	Signal
Ground wire	Ground

RF power output measurements according to CFR 47 § 22.913/ RSS-132 5.4, conducted

Date	Temperature	Humidity
2024-02-19	23 °C ± 3 °C	17 % ± 5 %
2024-02-20	22 °C ± 3 °C	20 % ± 5 %
2024-02-21	23 °C ± 3 °C	24 % ± 5 %

Test set-up and procedure

The measurements were made per definition in ANSI C63.26, 5.2.3.4. The test object was connected to a signal analyser measuring peak and RMS output power in CDF mode. A resolution bandwidth of 80 MHz was used if not otherwise specified.

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	902 282
Coaxial cable Sucoflex 102EA	BX 50236
Coaxial cable Sucoflex 102EA	BX 50237
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 1.1 dB

Results WCDMA B5 Single carrier

Single carrier Test model TM1

Rated output power level at each RF port 1x 46.0 dBm/ port.

	Output power CCDF [RMS dBm/ PAR dB]				
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
B	46.13/7.22	46.18/7.22	46.03/7.22	46.12/7.22	52.13
M	46.03/7.22	46.00/7.18	46.02/7.18	46.09/7.18	52.05
T	46.03/7.24	46.02/7.24	45.86/7.24	46.04/7.24	52.00

1): summed output power according to ANSI C63.26 section 6.4.3.1
Note: The PAR value is the 0.1 % Peak to Average Ratio.

Single carrier Test model TM5

Rated output power level at each RF port 1x 46.0 dBm/ port.

	Output power CCDF [RMS dBm/ PAR dB]				
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
B	46.19/7.18	46.12/7.18	46.14/7.2	46.18/7.18	52.18

1): summed output power according to ANSI C63.26 section 6.4.3.1
Note: The PAR value is the 0.1 % Peak to Average Ratio.

Single carrier Test model TM6

Rated output power level at each RF port 1x 46.0 dBm/ port.

	Output power CCDF [RMS dBm/ PAR dB]				
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
B	46.16/7.18	46.22/7.18	46.13/7.18	46.17/7.2	52.19

1): summed output power according to ANSI C63.26 section 6.4.3.1
Note: The PAR value is the 0.1 % Peak to Average Ratio.

Single carrier Test model TM1

Rated output power level at each RF port 1x 46.0 dBm/ port.

	Output power per 1 MHz [RMS dBm]					
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[2)]	Maximum Antenna gain[3)] [dBd]/ ERP Limit [dBm]
B	40.84	40.91	40.75	40.8	46.91	16.09/ 63.0

[2)]: 6 dB (10 $\log_{10}$ (N_{out})) was added to the highest measured power among the measured ports, according to the procedure described in ANSI C63.26 section 6.4.3.2.4.
[3)]: The gain value is the maximum antenna gain that can be used with the tested device for the configuration tested, and still comply with the maximum ERP limit as defined in FCC 22.913(a)(4)
Feeder loss is assumed to be 0 dB in the antenna gain calculation.
The used formula is: Maximum antenna gain (dBd) = ERP limit (dBm) - Measured Total power[2)]/ 1 MHz (dBm) + feeder loss (dB).
Please note that the maximum ERP limit for a specific site may be lower due to various site conditions.

Single carrier Test model TM1

Rated output power level at each RF port 1x 46.0 dBm/ port.

	Output power per 5 MHz [RMS dBm]					
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[2)]	Maximum Antenna gain[3)] [dBi]/ EIRP Limit [dBm]
B	45.66	45.75	45.63	45.69	51.75	10.40/ 62.15

[2)]: 6 dB (10 $\log_{10}$ (N_{out})) was added to the highest measured power among the measured ports, according to the procedure described in ANSI C63.26 section 6.4.3.2.4.
[3)]: The gain value is the maximum antenna gain that can be used with the tested device for the configuration tested, and still comply with the maximum EIRP limit as defined in SRSP-503.
Feeder loss is assumed to be 0 dB in the antenna gain calculation.
The used formula is: Maximum antenna gain (dBi) = EIRP limit (dBm) - Measured Total power[2)]/ 5 MHz (dBm) + feeder loss (dB).
Please note that the maximum EIRP limit for a specific site may be lower due to various site conditions.

Single carrier Test model TM5

Rated output power level at each RF port 1x 46.0 dBm/ port.

	Output power per 1 MHz [RMS dBm]					
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[2)]	Maximum Antenna gain[3)] [dBd]/ ERP Limit [dBm]
B	40.78	40.82	40.79	40.81	46.81	16.19/ 63.0

[2)]: 6 dB (10 $\log_{10}$ (N_{out})) was added to the highest measured power among the measured ports, according to the procedure described in ANSI C63.26 section 6.4.3.2.4.
[3)]: The gain value is the maximum antenna gain that can be used with the tested device for the configuration tested, and still comply with the maximum ERP limit as defined in FCC 22.913(a)(4)
Feeder loss is assumed to be 0 dB in the antenna gain calculation.
The used formula is: Maximum antenna gain (dBd) = ERP limit (dBm) - Measured Total power[2)]/ 1 MHz (dBm) + feeder loss (dB).
Please note that the maximum ERP limit for a specific site may be lower due to various site conditions.

Single carrier Test model TM5

Rated output power level at each RF port 1x 46.0 dBm/ port.

	Output power per 5 MHz [RMS dBm]					
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[2)]	Maximum Antenna gain[3)] [dBi]/ EIRP Limit [dBm]
B	45.65	45.63	45.61	45.66	51.66	10.49/ 62.15

[2)]: 6 dB (10 $\log_{10}$ (N_{out})) was added to the highest measured power among the measured ports, according to the procedure described in ANSI C63.26 section 6.4.3.2.4.
[3)]: The gain value is the maximum antenna gain that can be used with the tested device for the configuration tested, and still comply with the maximum EIRP limit as defined in SRSP-503.
Feeder loss is assumed to be 0 dB in the antenna gain calculation.
The used formula is: Maximum antenna gain (dBi) = EIRP limit (dBm) - Measured Total power[2)]/ 5 MHz (dBm) + feeder loss (dB).
Please note that the maximum EIRP limit for a specific site may be lower due to various site conditions.

Single carrier Test model TM6

Rated output power level at each RF port 1x 46.0 dBm/ port.

	Output power per 1 MHz [RMS dBm]					
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[2)]	Maximum Antenna gain[3)] [dBd]/ ERP Limit [dBm]
B	40.78	40.88	40.77	40.81	46.88	16.12/ 63.0

[2)]: 6 dB (10 $\log_{10}$ (N_{out})) was added to the highest measured power among the measured ports, according to the procedure described in ANSI C63.26 section 6.4.3.2.4.
[3)]: The gain value is the maximum antenna gain that can be used with the tested device for the configuration tested, and still comply with the maximum ERP limit as defined in FCC 22.913(a)(4)
Feeder loss is assumed to be 0 dB in the antenna gain calculation.
The used formula is: Maximum antenna gain (dBd) = ERP limit (dBm) - Measured Total power[2)]/ 1 MHz (dBm) + feeder loss (dB).
Please note that the maximum ERP limit for a specific site may be lower due to various site conditions.

Single carrier Test model TM6

Rated output power level at each RF port 1x 46.0 dBm/ port.

	Output power per 5 MHz [RMS dBm]					
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[2)]	Maximum Antenna gain[3)] [dBi]/ EIRP Limit [dBm]
B	45.63	45.73	45.62	45.66	51.73	10.42/ 62.15

[2)]: 6 dB (10 $\log_{10}$ (N_{out})) was added to the highest measured power among the measured ports, according to the procedure described in ANSI C63.26 section 6.4.3.2.4.
[3)]: The gain value is the maximum antenna gain that can be used with the tested device for the configuration tested, and still comply with the maximum EIRP limit as defined in SRSP-503.
Feeder loss is assumed to be 0 dB in the antenna gain calculation.
The used formula is: Maximum antenna gain (dBi) = EIRP limit (dBm) - Measured Total power[2)]/ 5 MHz (dBm) + feeder loss (dB).
Please note that the maximum EIRP limit for a specific site may be lower due to various site conditions.

Results WCDMA B5 Multi carrier

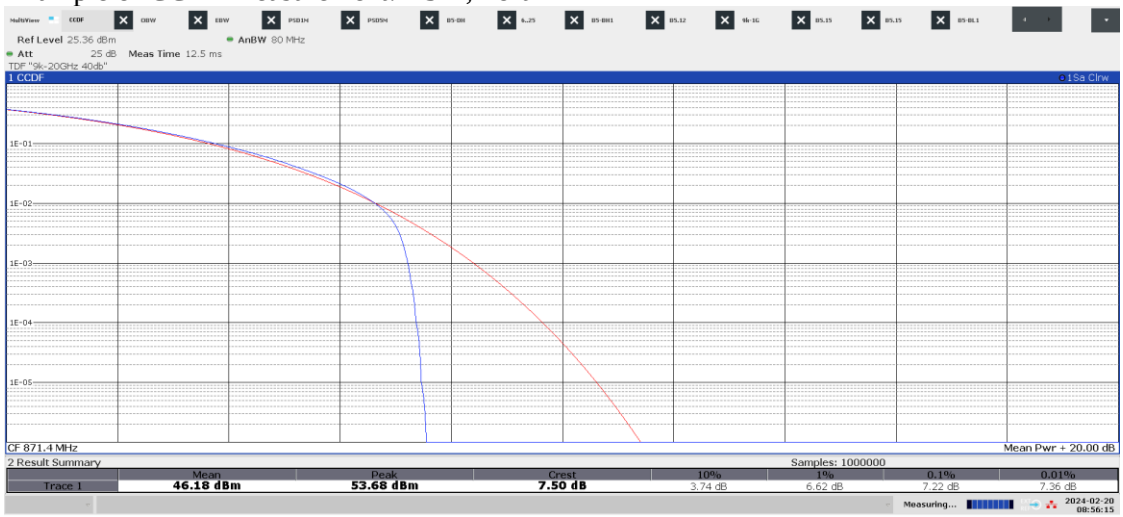
Multi carrier, TM1

Rated output power level at each RF port 4x 40 dBm/ port.

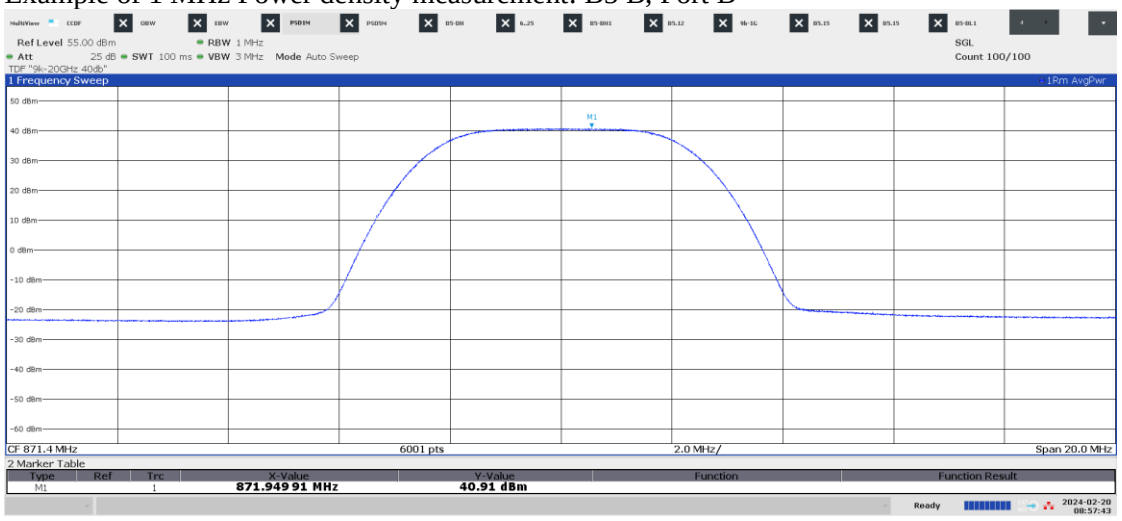
	Output power CCDF [RMS dBm]				
Symbolic name	Port RF A	Port RF B	Port RF C	Port RF D	Total power[1)]
M4	45.72	45.79	45.65	45.66	51.73

[1)]: summed output power according to ANSI C63.26 section 6.4.3.1

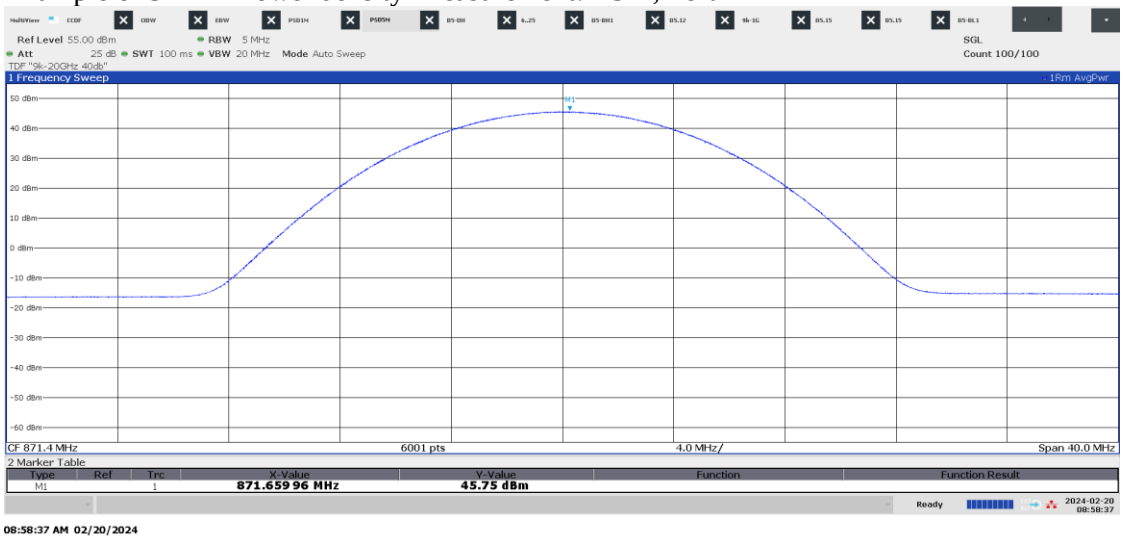
Example of CCDF measurement: B5 B, Port B



Example of 1 MHz Power density measurement: B5 B, Port B



Example of 5 MHz Power density measurement: B5 B, Port B



Remark

ERP/EIRP compliance is addressed at the time of licensing, as required by the responsible FCC/ISED Bureau(s). Licensees are required to take into account maximum antenna gain used in combination with above power settings to prevent the radiated output power to exceed the limits.

Limits

§22.913:

(a) (4ii) Extend coverage into Unserved Area on a secondary basis (see § 22.949), are permitted to operate base transmitters and repeaters with an ERP greater than 800 watts/MHz (PSD) per sector, up to a maximum of 2000 watts/MHz (PSD) per sector.

(d) The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB.

RSS-132 section 5.4/ SRSP-503

The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB

Base stations located in geographical areas at a distance greater than 26 km from large or medium population centres and transmitting in accordance with paragraphs 14 and15 within the frequency range 869-894 MHz, may increase their e.i.r.p. up to a maximum of 1640 watts/5 MHz (i.e. no more than 1640 watts e.i.r.p. in any 5 MHz band segment), with an antenna HAAT up to 150 metres.

Complies?	Yes

Occupied bandwidth measurements according to CFR47 §2.1049/ RSS-Gen 6.7

Date	Temperature	Humidity
2024-02-22	22 °C ± 3 °C	22 % ± 5 %
2024-02-23	23 °C ± 3 °C	24 % ± 5 %

Test set-up and procedure

The measurements were made per definition in ANSI C63.26, 5.4.4. The output was connected to a signal analyzer using the built in OBW function with the Peak detector activated in max hold.

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	902 282
Coaxial cable Sucoflex 102EA	BX50236
Coaxial cable Sucoflex 102EA	BX50237
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 2.6%

Results WCDMA B5

Single carrier: TM1

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [kHz]
1.1	B	RF A	4170
1.2	M	RF C	4166
1.3	T	RF B	4165

Diagram	Symbolic name	Tested Port	EBW (-26dB) [kHz]
1.4	B	RF A	4690

Single carrier: TM5

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [kHz]
1.5	B	RF B	4167

Single carrier: TM6

Diagram	Symbolic name	Tested Port	Occupied BW (99%) [kHz]
1.6	B	RF A	4155

Diagram 1.1 WCDMA: TM1, B, Port A:

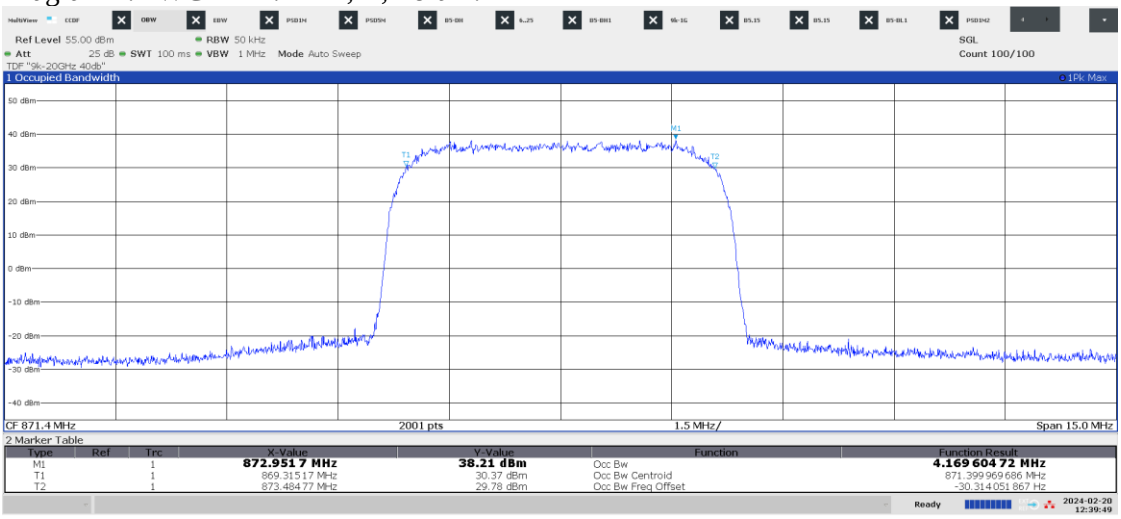


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Diagram 1.2 WCDMA: TM1, M, Port C:

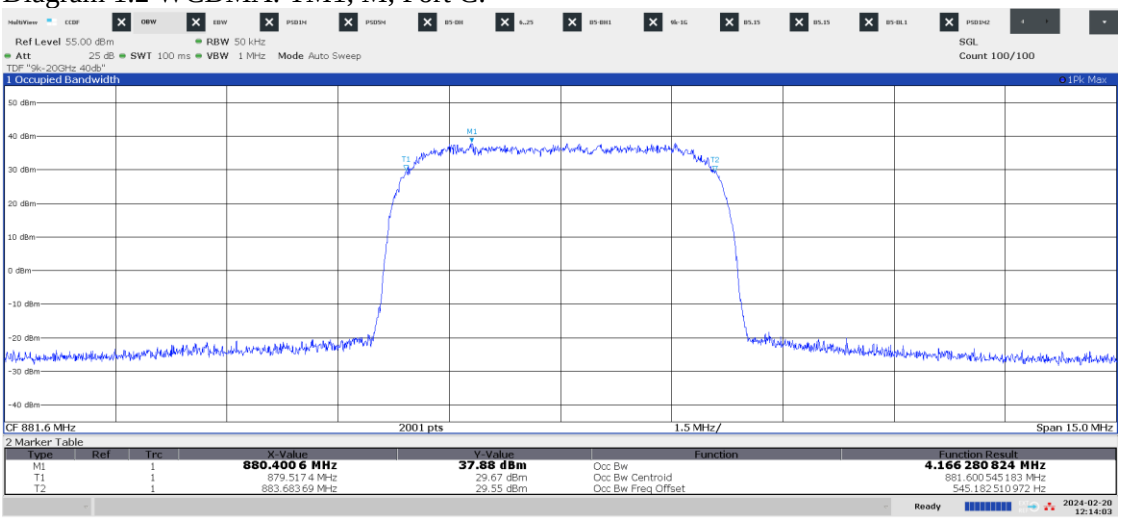

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Diagram 1.3 WCDMA: TM1, T, Port B:

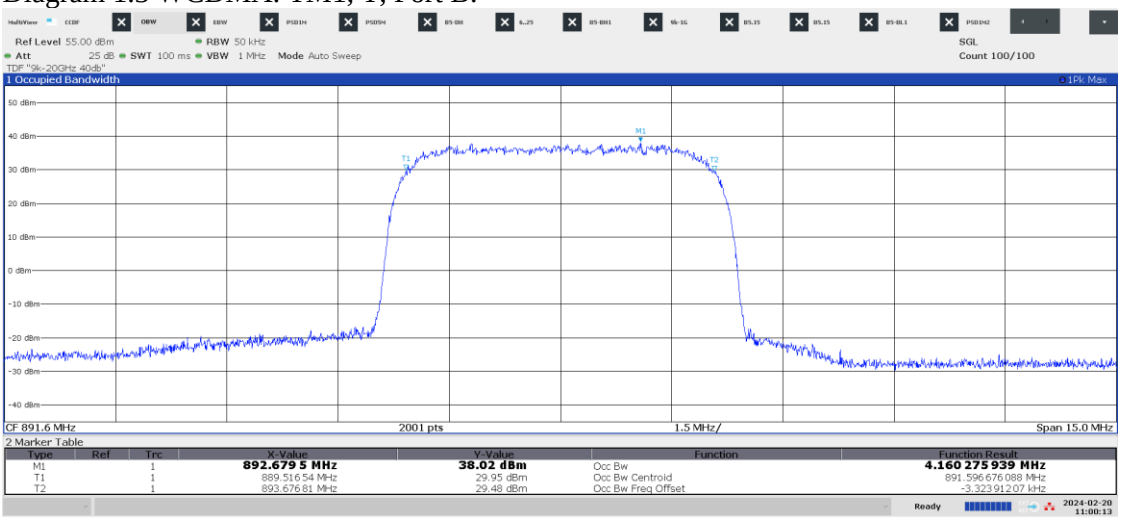

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Diagram 1.4 WCDMA: TM1, T, Port A:

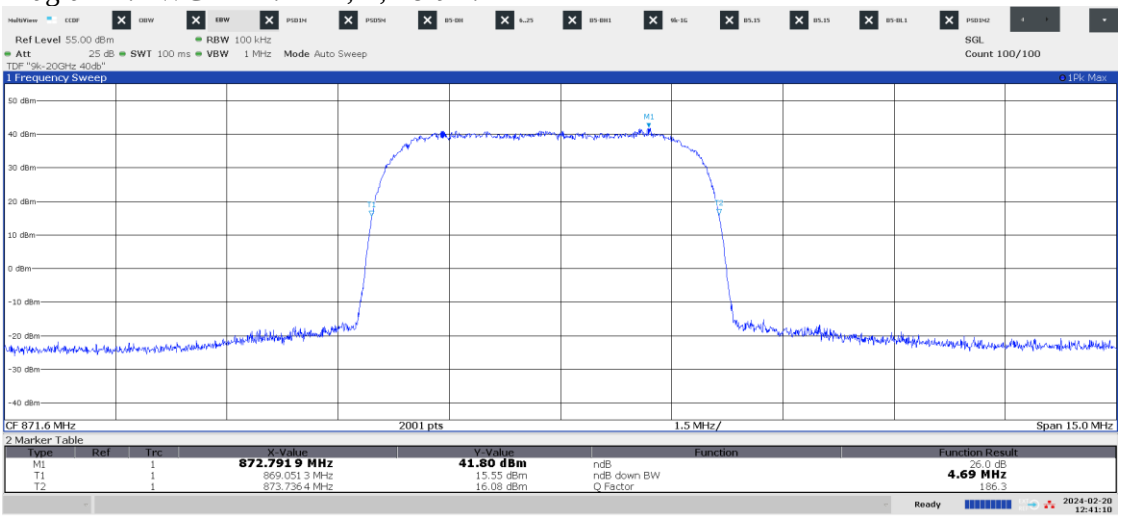

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Diagram 1.5 WCDMA: TM5, B, Port B:

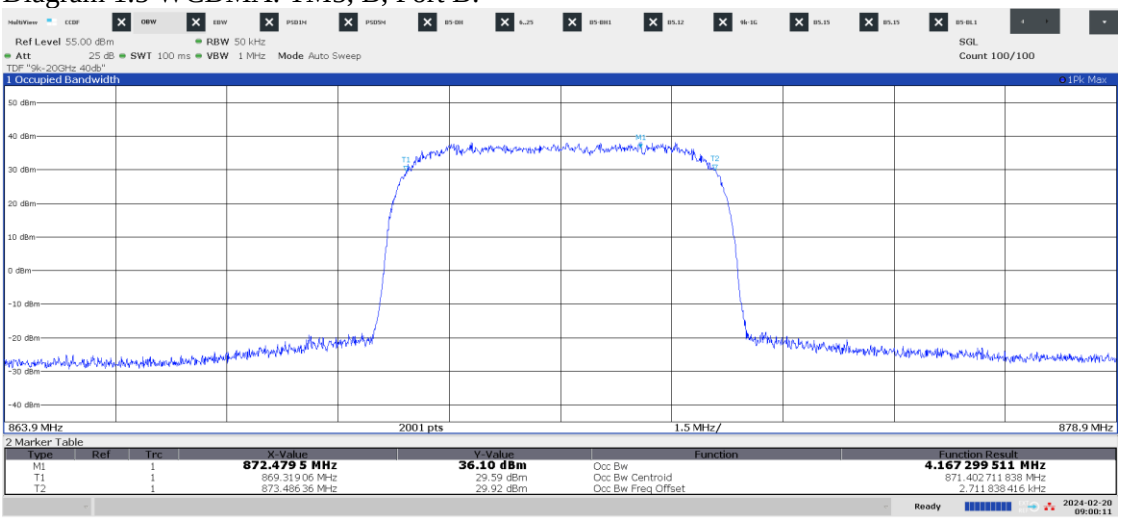

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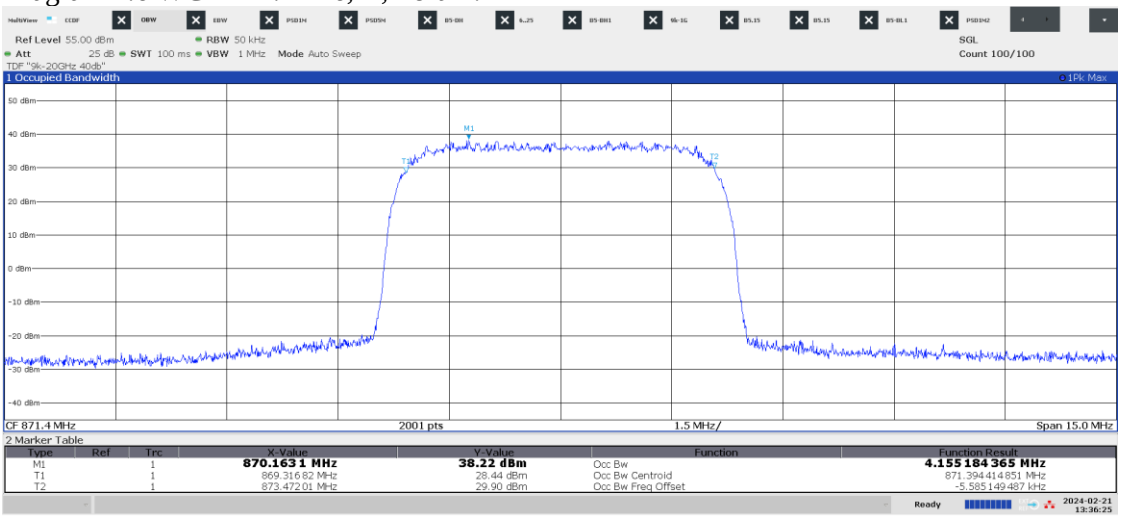
Diagram 1.6 WCDMA: TM6, B, Port A:



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Band edge measurements according to CFR 47 §22.917/ RSS-132 5.5

Date	Temperature	Humidity
2024-02-22	22 °C ± 3 °C	22 % ± 5 %
2024-02-23	23 °C ± 3 °C	24 % ± 5 %
2024-02-26	22 °C ± 3 °C	25 % ± 5 %

Test set-up and procedure

The measurements were made per definition in ANSI C63.26, 5.7.2. The test object was connected to a spectrum analyzer with the RMS detector activated.

Band 5
A RBW of at least 1% of the OBW/EBW is to be used up to 1 MHz away from the band edges and for measurements more than 1 MHz from the band edges a RBW of 100 kHz is to be used.

An offset of 6 dB has been used to cover 4x4 MIMO according to ANSI C63.26 6.4.4.1 c "measure and add 10 $\log_{10}$ (N_{ANT})".

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	902 282
Coaxial cable Sucoflex 102EA	BX50236
Coaxial cable Sucoflex 102EA	BX50237
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 2.6 dB

Results WCDMA B5

Single carrier WCDMA: TM1

Diagram	Symbolic name	Tested Port
2.1 a-b	B	RF A
2.2 a-b	T	RF D

Multi carrier WCDMA: TM1

Diagram	Symbolic name	Tested Port
2.3 a-b	Bim	RF B
2.4 a-b	Tim	RF B
2.5 a-d	M4	RF A

Limits

CFR 47 § 22.917 (a)
Out of band emissions. 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.

CFR 47 § 22.917 (b)
Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

- In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). 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.
- In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.

RSS-132 5.5

i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated below the transmitter output power P (dBW) by at least 43 + 10 log(p) dB.

ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated below the transmitter output power P (dBW) by at least 43 + 10 log(p) dB. If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

Complies?	Yes

Diagram 2.1a WCDMA: TM1, B, Port A:

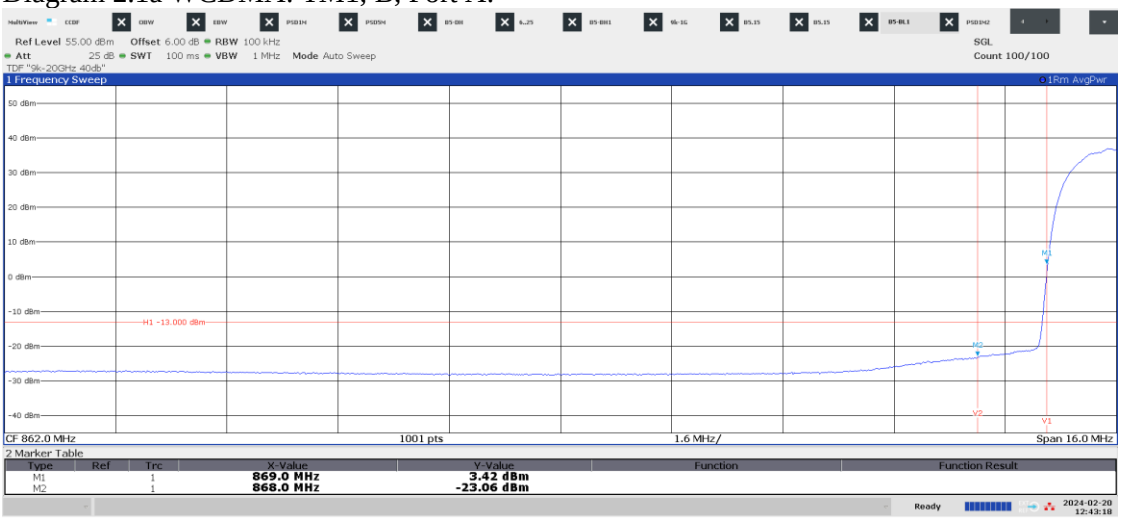


Diagram 2.1b WCDMA: TM1, B, Port A:

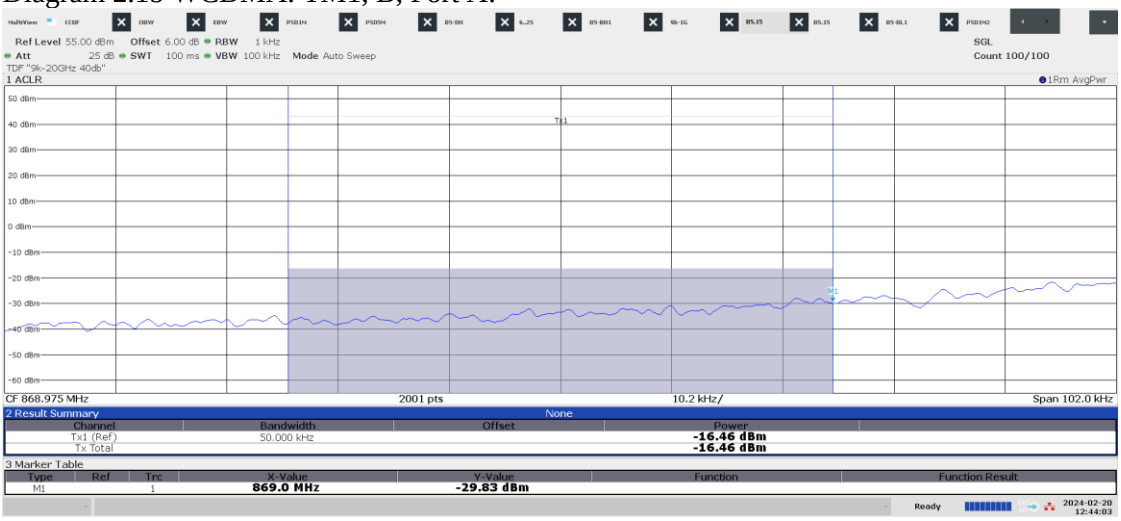


Diagram 2.2a WCDMA: TM1, T, Port D:

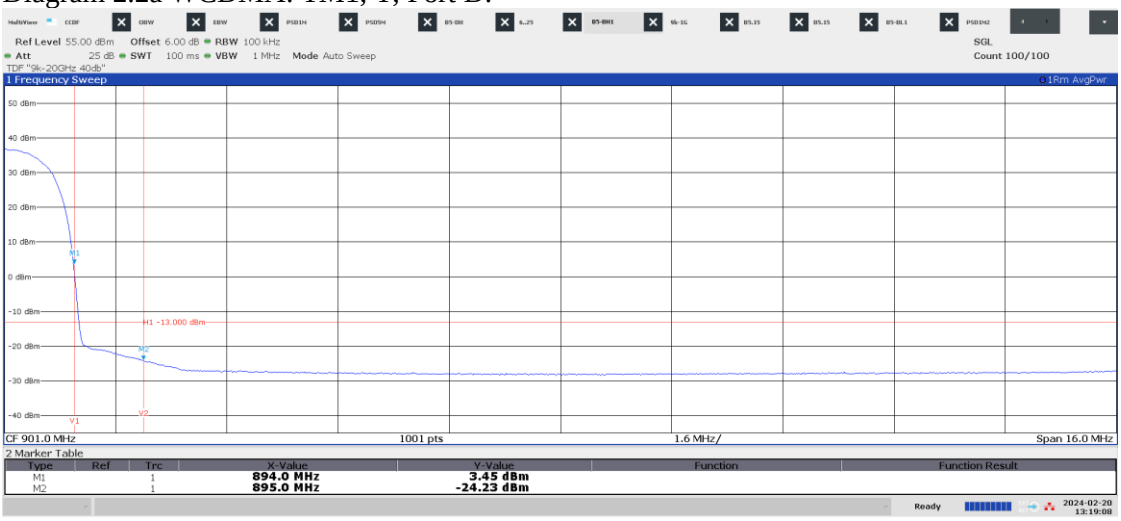


Diagram 2.2b WCDMA: TM1, T, Port D:

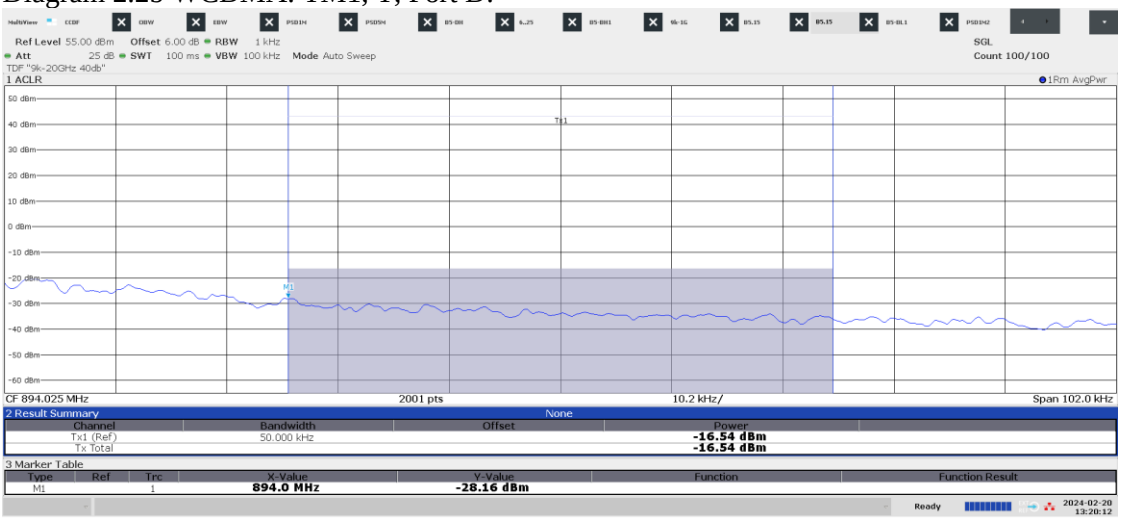


Diagram 2.3a WCDMA: TM1, Bim, Port B:

Diagram 2.3b WCDMA: TM1, Bim, Port B:

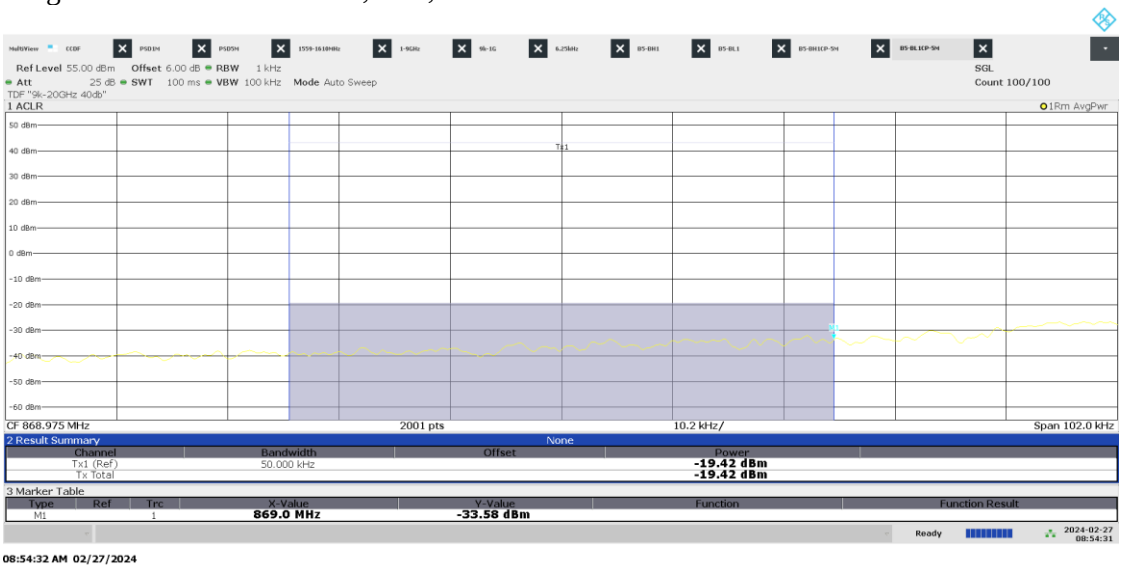


Diagram 2.4a WCDMA: TM1, Tim, Port B:

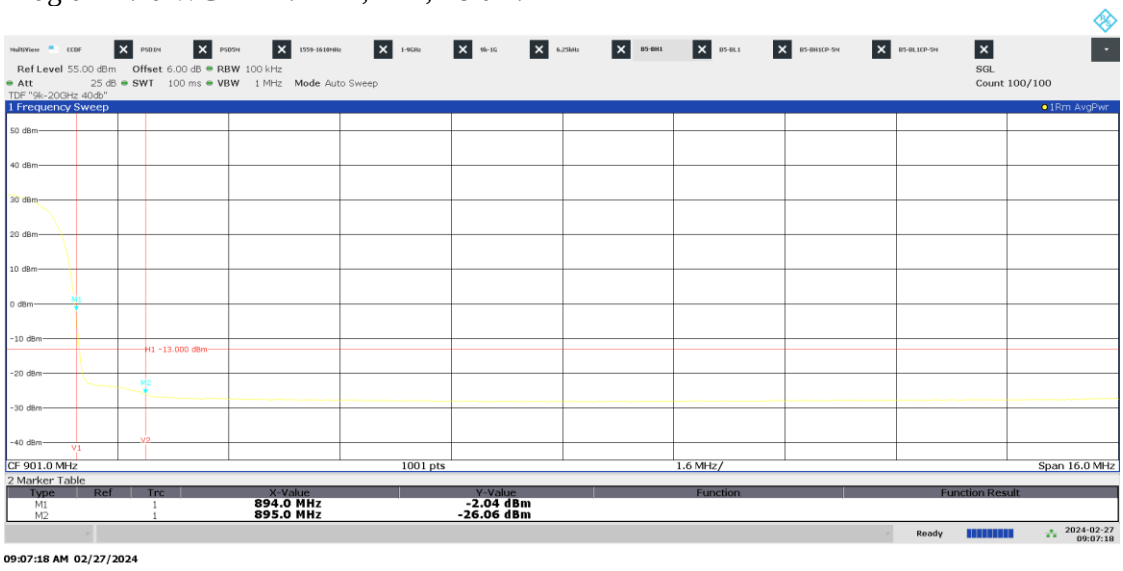


Diagram 2.4b WCDMA: TM1, Tim, Port B:

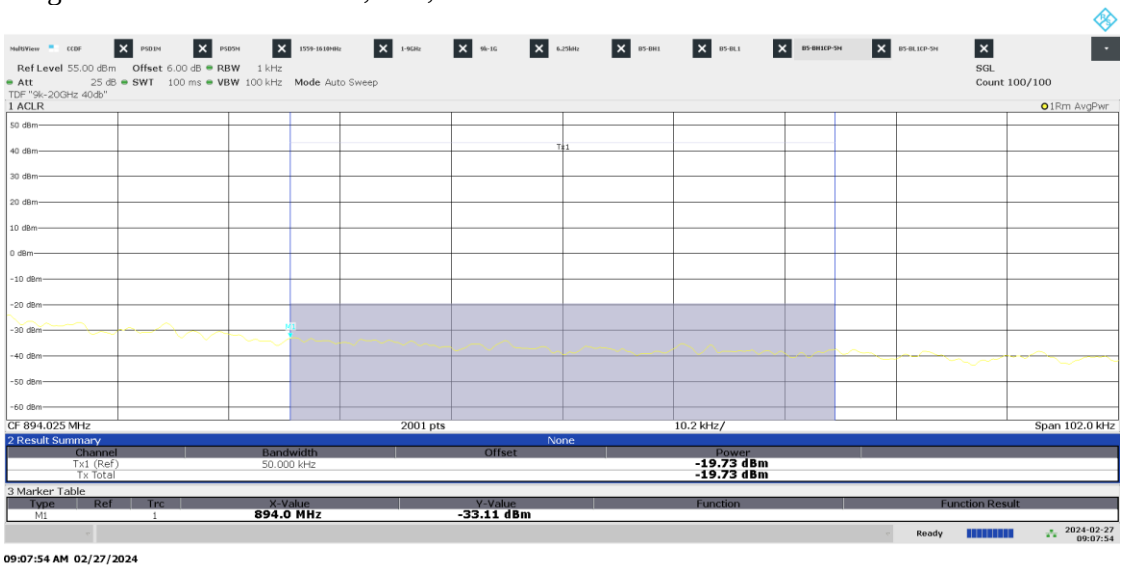


Diagram 2.5a WCDMA: TM1, M4, Port B:

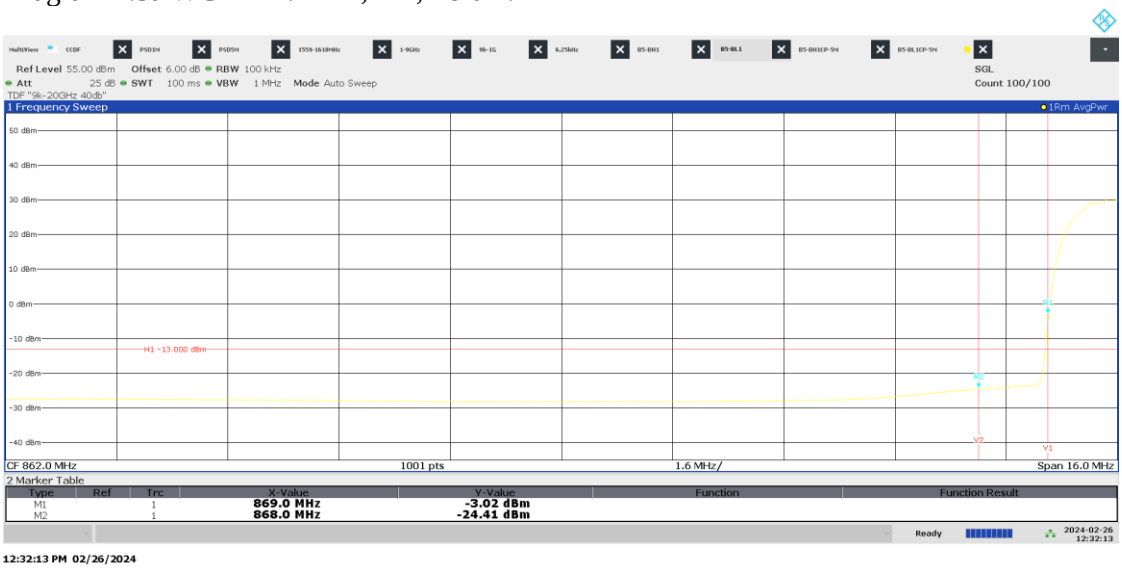


Diagram 2.5b WCDMA: TM1, M4, Port B:

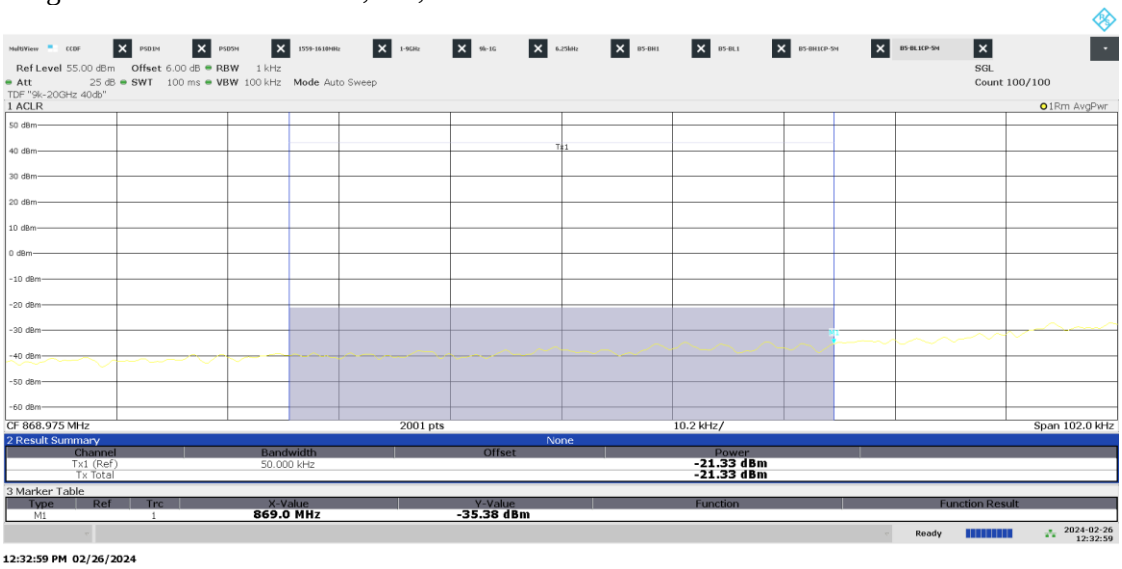


Diagram 2.5c WCDMA: TM1, M4, Port B:

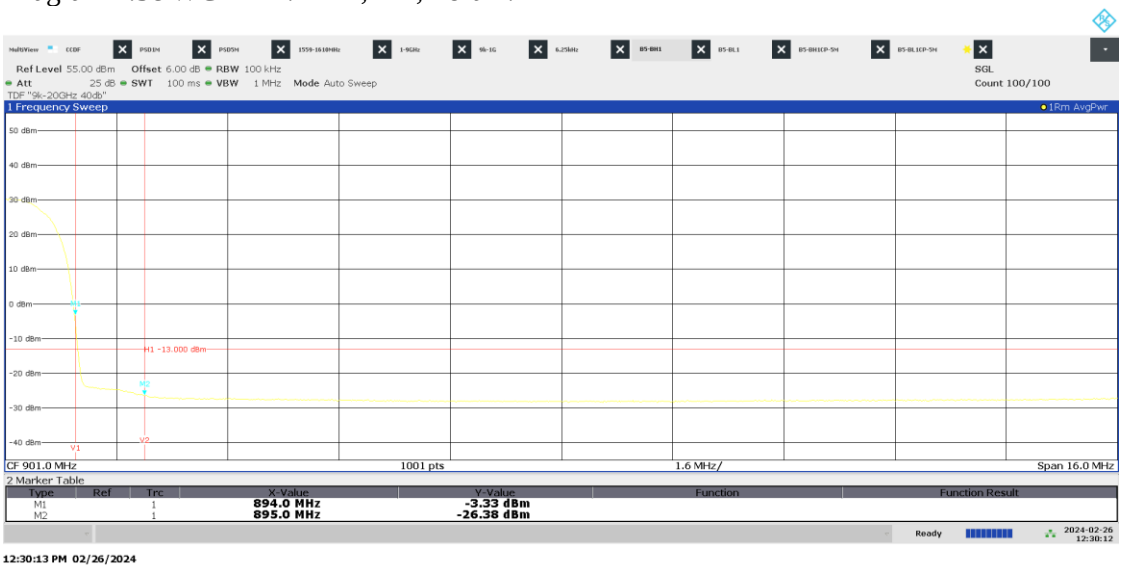
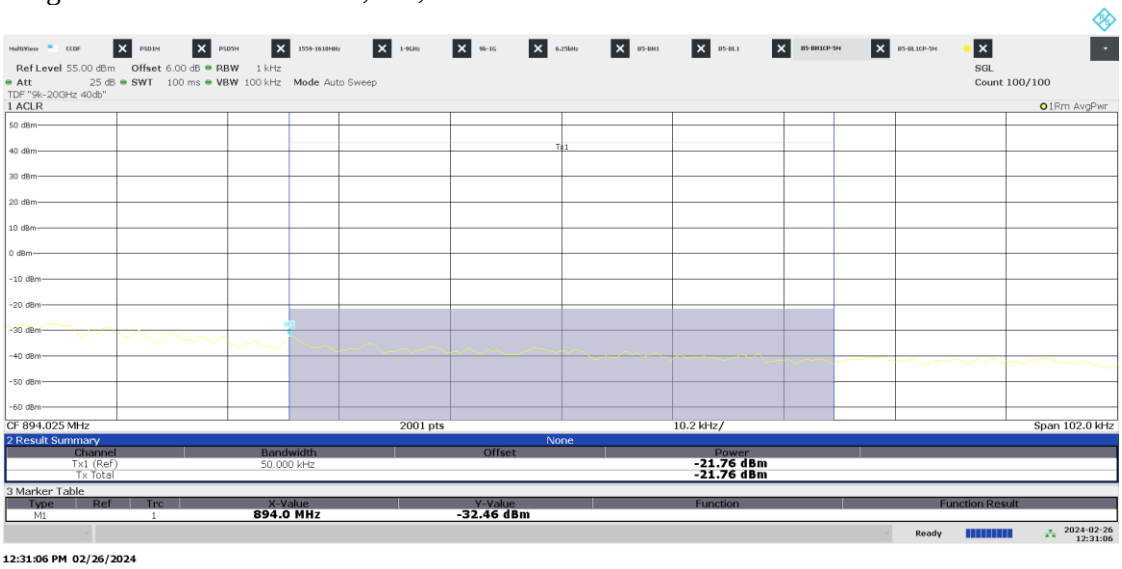


Diagram 2.5d WCDMA: TM1, M4, Port B:



Conducted spurious emission measurements according to CFR 47 §22.917/ RSS-132 5.5

Date	Temperature	Humidity
2024-02-20	22 °C ± 3 °C	20 % ± 5 %
2024-02-26	23 °C ± 3 °C	24 % ± 5 %
2024-02-27	22 °C ± 3 °C	25 % ± 5 %

Test set-up and procedure

The measurements were made per definition in ANSI C63.26, 5.7.4. The output was connected to a spectrum analyzer with the RMS detector activated.

An offset of 6 dB has been used to cover 4x4 MIMO according to ANSI C63.26 6.4.4.1 c "measure and add 10 $\log_{10}$ (N_{ANT})" In the frequency range 1-9 GHz an additional 0,62 dB was added to compensate for the pathloss in the High Pass filter used, resulting in a total offset of 6,62 dB in this frequency range.

The vertical lines V1 and V2 in the plots 9k to 1 GHz represent the band edges of the operating band 13.
The vertical lines V3 and V4 in the plots 9k to 1 GHz represent the band edges of the operating band 5

Measurement equipment	RISE number
R&S FSW 43	902 073
RF attenuator	902 282
High pass filter 1-20 GHz	504 199
Coaxial cable Sucoflex 102EA	BX50236
Coaxial cable Sucoflex 102EA	BX50237
Testo 635, temperature and humidity meter	504 203

Measurement uncertainty: 2.6 dB

Results WCDMA B5

Single carrier WCDMA: TM1

Diagram	Symbolic name B5	Tested Port
3.1 a-b	B	RF A
3.2 a-b	M	RF A
3.3 a-b	M	RF B
3.4 a-b	M	RF C
3.5 a-b	M	RF D
3.6 a-b	T	RF A

Note: Measurements were mainly limited to port RF B due to the measurement result in single carrier mode that shows that the ports are electrical identical as declared by the client.

Multi carrier WCDMA: TM1

Diagram	Symbolic name B5	Tested Port
3.7 a-b	Bim	RF B
3.8 a-b	Tim	RF B
3.9 a-b	M4	RF B

Multi RAT: WCDMA: TM1 NR and LTE: TM1.1

Diagram	Symbolic name B5	Tested Port
3.10 a-b	W+N+L	RF B

Remark

The emission at 9 kHz on the plots was not generated by the test object. A complementary measurement with a smaller RBW showed that it was related to the LO feed-through.

The highest fundamental frequency is 894 MHz. The measurements were made up to 9 GHz (10x894 MHz = 8.94 GHz).

Limits

CFR 47 § 22.917 (a)
Out of band emissions. 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.

CFR 47 § 22.917 (b)
Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

- In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). 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.
- In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.

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iii. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated below the transmitter output power P (dBW) by at least 43 + 10 log(p) dB.

iv. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated below the transmitter output power P (dBW) by at least 43 + 10 log(p) dB. If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

Complies?	Yes

Diagram 3.1a WCDMA: TM1, B_5, 9 kHz – 1 GHz, PortA:

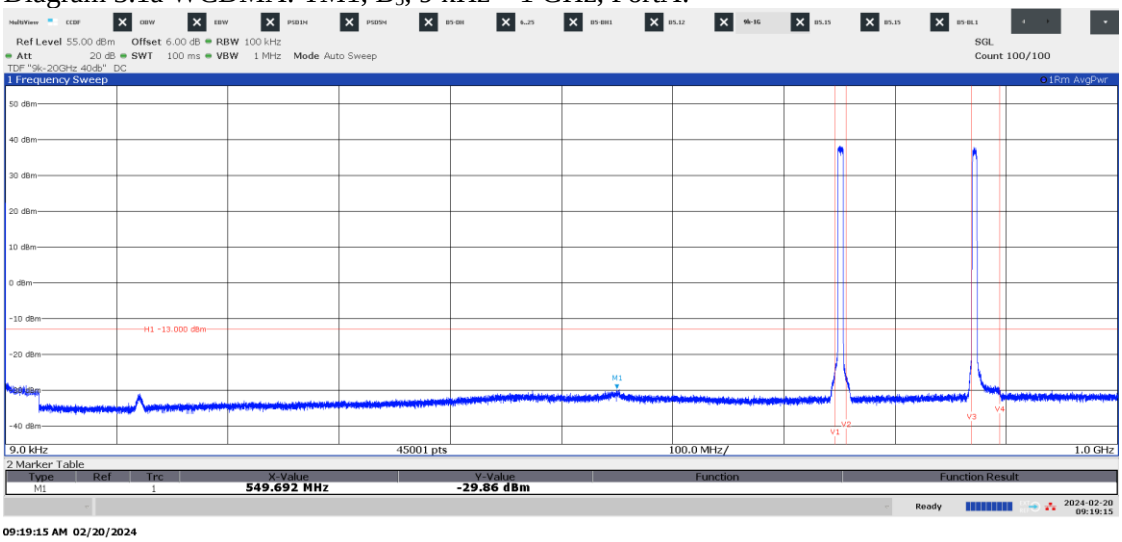

Diagram 3.1b WCDMA: TM1, B_5, 763 – 805 MHz, Port A:

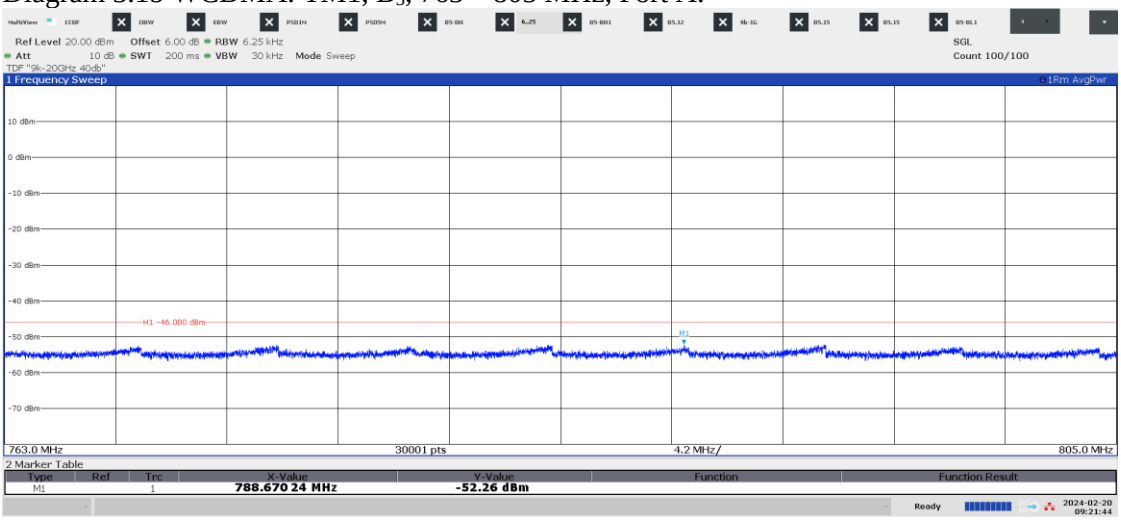

Diagram 3.1c WCDMA: TM1, B_5, 1 – 9 GHz, Port A:

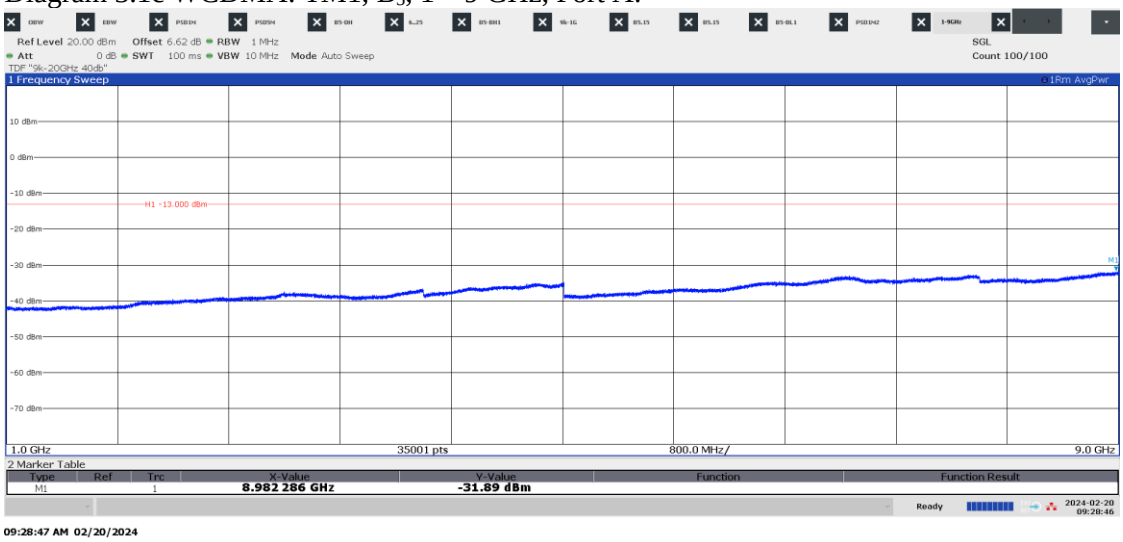

Diagram 3.1d WCDMA: TM1, B_5, 1559 – 1610 MHz, Port A:

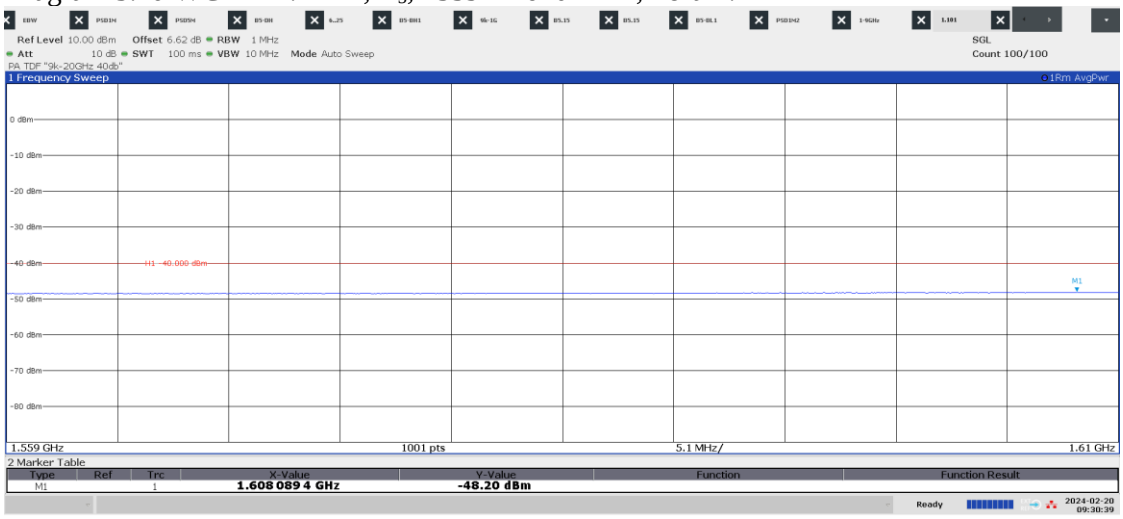

Diagram 3.2a WCDMA: TM1, M_5, 9 kHz – 1 GHz, Port A:

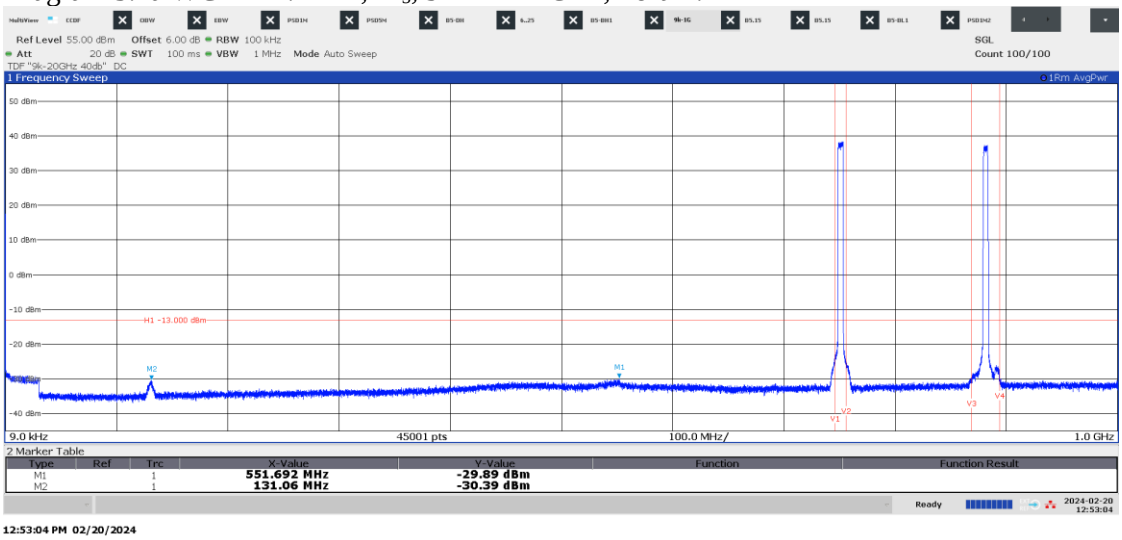

Diagram 3.2b WCDMA: TM1, M_5, 763 – 805 MHz, Port A:

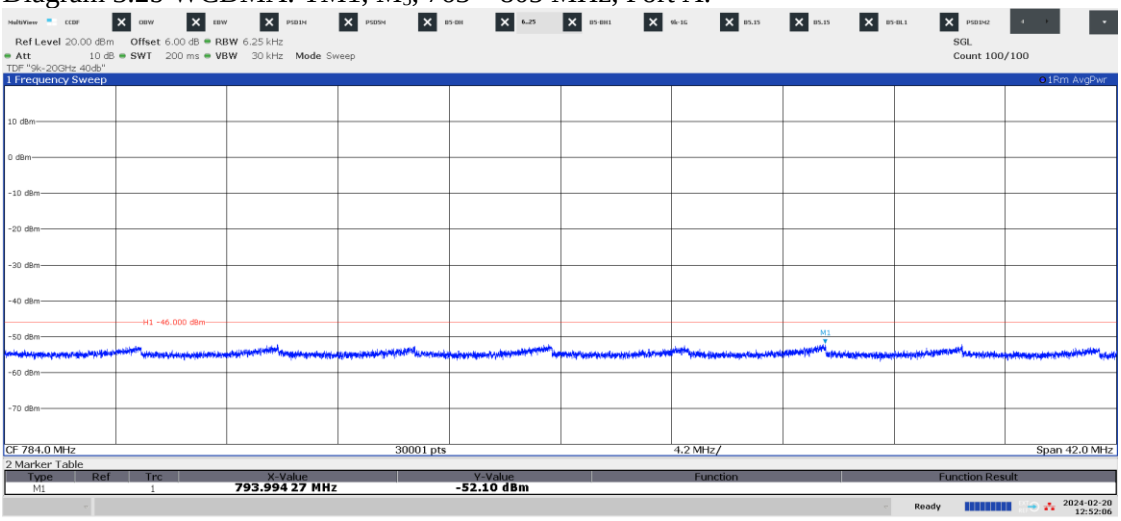

Diagram 3.2c WCDMA: TM1, M_5, 1 – 9 GHz, Port A:

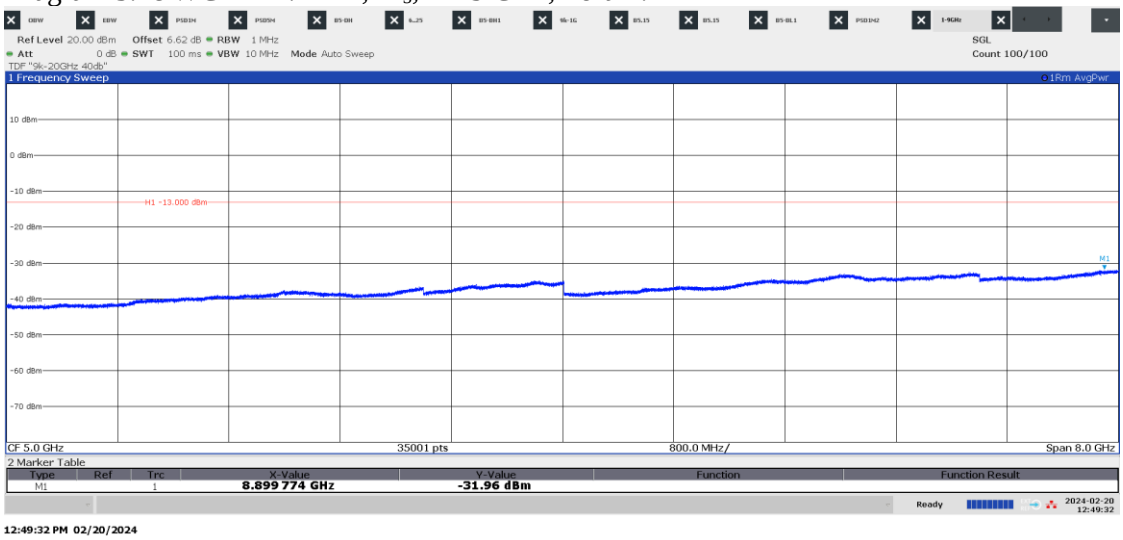

Diagram 3.2d WCDMA: TM1, M_5, 1559 – 1610 MHz, Port A:

Diagram 3.3a WCDMA: TM1, M_5, 9 kHz – 1 GHz, Port B:

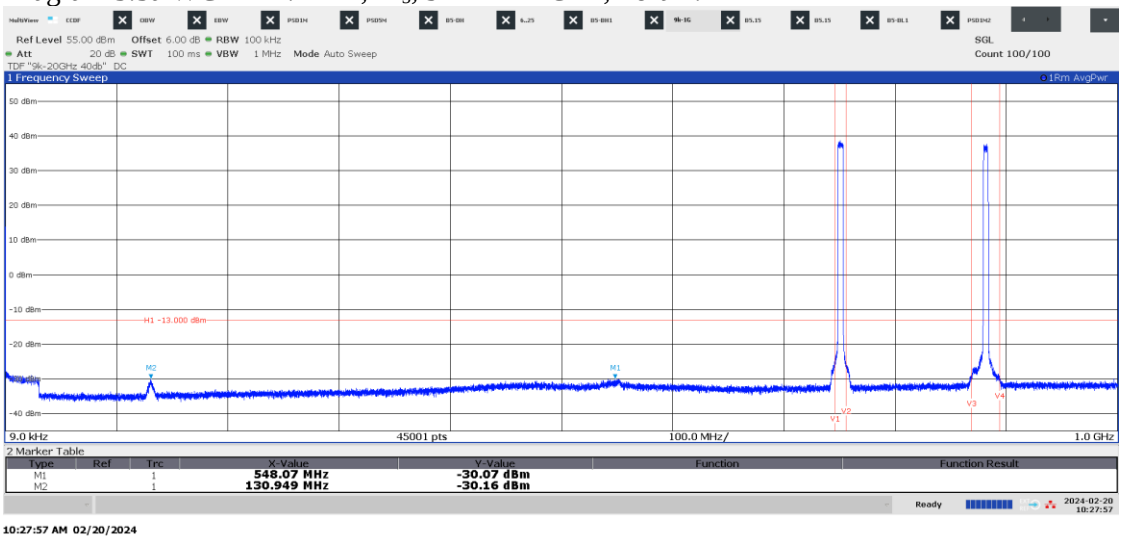

Diagram 3.3b WCDMA: TM1, M_5, 763 – 805 MHz, Port B:

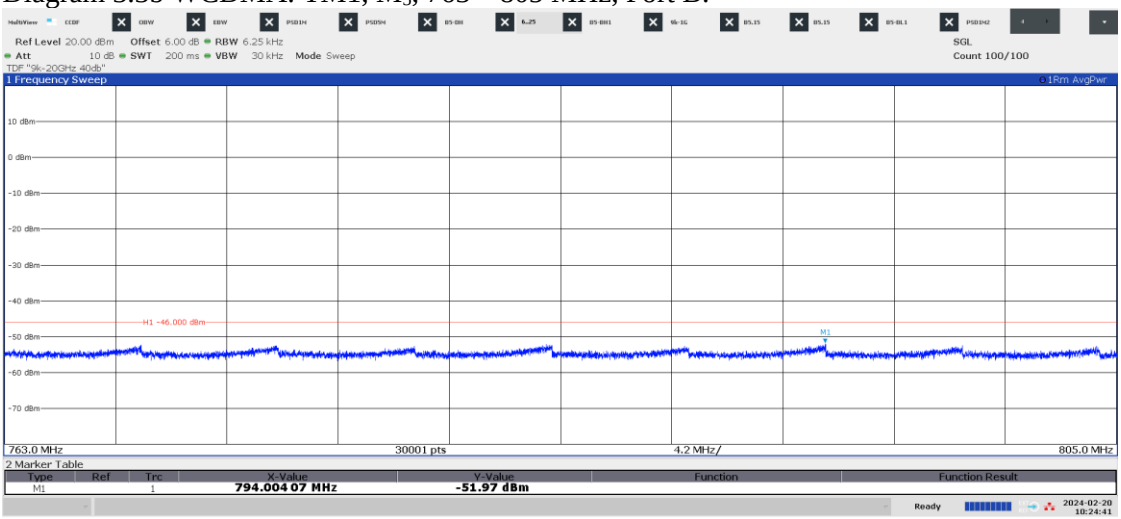

Diagram 3.3c WCDMA: TM1, M_5, 1 – 9 GHz, Port B:

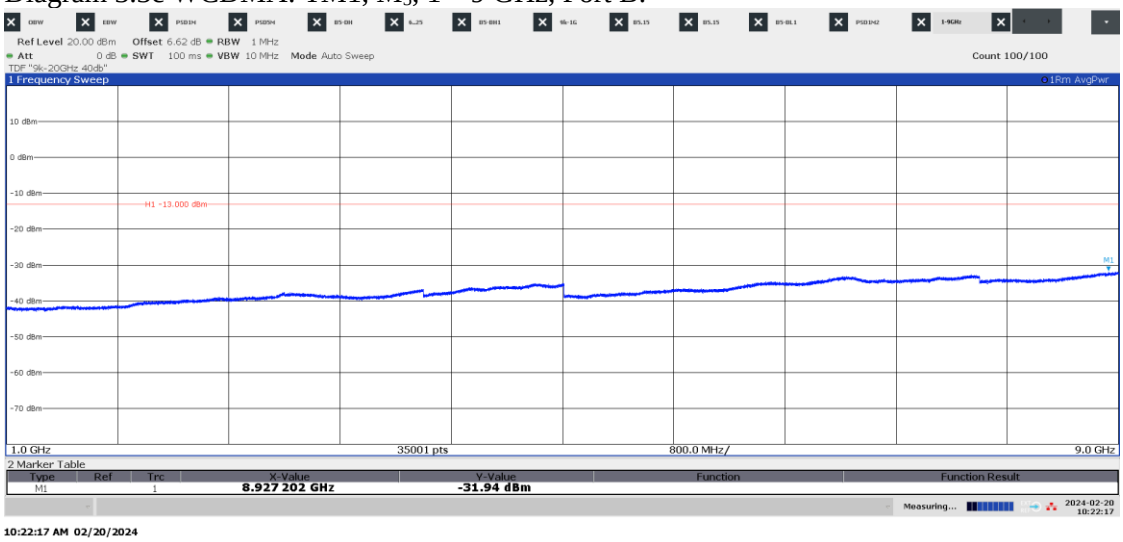

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Diagram 3.3d WCDMA: TM1, M_5, 1559 – 1610 MHz, Port B:

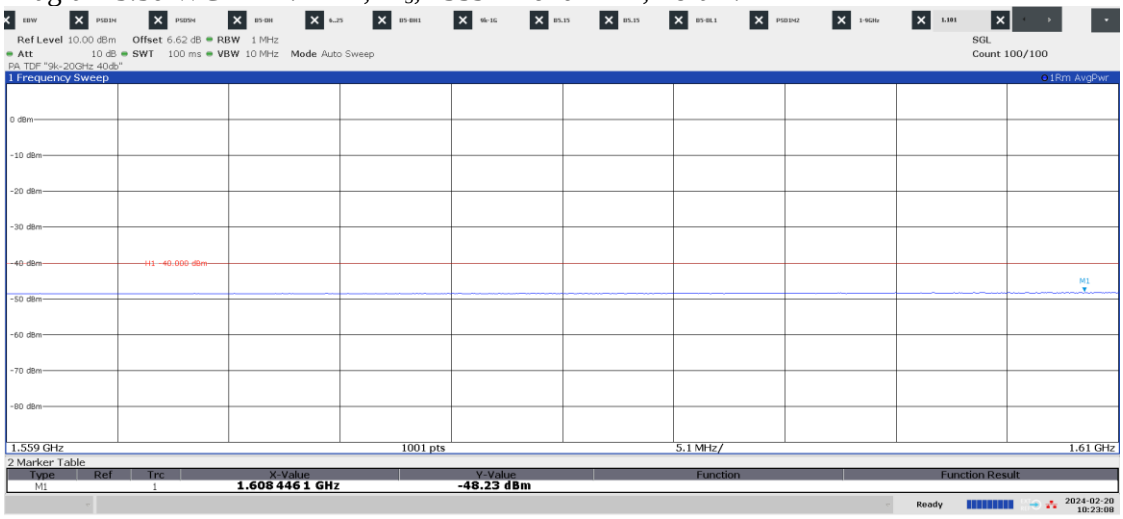

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Diagram 3.4a WCDMA: TM1, M_5, 9 kHz – 1 GHz, Port C:

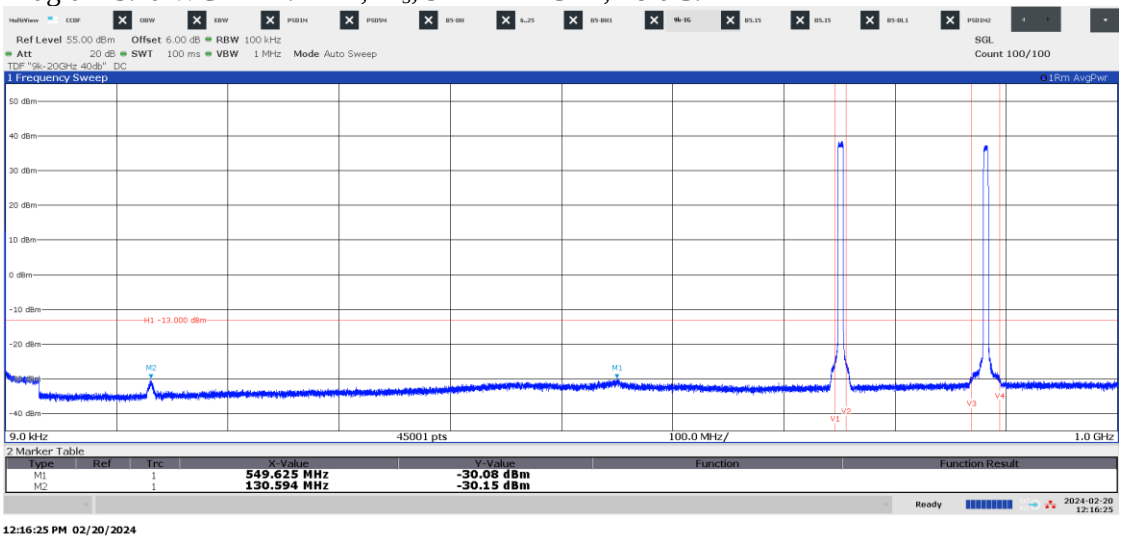

Diagram 3.4b LTE: TM1.1, M_5, 763 – 805 MHz, Port C:

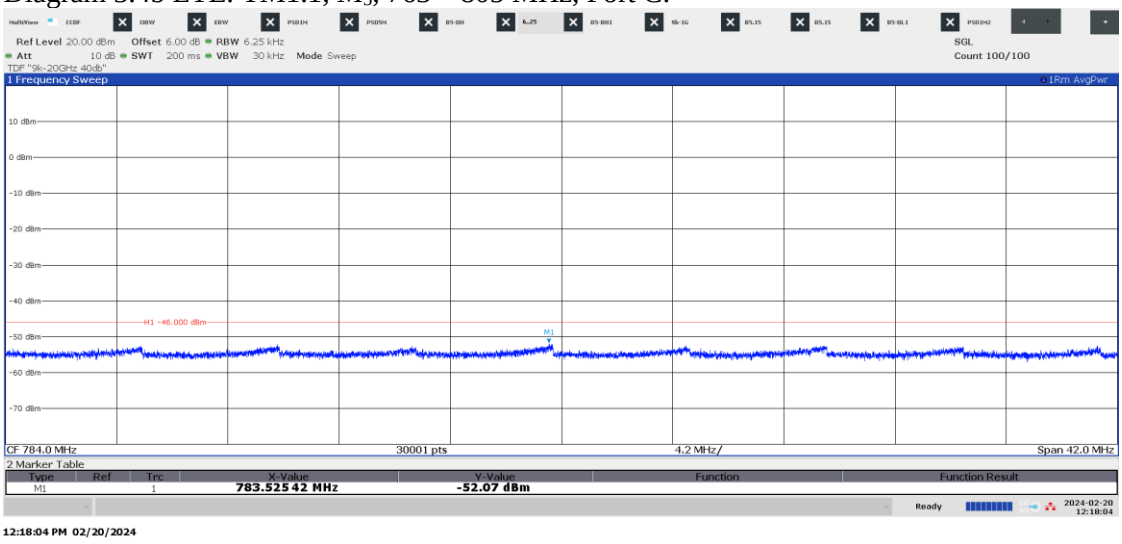

Diagram 3.4c WCDMA: TM1, M_5, 1 – 9 GHz, Port C:

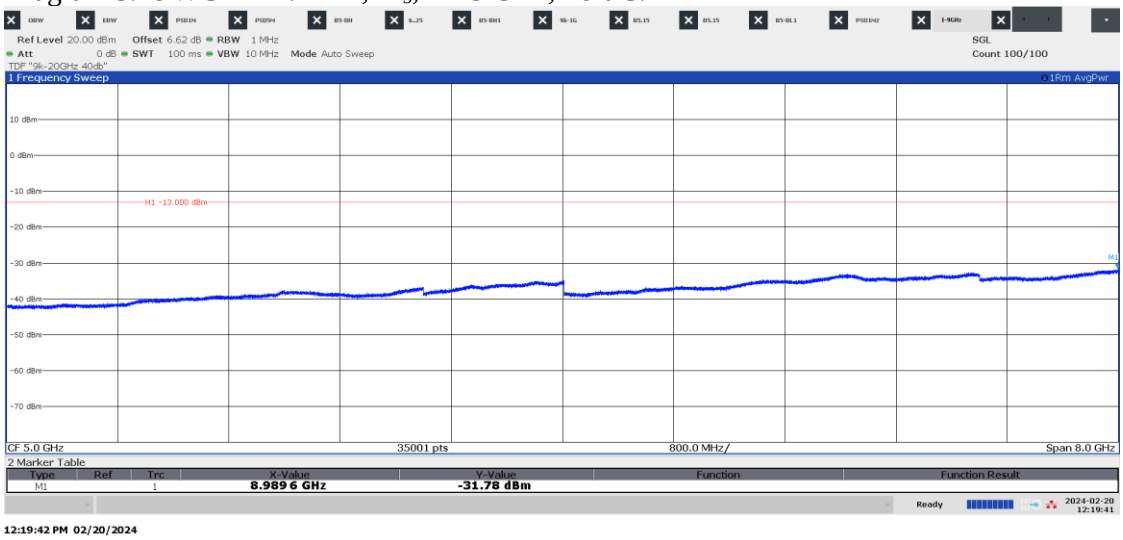

Diagram 3.4d WCDMA: TM1, M_5, 1559 – 1610 MHz, Port C:

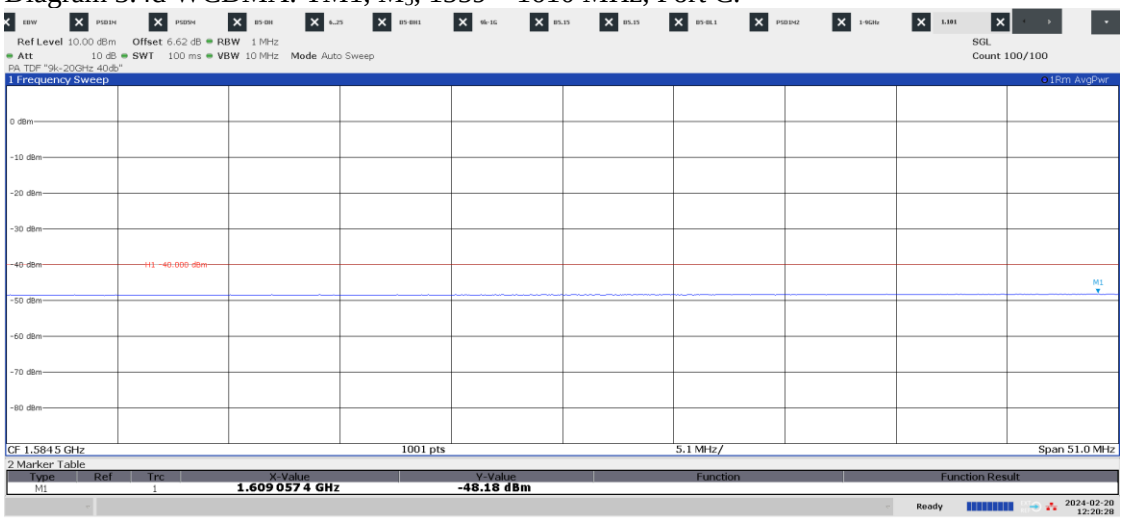

Diagram 3.5a WCDMA: TM1, M_5, 9 kHz – 1 GHz, Port D:

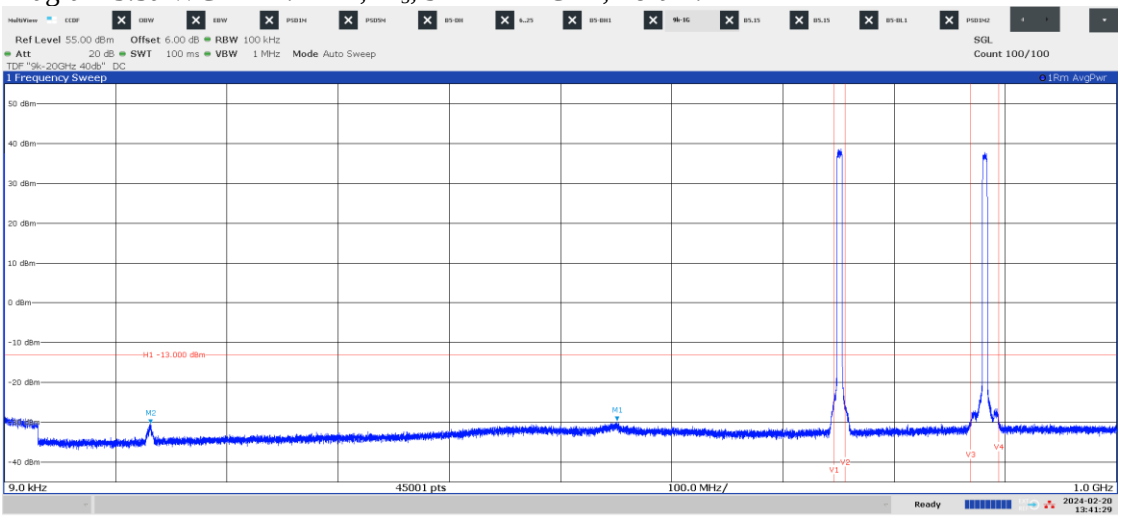

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Diagram 3.5b WCDMA: TM1, M_5, 763 – 805 MHz, Port D:

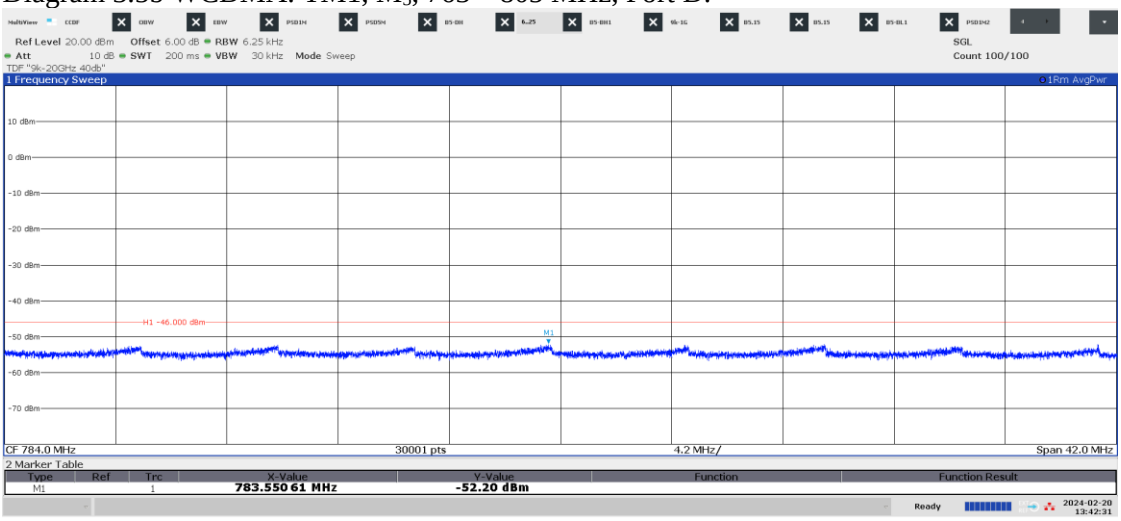

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Diagram 3.5c WCDMA: TM1, M_5, 1 – 9 GHz, Port D:

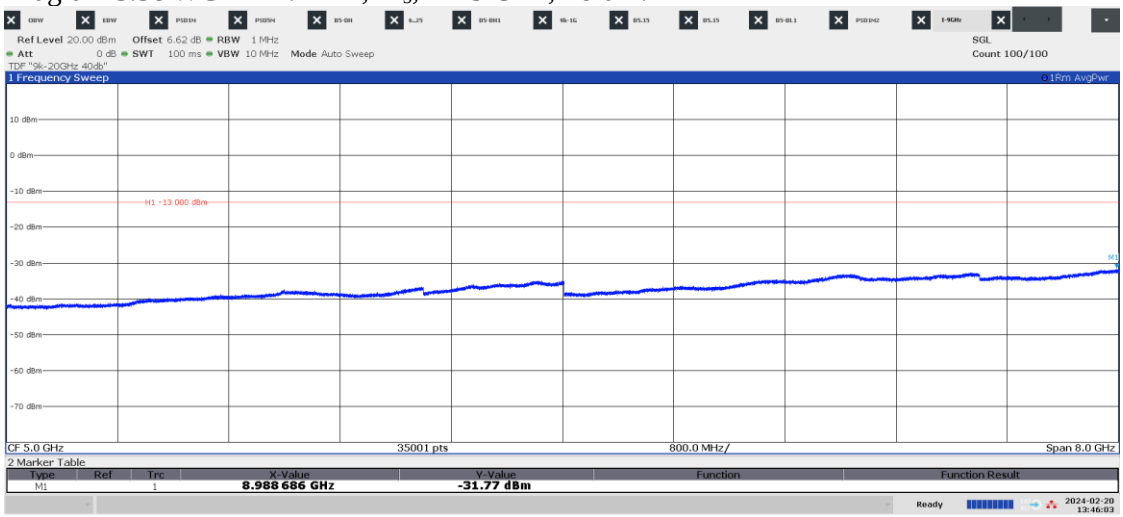

Diagram 3.5d WCDMA: TM1, M_5, 1559 – 1610 MHz, Port D:

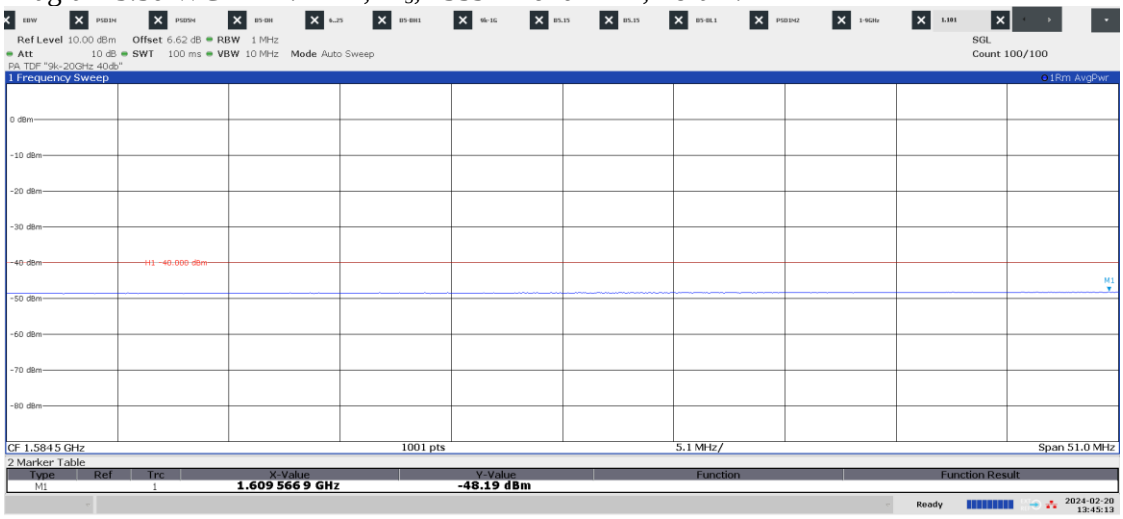

Diagram 3.6a WCDMA: TM1, T_5, 9 kHz – 1 GHz, Port A:

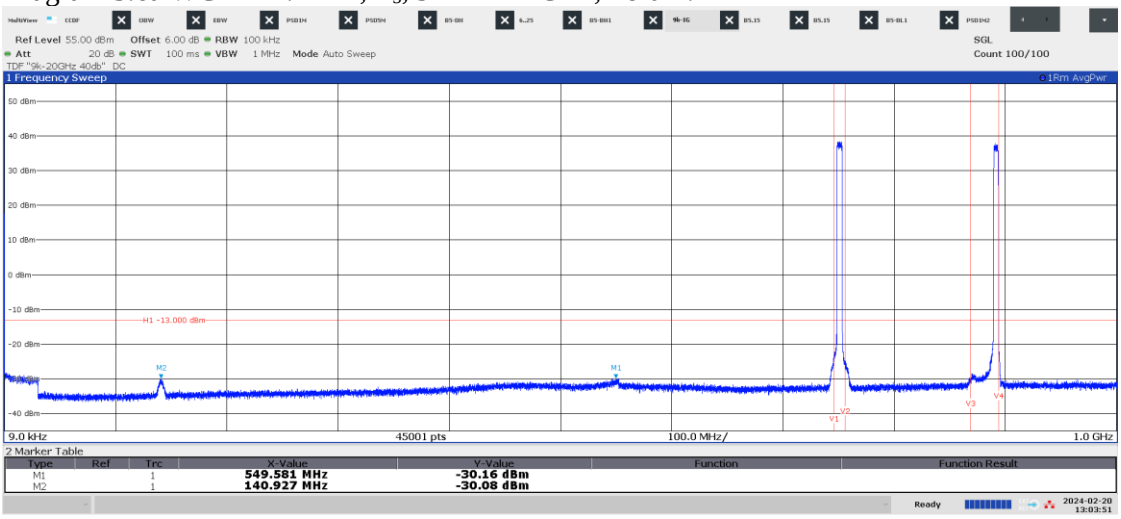

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Diagram 3.6b WCDMA: TM1, T_5, 763 – 805 MHz, Port A:

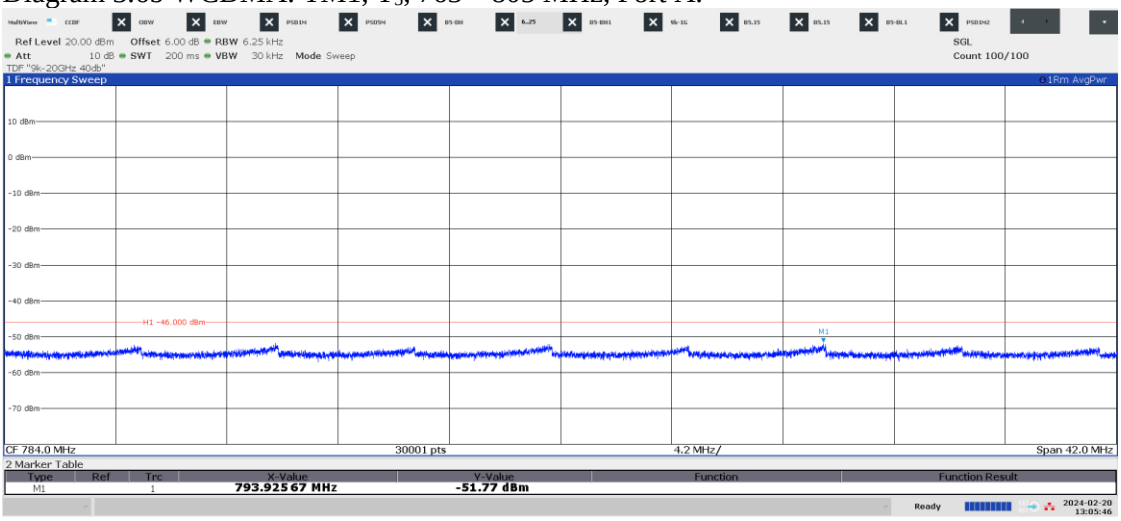

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Diagram 3.6c WCDMA: TM1, T_5, 1 – 9 GHz, Port A:

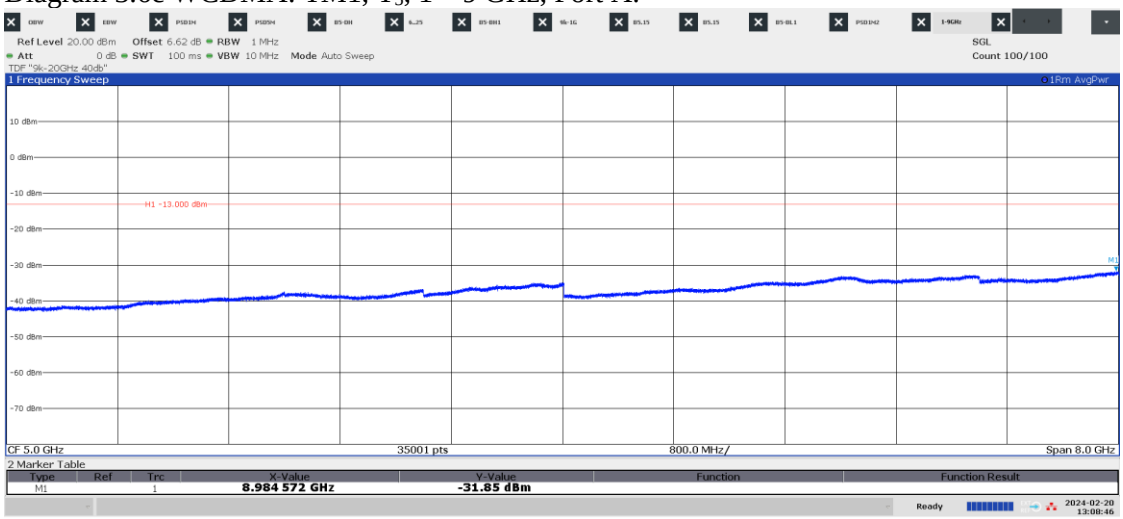

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Diagram 3.6d WCDMA: TM1,T_5, 1559 – 1610 MHz, Port A:

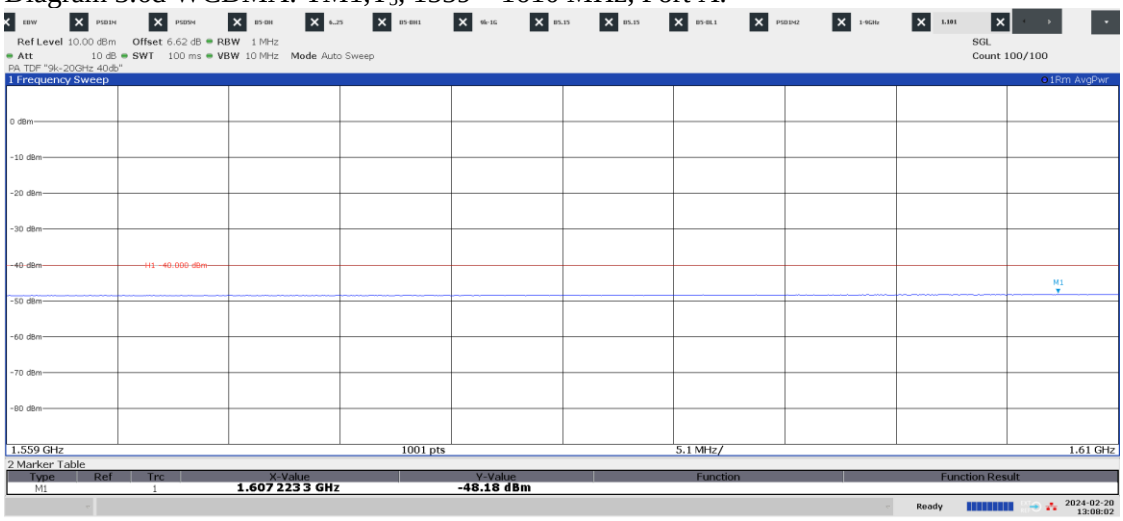

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Diagram 3.7a WCDMA: TM1, Bim, 9 kHz – 1 GHz, Port B:

08:51:24 AM 02/27/2024

Diagram 3.7b WCDMA: TM1, Bim, 763 – 805 MHz, Port B:

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Diagram 3.7c WCDMA: TM1, Bim, 1 – 9 GHz, Port B:

08:59:12 AM 02/27/2024

Diagram 3.7d WCDMA: TM1,Bim, 1559 – 1610 MHz, Port B:

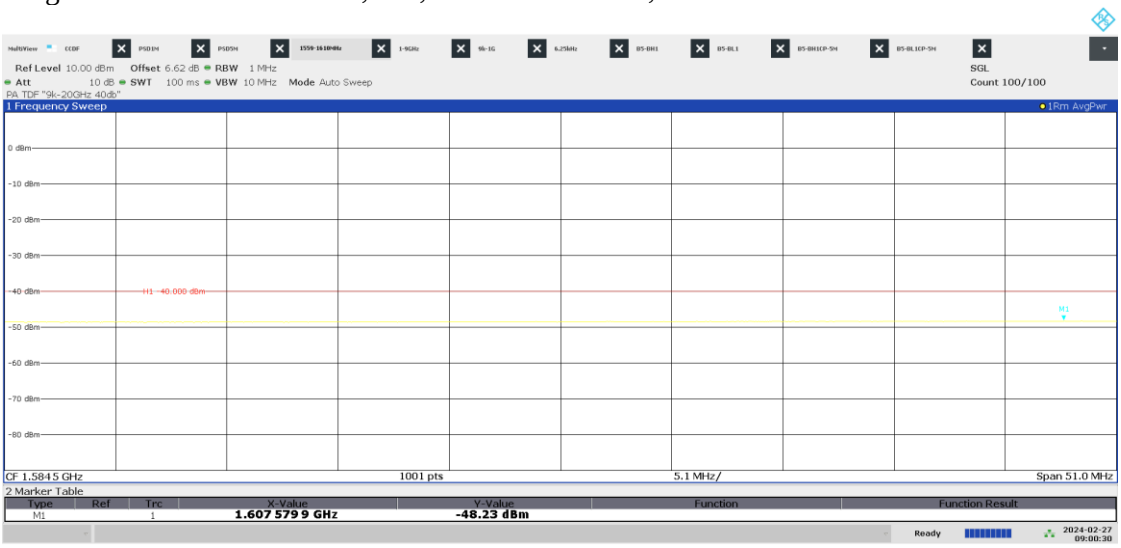

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Diagram 3.8a WCDMA: TM1, Tim, 9 kHz – 1 GHz, Port B:

Diagram 3.8b WCDMA: TM1, Tim, 763 – 805 MHz, Port B:

Diagram 3.8c WCDMA: TM1, Tim, 1 – 9 GHz, Port B:

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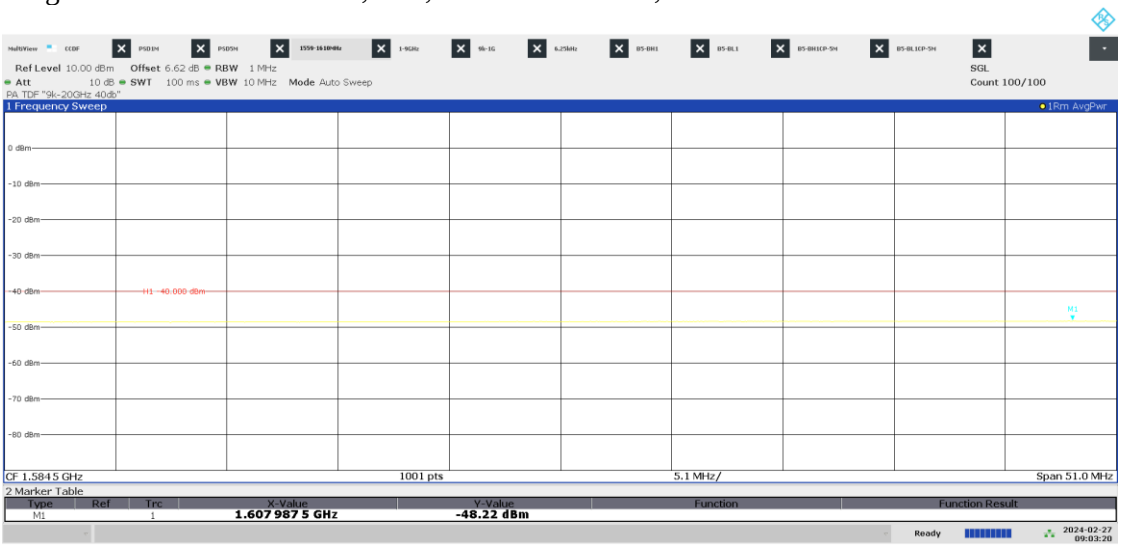
Diagram 3.8d WCDMA: TM1, Tim, 1559 – 1610 MHz, Port B:



09:03:20 AM 02/27/2024

Diagram 3.9a WCDMA: TM1, M4, 9 kHz – 1 GHz, Port B:

Diagram 3.9b WCDMA: TM1, M4, 763 – 805 MHz, Port B:

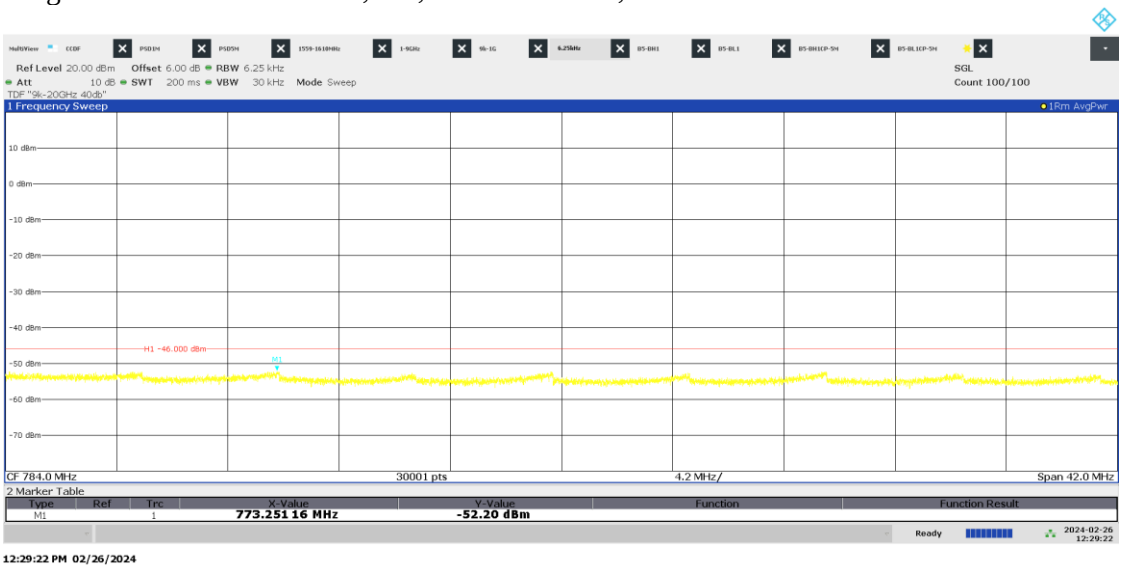


Diagram 3.9c WCDMA: TM1, M4, 1 – 9 GHz, Port B:

Diagram 3.9d WCDMA: TM1, M4, 1559 – 1610 MHz, Port B:

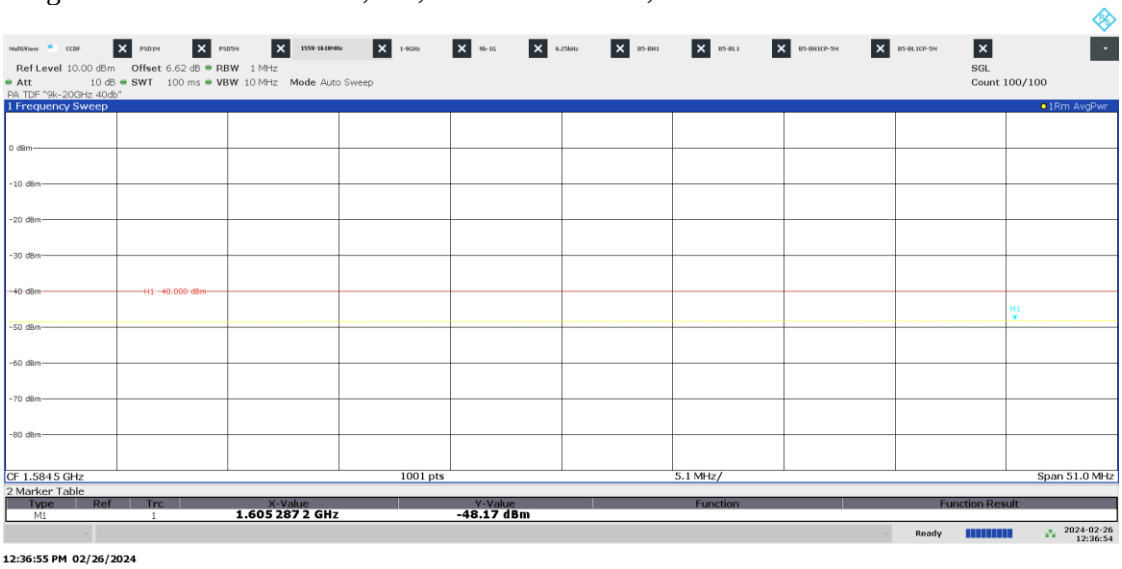


Diagram 3.10a WCDMA: TM1, NR: FR1-TM1.1 and LTE: E-TM1.1 W+N+L, 9 kHz – 1 GHz, Port B:

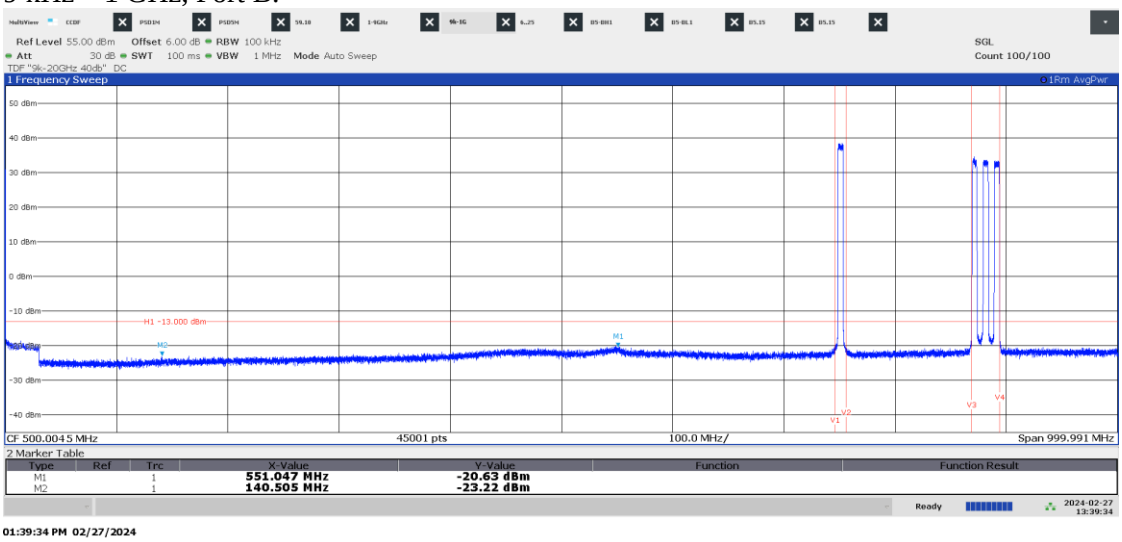


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Diagram 3.10b WCDMA: TM1, NR: FR1-TM1.1 and LTE: E-TM1.1 W+N+L, 763 – 805 MHz, Port B:

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Diagram 3.10c WCDMA: TM1, NR: FR1-TM1.1 and LTE: E-TM1.1 W+N+L, 1 – 9 GHz, Port B:

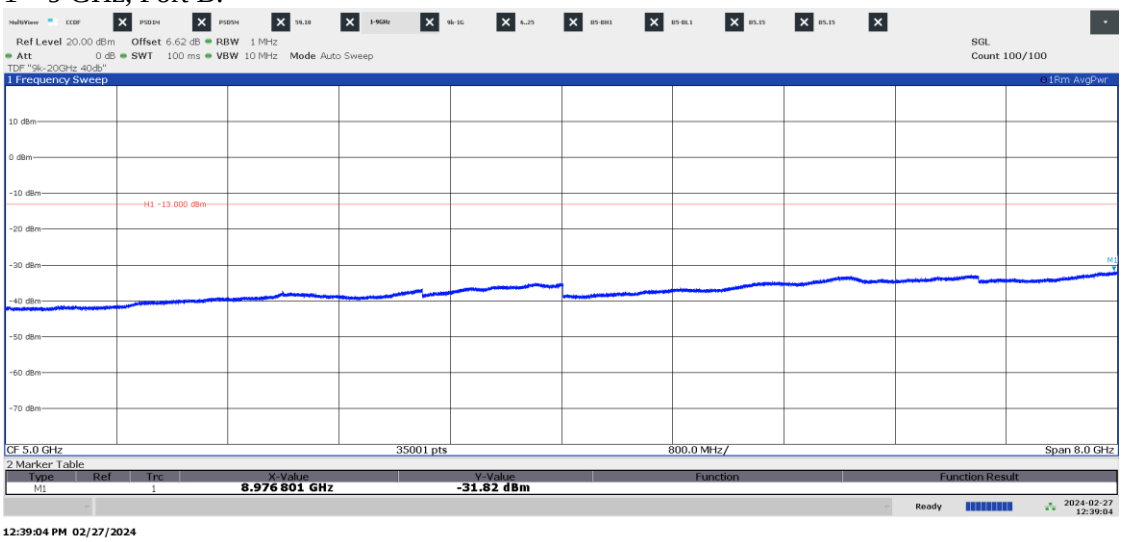


Diagram 3.10d WCDMA: TM1, NR: FR1-TM1.1 and LTE: E-TM1.1 W+N+L, 1559 – 1610 MHz, Port B:

Field strength of spurious radiation measurements according to CFR 47 §27.53 and 22.917/ RSS-130 4.7 and RSS132 5.5

Date	Temperature	Humidity
2024-03-11	21 °C ± 3 °C	19 % ± 5 %
2024-03-12	22 °C ± 3 °C	22 % ± 5 %

The test site conforms to the site validation criterion specified in ANSI C63.4.

The measurements were performed with both horizontal and vertical polarization of the antenna.

The antenna distance was 3 m in the frequency range 30 MHz – 9 GHz.

The EUT was placed 0.8 m above reference ground plane in frequency range 30 MHz – 1 GHz and 1.5 m above reference ground plane in frequency range 1 GHz – 9 GHz.

The measurement was performed with an RBW of 1 MHz.

A propagation loss in free space was calculated. The used formula was $\gamma = 20\log\left(\frac{4\pi D}{\lambda}\right)$, γ is the propagation loss and D is the antenna distance.

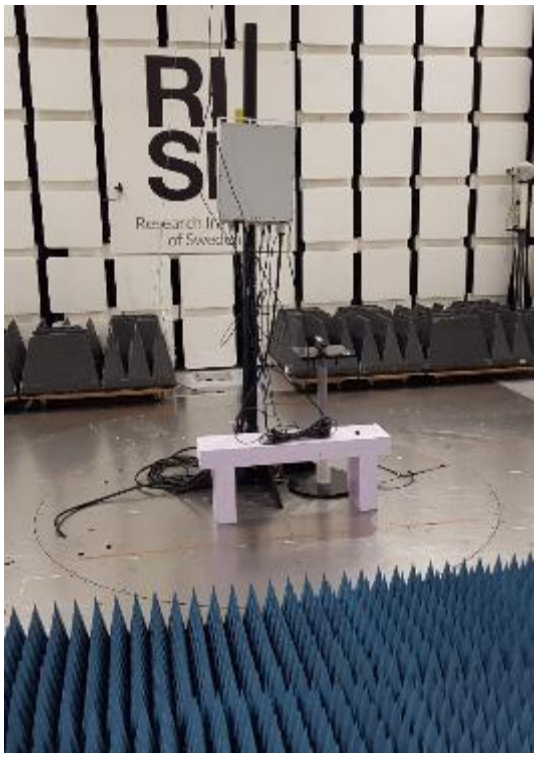
The measurement procedure was as the following:

1. A pre-measurement is performed with peak detector. For measurement < 1 GHz the test object was measured in eight directions with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m. For measurements > 1 GHz the test object was measured in seventeen directions with the antenna height 1.5 m, 2.0 m and 2.5 m with elevation angle.
2. Spurious radiation on frequencies closer than 20 dB to the limit in the pre-measurement is scanned 0-360 degrees and the antenna is scanned 1- 4 m for maximum response. The emission is then measured with the RMS detector and the RMS value is reported. Frequencies closer than 10 dB to the limit when measured with the RMS detector were measured with the substitution method according to ANSI 63.26.

The test set-up during the spurious radiation measurements is shown in the pictures below:

Test setup 30-1000 MHz:

Test setup 1-9 GHz:



Measurement equipment

Item	Name	Inv.no
Semi Anechoic Chamber	Tesla	503881
	NSA	BX90699
	SVSWR	BX90702
Spectrum Analyzer	Rohde & Schwarz ESU40	901385
Software	Rohde & Schwarz Electra	-
RF cable	Huber & Suhner Eacon 4C	BX91490
RF Cable	Rosenberger UFB311A	503508
RF Cable	Rosenberger UFB311A	503509
Antenna, Bilog	Teseq CBL6143A	BX92331
Preamplifier	MicroComp Nordic MCN-JS42-00101800-28-10P	901545
HP filter	Wainwright WHKX1.0/18G-10SS	901373
Antenna, Horn	Emco 3115	502175
Thermohygrometer	Testo 625	504188

Tested frequencies

Symbolic name: B5
B
M
T
Bim
Tim
W+N+L

Results

Representing worst case:
WCDMA:
Symbolic name: Bim, Diagram 4.1a-b

Multi RAT:
Symbolic name: W+N+L, Diagram 4.2a-b

Frequency (MHz)	Spurious emission level (dBm)	
	Vertical	Horizontal
30-9000	All emission > 20 dB below limit	All emission > 20 dB below limit

Measurement uncertainty: 3.1 dB

Limits

CFR 47 § 22.917 (a)
Out of band emissions. 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.

CFR 47 § 22.917 (b)
Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

- In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). 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.
- In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.

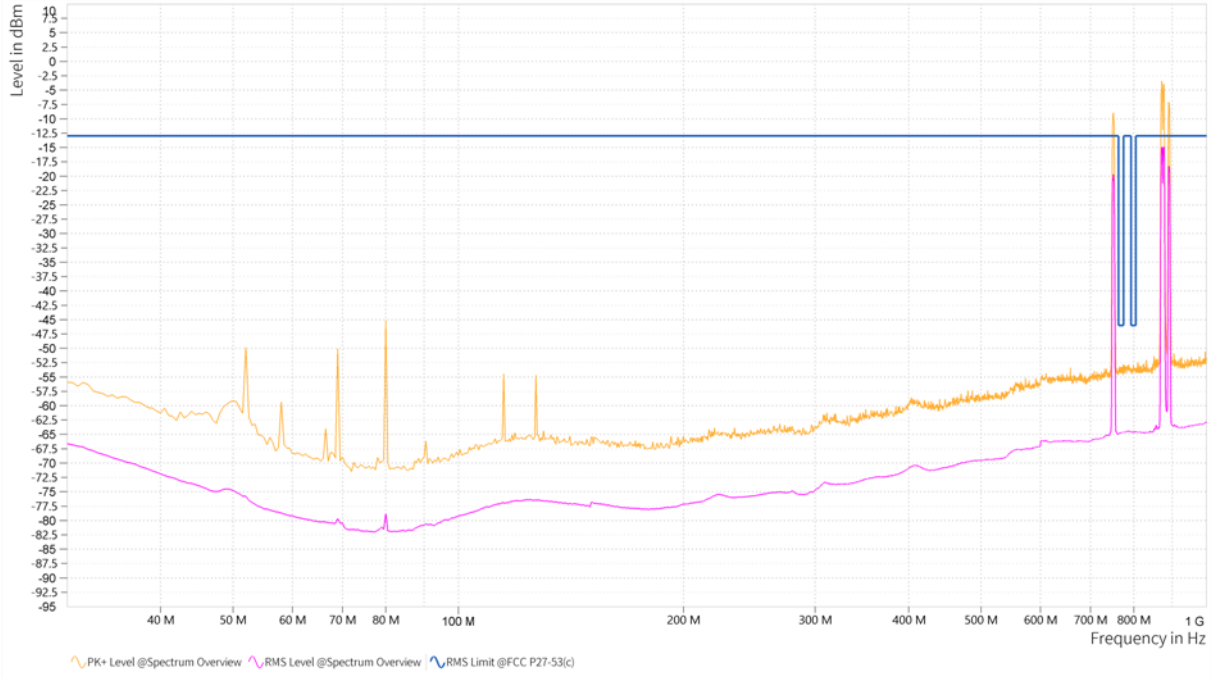
RSS-132 5.5

v. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated below the transmitter output power P (dBW) by at least 43 + 10 log(p) dB.

vi. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated below the transmitter output power P (dBW) by at least 43 + 10 log(p) dB. If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

Complies?	Yes

Diagram 4.1a: WCDMA: Bim, 30 - 1000 MHz



Note: The emissions in frequency range 746-756 MHz and 869-894 MHz are the carrier frequencies and shall be ignored in the context.

Diagram 4.1b: WCDMA Bim, 1 - 9 GHz

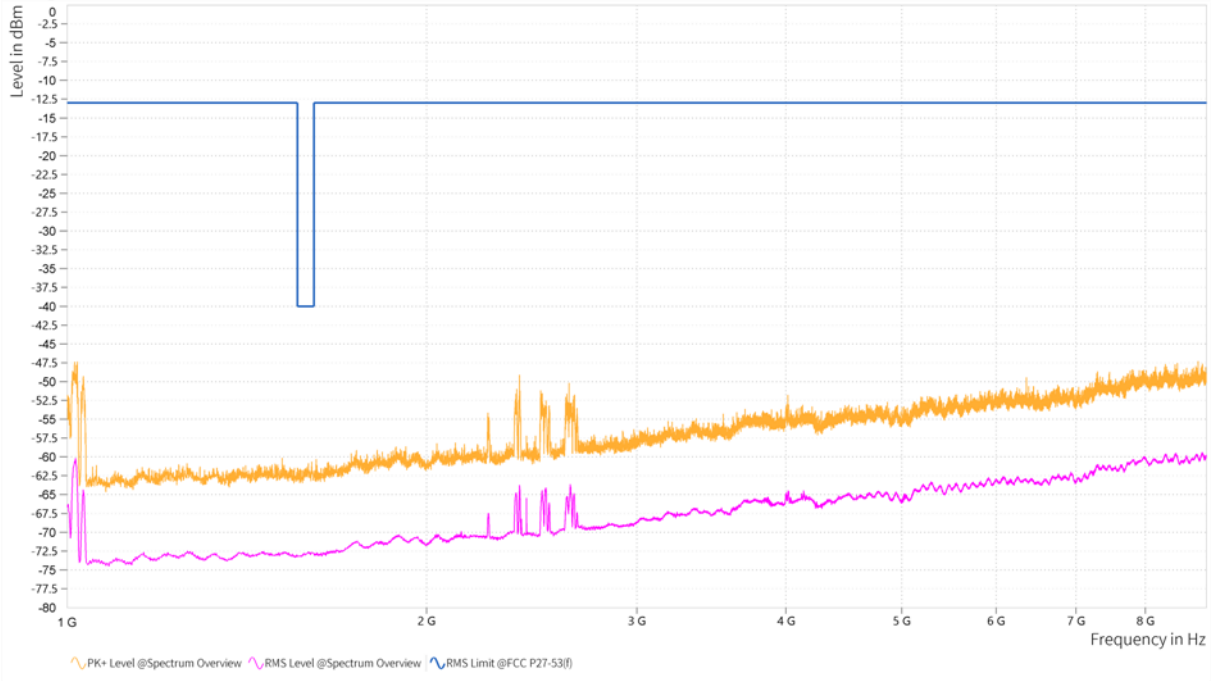
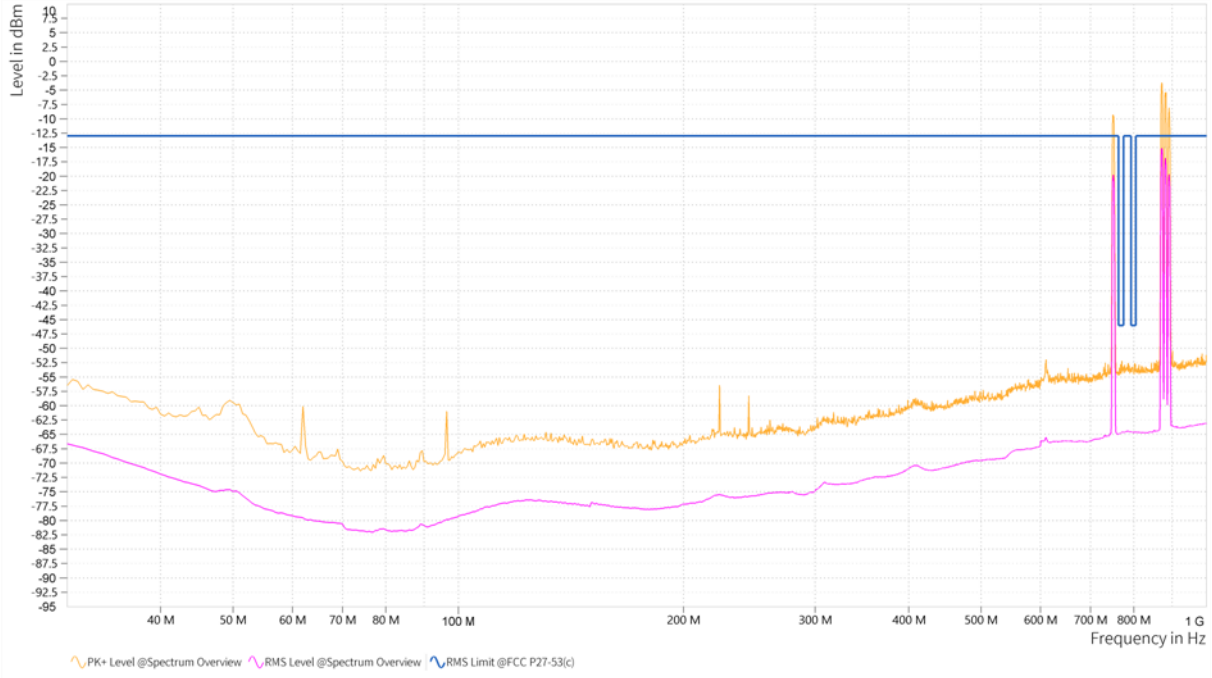
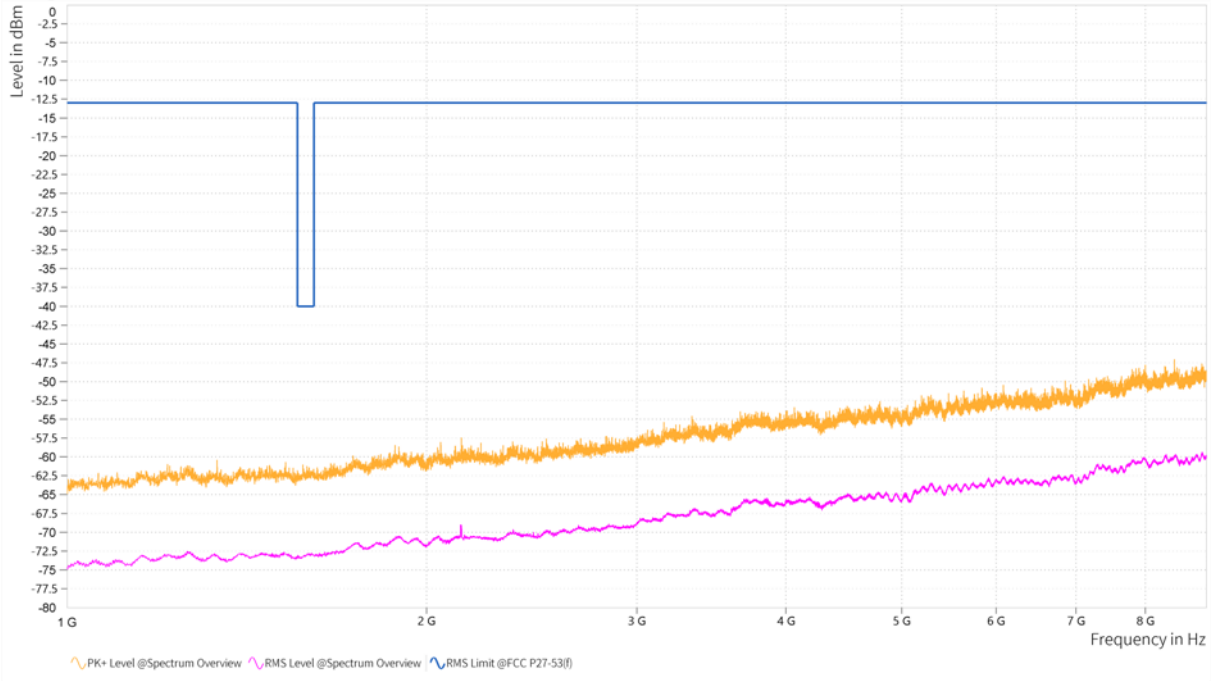


Diagram 4.2a: Multi W+N+L, 30 - 1000 MHz



Note: The emissions in frequency range 746-756 MHz and 869-894 MHz are the carrier frequencies and shall be ignored in the context.

Diagram 4.2b: Multi W+N+L, 1 - 9 GHz



Frequency stability measurements according to CFR 47 § 2.1055, §22.335/ RSS-Gen+RSS-132 5.3

Date	Temperature (test equipment)	Humidity (test equipment)
2024-02-27	23 °C ± 3 °C	21 % ± 5 %
2024-02-28	23 °C ± 3 °C	20 % ± 5 %
2024-02-29	25 °C ± 3 °C	17 % ± 5 %

Test set-up and procedure

The option *WCDMA downlink* measurements *K72* in the spectrum analyser was used to demodulate the signal and report the frequency error result. The spectrum analyser was connected to an external 10 MHz reference standard during the measurements.

Measurement equipment	RISE number
R&S FSQ40	504 143
RF attenuator	902 282
Coaxial cable Sucoflex 102EA	BX 50236
Coaxial cable Sucoflex 102EA	BX 50237
Temperature Chamber	503 360
Testo 635, temperature and humidity meter	504 203
Multimeter Fluke 87	502 190

Results WCDMA B5

Nominal transmitter frequency was 871.4 MHz (B) with a bandwidth of 5 MHz. Rated output power level at connector RF B (maximum): 46.0 dBm.

Test conditions		Frequency error (Hz)
Supply voltage DC (V)	Temp. (°C)	
40.8	+20	-3
55.2	+20	-6
48	+20	5
48	+30	2
48	+40	-5
48	+50	5
48	+10	3
48	0	6
48	-10	6
48	-20	-5
48	-30	3
Maximum freq. error (Hz)		6
Measurement uncertainty		$< \pm 1 \times 10^{-7}$

The frequency error results clearly shows that the frequency stability is good enough to ensure that the transmitted carrier stays within the operating band.

Remark

It was deemed sufficient to test one combination of TX frequency, channel bandwidth configuration and test model (modulation), as all combinations share a common internal reference to derive the TX frequency from.

Limits

§22.335
Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C–1 of this section.
1.5 ppm (±1.307 kHz @871.4 MHz)

RSS-132 5.3
The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within each of the sub-bands when tested at the temperature and supply voltage variations specified in RSS-Gen.

Complies?	Yes

Photos of test object

Front side

Rear side

Left side

Right side

Bottom side

Top side

Test object label:

End of report.