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Wireless Test Report- 398691-1TRFWL

398691-1TRFWL

Date of issue: September 2, 2020

Applicant:

Blinq Wireless, Inc

Product:

Base station

Model:

FW-300i

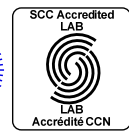
FCC ID:

ROR00000005

Specifications:

◆ **FCC 47 CFR Part 96**

Citizens Broadband Radio Service



Test location

Company name	Nemko Canada Inc.			
Facilities	Ottawa site:	Montréal site:	Cambridge site:	Almonte site:
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	Fax: +1 613 737 9691	Fax: +1 514 694 3528		Fax: +1 613 256-8848
Test site registration	Organization	Recognition numbers and location		
	FCC/ISED	CA2040 (Ottawa/Almonte); CA2041 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

Tested by	Fahar Abdul Sukkoor
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Date	September 9, 2020
Signature of reviewer	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Blinq Wireless, Inc.
Address	140 Renfrew Drive Suite 205
City	Markham
Province/State	ON
Postal/Zip code	L3R 6B3
Country	Canada

1.2 Test specifications

FCC 47 CFR Part 96	Citizens Broadband Radio Service
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1.3 Test method

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
940660 D01 Part 96 CBRS Eqpt v01	Certification and test procedures for citizens broadband radio service devices authorized under Part 96
662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Exclusions

This report is C2PC for original report under FCC ID:ROR00000005. This report covers 2CC and 3CC carrier channels of unit. Original report includes single carrier channels of unit.

This test report covers only general requirements of Part 96. For SAS and functionality please refer to the WINNF test report.

1.6 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 96 test results

Part	Test description	Verdict
§96.41(e)(3)	Emission and occupied bandwidth	Pass
§96.41(b)	Power limits	Pass
§96.41(e)(1)	3.5 GHz Emissions and Interference Limits	Pass
§96.41(e)(2)	Additional protection levels	Pass
§96.41(g)	The peak-to-average power ratio (PAPR)	Pass
§2.1055	Frequency stability	Not applicable

Notes: Frequency stability test is covered in original report under FCC ID:ROR00000005

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	August 17, 2020
Nemko sample ID number	1
Software details	BLiNQ_FW600_2.0.11_1

3.2 EUT information

Product name	Base station
Model	FW-300i
Serial number	A180405004
Revision number	N/A

3.3 Technical information

Operating band	3550–3700 MHz
Operating frequencies	3555–3695 (20MHz), 3555-3695 (40 MHz), 3555 – 3690 (30 MHz), 3555 – 3695 (60 MHz)
Modulation type	OFDM using QPSK and 64 QAM modulations
Channel bandwidth	20 MHz, 30 MHz, 40 MHz, 60 MHz
Occupied bandwidth (99 %)MHz	18.90 (20MHz) ,28.69 (30 MHz) , 37.66 (40 MHz), 57.49 (60 MHz)
Emission designator	W7D
Power requirements	48 V _{DC} via 120Vac power adaptor
MIMO type	2 × 2 with completely uncorrelated type of signal
Antenna information	BLiNQ Antenna, Cross-polarized, 17 dBi gain

3.4 Product description and theory of operation

The BLINQ FW-300i system is a tri-sector and tri-carrier Long-Term Evolution (LTE) Evolved Node B (eNB) with the capability to operate in the following bands: 42, 43, 46 and 48 (Citizens Broadband Radio Service (CBRS)). With a distinctive feature set and integration level, the FW-300i brings an ideal solution to an “install anywhere” micro-base transceiver station (micro-BTS) that fully serves private networks, fixed wireless access and mobility use cases.

3.5 EUT exercise details

The EUT was controlled from laptop via Ethernet using Tera term. Link

Power settings:

Carrier Configuration		2CC		3CC	
BW(MHz)		10	20	10	20
Aggregated BW(MHz)		20	40	30	60
FW300 Secor 1	Power set per BW	25 ¹	25 ²	25 ³	24 ⁴

Note1: Edge carrier shall not exceed 23dBm if center frequency is greater than or equal to 3690 MHz

Note2: Edge carrier shall not exceed 20dBm and inner carrier shall not exceed 24dBm if center frequency is 3675 MHz

Note 3: Secondary Carriers shall not exceed 22dBm if middle carrier is less than 3675 MHz. Primary carrier power shall not exceed 24dBm and secondary Carriers shall not exceed 18dBm if Primary carrier frequency is greater than or equal to 3675 MHz

Note 4: Secondary Carriers shall not exceed 22dBm if primary carrier frequency less than 3665 MHz. Primary carrier power shall not exceed 23dBm and secondary Carriers shall not exceed 18dBm if primary carrier is greater than or equal to 3665 MHz

3.6 EUT setup diagram

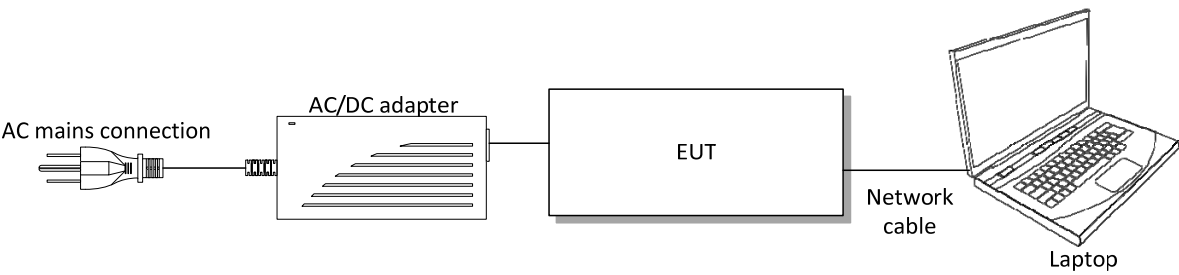


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

Table 3.7-1: EUT support equipment

Description	Brand name	Model/Part number	Serial number
Power adaptor	Mean Well	HLG-240H-48	HB81K11319
laptop	Dell Latitude	E6440	FA002914

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

All modulation modes are scanned and found QPSK mode to be worst case scenario in power, bandwidth and band edges. QPSK modulation is used for measurements in report.

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	Oct 10/20
Flush mount turntable	SUNAR	FM2022	FA003006	—	NCR
Controller	SUNAR	SC110V	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	FA003007	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	FA002969	1 year	Dec 04/20
Spectrum analyzer	Rohde & Schwarz	FSW43	FA002971	1 year	Dec 21/20
Power sensor	Rohde & Schwarz	NRP-6A	FA002963	1 year	Dec 20/20
Radiated Emissions cable set	Huber + Suhner Inc	—	FA003047	—	NCR
Radiated Emissions cable set	Huber + Suhner Inc	—	FA003044	—	NCR
Preamp (1–18 GHz)	ETS-Lindgren	124334	FA002956	1 year	Sep 26/20
Bilog antenna (20–2000 MHz)	Sun AR	JB1	FA003010	1 year	Sep 26/20
Horn antenna (1–18 GHz)	ETS-Lindgren	3117	FA002956	1 year	Sep 11/20
Horn antenna (18–40 GHz)	EMCO	3116B	FA002948	1 year	Jan 09/20

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 96.41(b) Output power and PSD

8.1.1 Definitions and limits

Unless otherwise specified in this section, the maximum effective isotropic radiated power (EIRP) and maximum Power Spectral Density (PSD) of any CBSD and End User Device must comply with the limits shown in the following table below

Table 8.1-1: Output power and PSD limits

Device	Maximum EIRP, dBm/10 MHz	Maximum PSD, dBm/MHz
End User Device	23	N/A
Category A CBSD	30	20
Category B CBSD	47	37

8.1.2 Test summary

Test date August 19, 2020

8.1.3 Observations, settings and special notes

Based on the maximum RF power listed in this report, considerations pertaining to the maximum allowed EIRP and antenna type should be considered for each installation. As per manufacturer declaration: EUT doesn't transmit more than one channel bandwidth simultaneously.

The test was performed using RMS detector of the spectrum analyzer with RBW of 1 MHz and VBW of 10 MHz and 10 MHz RBW integrated over channel bandwidth.

Total transmission power measurement results are provided (in dBm units), at the first two tables, and are for the information purposes only. There is no requirement in section §96.41 for total transmission power, and has been included as a request from the applicant. These values are measured across the entire channel BW using the channel power integration method (i.e. dBm/Bandwidth MHz).

Test results are taken with EUT transmitting using QPSK modulation. The measured power spectral density for QPSK modulation is the worst case for available modulations. The transmitter output signals are completely uncorrelated as defined in Attachment 662911 D01, therefore each antenna port EIRP and ERP (total or spectral density) must individually be below the limit

8.1.4 Test data

Table 8.1-2: Maximum total channel transmission power and EIRP result for 2CC sector 1 MIMO operation of CBRS Category B

Frequency, MHz	Bandwidth, MHz	Ch 0/1	Tx power, dBm	Antenna gain, dBi	EIRP, dBm
3565	20(low)	0	26.96	17	43.96
		1	27.53	17	44.53
3630	20(mid)	0	27.65	17	44.65
		1	27.58	17	44.58
3685	20(high)	0	26.09	17	43.09
		1	25.95	17	42.95
3575	40(low)	0	26.55	17	43.55
		1	26.66	17	43.66
3625	40(mid)	0	26.93	17	43.93
		1	27.09	17	44.09
3675	40(high)	0	22.73	17	39.73
		1	24.58	17	41.58

Table 8.1-3: Maximum total channel transmission power and EIRP result for 3CC sector 1 MIMO operation of CBRS Category B

Frequency, MHz	Bandwidth, MHz	Ch 0/1	Tx power, dBm	Antenna gain, dBi	EIRP, dBm
3570	30(low)	0	26.56	17	43.56
		1	27.13	17	44.13
3625	30(mid)	0	27.44	17	44.44
		1	27.29	17	44.29
3675	30(high)	0	24.84	17	41.84
		1	25.22	17	42.22
3585	60(low)	0	25.72	17	42.72
		1	26.05	17	43.05
3625	60(mid)	0	26.82	17	43.82
		1	27.25	17	44.25
3665	60(high)	0	23.34	17	40.34
		1	23.63	17	40.63
3655	60(high)	0	24.97	17	41.97
		1	25.19	17	42.19

8.1.1 Test data continued

Table 8.1-4: EIRP in 10 MHz measurement result for 2CC sector 1 MIMO operation of CBRS Category B

Frequency, MHz	Bandwidth, MHz	Ch 0/1	Output power, dBm/10 MHz	Antenna gain, dBi	EIRP, dBm / 10 MHz	Limit, , dBm / 10 MHz	Margin, dB
3565	20(low)	0	24.59	17	41.59	47	5.41
		1	24.78	17	41.78	47	5.22
3630	20(mid)	0	24.97	17	41.97	47	5.03
		1	24.63	17	41.63	47	5.37
3685	20(high)	0	24.84	17	41.84	47	5.16
		1	24.58	17	41.58	47	5.42
3575	40(low)	0	22.48	17	39.48	47	7.52
		1	22.31	17	39.31	47	7.69
3625	40(mid)	0	22.52	17	39.52	47	7.48
		1	22.21	17	39.21	47	7.79
3675	40(high)	0	19.85	17	36.85	47	10.15
		1	21.52	17	38.52	47	8.48

Table 8.1-5: EIRP in 10 MHz measurement result for 3CC sector 1 MIMO operation of CBRS Category B

Frequency, MHz	Bandwidth, MHz	Ch 0/1	Output power, dBm/10 MHz	Antenna gain, dBi	EIRP, dBm / 10 MHz	Limit, , dBm / 10 MHz	Margin, dB
3570	30(low)	0	26.56	17	43.56	47	3.44
		1	27.13	17	44.13	47	2.87
3625	30(mid)	0	27.44	17	44.44	47	2.56
		1	27.29	17	44.29	47	2.71
3675	30(high)	0	24.84	17	41.84	47	5.16
		1	25.22	17	42.22	47	4.78
3585	60(low)	0	25.72	17	42.72	47	4.28
		1	26.05	17	43.05	47	3.95
3625	60(mid)	0	26.82	17	43.82	47	3.18
		1	27.25	17	44.25	47	2.75
3665	60(high)	0	23.34	17	40.34	47	6.66
		1	23.63	17	40.63	47	6.37
3655	60(high)	0	21.62	17	43.56	47	3.44
		1	20.87	17	44.13	47	2.87

8.1.1 Test data continued

Table 8.1-6: PSD in 1 MHz measurement result for 2CC sector 1 CBSD Category B

Frequency, MHz	Bandwidth, MHz	Ch 0/1	PSD , dBm/MHz	Antenna gain, dBi	PSD with antenna gain dBm/MHz	PSD Limit, dBm/MHz	Margin, dB
3565	20(low)	0	15.62	17	32.62	37	4.38
		1	15.49	17	32.49	37	4.51
3630	20(mid)	0	16.37	17	33.37	37	3.63
		1	15.77	17	32.77	37	4.23
3685	20(high)	0	16.15	17	33.15	37	3.85
		1	16.04	17	33.04	37	3.96
3575	40(low)	0	12.80	17	29.80	37	7.20
		1	12.93	17	29.93	37	7.07
3625	40(mid)	0	13.68	17	30.68	37	6.32
		1	12.33	17	29.33	37	7.67
3675	40(high)	0	9.73	17	26.73	37	10.27
		1	12.45	17	29.45	37	7.55

Table 8.1-7: PSD in 1 MHz measurement result for 3CC sector 1 CBSD Category B

Frequency, MHz	Bandwidth, MHz	Ch 0/1	PSD , dBm/MHz	Antenna gain, dBi	PSD with antenna gain dBm/MHz	PSD Limit, dBm/MHz	Margin, dB
3570	30(low)	0	14.08	17	31.08	37	5.92
		1	15.51	17	32.51	37	4.49
3625	30(mid)	0	15.97	17	32.97	37	4.03
		1	15.37	17	32.37	37	4.63
3675	30(high)	0	13.32	17	30.32	37	6.68
		1	13.33	17	30.33	37	6.67
3585	60(low)	0	12.31	17	29.31	37	7.69
		1	11.36	17	28.36	37	8.64
3625	60(mid)	0	12.90	17	29.90	37	7.1
		1	11.26	17	28.26	37	8.74
3665	60(high)	0	11.04	17	28.04	37	8.96
		1	10.45	17	27.45	37	9.55
3655	60(high)	0	12.87	17	29.87	37	7.13
		1	11.64	17	28.64	37	8.36

8.1.1 Test data continued

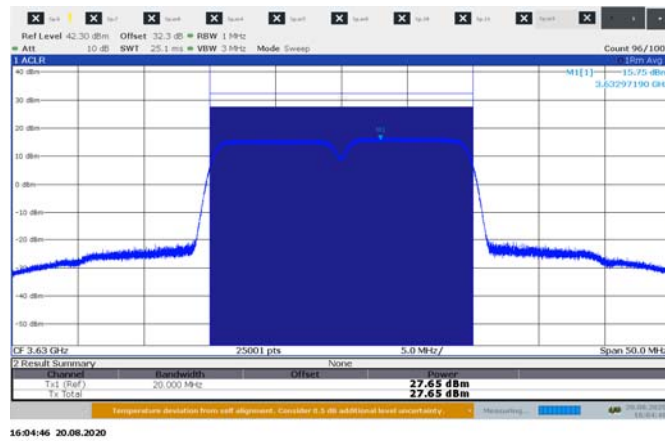


Figure 8.1-1: Total channel transmission power sample plot, 2cc 10 MHz channel

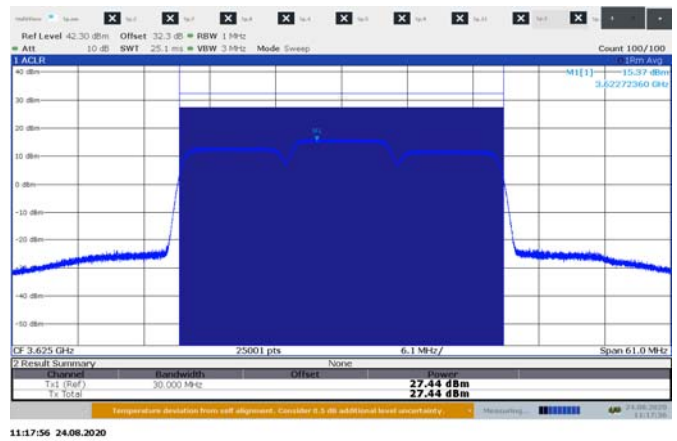


Figure 8.1-2: Total channel transmission power sample plot, 3cc 10 MHz channel

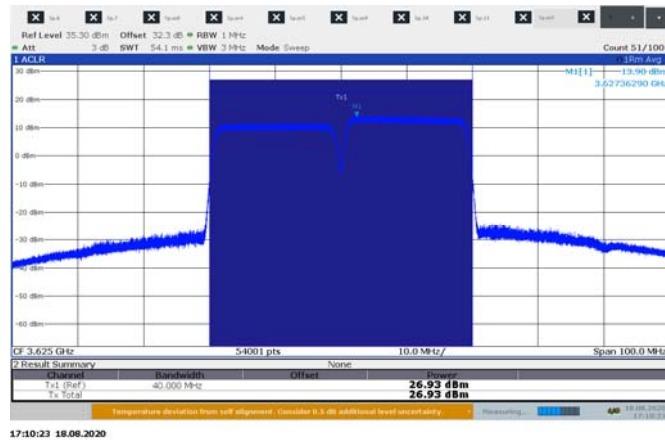


Figure 8.1-3: Total channel transmission power sample plot, 2cc 20 MHz channel

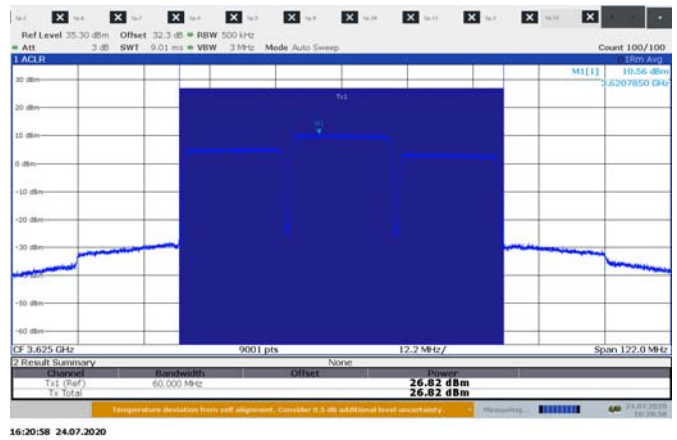


Figure 8.1-4: Total channel transmission power sample plot, 3cc 20 MHz channel

8.1.1 Test data continued

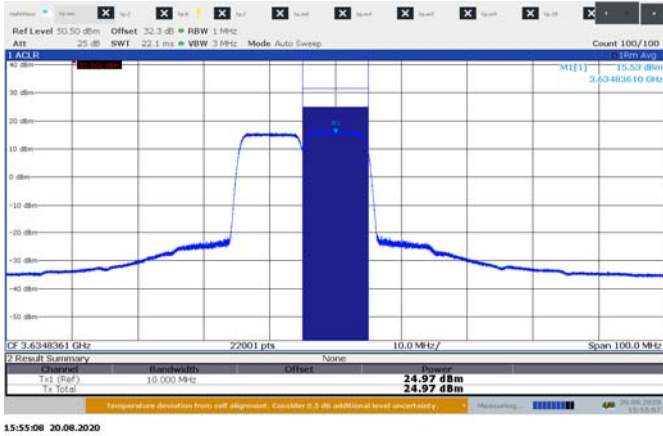


Figure 8.1-5: Ouput power dBm/10 MHz sample plot,2cc 10 MHz channel

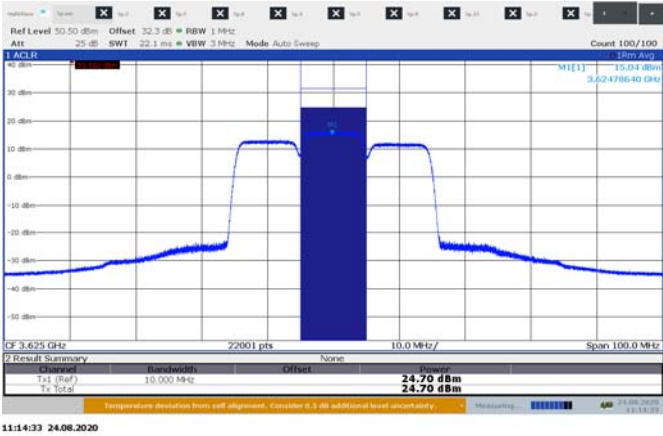


Figure 8.1-6: Ouput power dBm/10 MHz sample plot,3cc 10 MHz channel

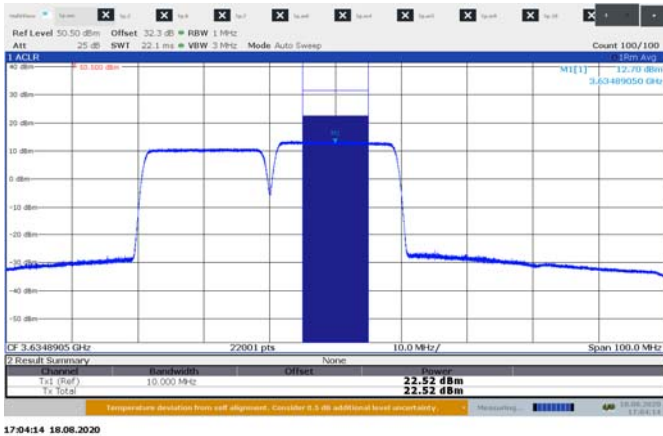


Figure 8.1-7: : Ouput power dBm/10 MHz sample plot,2cc 20 MHz channel

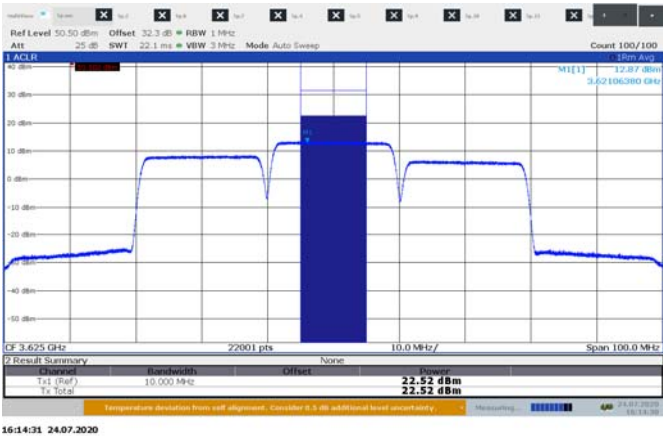


Figure 8.1-8: : Ouput power dBm/10 MHz sample plot, 3cc, 20 MHz channel

8.1.1 Test data continued

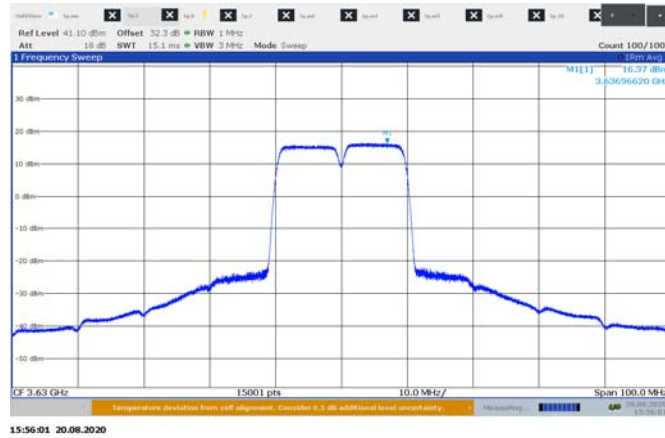


Figure 8.1-9: PSD dBm/ 1 MHz sample plot,2cc 10 MHz channel

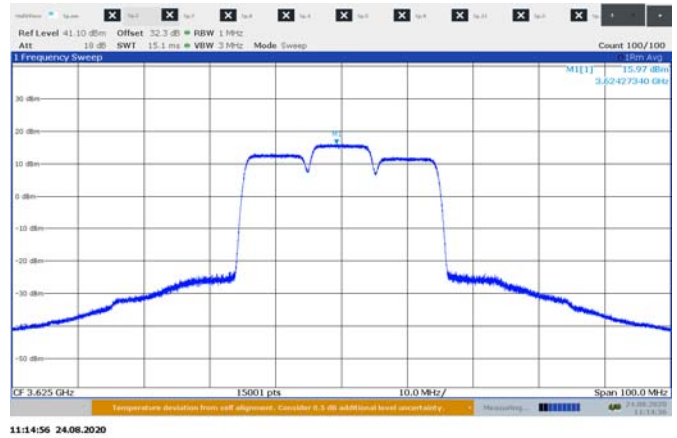


Figure 8.1-10: PSD dBm/1 MHz sample plot,3cc 10 MHz channel

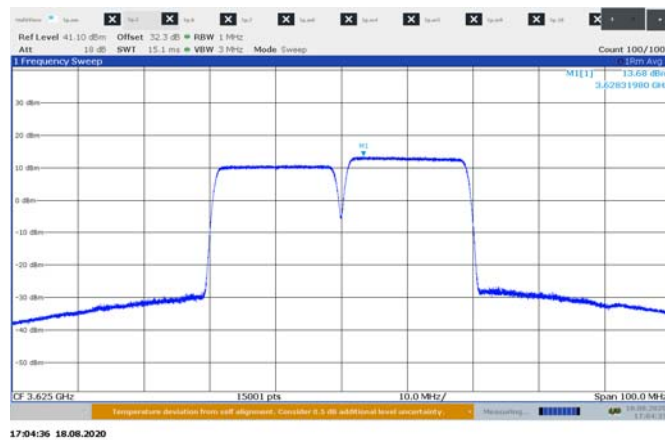


Figure 8.1-11: PSD dBm/1 MHz sample plot,2cc 20 MHz channel

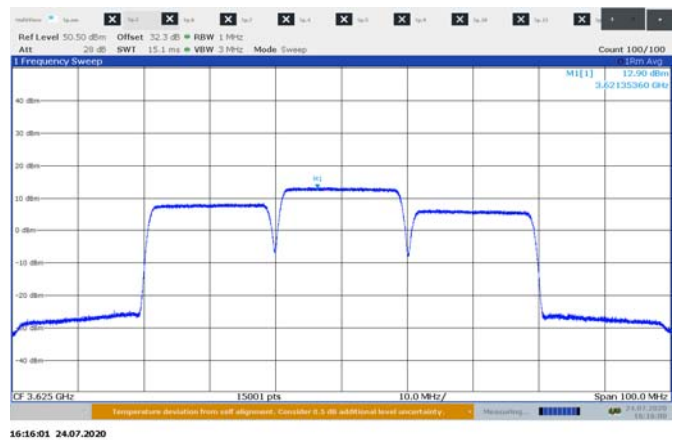


Figure 8.1-12: PSD dBm/1 MHz sample plot, 3cc, 20 MHz channel

8.2 FCC 96.41(g) The peak-to-average power ratio (PAPR)

8.2.1 Definitions and limits

The peak-to-average power ratio (PAPR) of any CBSD transmitter output power must not exceed 13 dB. PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities or another Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

8.2.2 Test summary

Test date August 19, 2020

8.2.3 Observations, settings and special notes

The test was performed using spectrum analyzer signal statistics' Complimentary Cumulative Distribution Function

8.2.4 Test data

Table 8.2-1: PAPR measurement results sector 1

Channel BW, MHz	No. of carriers	Frequency, MHz	Antenna port	CCDF at 0.1%, dB	Limit, dB	Margin, dB
20 (low)	2	3565	0	8.78	13	4.22
	2		1	8.66	13	4.34
20 (mid)	2	3630	0	8.70	13	4.30
	2		1	8.68	13	4.32
20 (high)	2	3685	0	8.72	13	4.28
	2		1	8.72	13	4.28
40(low)	2	3575	0	8.44	13	4.56
	2		1	8.42	13	4.58
40 (mid)	2	3625	0	8.46	13	4.54
	2		1	8.50	13	4.50
40 (high)	2	3675	0	8.52	13	4.48
	2		1	8.26	13	4.74
30 (low)	3	3570	0	8.24	13	4.76
	3		1	8.14	13	4.86
30 (mid)	3	3625	0	8.14	13	4.86
	3		1	8.10	13	4.90
30 (high)	3	3675	0	8.26	13	4.74
	3		1	8.26	13	4.74
60 (low)	3	3585	0	8.56	13	4.44
	3		1	8.56	13	4.44
60 (mid)	3	3625	0	8.36	13	4.64
	3		1	8.40	13	4.60
60 (high)	3	3665	0	8.54	13	4.46
	3		1	8.56	13	4.44
60 (high)	3	3655	0	8.50	13	4.50
	3		1	8.50	13	4.50

8.2.1 Test data continued

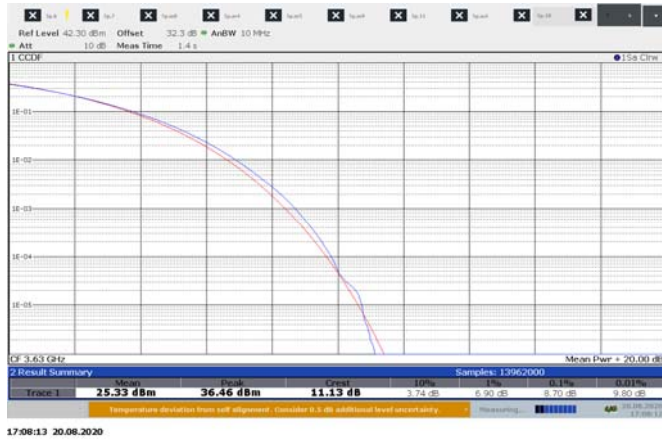


Figure 8.2-1: CCDF sample plot, 2cc 10 MHz channel

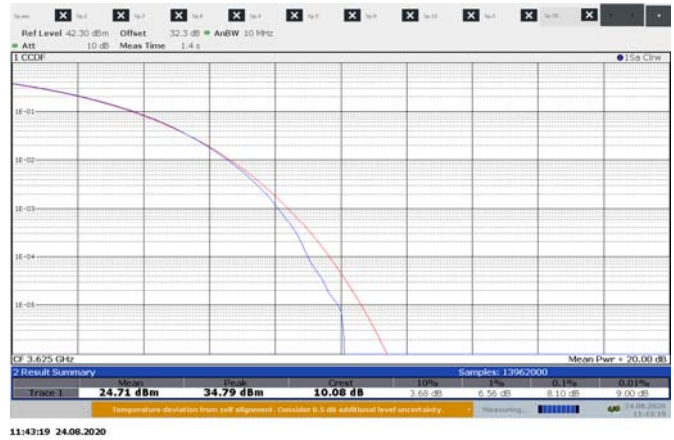


Figure 8.2-2: CCDF sample plot, 3cc 10 MHz channel

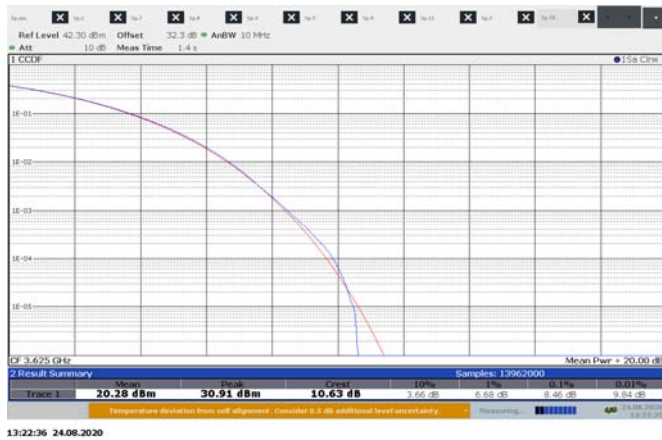


Figure 8.2-3: CCDF sample plot, 2cc 20 MHz channel

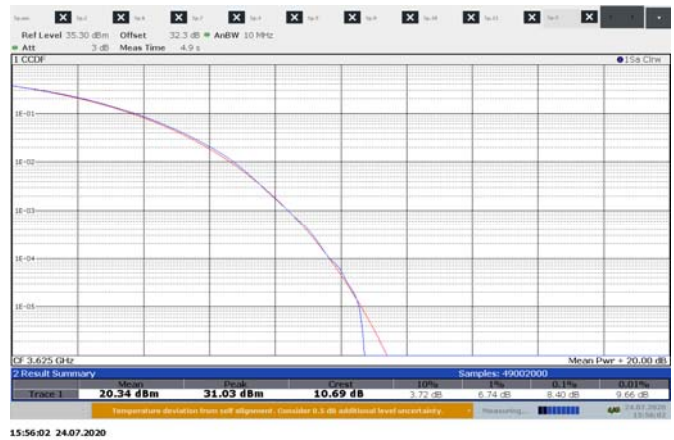


Figure 8.2-4: CCDF sample plot, 3cc 20 MHz channel

8.3 FCC 96.41(e)(3) Emission bandwidth and occupied bandwidth

8.3.1 Definitions and limits

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.

FCC 2.1049 The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

8.3.2 Test summary

Test date August 19, 2020

8.3.3 Observations, settings and special notes

Spectrum analyser settings for OBW measurements:

Resolution bandwidth	1 % of OBW
Video bandwidth	3 x RBW
Detector mode	Peak
Trace mode	Max Hold

8.3.4 Test data

Table 8.3-1: Occupied bandwidth measurement results for sector 1

Bandwidth, MHz	No of carriers	Frequency, MHz	Antenna, Port	99% OBW, MHz	26 dB BW, MHz
20 (low)	2	3565	0	18.90	20.02
	2		1	18.89	20.05
20 (mid)	2	3630	0	18.88	20.08
	2		1	18.89	20.02
20 (high)	2	3685	0	18.80	19.98
	2		1	18.81	19.98
40 (low)	2	3575	0	37.66	39.90
	2		1	37.61	40.00
40 (mid)	2	3625	0	37.59	39.63
	2		1	37.63	40.51
40 (high)	2	3675	0	37.21	39.87
	2		1	37.18	39.93
30 (low)	3	3570	0	28.69	30.02
	3		1	28.59	29.92
30 (mid)	3	3625	0	28.58	29.95
	3		1	28.60	29.89
30 (high)	3	3675	0	28.50	29.85
	3		1	28.63	29.90
60 (low)	3	3585	0	56.71	60.03
	3		1	57.31	60.45
60 (mid)	3	3625	0	56.84	60.03
	3		1	57.49	60.57
60 (high)	3	3665	0	54.29	59.31
	3		1	56.36	60.15
60 (high)	3	3655	0	54.96	59.91
	3		1	56.58	60.15

8.3.5 Test data continued

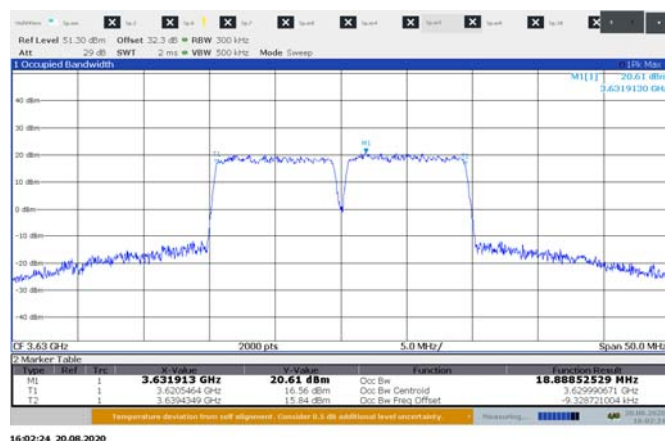


Figure 8.3-1: Occupied bandwidth sample plot for 2CC 10 MHz channel

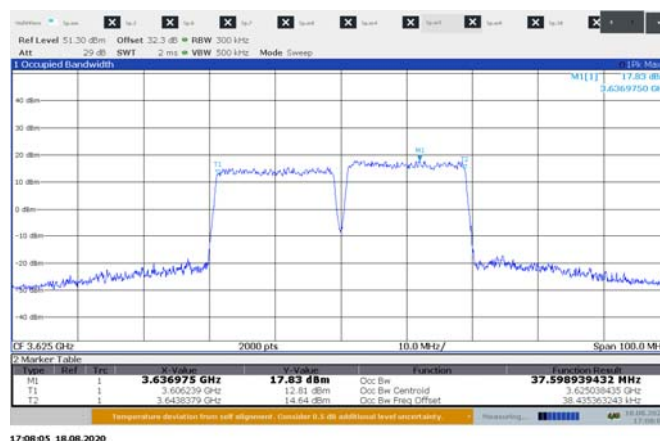


Figure 8.3-2: Occupied bandwidth sample plot for 2CC 20 MHz channel



Figure 8.3-3: Occupied bandwidth sample plot for 3CC 10 MHz channel



Figure 8.3-4: Occupied bandwidth sample plot for 3CC 20 MHz channel

8.3.6 Test data continued

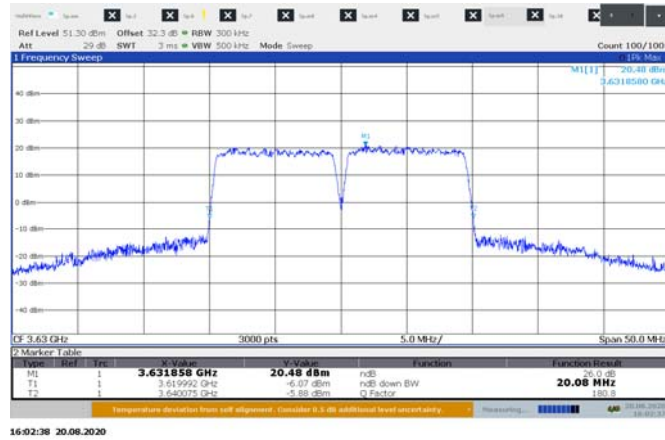


Figure 8.3-5: 26 dB bandwidth sample plot for 2 CC 10 MHz channel

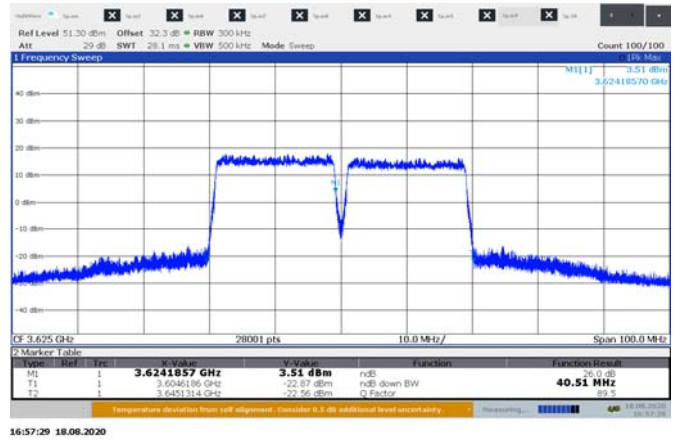


Figure 8.3-6: 26 dB bandwidth sample plot for 2CC 20 MHz channel

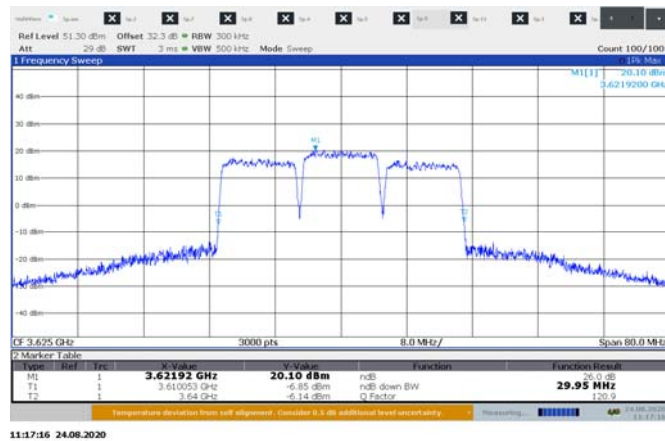


Figure 8.3-7: 26 dB bandwidth sample plot for 3 CC 10 MHz channel

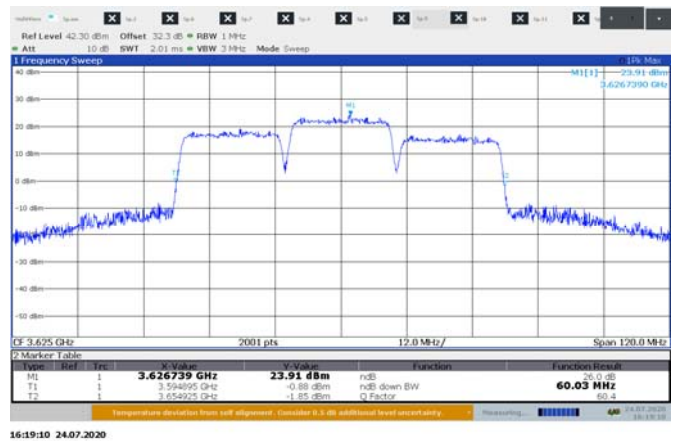


Figure 8.3-8: 26 dB bandwidth sample plot for 3 CC 20 MHz channel

8.4 FCC 96.41(e)(1) 3.5 GHz emissions and interference limits

8.4.1 Definitions and limits

General protection levels. Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by the SAS to CBSDs, the conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0–10 MHz above the upper SAS-assigned channel edge and within 0–10 MHz below the lower SAS-assigned channel edge. At all frequencies greater than 10 MHz above the upper SAS assigned channel edge and less than 10 MHz below the lower SAS assigned channel edge, the conducted power of any emission shall not exceed -25 dBm/MHz. The upper and lower SAS assigned channel edges are the upper and lower limits of any channel assigned to a CBSD by an SAS, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.

(3) Measurement procedure. (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the licensee's authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (i.e., 1 MHz 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.

8.4.2 Test summary

Test date	August 19, 2020
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8.4.3 Observations, settings and special notes

This test was performed at the antenna ports and radiated with both antennas terminated with 50 Ohm load.
EUT was transmitting from both antenna connectors at the maximum power settings.
Spectrum analyser settings for measurements within 1 MHz from the SAS assigned channel edges:

Resolution bandwidth	1 % of occupied Bandwidth
Video bandwidth	3 × RBW
Detector mode	RMS
Trace mode	Power averaging

Spectrum analyser settings for measurements outside 1 MHz from the SAS assigned channel edges:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	RMS
Trace mode	Power averaging

8.4.4 Test data

Table 8.4-1: Emission mask measurements for sector 1 2CC results

Antenna port	No of carriers	Channel & Bandwidth,MHz	Offset from the SAS assigned channel edges, MHz	Frequency of max emission, MHz	Emission level, dBm	Limit ¹ , dBm	Margin, dB
0	2	20(low)	>10	3545	-28.20	-28	0.20
1	2	20(low)	>10	3545	-29.88	-28	1.88
0	2	20(low)	0-1	3555	-26.34	-16	10.34
1	2	20(low)	0-1	3555	-27.01	-16	11.01
0	2	20(low)	0-1	3575	-24.69	-16	8.69
1	2	20(low)	0-1	3575	-24.90	-16	8.90
0	2	20(low)	>10	3585	-28.60	-28	0.60
1	2	20(low)	>10	3585	-28.12	-28	0.12
0	2	20(mid)	>10	3610	-28.10	-28	0.10
1	2	20(mid)	>10	3610	-28.80	-28	0.80
0	2	20(mid)	0-1	3620	-22.44	-16	6.44
1	2	20(mid)	0-1	3620	-23.75	-16	7.75
0	2	20(mid)	0-1	3640	-22.38	-16	6.38
1	2	20(mid)	0-1	3640	-24.90	-16	8.9
0	2	20(mid)	>10	3650	-28.25	-28	0.25
1	2	20(mid)	>10	3650	-28.53	-28	0.53
0	2	20(high)	>10	3665	-29.09	-28	1.09
1	2	20(high)	>10	3665	-29.69	-28	1.69
0	2	20(high)	0-1	3675	-22.73	-16	6.73
1	2	20(high)	0-1	3675	-24.98	-16	8.98
0	2	20(high)	0-1	3695	-28.38	-16	12.38
1	2	20(high)	0-1	3695	-29.16	-16	13.16
0	2	20(high)	>10	3705	-33.26	-28	5.26
1	2	20(high)	>10	3705	-33.43	-28	5.43
0	2	40(low)	>10	3545	-30.96	-28	2.96
1	2	40(low)	>10	3536	-30.78	-28	2.78
0	2	40(low)	0-1	3555	-26.12	-16	10.12
1	2	40(low)	0-1	3555	-33.34	-16	17.34
0	2	40(low)	0-1	3595	-30.47	-16	14.47
1	2	40(low)	0-1	3595	-27.64	-16	11.64
0	2	40(low)	>10	3605	-28.06	-28	0.06
1	2	40(low)	>10	3605	-28.12	-28	0.12
0	2	40(mid)	>10	3595	-32.29	-28	4.29
1	2	40(mid)	>10	3595	-28.73	-28	0.73
0	2	40(mid)	0-1	3605	-37.84	-16	21.84
1	2	40(mid)	0-1	3605	-35.53	-16	19.53
0	2	40(mid)	0-1	3645	-36.82	-16	20.82
1	2	40(mid)	0-1	3645	-37.02	-16	21.02
0	2	40(mid)	>10	3655	-29.76	-28	1.76
1	2	40(mid)	>10	3655	-29.45	-28	1.45
0	2	40(high)	>10	3650	-33.03	-28	5.03
1	2	40(high)	>10	3650	-33.91	-28	5.91
0	2	40(high)	0-1	3660	-29.39	-16	13.39
1	2	40(high)	0-1	3660	-24.10	-16	8.10
0	2	40(high)	0-1	3700	-41.35	-16	25.35
1	2	40(high)	0-1	3700	-37.09	-16	21.09
0	2	40(high)	>10	3718	-38.26	-28	10.26
1	2	40(high)	>10	3718	-39.13	-28	11.13

Note: ¹Margin of SISO operation. For MIMO 2x2 operation 3 dB is subtracted from the limit in the table above

8.4.5 Test data continued

Table 8.4-2: Emission mask measurements for sector 1 3CC results

Antenna port	No of carriers	Channel & Bandwidth,MHz	Offset from the SAS assigned channel edges, MHz	Frequency of max emission, MHz	Emission level, dBm	Limit ¹ , dBm	Margin, dB
0	3	30(low)	>10	3545	-28.84	-28	0.84
1	3	30(low)	>10	3545	-31.73	-28	3.73
0	3	30(low)	0-1	3555	-27.63	-16	11.63
1	3	30(low)	0-1	3555	-29.58	-16	13.58
0	3	30(low)	0-1	3585	-28.77	-16	12.77
1	3	30(low)	0-1	3585	-25.52	-16	9.52
0	3	30(low)	>10	3595	-29.02	-28	1.02
1	3	30(low)	>10	3595	-27.60	-28	-0.40
0	3	30(mid)	>10	3600	-28.19	-28	0.19
1	3	30(mid)	>10	3600	-28.72	-28	0.72
0	3	30(mid)	0-1	3610	-26.52	-16	10.52
1	3	30(mid)	0-1	3610	-26.89	-16	10.89
0	3	30(mid)	0-1	3640	-27.26	-16	11.26
1	3	30(mid)	0-1	3640	-25.70	-16	9.70
0	3	30(mid)	>10	3650	-28.57	-28	0.57
1	3	30(mid)	>10	3650	-28.28	-28	0.28
0	3	30(high)	>10	3650	-31.13	-28	3.13
1	3	30(high)	>10	3650	-30.78	-28	2.78
0	3	30(high)	0-1	3660	-27.95	-16	11.95
1	3	30(high)	0-1	3660	-28.36	-16	12.36
0	3	30(high)	0-1	3690	-32.26	-16	16.26
1	3	30(high)	0-1	3690	-27.75	-16	11.75
0	3	30(high)	>10	3700	-36.38	-28	8.38
1	3	30(high)	>10	3700	-32.81	-28	4.81
0	3	60(low)	>10	3545	-28.86	-28	0.86
1	3	60(low)	>10	3545	-32.10	-28	4.10
0	3	60(low)	0-1	3555	-32.30	-16	16.3
1	3	60(low)	0-1	3555	-34.61	-16	18.61
0	3	60(low)	0-1	3615	-30.15	-16	14.15
1	3	60(low)	0-1	3615	-27.71	-16	11.71
0	3	60(low)	>10	3625	-28.62	-28	0.62
1	3	60(low)	>10	3625	-27.66	-28	-0.34
0	3	60(mid)	>10	3585	-28.60	-28	0.60
1	3	60(mid)	>10	3585	-28.18	-28	0.18
0	3	60(mid)	0-1	3595	-28.49	-16	12.49
1	3	60(mid)	0-1	3595	-27.64	-16	11.64
0	3	60(mid)	0-1	3655	-30.43	-16	14.43
1	3	60(mid)	0-1	3655	-27.16	-16	11.16
0	3	60(mid)	>10	3665	-28.69	-28	0.69
1	3	60(mid)	>10	3665	-28.50	-28	0.50
0	3	60(high)	>10	3625	-36.02	-28	8.02
1	3	60(high)	>10	3625	-34.92	-28	6.92
0	3	60(high)	0-1	3635	-32.93	-16	16.93
1	3	60(high)	0-1	3635	-34.57	-16	18.57
0	3	60(high)	0-1	3695	-39.63	-16	23.63
1	3	60(high)	0-1	3695	-34.63	-16	18.63
0	3	60(high)	>10	3705	-38.41	-28	10.41
1	3	60(high)	>10	3705	-36.09	-28	8.09
0	3	60(3655)	>10	3615	-32.60	-28	4.60
1	3	60(3655)	>10	3615	-31.07	-28	3.07
0	3	60(3655)	0-1	3625	-32.09	-16	16.09
1	3	60(3655)	0-1	3625	-31.84	-16	15.84
0	3	60(3655)	0-1	3685	-36.74	-16	20.74
1	3	60(3655)	0-1	3685	-34.99	-16	18.99
0	3	60(3655)	>10	3695	-36.66	-28	8.66
1	3	60(3655)	>10	3695	-35.01	-28	7.01

Note: ¹Margin of SISO operation. For MIMO 2x2 operation 3 dB is subtracted from the limit in the table above

8.4.6 Test data continued



Figure 8.4-1: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 2cc low channel

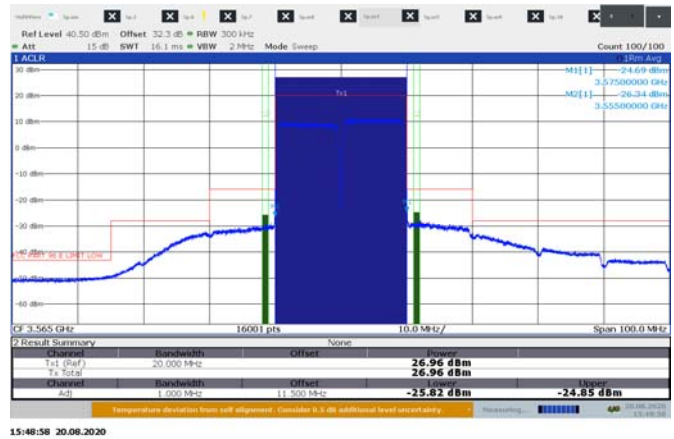


Figure 8.4-2: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 2cc low channel

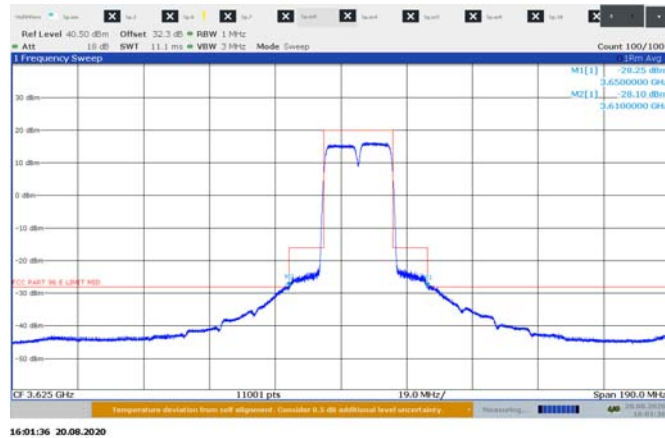


Figure 8.4-3: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 2cc mid channel

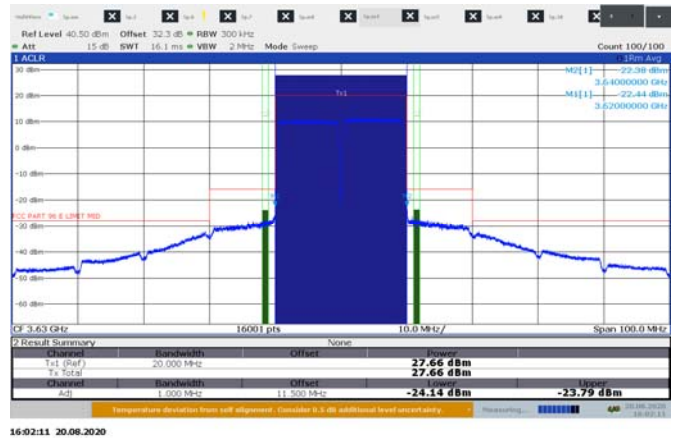


Figure 8.4-4: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 2cc mid channel



Figure 8.4-5: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 2cc high channel

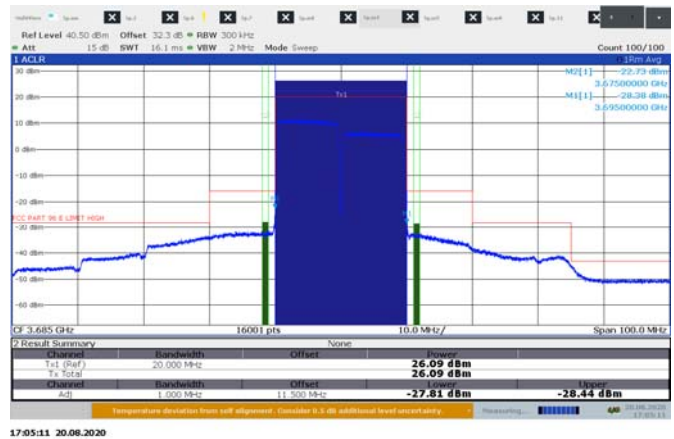


Figure 8.4-6: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 2cc high channel

8.4.7 Test data continued



Figure 8.4-7: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 3cc low channel

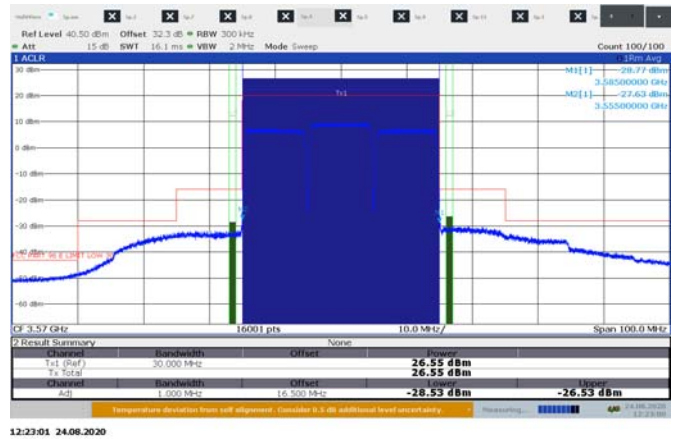


Figure 8.4-8: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 3cc low channel

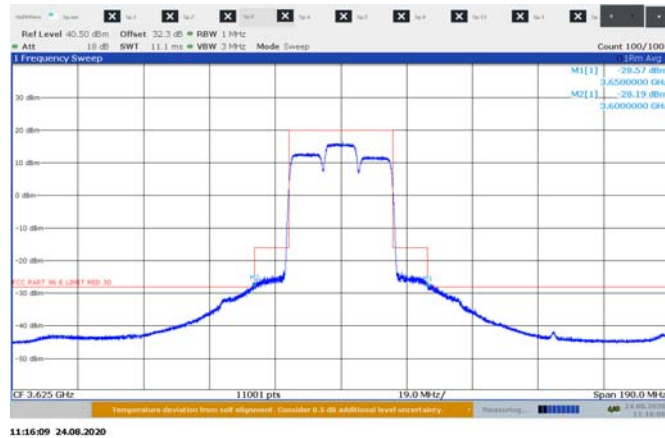


Figure 8.4-9: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 3cc mid channel

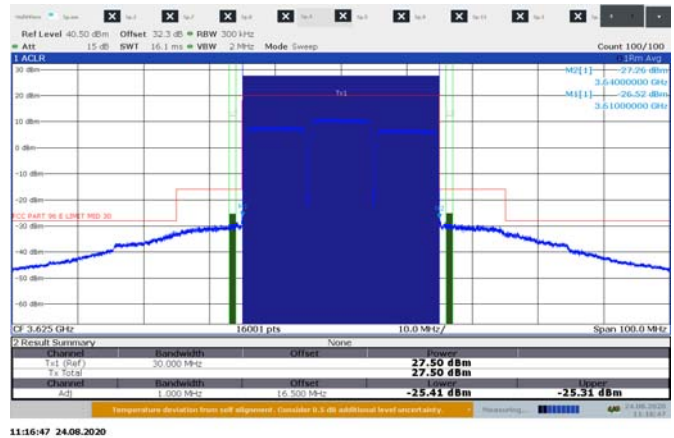


Figure 8.4-10: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 3cc mid channel



Figure 8.4-11: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 3cc high channel

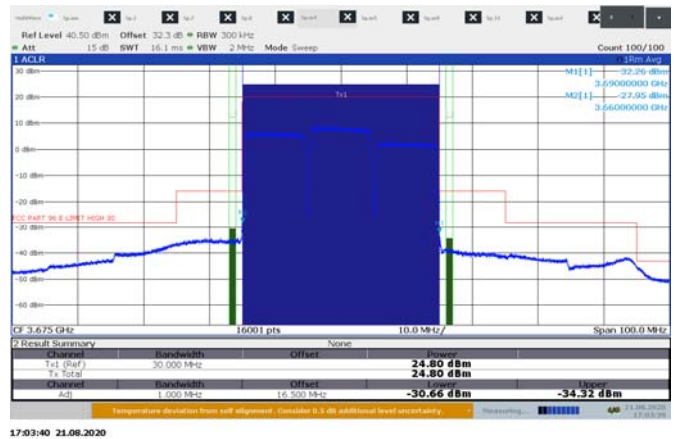


Figure 8.4-12: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 10 MHz 3cc high channel

8.4.8 Test data continued



Figure 8.4-13: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 2cc low channel

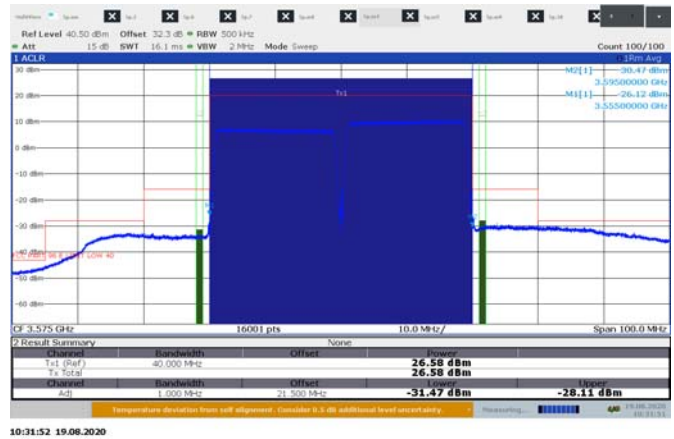


Figure 8.4-14: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 2cc low channel

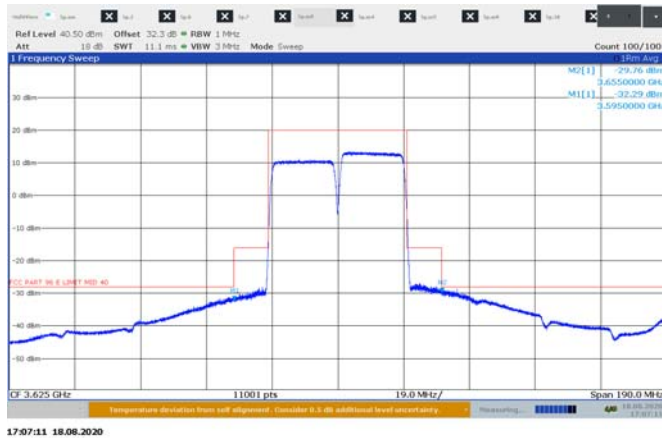


Figure 8.4-15: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 2cc mid channel

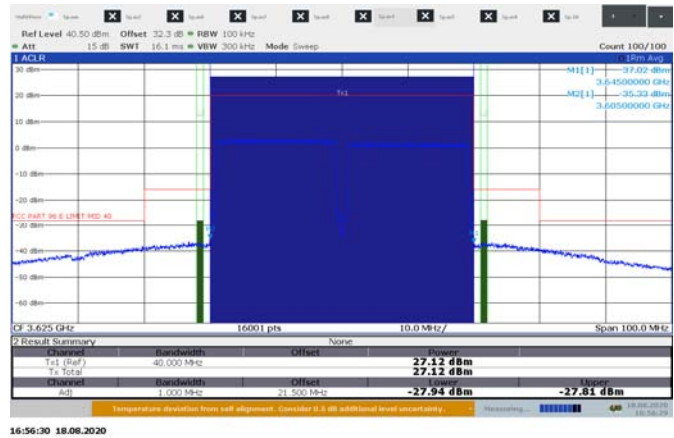


Figure 8.4-16: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 2cc mid channel



Figure 8.4-17: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 2cc high channel

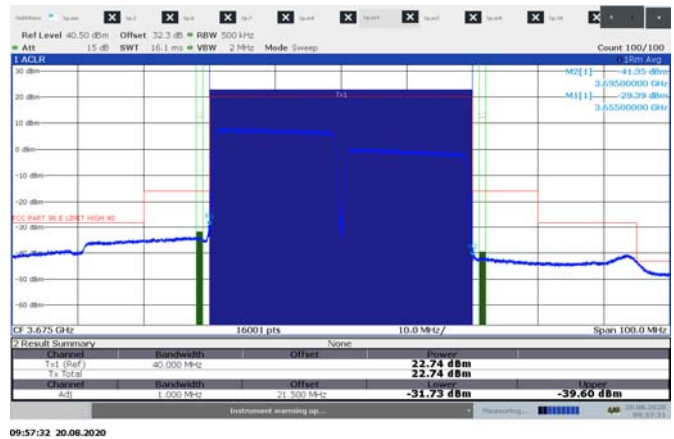


Figure 8.4-18: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 2cc high channel

8.4.9 Test data continued



Figure 8.4-19: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 3cc low channel

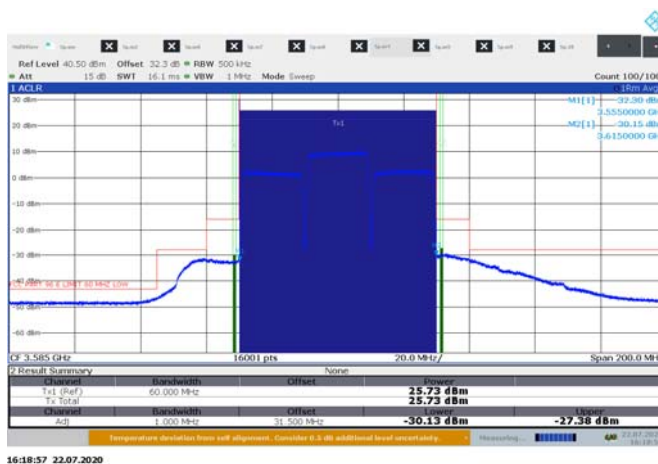


Figure 8.4-20: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 3cc low channel



Figure 8.4-21: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 3cc mid channel

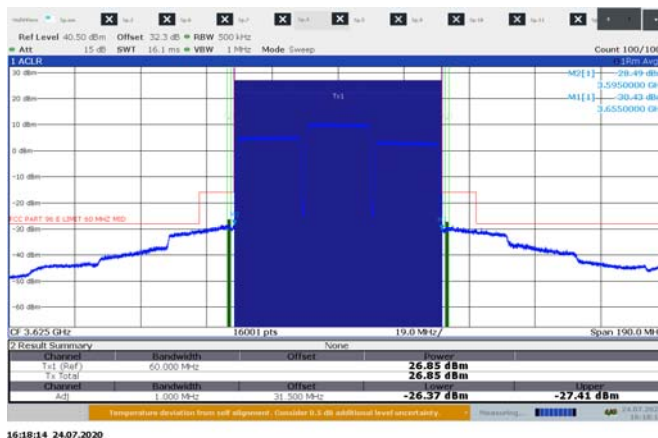


Figure 8.4-22: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 3cc mid channel

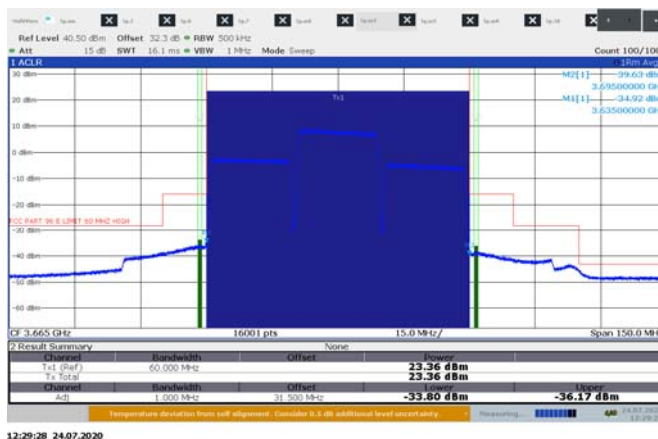


Figure 8.4-23: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 3cc high channel

Figure 8.4-24: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 3cc high channel

8.4.10 Test data continued



Figure 8.4-25: Emission measurement outside 10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 3cc additional high channel

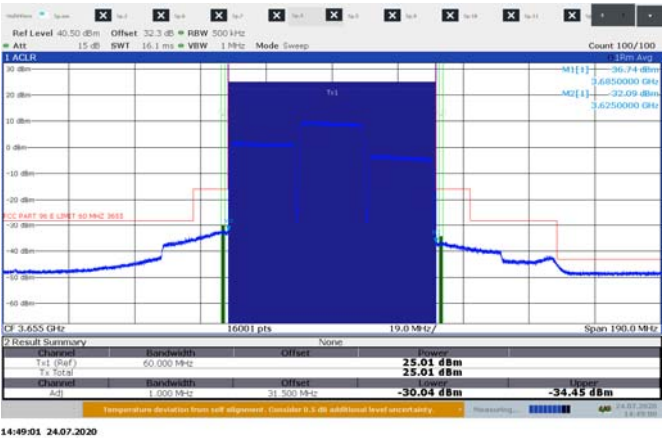


Figure 8.4-26: Emission measurement within 0-10 MHz from the SAS assigned channel edge, sample plot for 20 MHz 3cc additional high channel

8.5 FCC 96.41(e)(2) Additional protection levels

8.5.1 Definitions and limits

The conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40dBm/MHz.

8.5.2 Test summary

Test date July 17, 2019

8.5.3 Observations, settings and special notes

The testing was performed conducted on each antenna port as well as radiated with both ports operating simultaneously in MIMO mode and terminated with 50 Ohm loads. Spurious emissions were tested from 30 MHz to the 10th harmonic. Only critical plots provided in test data below. Spectrum analyser settings:

Resolution bandwidth	100 kHz (below 1 GHz) 1 MHz (conducted)
Video bandwidth	3 × RBW
Detector and trace mode	RMS Power averaging (conducted), Peak Max-hold (radiated)

8.5.4 Test data

Table 8.5-1: Additional emission measurements at 3530 and 3720 MHz sector 1 QPSK modulation 2CC results

Antenna port	No of carriers	Channel BW, MHz	Frequency of max emission, MHz	Emission level, dBm/MHz	Limit ¹ , dBm/MHz	Margin, dB
0	2	20(low)	3530	-48.53	-43	5.53
1	2	20(low)	3530	-43.99	-43	0.99
0	2	20(high)	3720	-43.04	-43	0.04
1	2	20(high)	3720	-44.34	-43	1.34
0	2	40(low)	3530	-45.40	-43	2.4
1	2	40(low)	3530	-43.41	-43	0.41
0	2	40(high)	3720	-43.77	-43	0.77
1	2	40(high)	3720	-43.65	-43	0.65

Note: ¹Margin of SISO operation. For MIMO 2x2 operation 3 dB is subtracted from the limit in the table above.

Table 8.5-2: Additional emission measurements at 3530 and 3720 MHz sector 1 QPSK modulation 3CC results

Antenna port	No of carriers	Channel BW, MHz	Frequency of max emission, MHz	Emission level, dBm/MHz	Limit ¹ , dBm/MHz	Margin, dB
0	3	30(low)	3530	-47.24	-43	4.24
1	3	30(low)	3530	-44.39	-43	1.39
0	3	30(high)	3720	-43.02	-43	0.02
1	3	30(high)	3720	-43.12	-43	0.12
0	3	60(low)	3530	-49.00	-43	6.00
1	3	60(low)	3530	-44.04	-43	1.04
0	3	60(high)	3720	-47.30	-43	4.3
1	3	60(high)	3720	-43.32	-43	0.32
0	3	60(high) additional	3720	-46.08	-43	3.08
1	3	60(high) additional	3720	-43.29	-43	0.29

Note: ¹Margin of SISO operation. For MIMO 2x2 operation 3 dB is subtracted from the limit in the table above.

8.5.5 Test data continued



Figure 8.5-1: Conducted spurious emissions for 10 MHz 2cc low channel sample plot 30 MHz – 40 GHz



Figure 8.5-2: Conducted spurious emissions for 10 MHz 2cc mid channel sample plot 30 MHz – 40 GHz



Figure 8.5-3: Conducted spurious emissions for 10 MHz 2cc high channel sample plot 30 MHz – 40 GHz

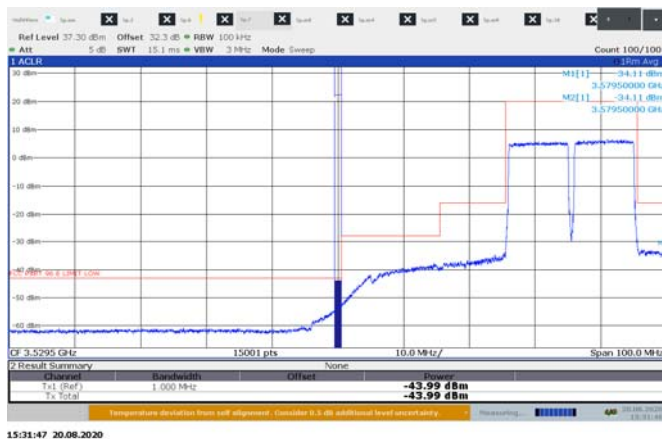


Figure 8.5-4: Low Bandedge for 10 MHz 2cc channel at 3530 MHz sample plot



Figure 8.5-5: High Bandedge for 10 MHz 2cc channel at 3720 MHz sample plot

8.5.6 Test data continued



Figure 8.5-6: : Conducted spurious emissions for 10 MHz 3cc low channel sample plot 30 MHz – 40 GHz



Figure 8.5-7: : Conducted spurious emissions for 10 MHz 3cc mid channel sample plot 30 MHz – 40 GHz



Figure 8.5-8: Conducted spurious emissions for 10 MHz 3cc high channel sample plot 30 MHz – 40 GHz

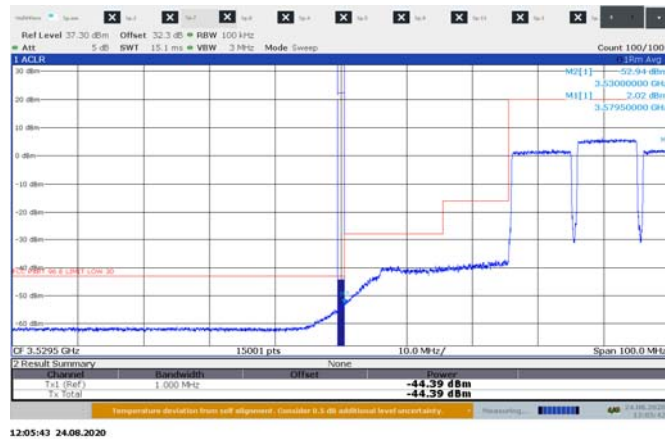


Figure 8.5-9: Low Bandedge for 10 MHz 3cc channel at 3530 MHz sample plot

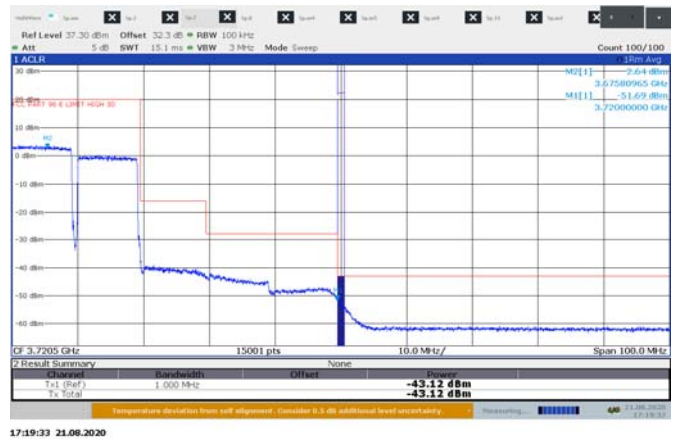


Figure 8.5-10: High Bandedge for 10 MHz 3cc channel at 3720 MHz sample plot

8.5.7 Test data continued



11:50:27 18.08.2020

Figure 8.5-11: : Conducted spurious emissions for 20 MHz 2cc low channel sample plot 30 MHz – 40 GHz



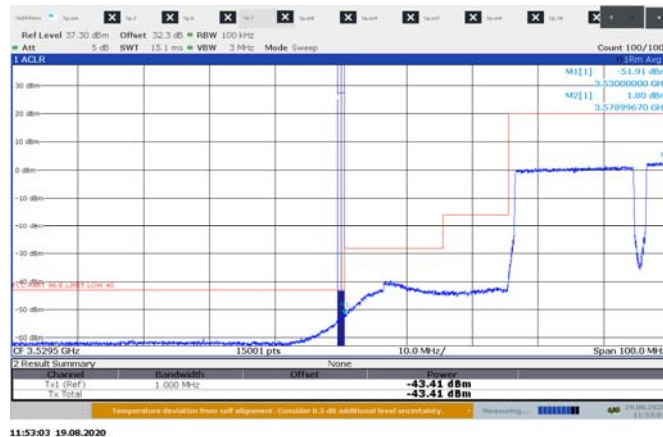
16:54:19 18.08.2020

Figure 8.5-12: : Conducted spurious emissions for 20 MHz 2cc mid channel sample plot 30 MHz – 40 GHz



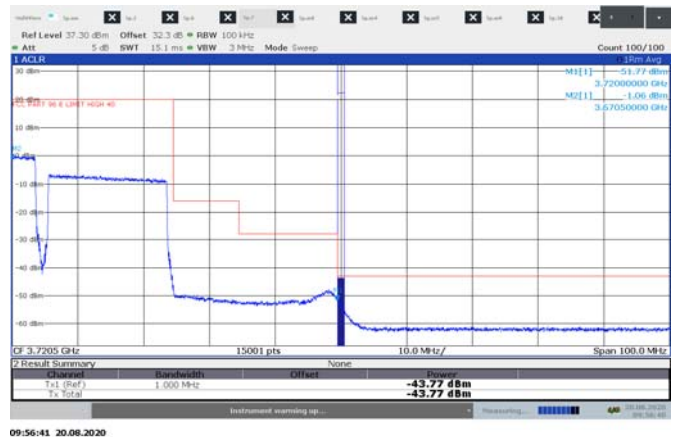
09:56:14 20.08.2020

Figure 8.5-13: Conducted spurious emissions for 20 MHz 2cc high channel sample plot 30 MHz – 40 GHz



11:53:03 19.08.2020

Figure 8.5-14: Low Bandedge for 20 MHz 2cc channel at 3530 MHz sample plot



09:56:41 20.08.2020

Figure 8.5-15: High Bandedge for 20 MHz 2cc channel at 3720 MHz sample plot

8.5.8 Test data continued



Figure 8.5-16: : Conducted spurious emissions for 20 MHz 3cc low channel sample plot 30 MHz – 40 GHz



Figure 8.5-17: : Conducted spurious emissions for 20 MHz 3cc mid channel sample plot 30 MHz – 40 GHz



Figure 8.5-18: Conducted spurious emissions for 20 MHz 3cc high channel sample plot 30 MHz – 40 GHz

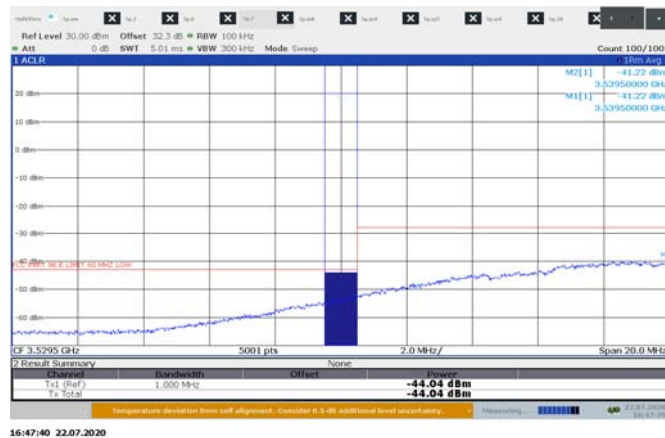


Figure 8.5-19: Low Banedge for 20 MHz 3cc channel at 3530 MHz sample plot



Figure 8.5-20: High Banedge for 20 MHz 3cc channel at 3720 MHz sample plot

8.5.9 Test data continued



Figure 8.5-21: : Conducted spurious emissions for 20 MHz 3cc high channel 3655 MHz sample plot 30 MHz – 40 GHz

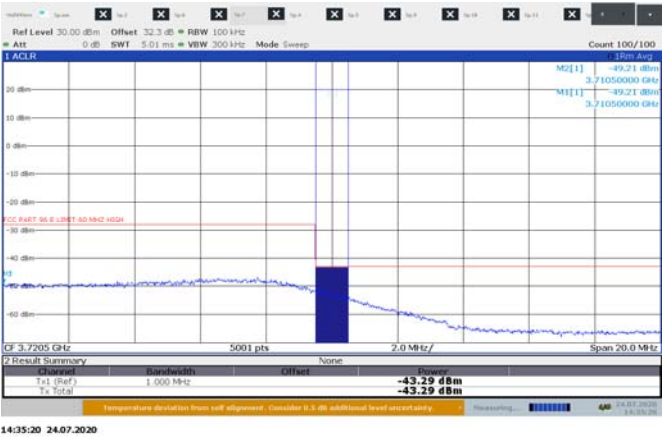


Figure 8.5-22: : High Bandedge for 20 MHz 3cc high channel 3655 MHz sample plot

8.5.10 Test data continued

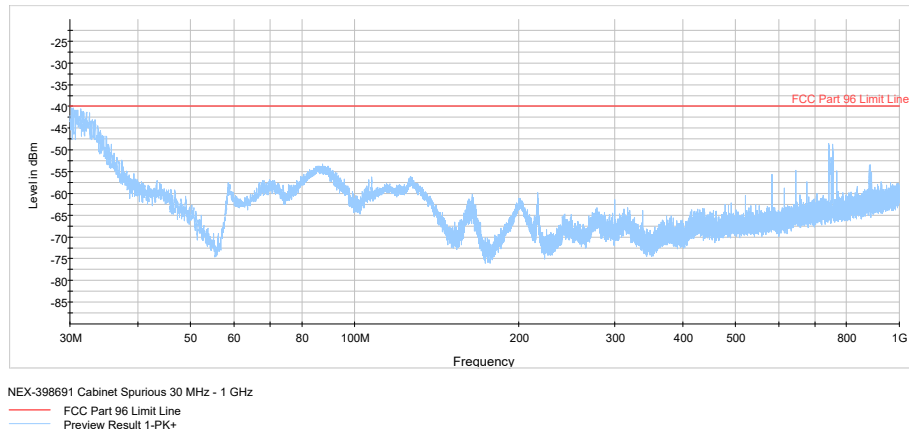


Figure 8.5-1: Cabinet spurious emissions sample plot (30 to 1000 MHz)

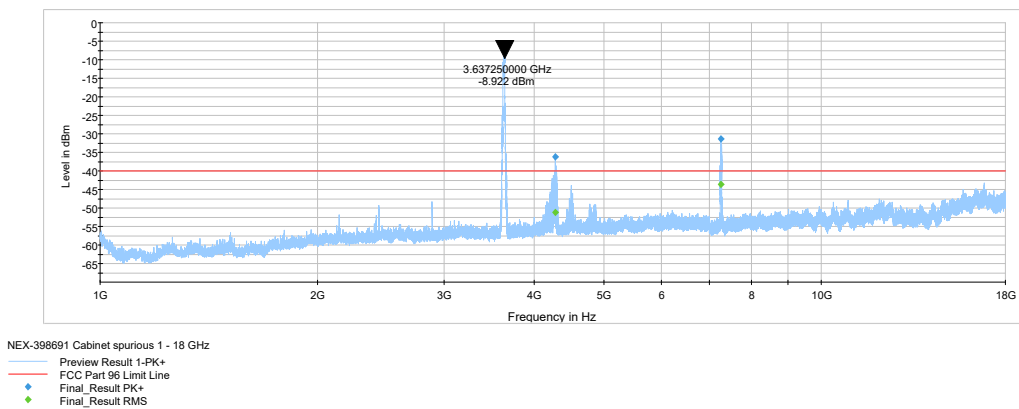


Figure 8.5-2: Cabinet spurious emissions sample plot (1 to 18 GHz)

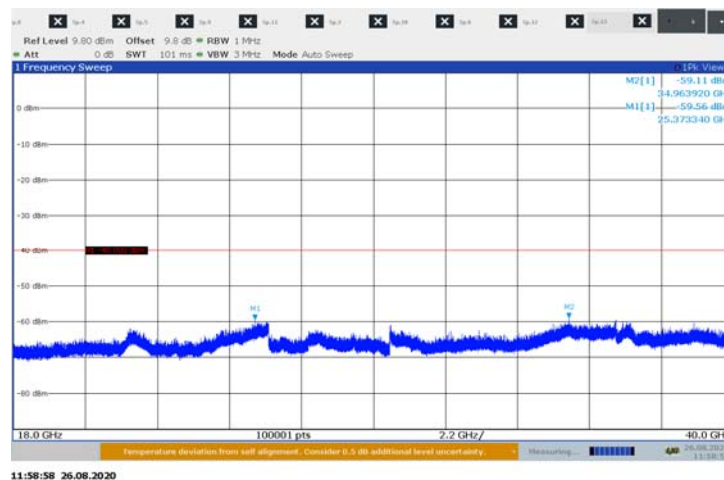


Figure 8.5-3: Cabinet spurious emissions sample plot (18 to 40 GHz)

8.5.11 Test data continued

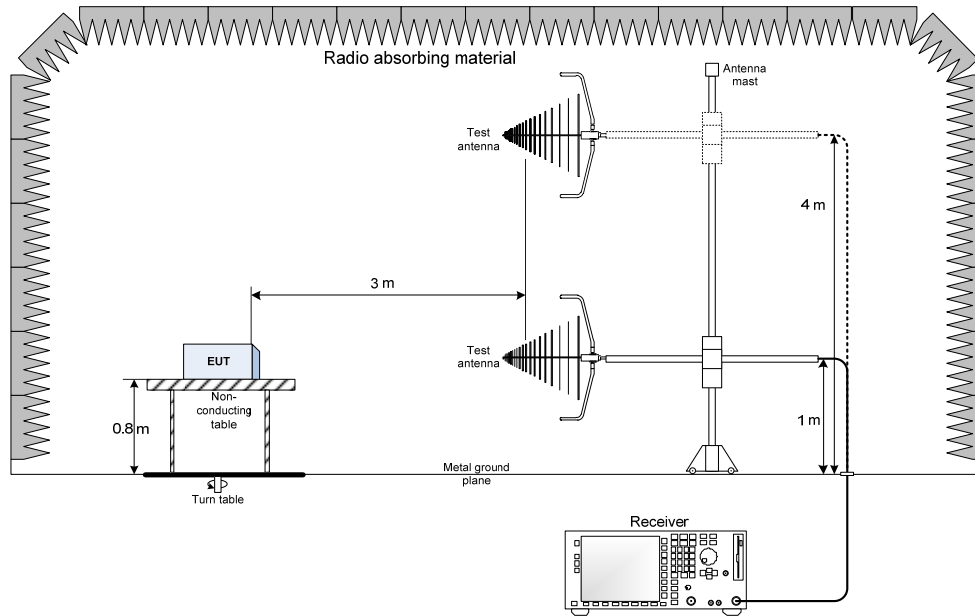
Table 8.5-3: Conducted spurious emission measurement results

Antenna port	No of carriers	Channel BW, MHz	Frequency of max emission, MHz	Emission level, dBm/MHz	Limit ¹ , dBm/MHz	Margin, dB
0	2	20(low)	25798.90	-47.73	-43	4.73
1	2	20(mid)	25799.55	-48.36	-43	5.36
0	2	40(low)	25798.25	-47.73	-43	4.73
1	2	40(mid)	25796.69	-47.78	-43	4.78
1	3	30(low)	25794.19	-48.38	-43	5.38
0	3	30(mid)	25796.69	-48.30	-43	5.30
1	3	60(low)	25787.89	-47.86	-43	4.86

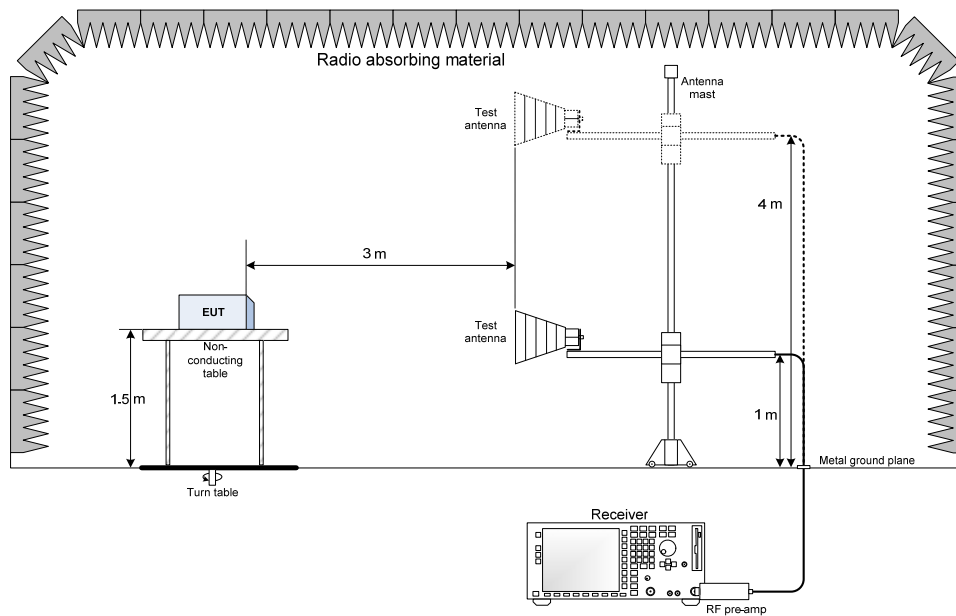
Note: ¹Margin of SISO operation. For MIMO 2x2 operation 3 dB is subtracted from the limit in the table above. All other spurious emissions are minimum 6 dB below limit line.

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up

