TEST REPORT: FCC RF Test Report AWHHJ

FCC ID: VBNAWHHJ-01

Date:	Oulu 23. Jul 2025
Pages:	69
Appendices:	2

Equipment Under Test:	AirScale Base Transceiver Station Remote Radio Head 4T4R n41 160W 2,5GHz
Radio Access technology:	NR (TDD)
Type:	AWHHJ
Manufacturer:	Nokia Solutions and Networks Oy
Address:	Kaapelitie 4, FI-90620, Oulu, Finland
Task:	Conformance test according to the specifications mentioned below
Test Specification(s):	FCC 47 CFR part 2 FCC 47 CFR part 27
Result:	The EUT complies with the requirements of the specification

The results relate only to the items tested as described in this test report.

Approved by:	**Date**	**Signature**
Jarkko Kenttälä Team Manager, Type Approval Nokia Networks	23 Jul 2025	

Contents

1 Summary

The following tests were performed according to the FCC rules in order to verify the compliance of the EUT with the FCC requirements:

Test No.	Measurement	FCC Rule	Page Number of this Report	Result
1	RF Output power	§ 2.1046, § 27.50,	10	compliant
2	Modulation Characteristics	§ 2.1047,	19	compliant
3	Occupied Bandwidth	§ 2.1049, § 2.201, § 27.53,	20	compliant
4	Spurious Emissions at Antenna Terminals	§ 2.1051, § 2.1057 § 27.53	23	compliant
5	Field Strength of Spurious Radiation	§27.53 §15.109	27	compliant
6	Frequency Stability	§27.54 §2.1055	-	Not needed*

*Testing was performed in previous test

Table 1 Results – Summary

In accordance with the FCC Rule §15.3 (z) the equipment was tested with the limits that are valid for an *unintentional radiator*.

Measurements guidance: FCC OET laboratory KDB: 662911 D01 Multiple Transmitter Output v01r02, 971168 D03 IM Emission Repeater Amp v01 and FCC KDB 971168 D01 Power Meas License Digital Systems v03r01: ANSI C63.26-2015.

Test Laboratory:

Nokia Solutions and Networks Oy

Kaapelitie 4,

FI-90620, Oulu, Finland

Jarkko Kenttälä

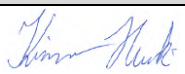
FCC Reg. No: 261413

Testing laboratory accreditation number: T297

1.1 Time Schedule

Test No.	1, 2, 3, 4	5
Start of Test:	16 May 2025	19 Jun 2025
End of Test:	5 Jun 2025	26 Jun 2025

1.2 Participants

Name	Function	Signature
Kimmo Huuki	Tests no: 1,2,3 and 4 Setup of EUT	
Tuomas Kaijanto	Test no 5 Setup of EUT	

2 Equipment Under Test

The EUT is an AirScale Base Transceiver Station Remote Radio Head

The BTS performs the full RAN function of NR system (New Radio).

2.1 Configuration of EUT

The used different EUT configurations are shown by the following table.

Module Type	**Airscale BTS RRH 4T4R, B41 40W per antenna 160W per radio**	
Radio Access Technology	NR	
Duplex mode	Time Division Duplex (TDD)	
Channel Bandwidth	NR Single carrier 15MHz (n41) (Config. A), NR Single slim carrier 49.5MHz (n41) (Config. B)	
Supply Voltage	48.0 V DC	
Single carrier		
Rated Output Power (Prat)	40W (46.0dBm) conducted / carrier	
Downlink/Uplink ratio	3:6	
	RX	**TX**
Number of Antenna Ports	4 (ANT1 to ANT4)	4 (ANT1 to ANT4)
MiMo	Yes	Yes

Table 2 Overview of EUT configuration

The tests were performed with one EUT at the antenna ports from ANT1 to ANT4.

The used different EUT configurations are shown by the following table.

Module Name	**Serial-No.**	**Module Type**	**Test No.**
AWHHJ	EB2352R0755	RRH	1,2,3,4
AWHHJ	1M242106988	RRH	5

Table 3 Configuration of EUT

For a functional description of the modules, please refer to the appropriate related parts and exhibit sections of this certification application.

2.2 Operating Conditions

The EUT supports QPSK, 16QAM, 64QAM and 256QAM modulation. If not stated otherwise, the following standard setup procedure for the EUT was used:

The transmitter was set up according to 3GPP TS 38.141-1 NR Test Models (TM) for all tests:

- TM 1.1: All QPSK modulation testing
- TM 3.1: All 64QAM modulation testing
- TM 3.1A All 256QAM modulation testing
- TM 3.2: All 16QAM modulation testing

During the measurements, one carrier channel was tested at a time. The carrier was set to the maximum power level to ensure the maximum emission amplitudes during all measurements.

During the tests, the AirScale BTS is transmitting a pseudo random bit pattern on the data channels. This ensures that the measurements of the emission characteristics of the transmitter are pursuant to § 2.1049.

Test models TM1.1, TM3.1, TM3.1A and TM3.2, have uplink/Downlink ratio 3:6.

3 Test Configuration

If not stated otherwise, the following measurement configuration was used to perform all measurements (see figure below).

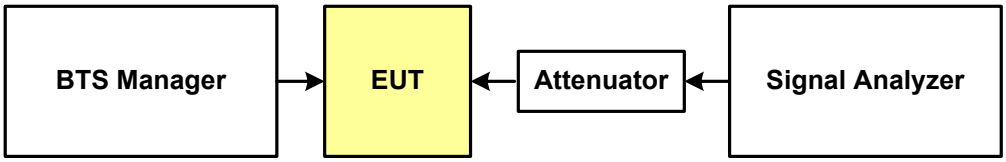


Figure 1 Test Configuration (single output)

The RF output of the transceiver (cell) under test is connected to a signal analyzer via a high-power attenuator to protect the input of the signal analyzer from high RF power levels. A description of the analyzer settings is given in each of the sections describing the measurements. The other transceivers are terminated.

A complete list of the measurement equipment is included on page 30 of this measurement report.

3.1 Calibration of the Test Equipment

All relevant test equipment has a valid calibration from an external calibration laboratory. Additionally, the signal analyzer has a built-in self-calibration procedure. This calibration procedure was activated prior to the measurements so that the analyzer is deemed accurate. High quality cables were used to connect the measurement equipment to the EUT. The actual loss of the attenuator and the cables was measured with a high precision network analyzer and taken into account for all measurements.

4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Case Description	Requirement	Measurement Uncertainty (MU)
RF Power Output	f ≤ 3.0 GHz 3.0 GHz < f ≤ 6.0 GHz 6.0 GHz < f ≤ 8.0 GHz	±0.46 dB ±0.73 dB ±0.76 dB
Occupied Bandwidth	Channel Bandwidth: 200 kHz 1.4 MHz 3 MHz 5 MHz 10 MHz 15 MHz 20 MHz 40 MHz 60 MHz 80 MHz 100 MHz	 ±842 Hz ±6.231 kHz ±11.322 kHz ±21.221 kHz ±42.43 kHz ±63.65 kHz ±99.00 kHz ±198.00 kHz ±226.28 kHz ±396.00 kHz ±424.27 kHz
Spurious Emissions at Antenna Terminals	9 kHz ≤ f < 10 MHz 10 MHz ≤ f < 50 MHz 50 MHz ≤ f < 6 GHz 6 GHz ≤ f < 8 GHz 8 GHz ≤ f < 13.6 GHz 13.6 GHz ≤ f < 22 GHz 22 GHz ≤ f < 26.5 GHz 26.5 GHz ≤ f < 40 GHz	±0.61 dB ±1.12 dB ±0.61 dB ±1.38 dB ±1.93 dB ±1.92 dB ±2.15 dB ±2.82 dB
Frequency Stability	For NR: BW = 1.4 MHz BW = 3 MHz BW = 5 MHz BW = 10 MHz BW = 15 MHz BW = 20 MHz BW = 40 MHz BW = 60 MHz BW = 80 MHz BW = 100 MHz For LTE:	 ±0.14 Hz ±0.3 Hz ±0.5 Hz ±1 Hz ±1.5 Hz ±2 Hz ±4 Hz ±6 Hz ±8 Hz ±10 Hz ±1 Hz

5 Test Results

5.1 Test No. 1: Transmitter Output Power (§ 2.1046, § 27.50)

5.1.1 Limits

The maximum output power of the equipment measured in terms of average values shall comply with the Total power limit:

EIRP limits are calculated and found in Appendix A.

BRS FCC EIRP limits: 33dBW + 10 log(X/Y) dBW + 10 log(360/beamwidth) dBW, where X is the channel width in MHz and Y is 5.5 or 6MHz. (§ 27.50(h)(ii)).

Peak to average power (PAPR) limit is 13dBm.

5.1.2 Test Procedure and Results

Detachable Antenna: The maximum output power at the antenna terminals was measured using a signal analyzer.

The RF power was measured with a frequency sweep across the carrier. The carrier power was calculated from the signal analyzer by integration over the result. The base station maximum output power was measured with signal analyzer with offset adjust in testcase. (Offset is measured connection loss of the test set up.)

For the MiMo output, RF power output was measured from each antenna port individually and the results summed mathematically in accordance with FCC KDB 662911 D01 and ANSI C63.26 -guidance.

Output power in all Tx ports were tested in Config A and B and one Tx port was selected for the remaining testing. The AWHHJ antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in the results) and antenna port 2 in config A and port 1 in config B was selected for the remaining testing based on ANSI C63.26-2015 clauses 5.2.5.3, 5.7.2i and 6.4.

Peak to average power (PAPR) was examined using CCDF method and 0.1% value recorded in dB to the tables below.

Average Power Spectral density was measured using FSW signal Analyzer.

The following table shows the measured output powers at the antenna connector.

Measured laboratory room temperature and humidity during the tests				
Date	Temperature Min-Max:		Humidity Min-Max:	
16.05.2025 – 30.05.2025	22.2 °C	24.9 °C	16.1 RH%	41.6 RH%

Config A:

	Channel Frequency (MHz)	Antenna Port1 Power (dBm)	Antenna Port2 Power (dBm)	Antenna Port3 Power (dBm)	Antenna Port 4 Power (dBm)	Total power/unit Power (W)
Test Model 1 Modulation QPSK	2592.99	45.57	45.76	45.75	45.73	**148.70**
Test Model 3.1 Modulation 64QAM	2592.99	45.58	45.75	45.72	45.73	148.47
Test Model 3.2 Modulation 16QAM	2592.99	45.54	45.71	45.68	45.68	146.91
Test Model 3.1A Modulation 256QAM	2592.99	45.54	45.69	45.61	45.66	146.15
Total power/antenna port (W)		143.79	**149.55**	148.26	148.63	

Table 4 RF Power Output (15 MHz BW NR Band 41)

Config B:

	Channel Frequency (MHz)	Antenna Port1 Power (dBm)	Antenna Port2 Power (dBm)	Antenna Port3 Power (dBm)	Antenna Port 4 Power (dBm)	Total power/unit Power (W)
Test Model 1 Modulation QPSK	2592.99	45.60	45.31	45.49	45.47	141.70
Test Model 3.1 Modulation 64QAM	2592.99	45.55	45.36	45.42	45.38	139.60
Test Model 3.2 Modulation 16QAM	2592.99	45.61	45.49	45.45	45.45	141.94
Test Model 3.1A Modulation 256QAM	2592.99	45.66	45.48	45.45	45.46	**142.36**
Total power/antenna port (W)		**145.40**	139.83	140.38	139.98	

Table 5 RF Power Output (49.5 MHz BW NR Band 41)

Config A:

Test Model 1.1 Modulation QPSK		Test Model 3.1 Modulation 64QAM		Test Model 3.2 Modulation 16QAM		Test Model 3.1a Modulation 256QAM	
Channel Frequency 2503.5MHz		Channel Frequency 2503.5MHz		Channel Frequency 2503.5MHz		Channel Frequency 2503.5MHz	
Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)
2	45.74	2	45.70	2	45.75	2	45.69
Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz	
Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)
2	45.76	2	45.71	2	47.75	2	45.69
Channel Frequency 2682.51MHz		Channel Frequency 2682.51MHz		Channel Frequency 2682.51MHz		Channel Frequency 2682.51MHz	
Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)
2	45.12	2	45.03	2	45.09	2	45.08

Table 6 RF Power Output (Band 41 NR 15 MHz Channel BW)

Config B:

Test Model 1.1 Modulation QPSK		Test Model 3.1 Modulation 64QAM		Test Model 3.2 Modulation 16QAM		Test Model 3.1a Modulation 256QAM	
Channel Frequency 2520.75MHz		Channel Frequency 2520.75MHz		Channel Frequency 2520.75MHz		Channel Frequency 2520.75MHz	
Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)
1	45.54	1	45.53	1	45.47	1	45.60
Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz	
Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)
1	45.60	1	45.61	1	45.55	1	45.66
Channel Frequency 2665.25MHz		Channel Frequency 2665.25MHz		Channel Frequency 2665.25MHz		Channel Frequency 2665.25MHz	
Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)	Tx Port	(dBm)
1	45.61	1	45.68	1	45.57	1	45.67

Table 7 RF Power Output (Band 41 NR 49.5 MHz Channel BW)

The base station maximum output power was found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

Config A:

Test Model 1.1 Modulation QPSK		Test Model 3.1 Modulation 64QAM		Test Model 3.2 Modulation 16QAM		Test Model 3.1a Modulation 256QAM	
Channel Frequency 2503.5MHz		Channel Frequency 2503.5MHz		Channel Frequency 2503.5MHz		Channel Frequency 2503.5MHz	
Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz
2	34.82	2	34.75	2	35.19	2	34.77
Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz	
Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz
2	34.68	2	34.65	2	35.16	2	34.66
Channel Frequency 2682.51MHz		Channel Frequency 2682.51MHz		Channel Frequency 2682.51MHz		Channel Frequency 2682.51MHz	
Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz
2	34.08	2	34.17	2	34.52	2	34.08

Table 8 Power Spectral Density (B41 NR 15 MHz Channel BW)

Config B:

Test Model 1.1 Modulation QPSK		Test Model 3.1 Modulation 64QAM		Test Model 3.2 Modulation 16QAM		Test Model 3.1a Modulation 256QAM	
Channel Frequency 2520.75MHz		Channel Frequency 2520.75MHz		Channel Frequency 2520.75MHz		Channel Frequency 2520.75MHz	
Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz
1	29.17	1	29.20	1	30.78	1	29.28
Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz		Channel Frequency 2592.99MHz	
Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz
1	29.22	1	29.24	1	30.82	1	29.30
Channel Frequency 2665.25MHz		Channel Frequency 2665.25MHz		Channel Frequency 2665.25MHz		Channel Frequency 2665.25MHz	
Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz	Tx Port	dBm/MHz
1	29.27	1	29.34	1	30.91	1	29.34

Table 9 Power Spectral Density (B41 NR 49.5 MHz Channel BW)

The base station power spectral density was found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

Config A:

Test Model 1.1 Modulation QPSK			Test Model 3.1 Modulation 64QAM		
Channel Frequency 2503.5MHz			Channel Frequency 2503.5MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
2	7.94	5.06	2	8.00	5.00
Test Model 1.1 Modulation QPSK			Test Model 3.1 Modulation 64QAM		
Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
2	7.96	5.04	2	8.00	5.00
Test Model 1.1 Modulation QPSK			Test Model 3.1 Modulation 64QAM		
Channel Frequency 2682.51MHz			Channel Frequency 2682.51MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
2	7.96	5.04	2	7.96	5.04
Test Model 3.2 Modulation 16QAM			Test Model 3.1a Modulation 256QAM		
Channel Frequency 2503.5MHz			Channel Frequency 2503.5MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
2	7.96	5.04	2	7.94	5.06
Test Model 3.2 Modulation 16QAM			Test Model 3.1a Modulation 256QAM		
Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
2	7.94	5.06	2	7.94	5.06
Test Model 3.2 Modulation 16QAM			Test Model 3.1a Modulation 256QAM		
Channel Frequency 2682.51MHz			Channel Frequency 2682.51MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
2	7.88	5.12	2	7.98	5.02

Table 10 Peak to Average Power (NR15 MHz BW)

Config B:

Test Model 1.1 Modulation QPSK			Test Model 3.1 Modulation 64QAM		
Channel Frequency 2520.75MHz			Channel Frequency 2520.75MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
1	8.46	4.54	1	8.46	5.54
Test Model 1.1 Modulation QPSK			Test Model 3.1 Modulation 64QAM		
Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
1	8.42	4.58	1	8.38	4.62
Test Model 1.1 Modulation QPSK			Test Model 3.1 Modulation 64QAM		
Channel Frequency 2665.25MHz			Channel Frequency 2665.25MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
1	8.48	4.52	1	8.48	4.52
Test Model 3.2 Modulation 16QAM			Test Model 3.1a Modulation 256QAM		
Channel Frequency 2520.75MHz			Channel Frequency 2520.75MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
1	8.52	4.48	1	8.46	4.44
Test Model 3.2 Modulation 16QAM			Test Model 3.1a Modulation 256QAM		
Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
1	8.46	4.54	1	8.40	4.60
Test Model 3.2 Modulation 16QAM			Test Model 3.1a Modulation 256QAM		
Channel Frequency 2665.25MHz			Channel Frequency 2665.25MHz		
Tx Port	CCDF 0.1% (dB)	Margin (dB)	Tx Port	CCDF 0.1% (dB)	Margin (dB)
1	8.54	4.46	1	8.48	4.52

Table 11 Peak to Average Power (NR49.5 MHz BW)

The peak to average power levels were found to be compliant with the manufacturer's specifications and with all requirements of the of IC rules.

5.2 Test No. 2: Modulation Characteristics (§ 2.1047)

The occupied bandwidth was measured to be compliant with the manufacturer's specifications and with all requirements of the FCC rules, which represents the 99% power bandwidth (see the following section and screenshots on page 36).

No further testing is required under this section of the FCC rules. No measurements other than the occupied bandwidth are required. Sample of modulation screenshots are on page 36, in I/Q constellation diagrams and tables, showing QPSK, 16QAM, 64QAM and 256QAM –modulation generation.

5.3 Test No. 3: Occupied Bandwidth (§ 2.1049, § 2.201, § 27.53)

5.3.1 Limits

Para. No. 2.1049. The 99% occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the emitted power.

FCC § 27.53(m)(6) for BRS: 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.

5.3.2 Test Procedure and Results

The 99% occupied bandwidth of the carrier emission is measured using a signal analyzer with Resolution Bandwidth set to 1MHz (1-5% of bandwidth; see screenshots on page 39 for details). The following tables summarize the results:

The Relative measurement procedure of OBW is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by a specified ratio (or in decibels, a specified number of dB down from the reference value). The typical ratio for transmitters is −26 dB, corresponding to the 26 dB BW. The Relative measurement procedure emission is measured using a signal analyzer with Resolution Bandwidth set to 1MHz (1-5% of bandwidth; see screenshots on page 38 for details).

Emission designator summary tables are found in Appendix B.

The following tables summarize the results:

Measured laboratory room temperature and humidity during the tests				
Date	Temperature Min-Max:		Humidity Min-Max:	
16.05.2025 – 28.05.2025	22.8 °C	24.9 °C	16.1 RH%	41.6 RH%

Config A:

Test Model 1.1 Modulation QPSK			Test Model 3.1 Modulation 64QAM			Test Model 3.2 Modulation 16QAM			Test Model 3.1a Modulation 256QAM		
Channel Frequency 2503.5MHz			Channel Frequency 2503.5MHz			Channel Frequency 2503.5MHz			Channel Frequency 2503.5MHz		
Tx Port	99% (MHz)	26dB (MHz)	Tx Port	Value 99% (MHz)	Value 26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)
2	13.64	14.83	2	13.63	14.71	2	13.59	14.65	2	13.66	14.75
Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz		
Tx Port	99% (MHz)	26dB (MHz)	Tx Port	Value 99% (MHz)	Value 26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)
2	13.65	14.82	2	13.64	14.78	2	13.56	14.66	2	13.65	14.77
Channel Frequency 2682.51MHz			Channel Frequency 2682.51MHz			Channel Frequency 2682.51MHz			Channel Frequency 2682.51MHz		
Tx Port	99% (MHz)	26dB (MHz)	Tx Port	Value 99% (MHz)	Value 26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)
2	13.66	14.81	2	13.64	14.82	2	13.56	14.64	2	13.65	14.78

Table 12 Occupied Bandwidth (B41 NR 15 MHz BW)

Config B:

Test Model 1.1 Modulation QPSK			Test Model 3.1 Modulation 64QAM			Test Model 3.2 Modulation 16QAM			Test Model 3.1a Modulation 256QAM		
Channel Frequency 2520.75MHz			Channel Frequency 2520.75MHz			Channel Frequency 2520.75MHz			Channel Frequency 2520.75MHz		
Tx Port	99% (MHz)	26dB (MHz)	Tx Port	Value 99% (MHz)	Value 26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)
1	46.86	49.45	1	46.86	49.51	1	47.01	49.38	1	46.87	49.58
Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz			Channel Frequency 2592.99MHz		
Tx Port	99% (MHz)	26dB (MHz)	Tx Port	Value 99% (MHz)	Value 26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)
1	46.88	49.48	1	46.89	49.62	1	47.04	49.78	1	46.88	49.53
Channel Frequency 2665.25MHz			Channel Frequency 2665.25MHz			Channel Frequency 2665.25MHz			Channel Frequency 2665.25MHz		
Tx Port	99% (MHz)	26dB (MHz)	Tx Port	Value 99% (MHz)	Value 26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)	Tx Port	99% (MHz)	26dB (MHz)
1	46.83	49.45	1	46.84	49.59	1	47.00	49.42	1	46.84	49.51

Table 13 Occupied Bandwidth (B41 NR 49.5 MHz BW)

The occupied bandwidth was found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

5.4 Test No. 4 Spurious Emissions at Antenna Terminals (§ 2.1051, § 2.1057, § 27.53)

5.4.1 Limits

FCC §27.53(m)(2) for BRS. The power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts.

The attenuation shall be not less than 43 + 10 log (P) dB (P = transmitter power in Watts).

The compliance limit was calculated in the following way:

Maximum transmitter output power [W]: P

Maximum transmitter output power [dBm]: 30 + 10 log10 P (conversion from W to dBm)

Attenuation required by FCC: 43 + 10 log10 P

Compliance limit = Maximum transmitter output power - Required attenuation

= 30 + 10 log10 P - (43 + 10 log10 P) = -13 dBm

For MiMo output from 4 TX antenna connectors, one antenna connector was measured individually, and the individual limit lime was reduced by 10log(4). Limit line was calculated to show -19.02 dBm emission limit, according to FCC KDB 662911 D01 and ANSI C6326-2015 guidance.

The AWHHJ antenna ports are essentially electrically identical (the RF power variation between antenna ports is small as shown in the results of Test No.1) and antenna port 2 in config A and port 1 in config B was selected for the remaining testing based on ANSI C63.26-2015 clauses 5.2.5.3, 5.7.2i and 6.4.

5.4.2 Test Procedure and Results

The tests were carried out in accordance with § 27.53. For all frequency ranges except two (immediately below and above the carrier frequency block) a 1 MHz resolution bandwidth was used for the measurements.

In the 1 MHz frequency bands immediately outside and adjacent to the carrier frequency block the resolution bandwidth is lowered to 1% of the 99%/ 26 dB occupied bandwidth of the transmitted carrier.

According to § 2.1057, all emissions including the fundamental frequency from the lowest radio frequency generated in the equipment, without going below 9 kHz, up to the 10th harmonic were investigated.

The following tables summarize the worst case detected emission levels (see screenshots on page 46 for details). The external attenuation (cable loss of the set up) is already added in the results.

Measured laboratory room temperature and humidity during the tests				
Date	Temperature Min-Max:		Humidity Min-Max:	
19.05 – 05.06 2025	22.2 °C	24.9 °C	16.4 RH%	48.9 RH%

Config A Lower band edge:

Carrier Frequency: 2503.5MHz					
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Limit [dBm]**	**Margin [dB]**	**Result**
QPSK-Modulation TX port 2					
2495-2496	2496	-23.80	-19.02	4.78	Pass
16QAM-Modulation TX port 2					
2495-2496	2496	-24.16	-19.02	5.14	Pass
64QAM-Modulation TX port 2					
2495-2496	2496	-25.09	-19.02	6.07	Pass
256QAM-Modulation TX port 2					
2495-2496	2496	-23.78	-19.02	4.76	Pass

Table 14 Spurious Emissions (Lower band edge) (B41 NR 15 MHz BW)

Config A Upper band edge:

Carrier Frequency: 2682.51MHz					
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Limit [dBm]**	**Margin [dB]**	**Result**
QPSK-Modulation TX port 2					
2690-2691	2690	-22.74	-19.02	3.72	Pass
16QAM-Modulation TX port 2					
2690-2691	2690	-23.40	-19.02	4.38	Pass
64QAM-Modulation TX port 2					
2690-2691	2690	-23.86	-19.02	4.84	Pass
256QAM-Modulation TX port 2					
2690-2691	2690	-23.70	-19.02	4.68	Pass

Table 15 Spurious Emissions (Upper band edge) (B41 NR 15 MHz BW)

Config A Spurious emissions:

Carrier Frequency: 2592.99MHz					
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Limit [dBm]**	**Margin [dB]**	**Result**
QPSK-Modulation Tx port 2					
0.009 – 27000	2835.79	-26.59	-19.02	7.57	Pass
16QAM-Modulation TX port 2					
0.009 – 27000	2881.28	-26.54	-19.02	7.52	Pass
64QAM-Modulation TX port 2					
0.009 – 27000	2996.75	-26.46	-19.02	7.44	Pass
256QAM-Modulation TX port 2					
0.009 – 27000	2992.25	-26.63	-19.02	7.63	Pass

Table 16 Spurious Emissions (B41 NR 15 MHz BW)

Config B Lower band edge:

Carrier Frequency: 2520.75MHz					
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Limit [dBm]**	**Margin [dB]**	**Result**
QPSK-Modulation TX port 1					
2495-2496	2496	-24.17	-19.02	5.15	Pass
16QAM-Modulation TX port 1					
2495-2496	2496	-25.45	-19.02	6,43	Pass
64QAM-Modulation TX port 1					
2495-2496	2496	-24.29	-19.02	5.27	Pass
256QAM-Modulation TX port 1					
2495-2496	2496	-25.44	-19.02	6.42	Pass

Table 17 Spurious Emissions (Lower band edge) (B41 NR 49.5 MHz BW)

Config B Upper band edge:

Carrier Frequency: 2665.25MHz					
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Limit [dBm]**	**Margin [dB]**	**Result**
QPSK-Modulation TX port 2					
2690-2691	2690	-24.40	-19.02	5.38	Pass
16QAM-Modulation TX port 2					
2690-2691	2690	-24.67	-19.02	5.65	Pass
64QAM-Modulation TX port 2					
2690-2691	2690	-24.83	-19.02	5.81	Pass
256QAM-Modulation TX port 2					
2690-2691	2690	-25.02	-19.02	6.00	Pass

Table 18 Spurious Emissions (Upper band edge) (B41 NR 49.5 MHz BW)

Config B Spurious emissions:

Carrier Frequency: 2592.99MHz					
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Limit [dBm]**	**Margin [dB]**	**Result**
QPSK-Modulation Tx port 2					
0.009 – 27000	4820.76	-30.03	-19.02	11.01	Pass
16QAM-Modulation TX port 2					
0.009 – 27000	4584.65	-29.75	-19.02	10.73	Pass
64QAM-Modulation TX port 2					
0.009 – 27000	4579.00	-30.05	-19.02	11.03	Pass
256QAM-Modulation TX port 2					
0.009 – 27000	4369.32	-29.94	-19.02	10.92	Pass

Table 19 Spurious Emissions (B41 NR 49.5 MHz BW)

The measured conducted emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

5.5 Test No. 5 Field Strength of Spurious Radiation (§ 2.1053, § 27.53)

5.5.1 FCC Section 2.1053 Field Strength of Spurious Emissions

Field strength measurements of radiated spurious emissions were made in an FCC registered 3m Semi-Anechoic Chamber which is maintained by Nokia in Oulu, Finland. A complete description and full measurement data for the site is on file with the FCC (Site Registration Number: 261413).

The spectrum from 30 MHz to beyond the tenth harmonic of the carrier 2.69 GHz, (26.9 GHz), was searched for spurious radiation. Measurements were made using both horizontally and vertically polarized broadband antennas. Per FCC regulations, the comparison of out of band spurious emissions directly to the limit is appropriately made using the substitution method. However, when the emissions are more than 20 dB below the specification limit, the use of field strength measurements for compliance determination is acceptable and those emissions are considered not reportable (FCC Section 2.1053). For this case the evaluation of acceptable radiated field strength is as follows.

5.5.2 Field Strength of Spurious Emissions - Limits

FCC Sections 2.1053 and 27.53 contain the requirements for the levels of spurious radiation as a function of the level of the unmodulated carrier. The reference level for the unmodulated carrier is calculated as the field produced by an ideal dipole excited by the transmitter output power according to the following relation taken from Reference Data for Radio Engineers, page 676, 4th edition, IT&T Corp.

$$E = [(30*P)^{1/2}]/R$$

$$20 \log (E*10^{6}) - (43 + 10 \log P) = 82.23 \text{ dB}\mu\text{V/meter}$$

Where:

E = Field Intensity in Volts/meter P = Transmitted Power in Watts

R = Measurement distance in meters = 3 m

The Part 27 Limit is 82.23 dBµV/m at 3m and 85.75 dBuV/m at 2m

The calculated emission levels were found by:

Measured level (dBμV) + Cable Loss(dB)+Antenna Factor(dB) = Field Strength (dBμV/m)

5.5.3 FCC 15.109 Class B Radiated Emissions Limits:

Frequency (MHz)	Field Strengh at 3m (dBμV/m) FCC §15.109	Field Strengh at 3m (dBμV/m) ICES-003	RBW (KHz)	Detector
30 – 88	40.0	40.0	100	QP
88 – 216	43.5	43.5	100	QP
216 – 960	46.0	46.0	100	QP
960 – 1000	54.0	54.0	100	QP
1000 – 10th harmonic	54.0	54.0	1000	Average

Table 20 Radiated Emission Limits

5.5.4 RESULTS:

For compliance with 47CFR Part 2and 27, the field strength of any spurious radiation, measured at 3m, is required to be less than 82.23 dBµV/meter (82.23 @ 3m). Over the out of band spectrum investigated from 30 MHz to beyond the tenth harmonic of the carrier (up to 26.9 GHz), no reportable spurious emissions were detected.

Measured laboratory room temperature and humidity during the tests				
Date	Temperature Min-Max:		Humidity Min-Max:	
19.06.2025 – 25.06.2025	21.3 °C	23.7 °C	29.3 RH%	41.8 RH%

Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
30 - 26900	13452.493868	-37.86 dBm	compliant
Measurement Uncertainty:			±5.33 dB

Table 21 Field Strength of Spurious Radiation

The measured emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC.

6 Test Data and Screenshots

6.1 Part List of the RF Measurement Test Equipment

No.	Test Equipment	Manufacturer & Type	Serial Number	Calibration date	Calibration due	Test No.
1	Signal Analyzer	Rohde & Schwarz FSW43	104599	12/2024	12/2025	1,2,3,4
2	Multimeter	Fluke 83	9922073A046	12/2024	12/2025	1,2,3,4
3	Network Analyzer	Rohde & Schwarz ZVL-13	101177	12/2024	12/2025	1,2,3,4
4	Vector Network Analyzer	Rohde&Schwarz, ZVA-40	100146	12/2024	12/2025	1,2,3,4
5	Calibration Unit	Rohde&Schwarz, ZV-Z54	100125	07/2024	07/2025	1,2,3,4
6	Humidity &temperature indicator	Vaisala HMP110	M2710515	07/2024	07/2025	1,2,3,4
7	Pressure, Humidity and Temperature Probe	Vaisala HMP3	W2512009	06/2024	06/2025	1,2,3,4
8	High Pass Filter	RF- Lambda RHPF23G06G40	21052000014	cnn	-	4
9	DC Power Supply	Elektro-Automatik PSI 8080-510	2057220001	cnn	-	1,2,3,4
10	Attenuator	SHX DTS100G-20dB-24G	14111101	cnn	-	4
11	EMI Test Receiver	R&S	103055	06/2025	06/2026	5
13	Bilog Antenna	Schaffner Chase	2003	08/2024	08/2025	5
14	Horn Antenna	ETS-Lindgren	69381	08/2024	08/2025	5
15	Horn Antenna	ETS-Lindgren	75823	11/2024	11/2025	5
16	Horn Antenna	ETS-Lindgren	206990	08/2024	08/2025	5
17	4-meter mast	Maturo	123/21250317	cnr	cnr	5
18	Mast Controller	Maturo	21250317	cnr	cnr	5
19	Humidity and temperature meter	Vaisala	T0841033	12/2024	12/2025	5

20	Anechoic Chamber	Comtest	1711-200-216453	10/2022	10/2025	5
21	High pass filter	Creowave Filters	2419001	cnr	cnr	5
22	Band Stop Filter	Creowave Filters	2337001	cnr	cnr	5

Table 22 Part List of the RF Measurement Test Equipment

6.2 Spectral Plots

NOTE: Only a sample of the spectral plots are used and visible in this report. All measured test results and data are saved in Oulu located server.

6.2.1 Test No. 1: RF Output Power

Config A Power spectral density NR 15MHz BW

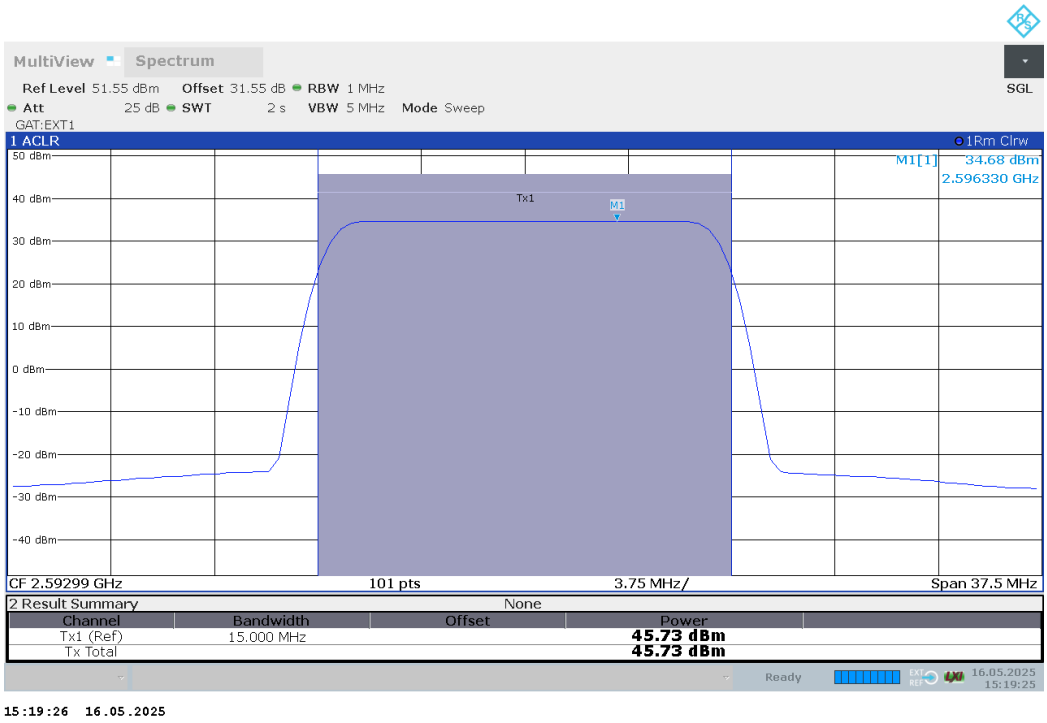


Figure 2 Test Model 1.1, Modulation QPSK, Channel Frequency 2592.99MHz, TX port 2

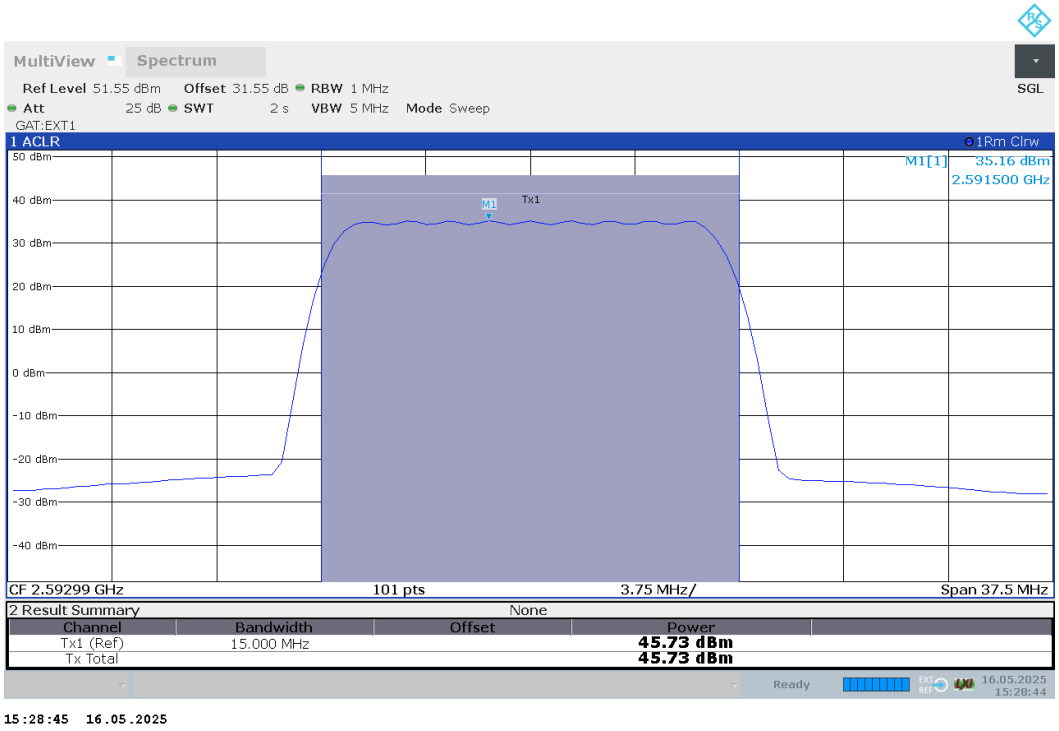


Figure 3 Test Model 3.2, Modulation 16QAM, Channel Frequency 2592.99MHz, TX port 2

Config B Power spectral density NR 49.5MHz BW

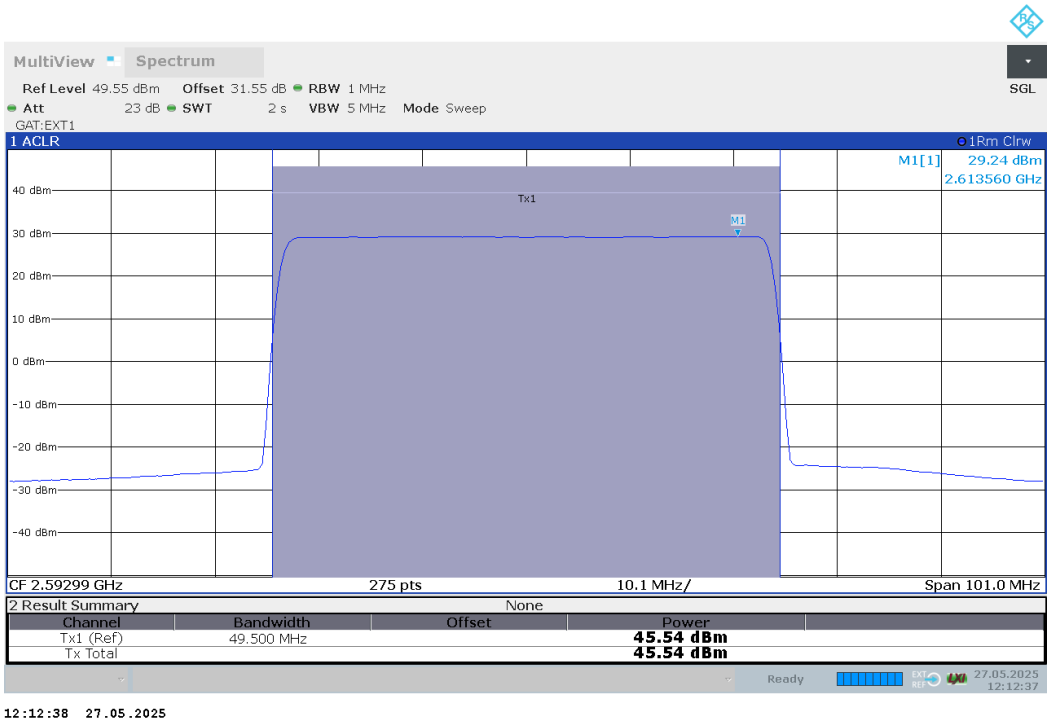


Figure 4 Test Model 3.1, Modulation 64QAM, Channel Frequency 2592.99MHz, TX port 1

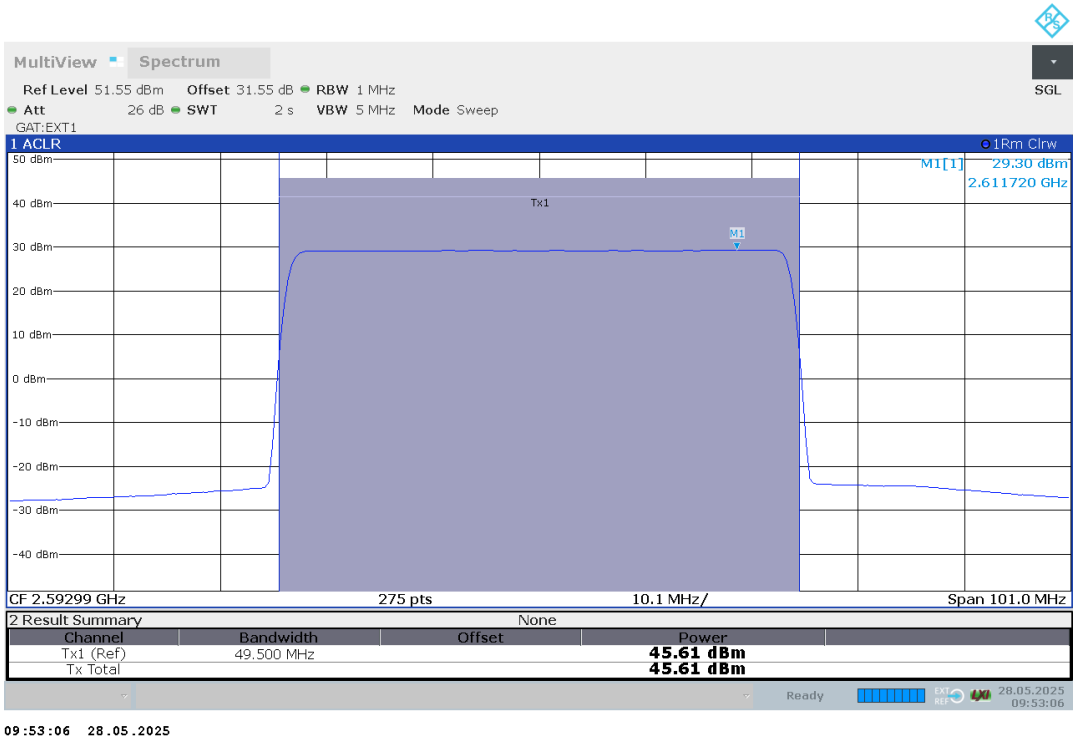


Figure 5 Test Model 3.1a, Modulation 256QAM, Channel Frequency 2592.99MHz, TX Port1

Config A Peak-to-Average Power Ratio (PAPR) NR 15MHz BW

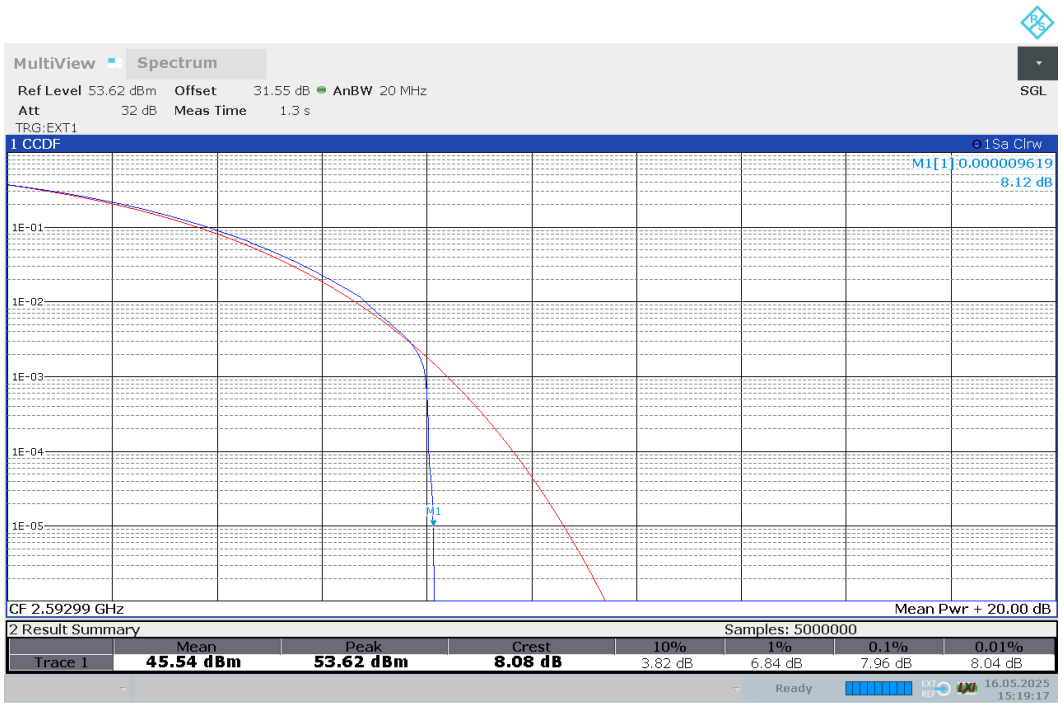


Figure 6 Test Model 1.1, Modulation QPSK, Channel Frequency 2592.99MHz, Tx Port2

Config B Peak-to-Average Power Ratio (PAPR) NR 49.5MHz BW

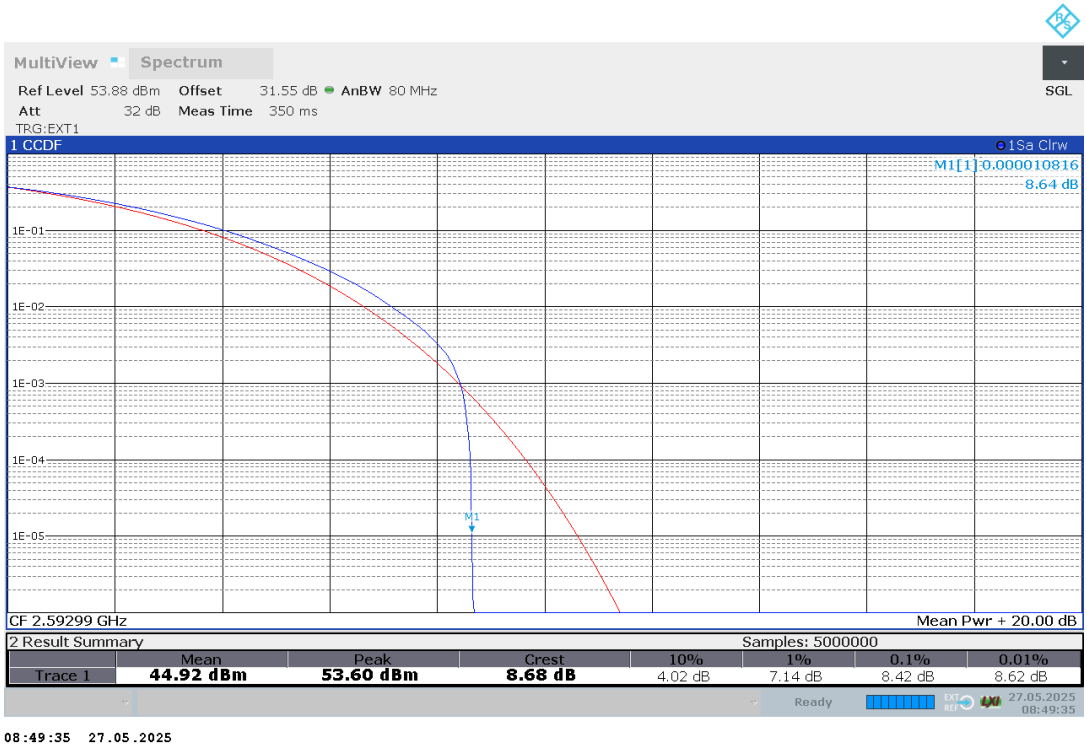


Figure 7 Test Model 1.1, Modulation QPSK, Channel Frequency 2592.99MHz, Tx Port1

6.2.2 Test No. 2: Modulation Characteristics

No additional measurements are required for the modulation characteristics. Please refer to test no. 3, occupied bandwidth on page 20.

Screenshots below show information about the modulations I/Q constellation form and modulation information table, displaying error to ideal modulation symbols.

Figure 8 I/Q constellation diagram with capture buffer – QPSK (2592.99MHz) (NR 15MHz Channel BW)

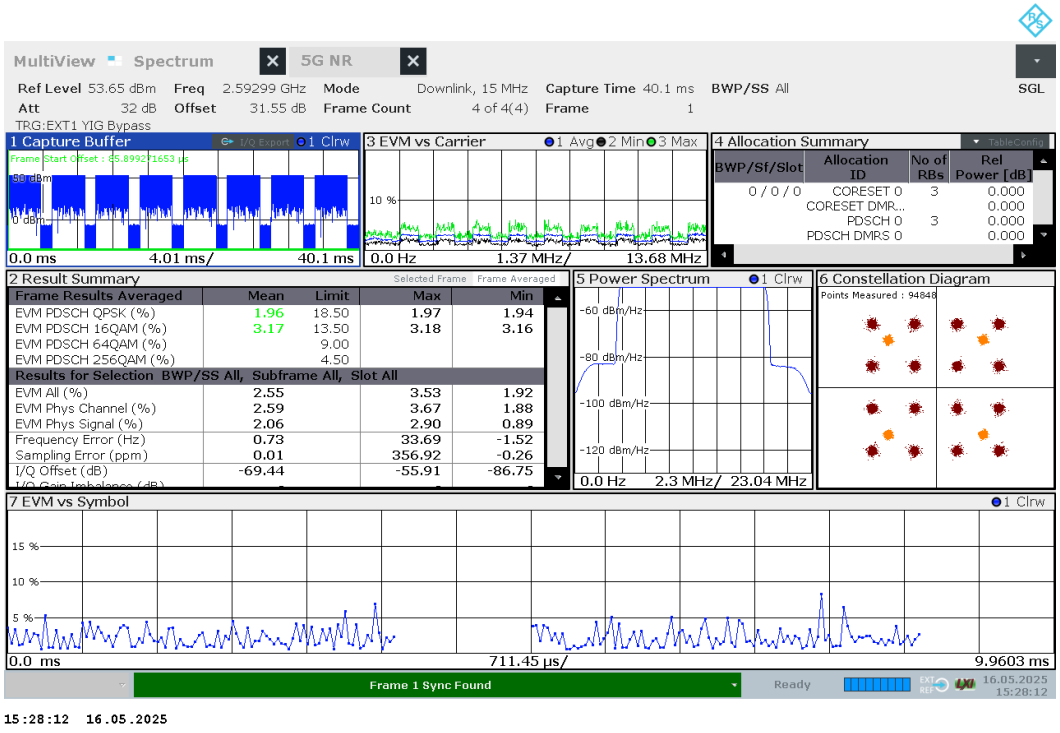


Figure 9 I/Q constellation diagram with capture buffer – 16QAM (2592.99 MHz) (NR 15MHz Channel BW)

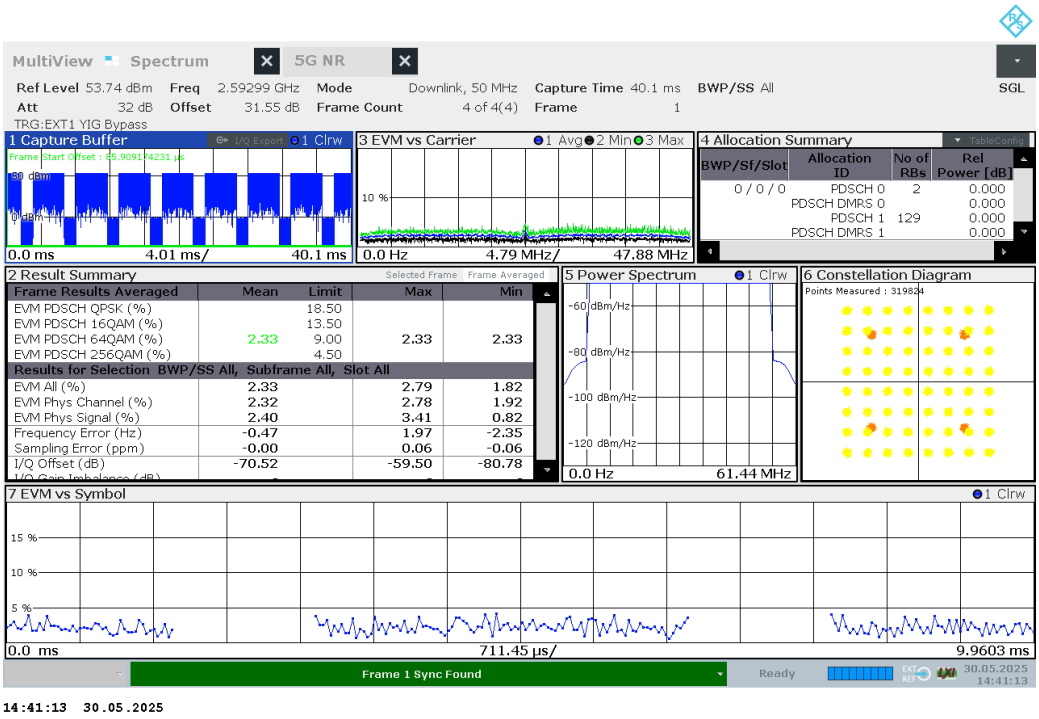


Figure 10 I/Q constellation diagram with capture buffer – 64QAM (2592.99 MHz) (NR 49.5MHz Channel BW)

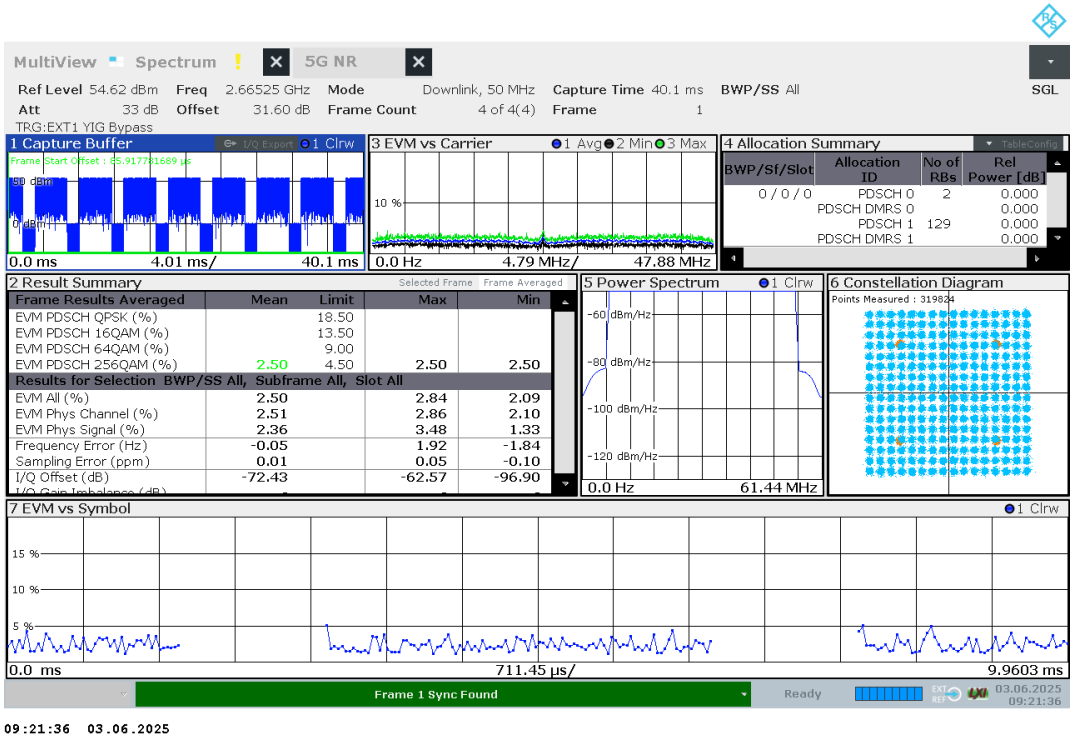


Figure 11 I/Q constellation diagram with capture buffer –256QAM (2592.99 MHz) (NR 49.5MHz Channel BW)

6.2.3 Test No. 3: Occupied Bandwidth

Config A Occupied Bandwidth 99% plots

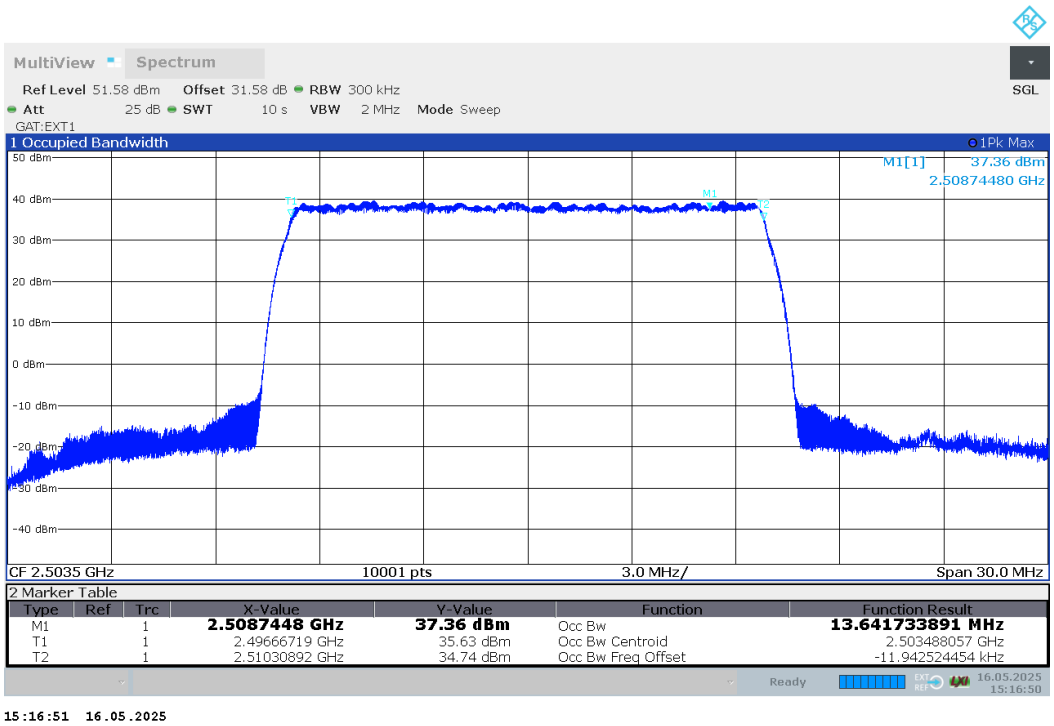


Figure 12 Test Model 1.1, Modulation QPSK, Channel Frequency 2503.5MHz, Tx Port2

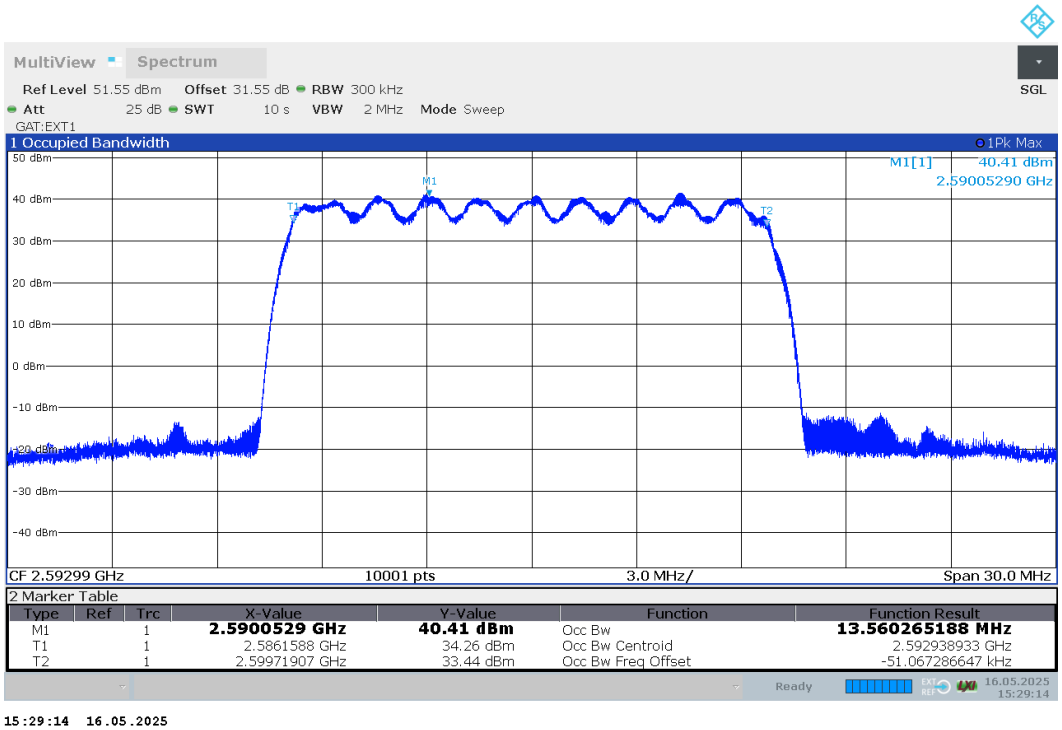


Figure 13 Test Model 3.2, Modulation 16QAM, Channel Frequency 2592.99MHz, Tx Port2

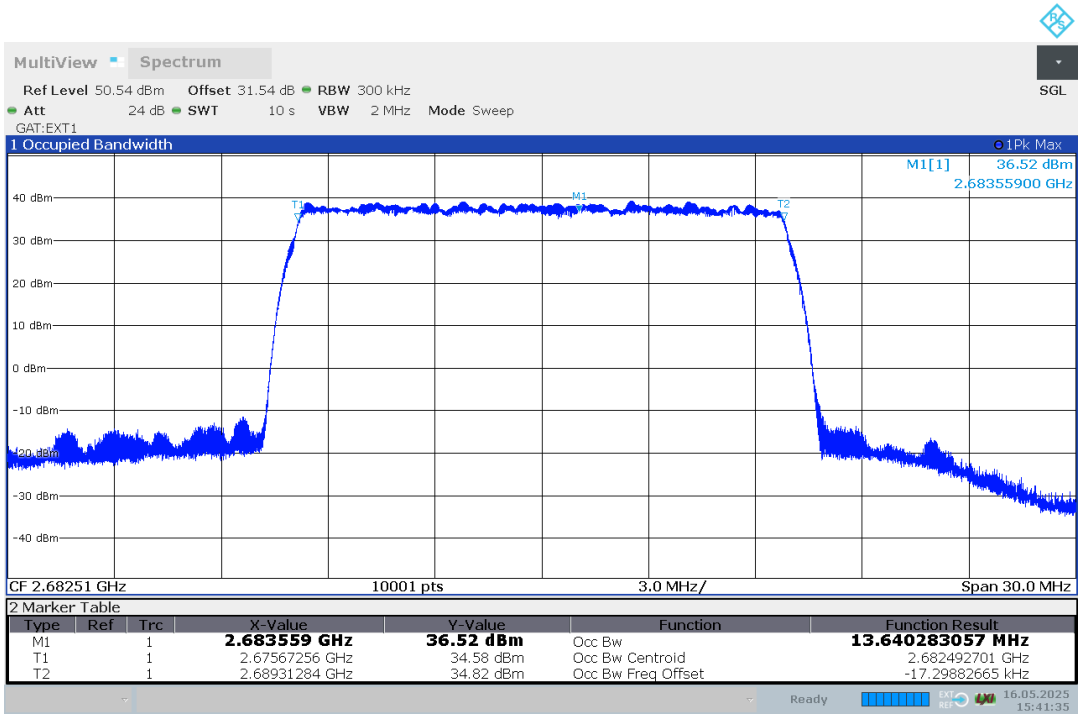


Figure 14 Test Model 3.1, Modulation 64QAM, Channel Frequency 2682.51MHz, Tx Port2

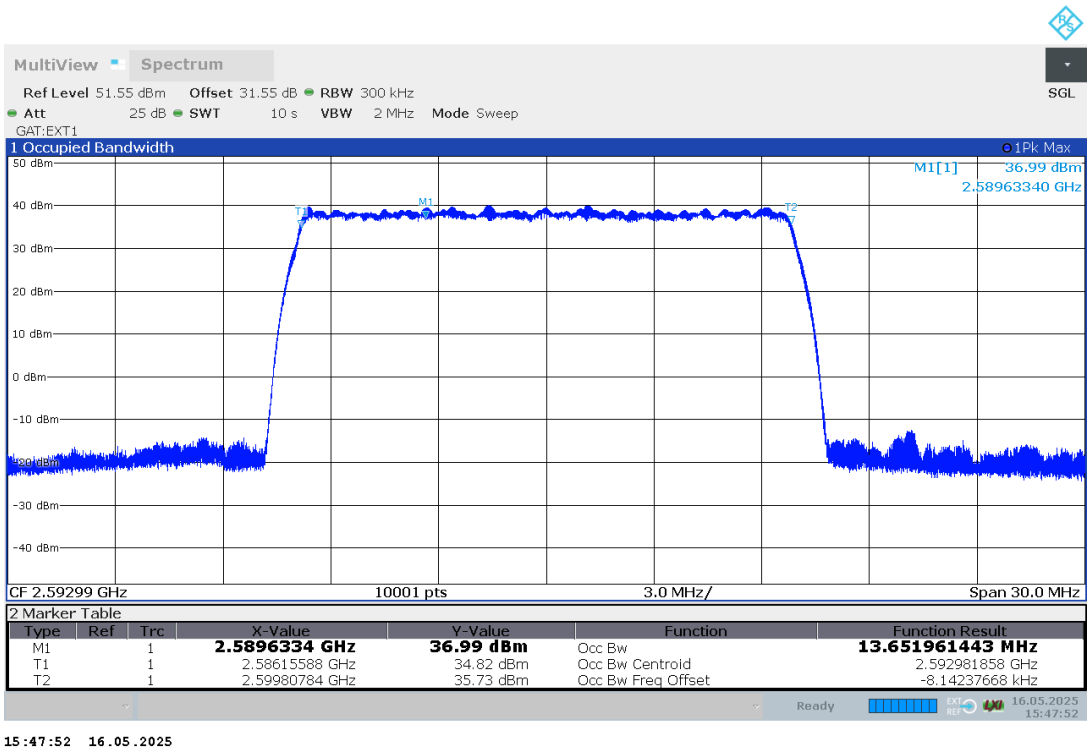


Figure 15 Test Model 3.1a, Modulation 256QAM, Channel Frequency 2592.99MHz, Tx Port2

Config A Occupied Bandwidth -26dB plots

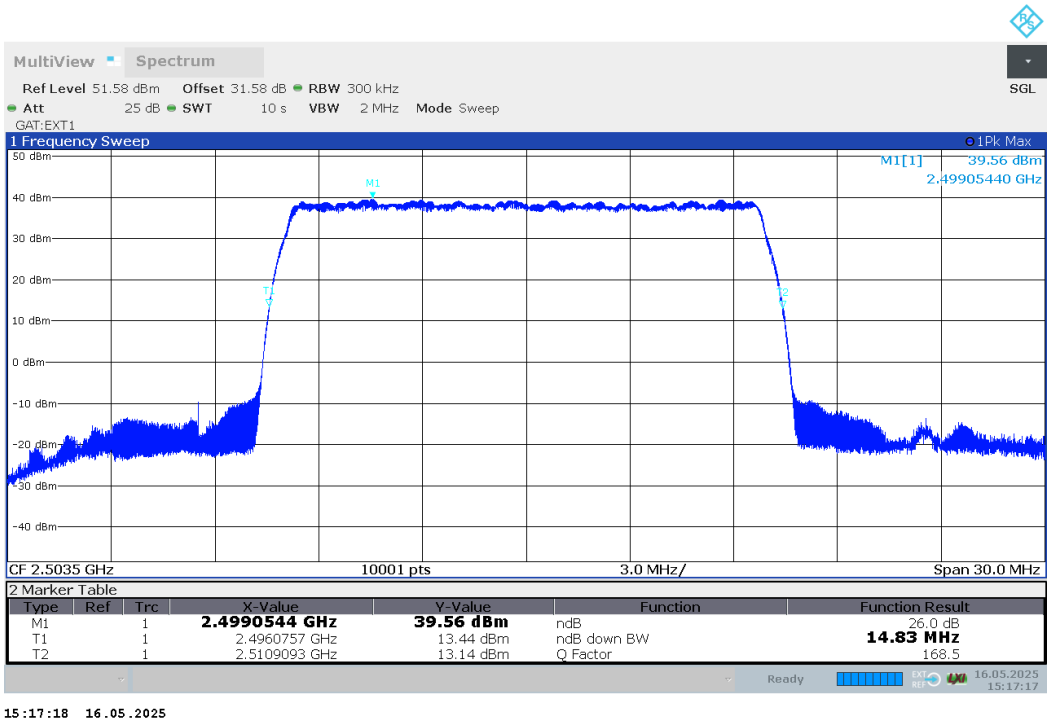


Figure 16 Test Model 1.1, Modulation QPSK, Channel Frequency 2503.5MHz, Tx Port2

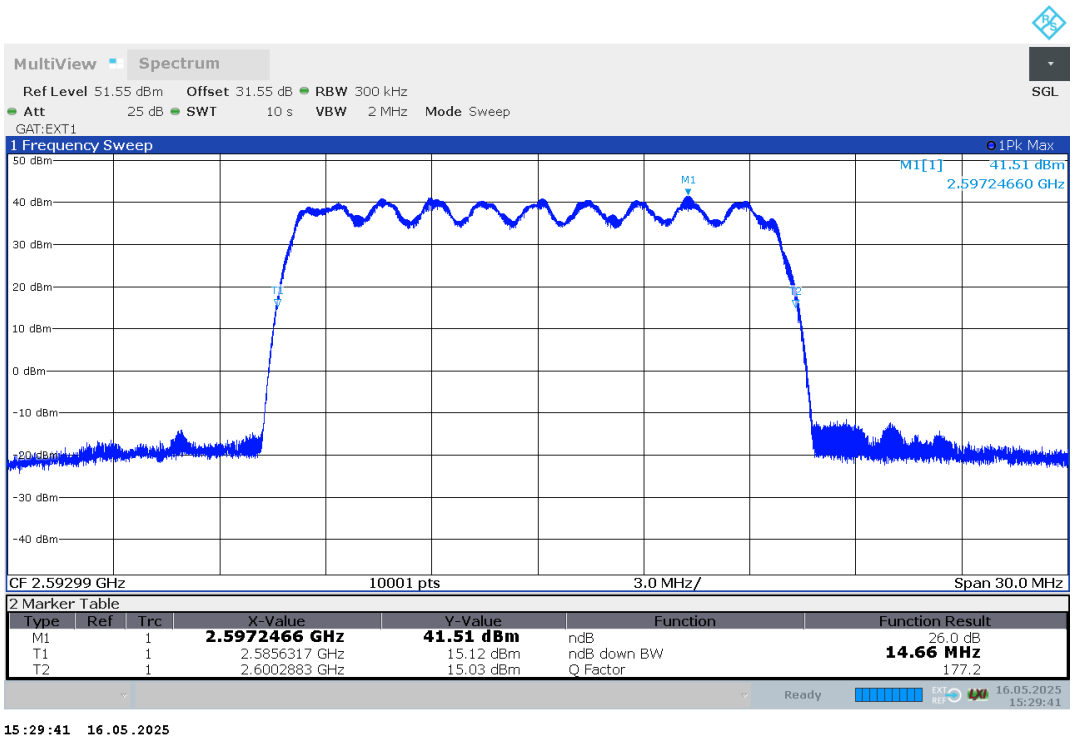


Figure 17 Test Model 3.2, Modulation 16QAM, Channel Frequency 2592.99MHz, Tx Port2

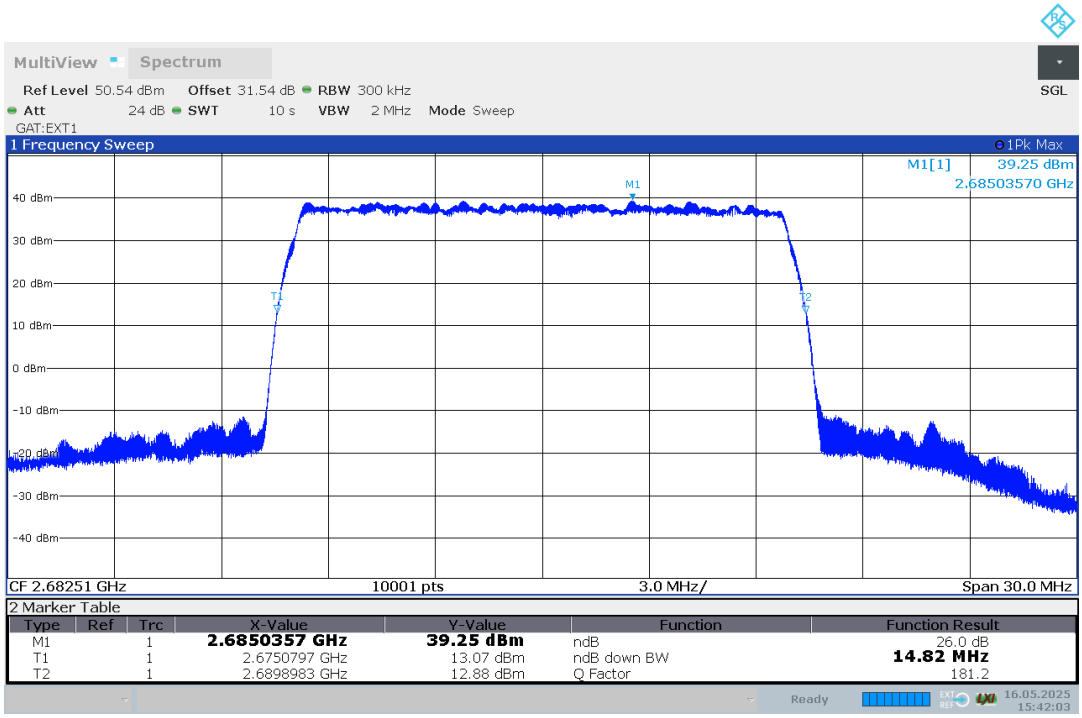


Figure 18 Test Model 3.1, Modulation 64QAM, Channel Frequency 2682.51MHz, Tx Port2

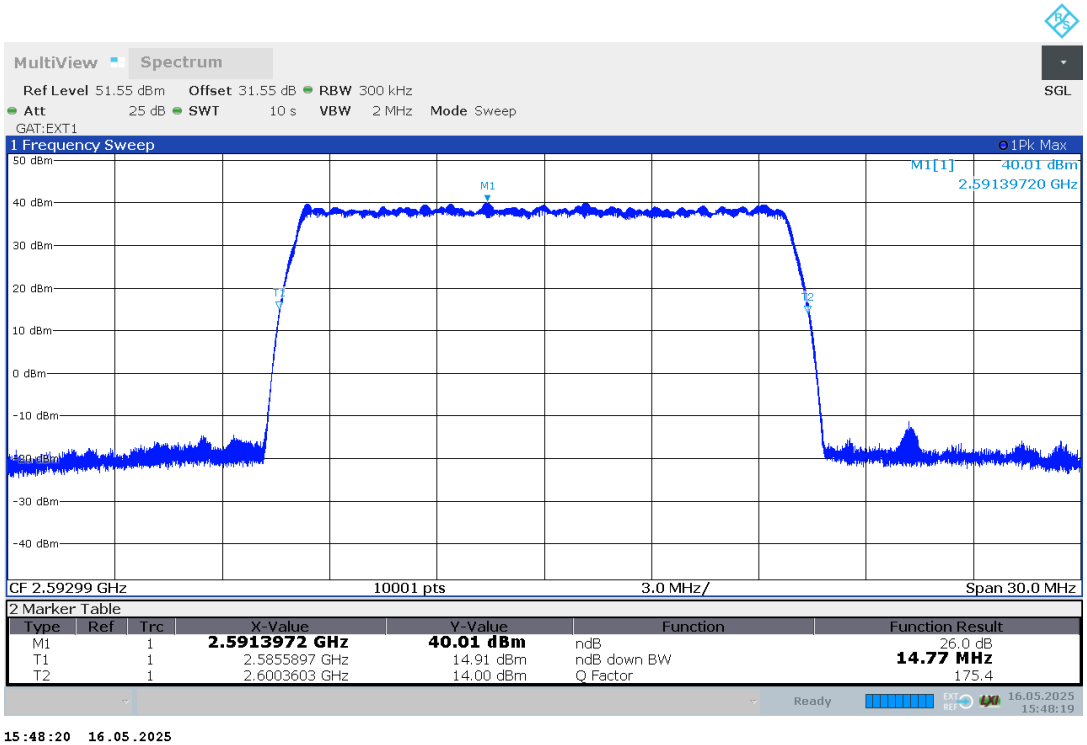
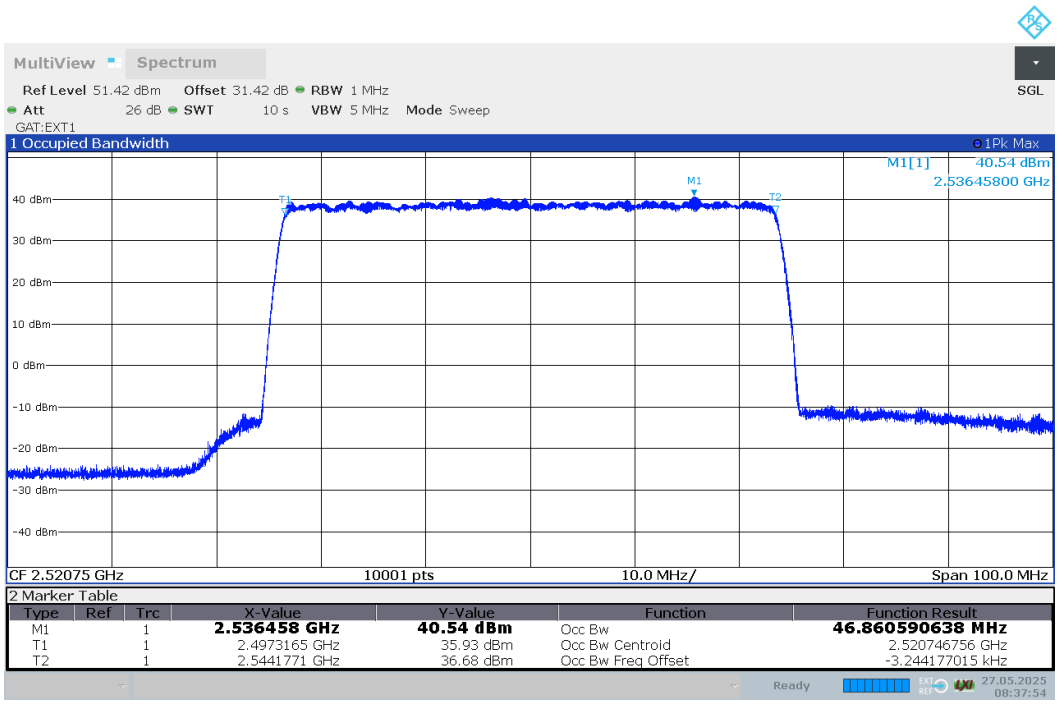


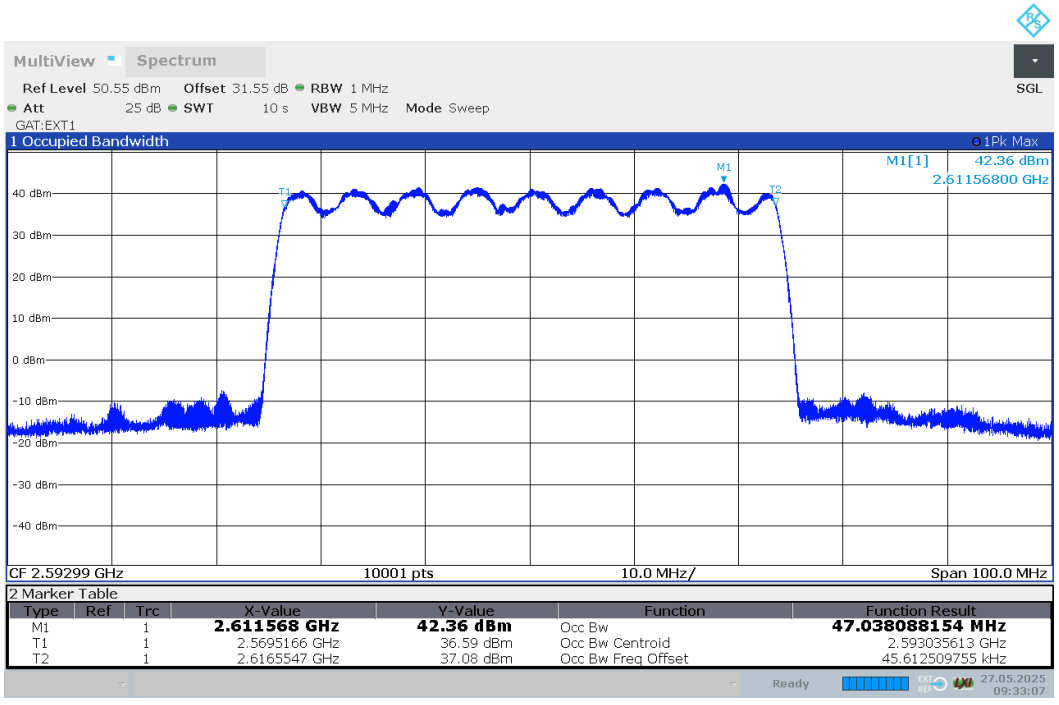
Figure 19 Test Model 3.1a, Modulation 256QAM, Channel Frequency 2592.99MHz, Tx Port2

Config B Occupied Bandwidth 99% plots



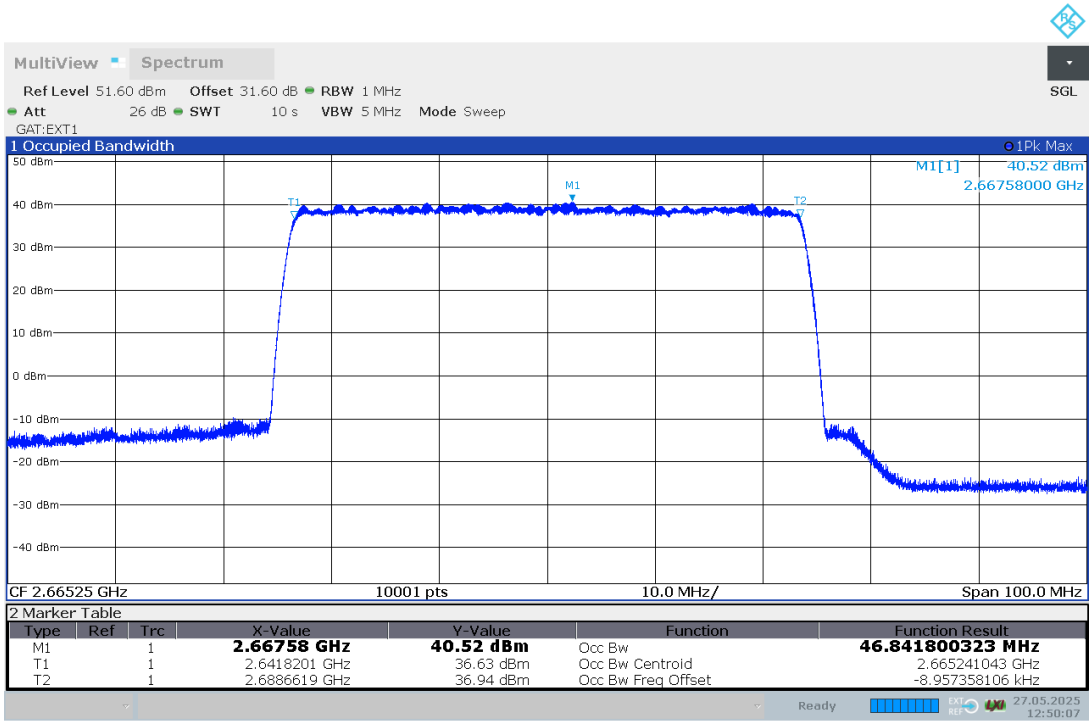
08:37:54 27.05.2025

Figure 20 Test Model 1.1, Modulation QPSK, Channel Frequency 2520.75MHz, Tx Port1



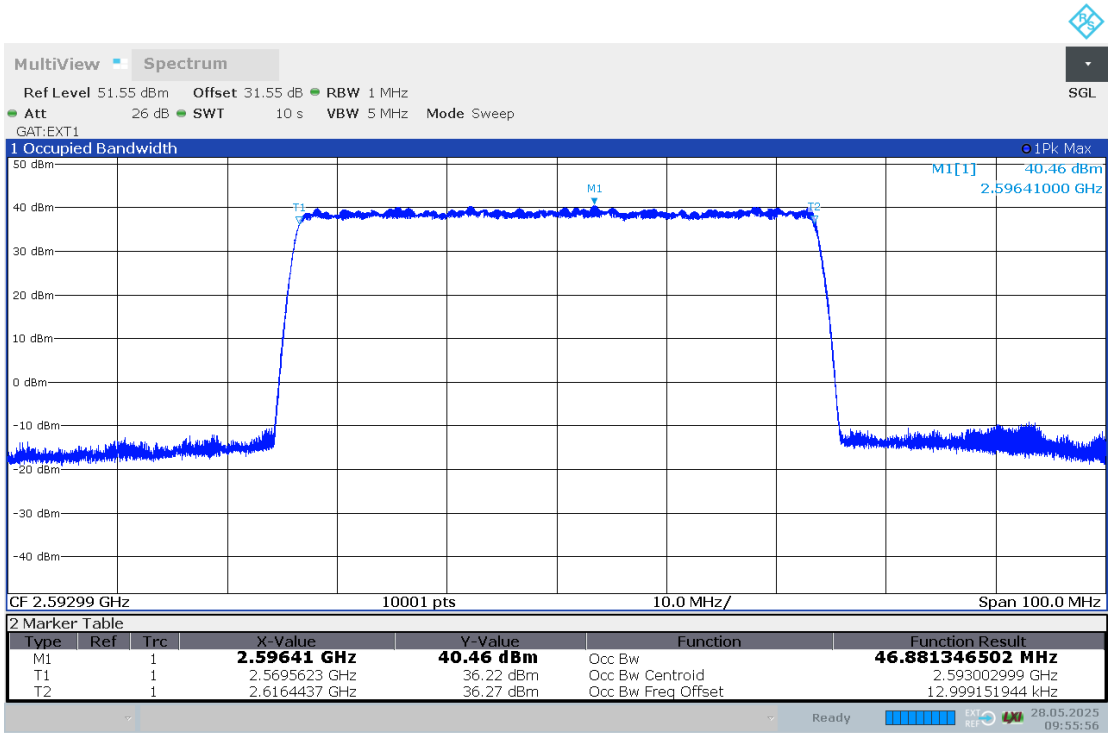
09:33:07 27.05.2025

Figure 21 Test Model 3.2, Modulation 16QAM, Channel Frequency 2592.99MHz, Tx Port1



12:50:07 27.05.2025

Figure 22 Test Model 3.1, Modulation 64QAM, Channel Frequency 2665.25MHz, Tx Port1



09:55:57 28.05.2025

Figure 23 Test Model 3.1a, Modulation 256QAM, Channel Frequency 2592.99MHz, Tx Port1

Config B Occupied Bandwidth -26dB plots

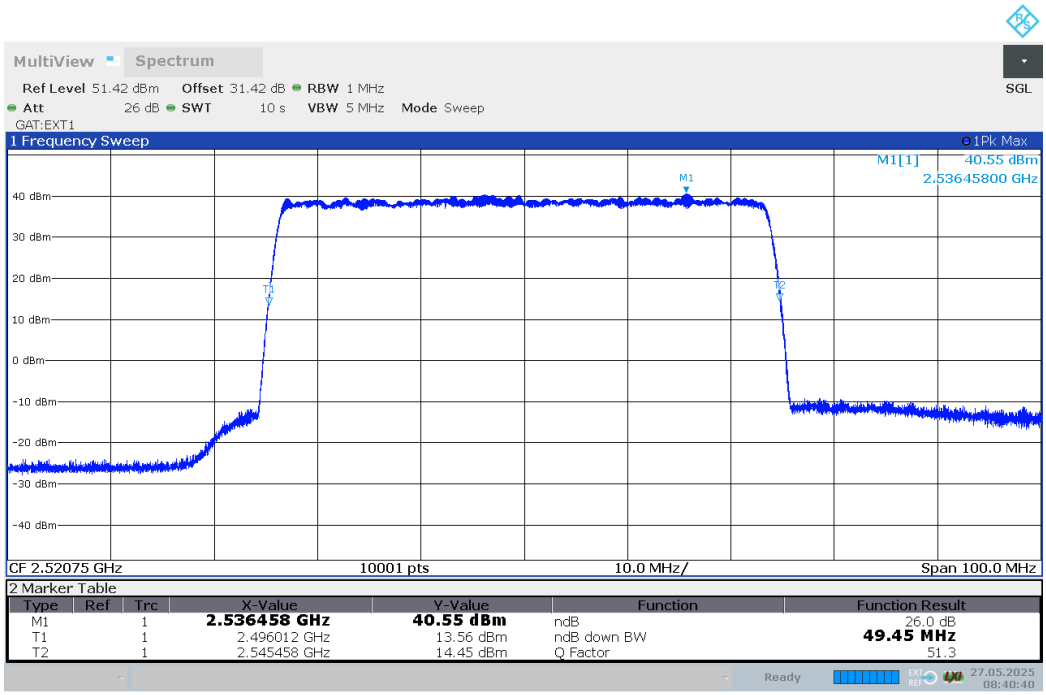


Figure 24 Test Model 1.1, Modulation QPSK, Channel Frequency 2520.75MHz, Tx Port1

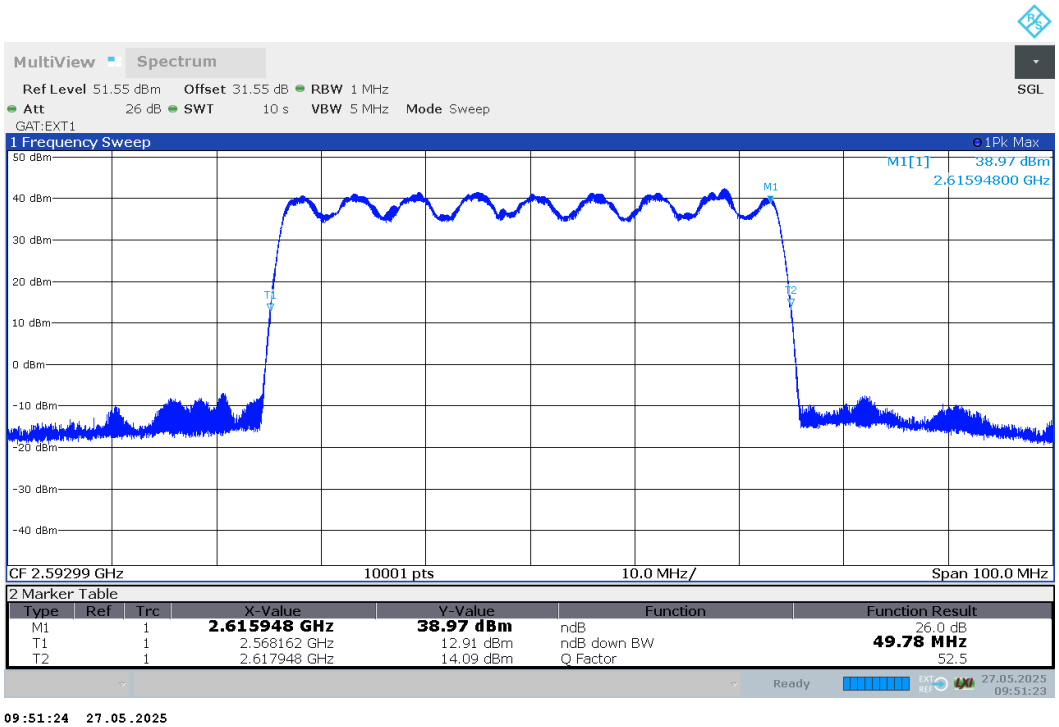
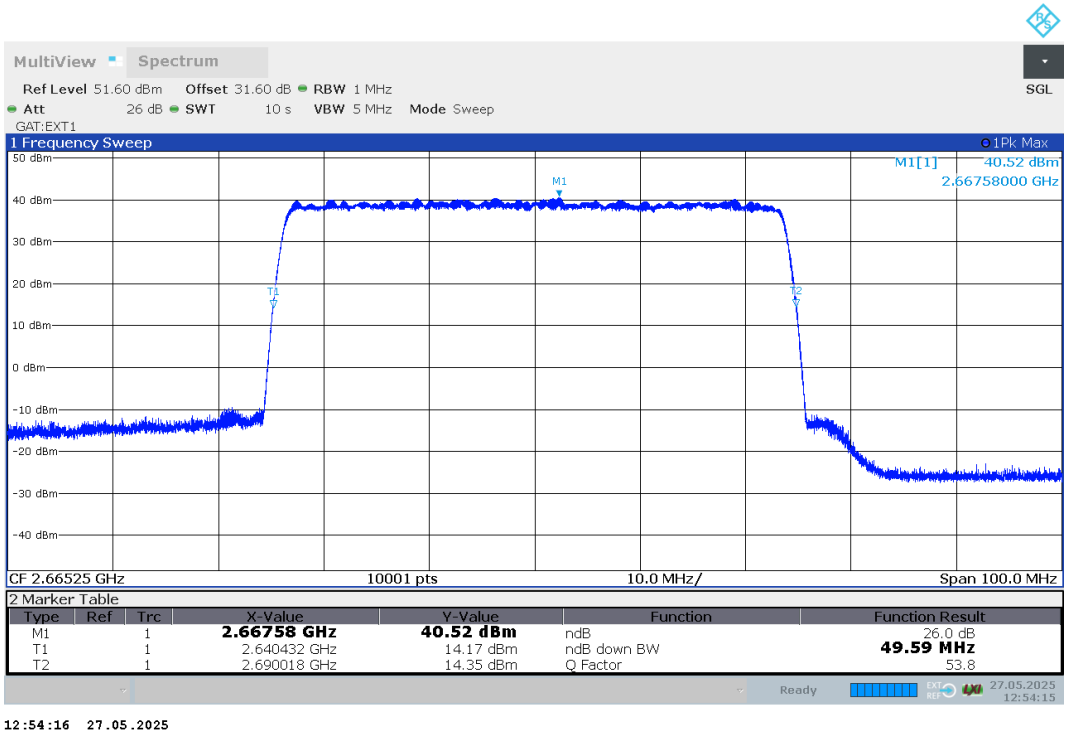
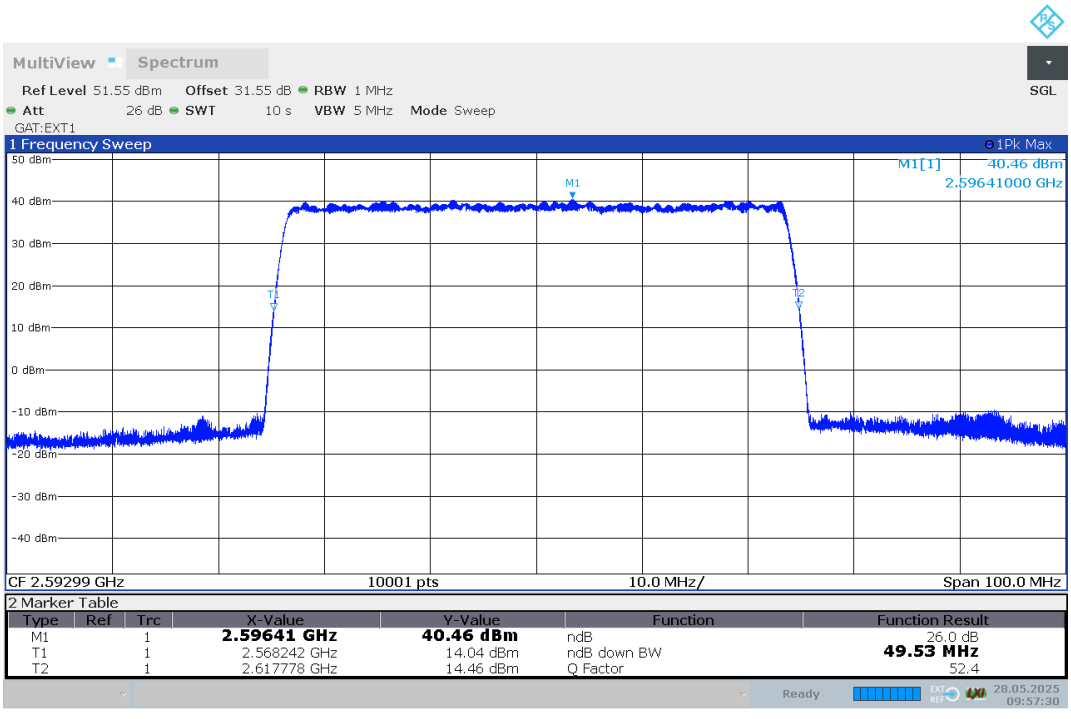


Figure 25 Test Model 3.2, Modulation 16QAM, Channel Frequency 2592.99MHz, Tx Port1



12:54:16 27.05.2025

Figure 26 Test Model 3.1, Modulation 64QAM, Channel Frequency 2665.25MHz, Tx Port1



09:57:31 28.05.2025

Figure 27 Test Model 3.1a, Modulation 256QAM, Channel Frequency 2592.99MHz, Tx Port1

6.2.4 Test No. 4: Spurious Emissions at the Antenna Terminals

Config A TX port 2:

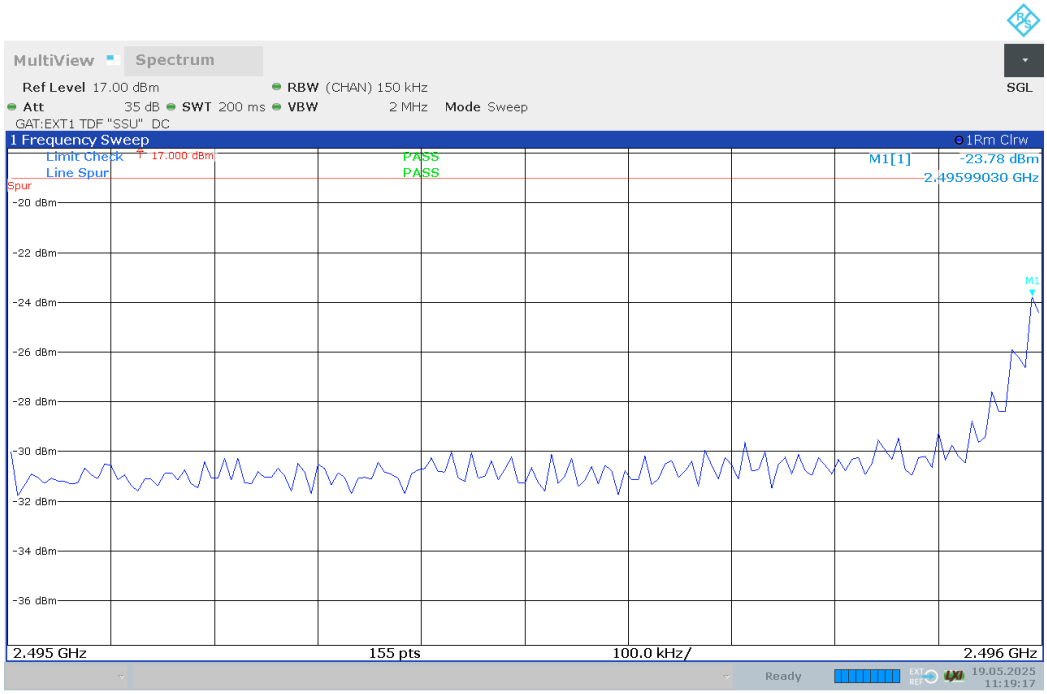


Figure 28 Spurious Emissions (Lower Band Edge) – 256QAM (2503.5MHz) (15MHz Channel BW)

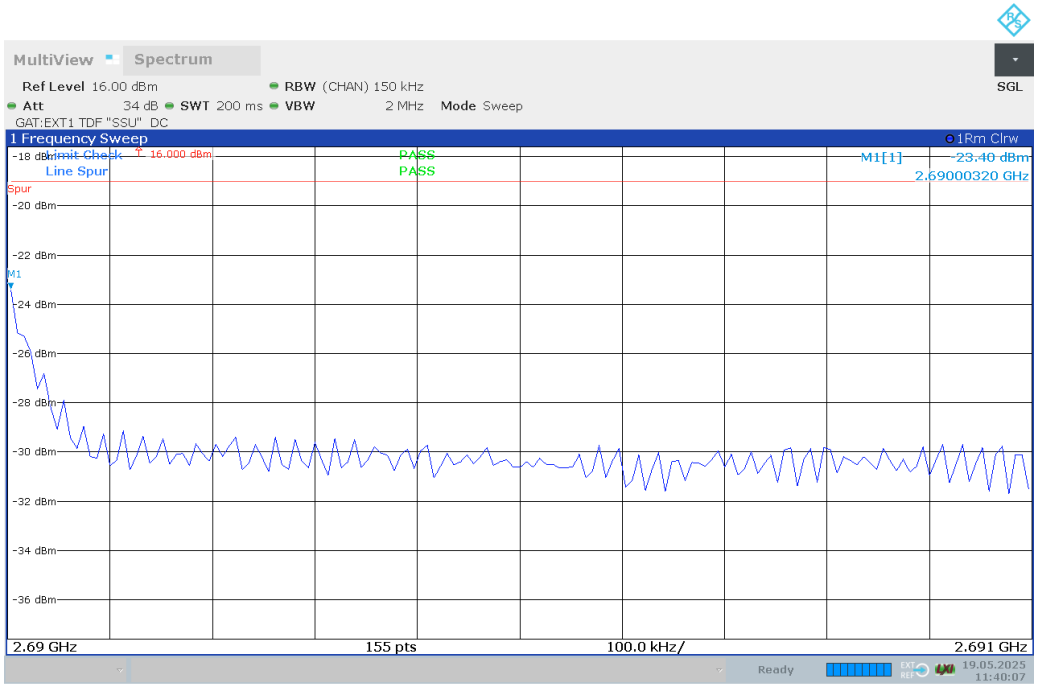


Figure 29 Spurious Emissions (Upper Band Edge) – 16QAM (2682.51MHz) (15MHz Channel BW)

Config A TX port 2:

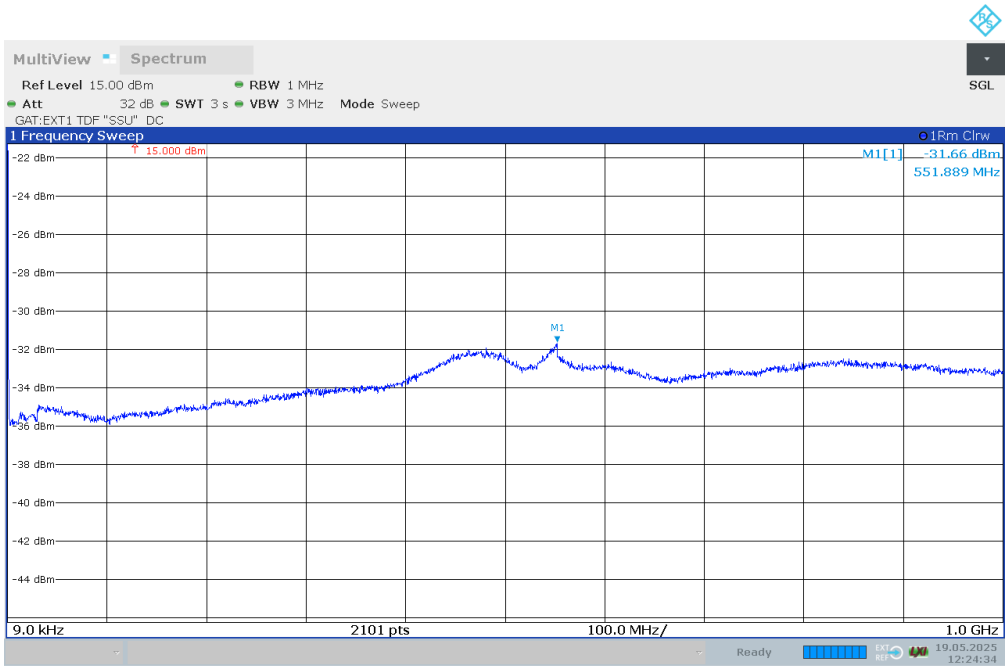


Figure 30 Spurious Emissions (9kHz – 1GHz) – 16QAM (2592.99 MHz) (15MHz Channel BW)

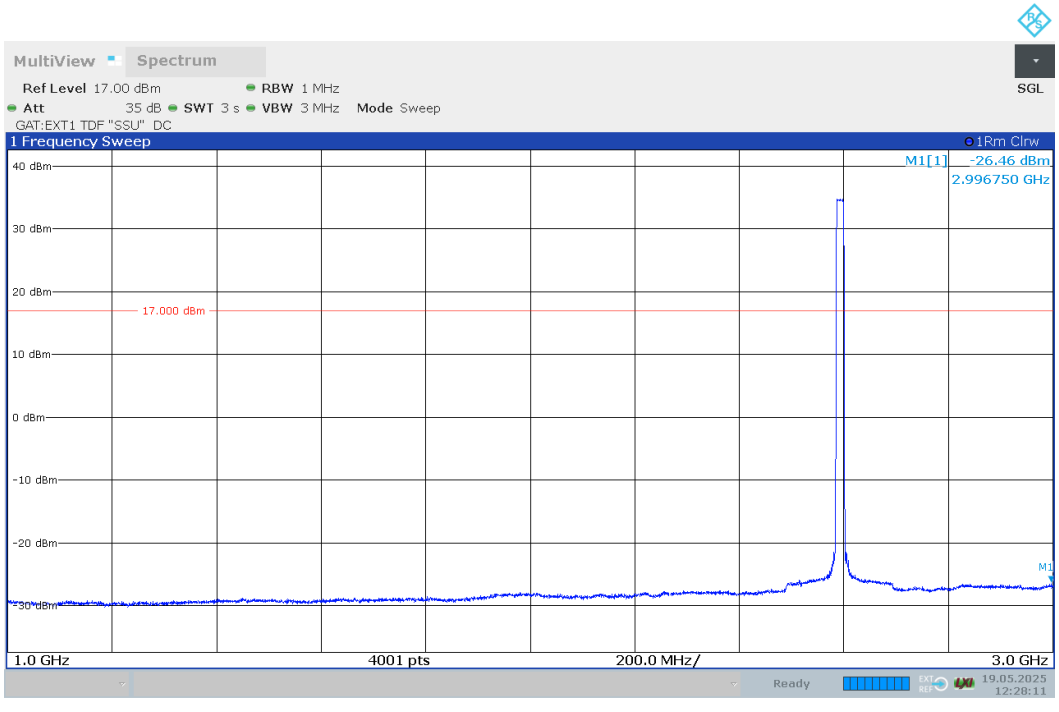


Figure 31 Spurious Emissions (1GHz – 3GHz) – 64QAM (2592.99 MHz) (15MHz Channel BW)

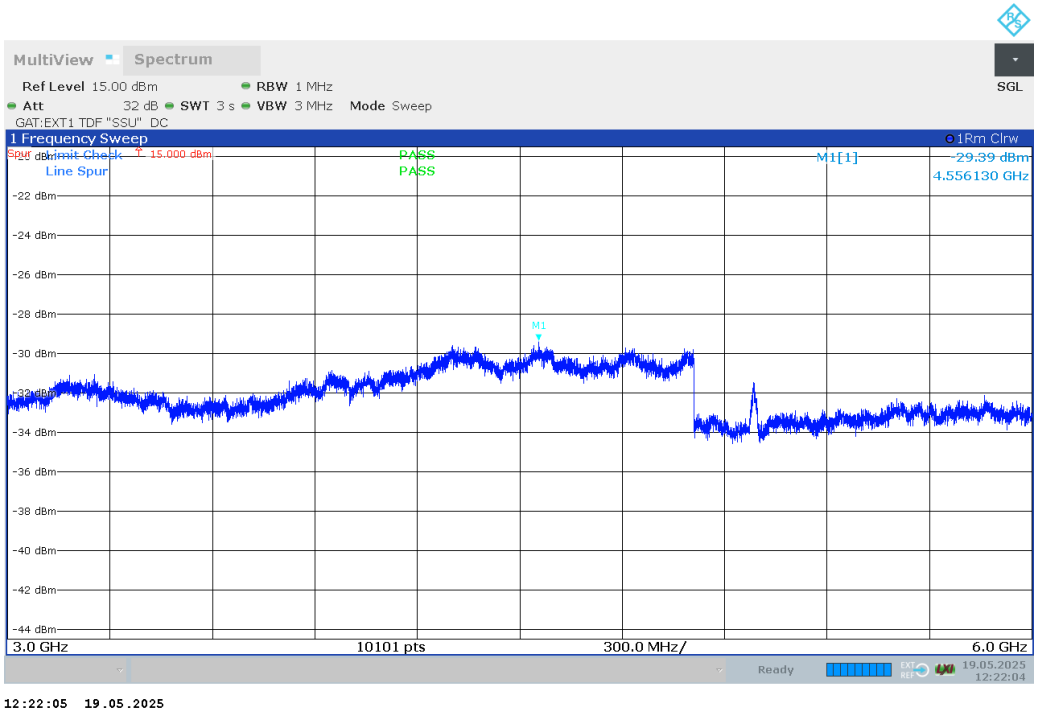


Figure 32 Spurious Emissions (3GHz – 6GHz) – 256QAM (2592.99 MHz) (15MHz Channel BW)

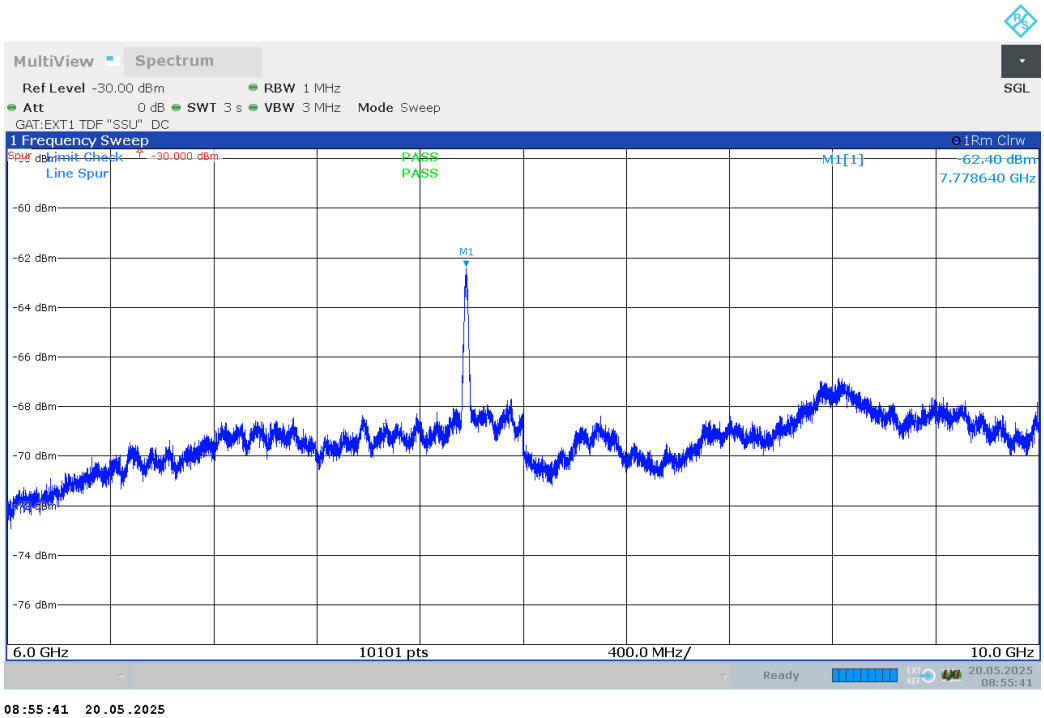


Figure 33 Spurious Emissions (6GHz – 10GHz) – 16QAM (2592.99 MHz) (15MHz Channel BW)

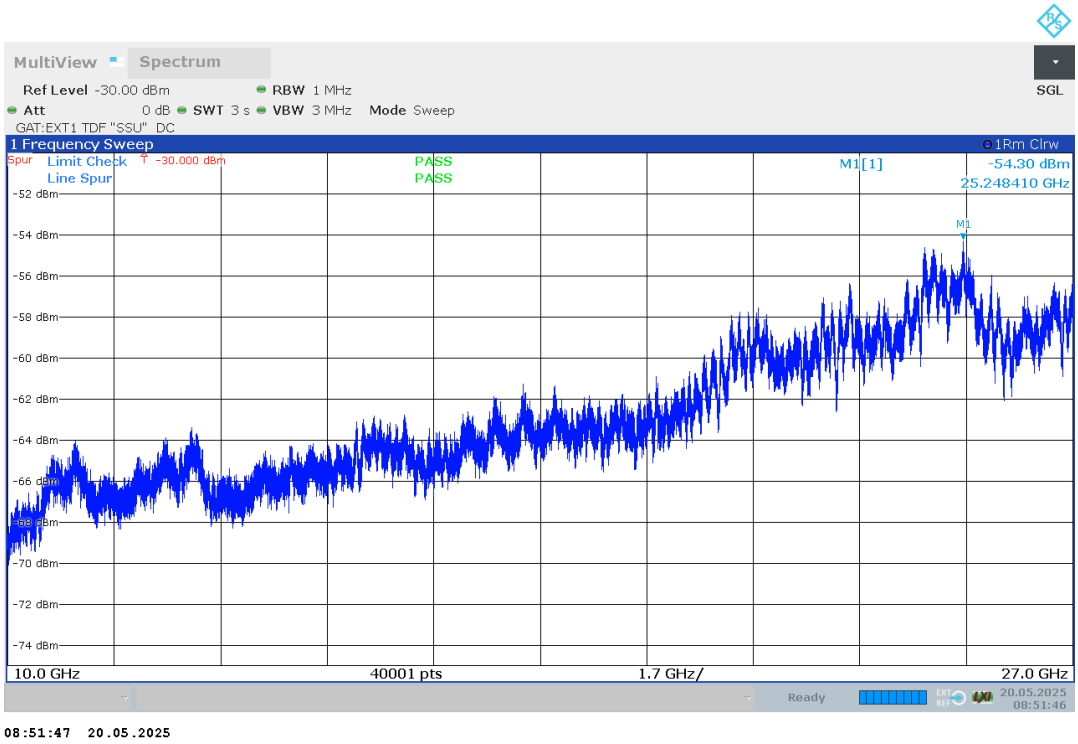


Figure 34 Spurious Emissions (10GHz – 27GHz) – QPSK (2592.99 MHz) (15MHz Channel BW)

Config B TX port 1:

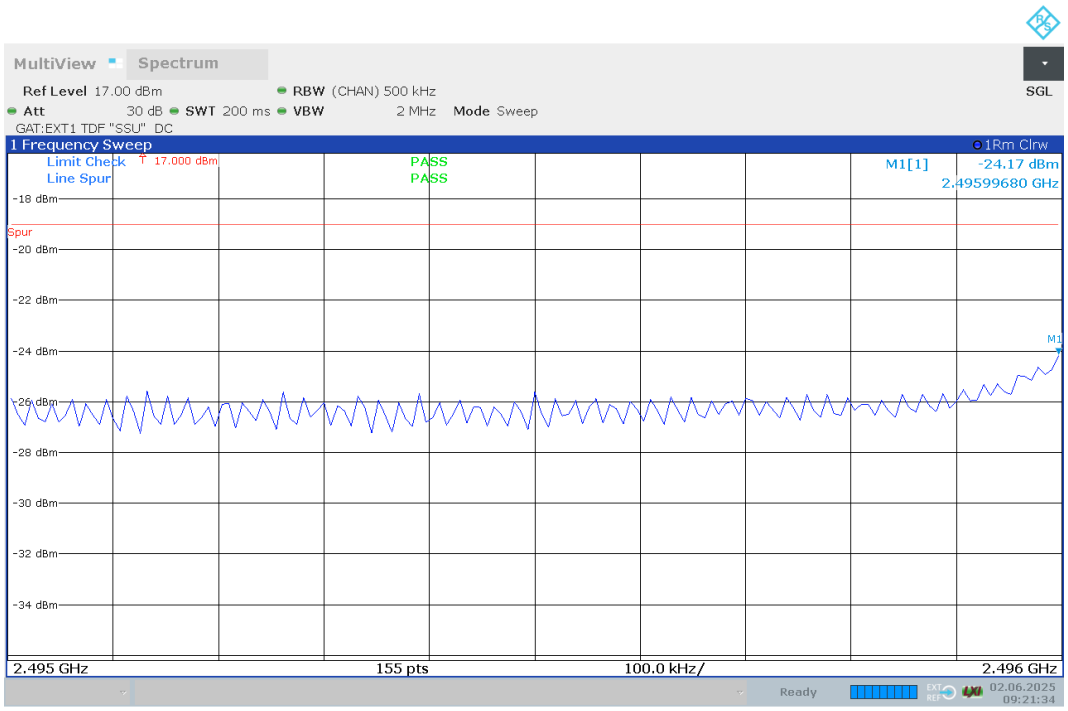


Figure 35 Spurious Emissions (Lower Band Edge) – QPSK (2520.75MHz) (49.5MHz Channel BW)

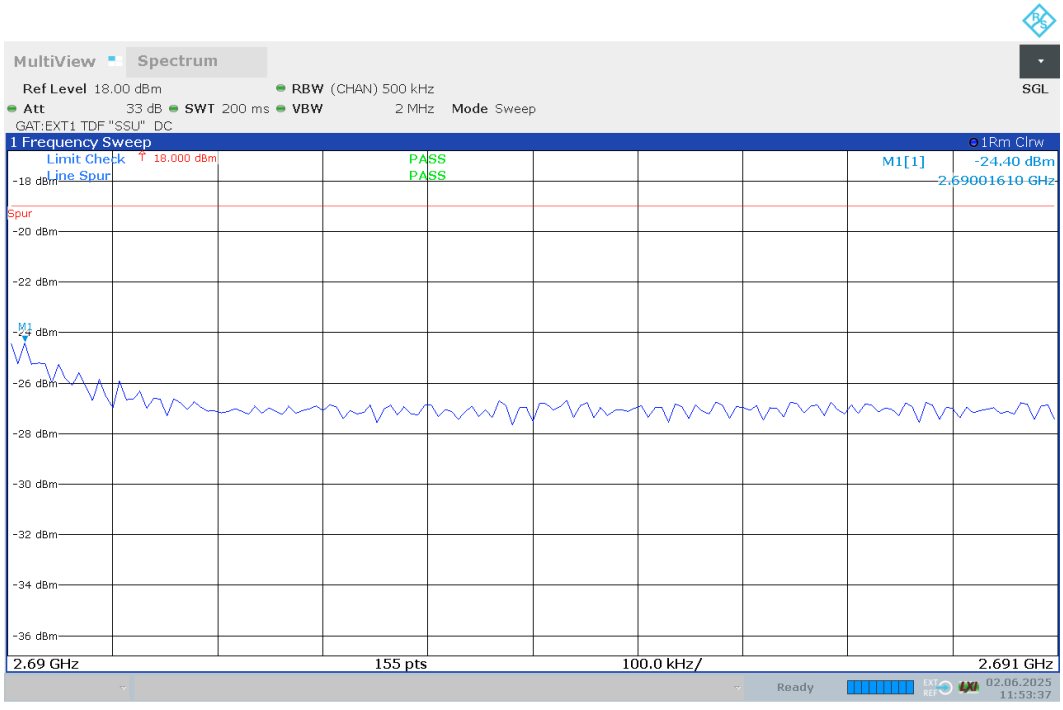


Figure 36 Spurious Emissions (Upper Band Edge) – QPSK (2665.25MHz) (49.5MHz Channel BW)

Config B TX port 1:

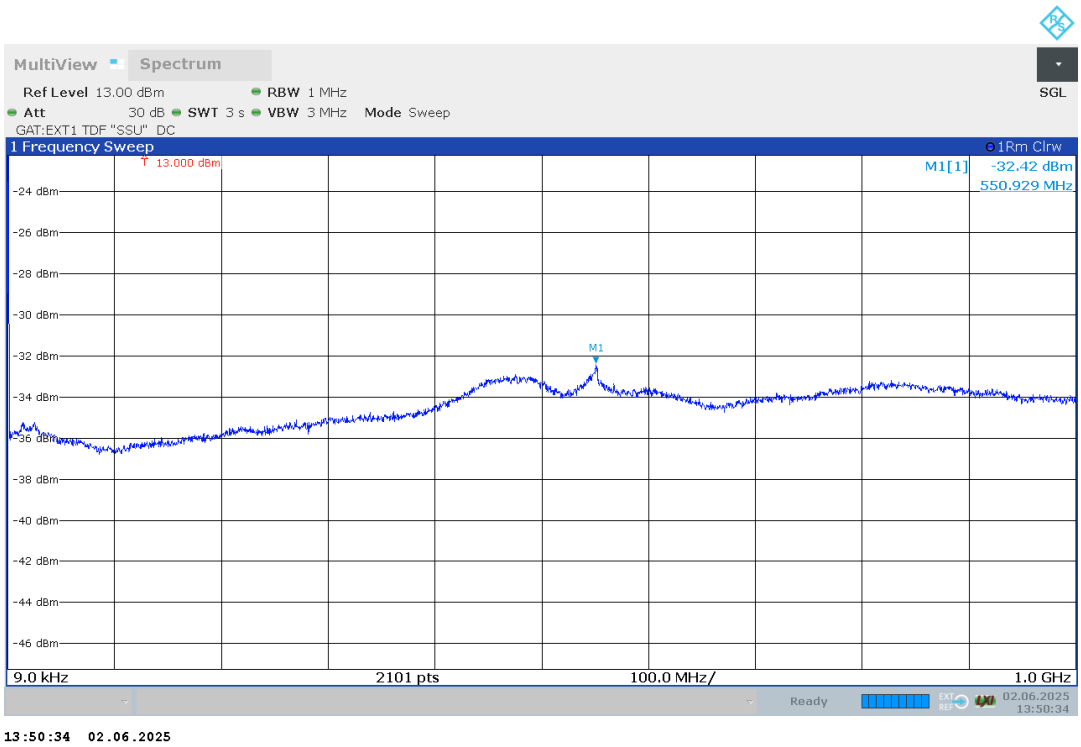


Figure 37 Spurious Emissions (9kHz – 1GHz) - QPSK (2592.99 MHz) (49.5MHz Channel BW)

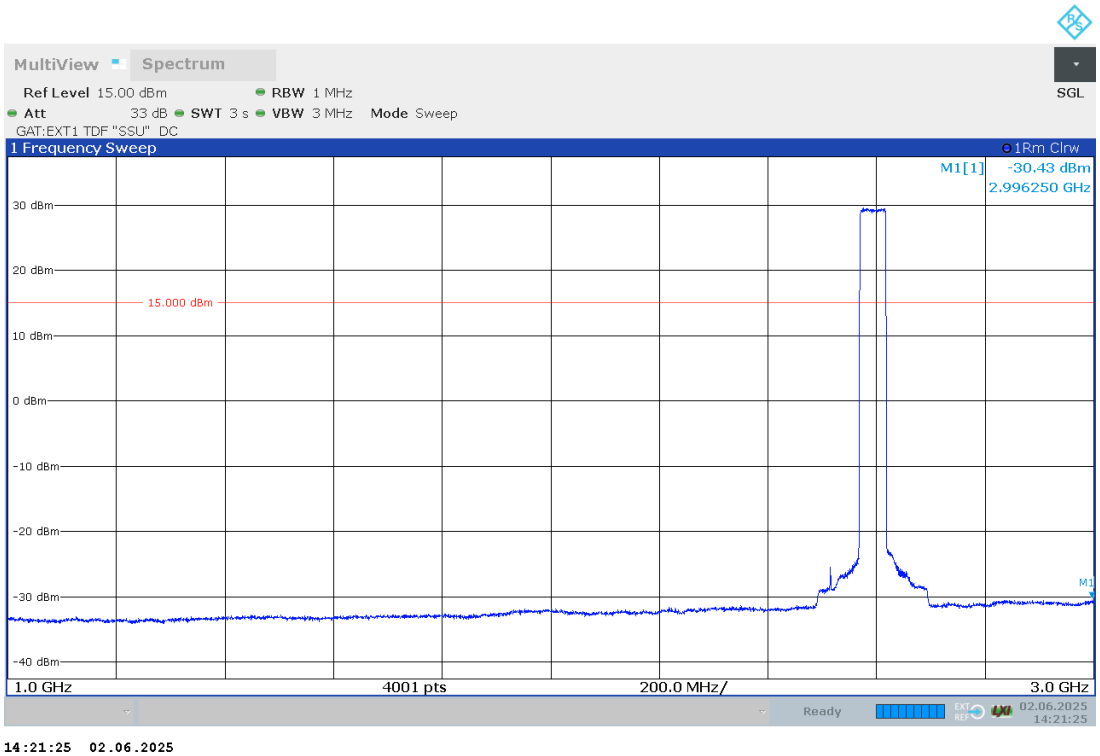
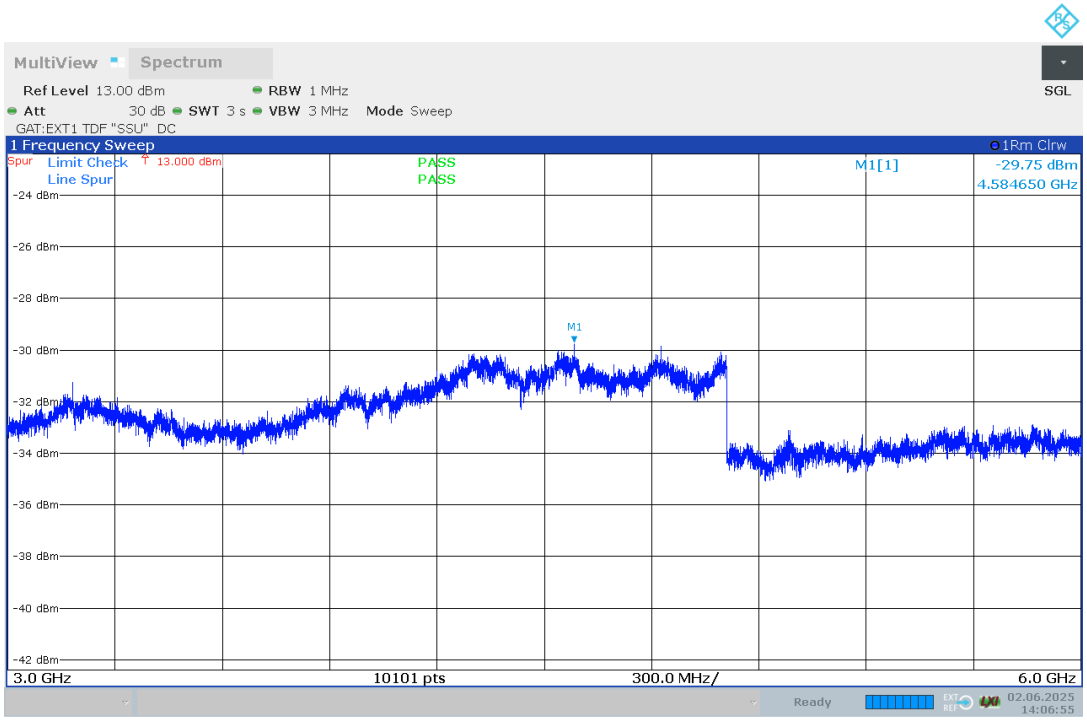
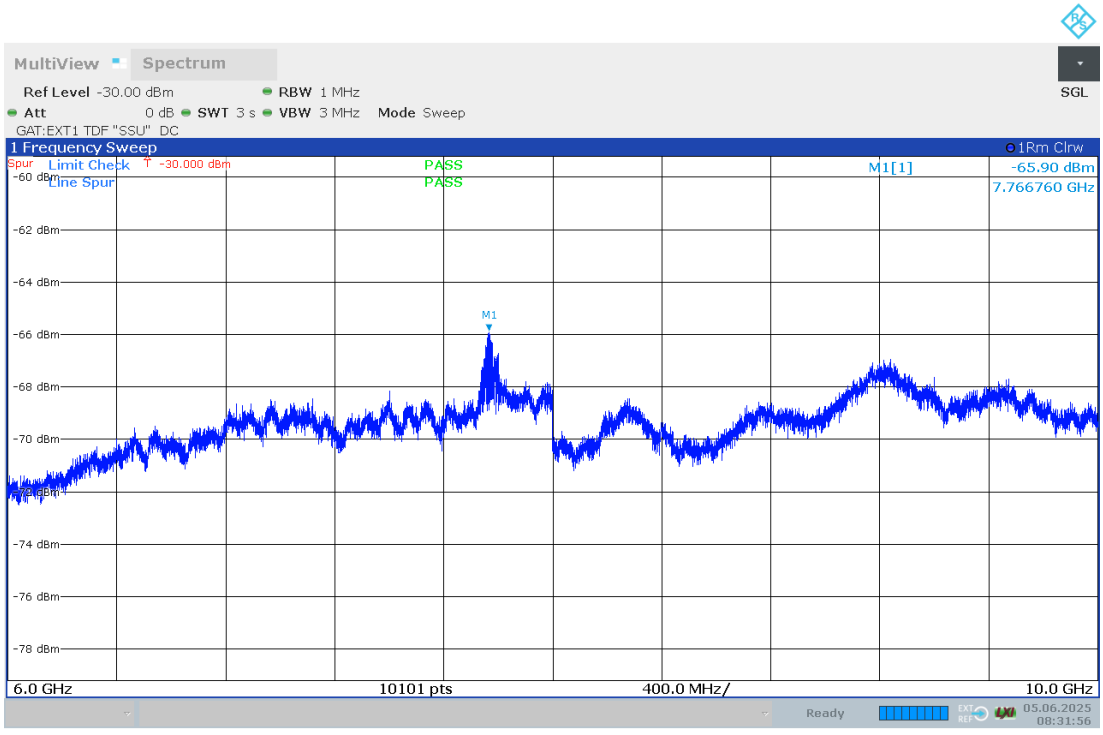


Figure 38 Spurious Emissions (1GHz – 3GHz) – 64QAM (2592.99 MHz) (49.5MHz Channel BW)



14:06:55 02.06.2025

Figure 39 Spurious Emissions (3GHz – 6GHz) – 16QAM (2592.99 MHz) (49.5MHz Channel BW)



08:31:57 05.06.2025

Figure 40 Spurious Emissions (6GHz – 10GHz) – 64QAM (2592.99 MHz) (49.5MHz Channel BW)

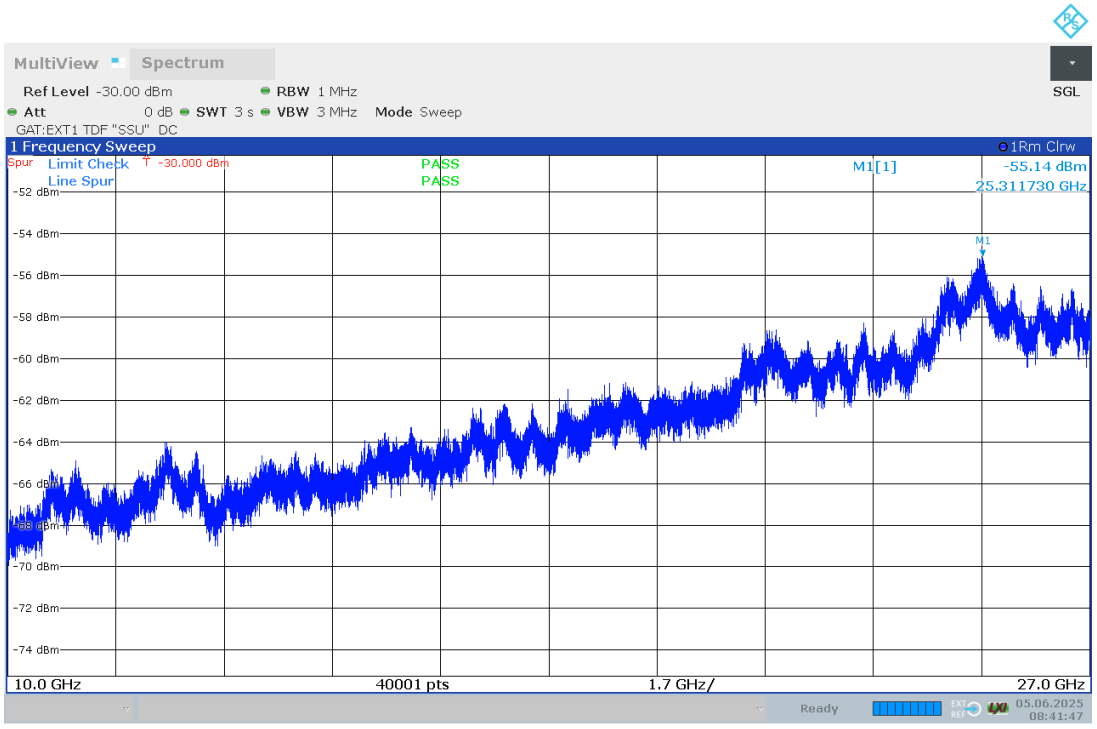


Figure 41 Spurious Emissions (10GHz – 27GHz) – 256QAM (2592.99 MHz) (49.5MHz Channel BW)

6.2.5 Test No. 5 Field Strength of Spurious Radiation

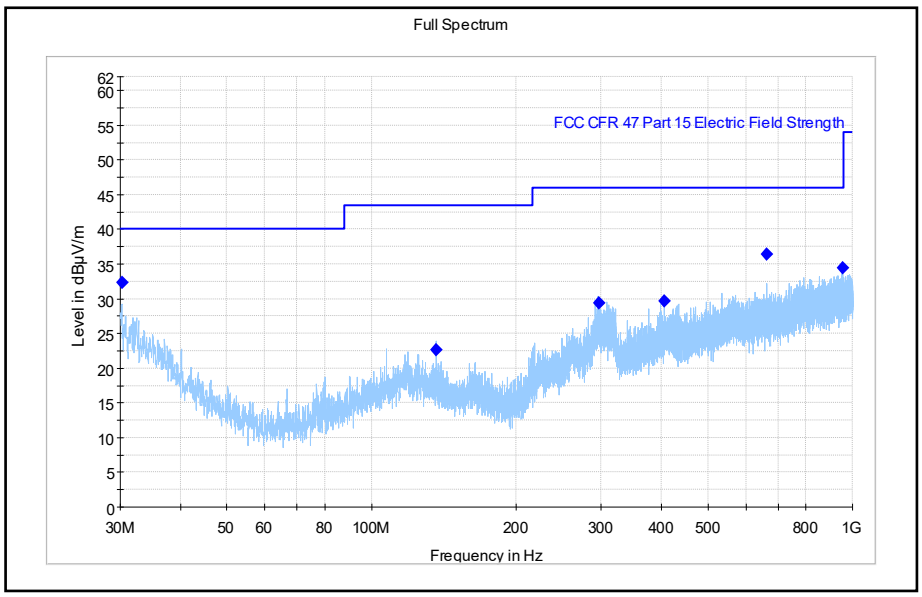


Figure 42 Field Strength of Spurious Radiation (30 MHz – 1 GHz) – QPSK (2520.75 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	QuasiPeak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
30.240000	32.33	40.00	7.67	100.0	V	306.0
136.450333	22.57	43.50	20.93	127.0	H	32.0
296.585333	29.40	46.00	16.60	112.0	H	0.0
405.286333	29.64	46.00	16.36	215.0	H	-5.0
663.541667	36.38	46.00	9.62	100.0	V	0.0
952.683000	34.44	46.00	11.56	144.0	H	148.0

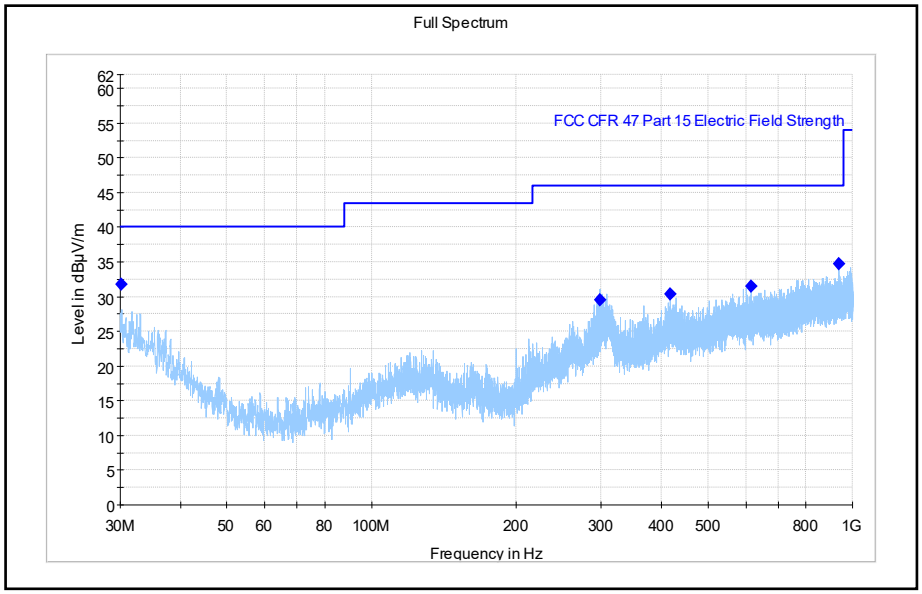


Figure 43 Field Strength of Spurious Radiation (30 MHz – 1 GHz) – QPSK (2593.005 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	QuasiPeak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
30.210000	31.79	40.00	8.21	100.0	V	157.0
298.496000	29.53	46.00	16.47	220.0	H	-5.0
417.369000	30.39	46.00	15.61	235.0	H	314.0
614.762667	31.45	46.00	14.55	126.0	V	222.0
936.154667	34.66	46.00	11.34	106.0	V	2.0

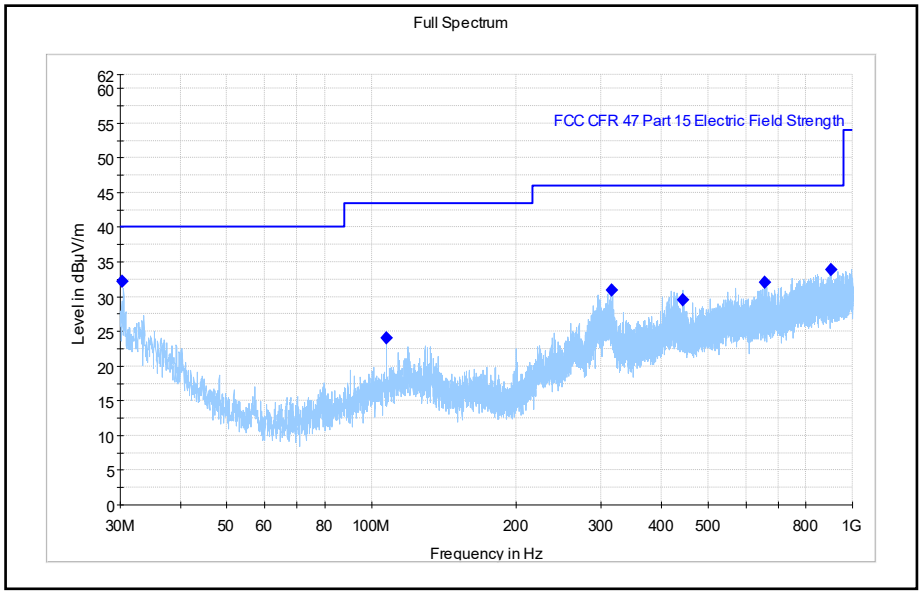


Figure 44 Field Strength of Spurious Radiation (30 MHz – 1 GHz) – QPSK (2665.249 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	QuasiPeak Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
30.240000	32.25	40.00	7.75	100.0	V	5.0
107.436000	24.06	43.50	19.44	102.0	V	149.0
315.871000	30.86	46.00	15.14	100.0	H	39.0
444.074000	29.47	46.00	16.53	131.0	V	325.0
655.481667	32.08	46.00	13.92	122.0	H	269.0
902.799000	33.90	46.00	12.10	204.0	H	297.0

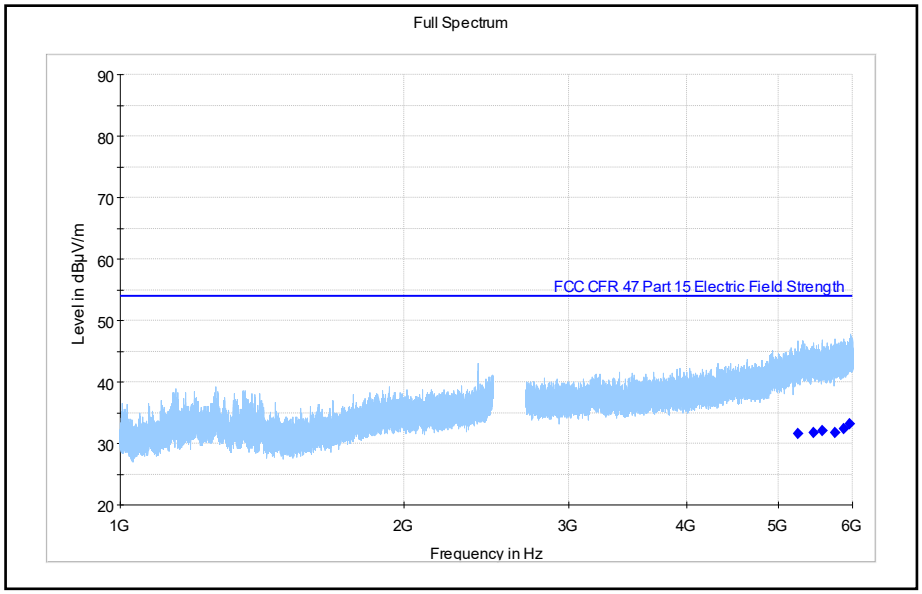


Figure 45 Field Strength of Spurious Radiation (1 GHz – 6 GHz) – QPSK (2520.75 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
5245.400167	31.56	54.00	22.44	303.0	H	168.0
5453.216167	31.78	54.00	22.22	246.0	H	99.0
5575.508000	32.00	54.00	22.00	153.0	H	105.0
5748.445000	31.76	54.00	22.24	155.0	H	15.0
5874.074833	32.44	54.00	21.56	117.0	V	274.0
5961.581000	33.16	54.00	20.84	334.0	V	20.0

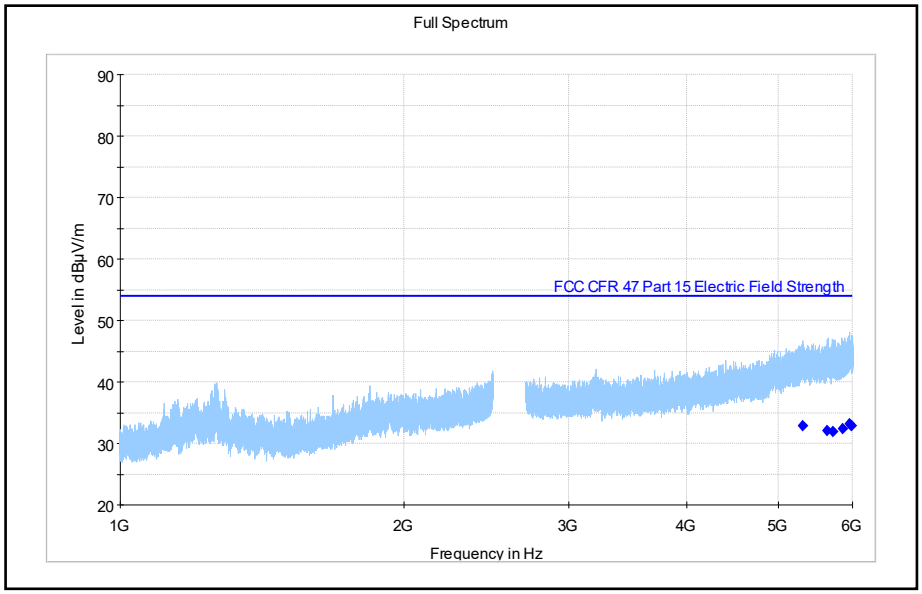


Figure 46 Field Strength of Spurious Radiation (1 GHz – 6 GHz) – QPSK (2593.005 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
5310.267167	32.78	54.00	21.22	247.0	V	2.0
5643.351833	32.13	54.00	21.87	186.0	H	18.0
5726.319167	31.88	54.00	22.12	107.0	H	199.0
5853.034167	32.41	54.00	21.59	100.0	V	273.0
5962.365167	33.11	54.00	20.89	100.0	V	225.0
5989.243167	32.89	54.00	21.11	209.0	H	95.0

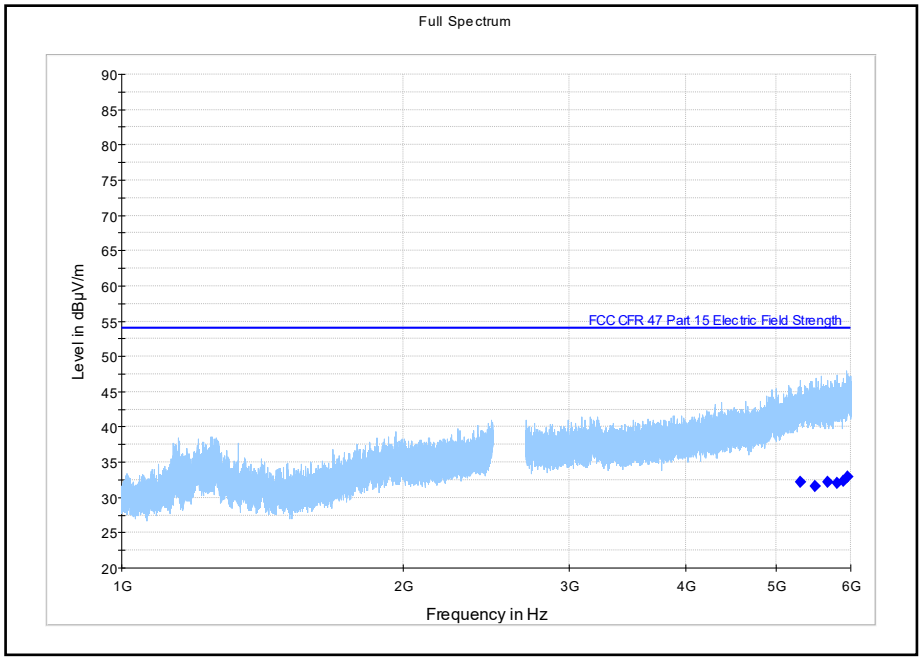


Figure 47 Field Strength of Spurious Radiation (1 GHz – 6 GHz) – QPSK (2665.249 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
5295.916833	32.23	54.00	21.77	163.0	H	210.0
5500.935833	31.59	54.00	22.41	348.0	H	337.0
5663.515000	32.16	54.00	21.84	164.0	V	195.0
5801.079167	31.99	54.00	22.01	107.0	V	291.0
5887.770833	32.29	54.00	21.71	123.0	V	2.0
5950.409000	32.86	54.00	21.14	314.0	H	35.0

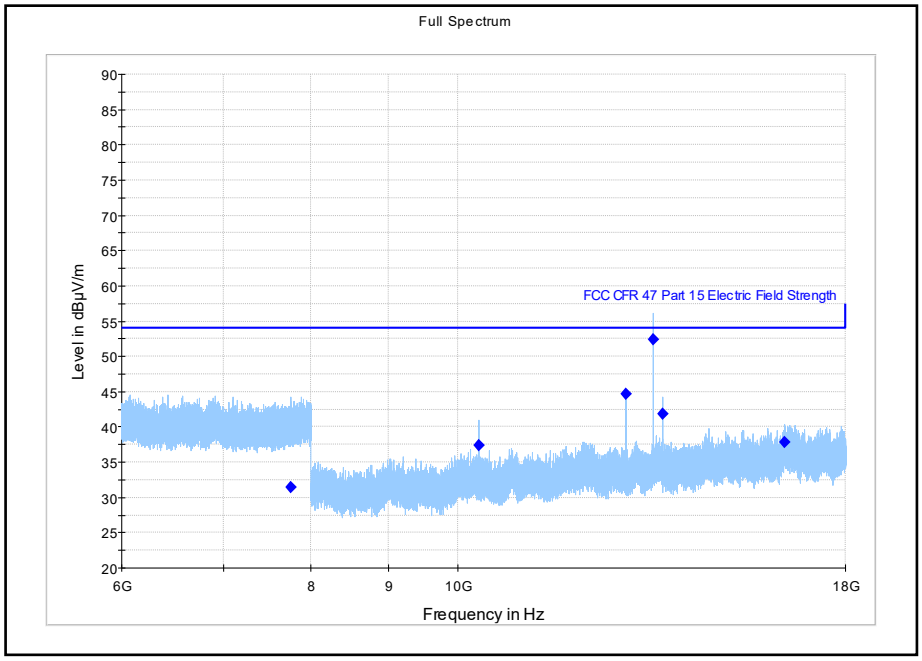


Figure 48 Field Strength of Spurious Radiation (6 GHz – 18 GHz) – QPSK (2520.75 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
7760.998667	31.47	54.00	22.53	100.0	H	300.0
10312.386360	37.46	54.00	16.54	215.0	H	23.0
12890.633012	44.67	54.00	9.33	148.0	V	0.0
13452.497348	52.46	54.00	1.54	100.0	V	1.0
13631.924748	41.83	54.00	12.17	228.0	V	303.0
16399.900000	37.90	54.00	16.10	218.0	H	143.0

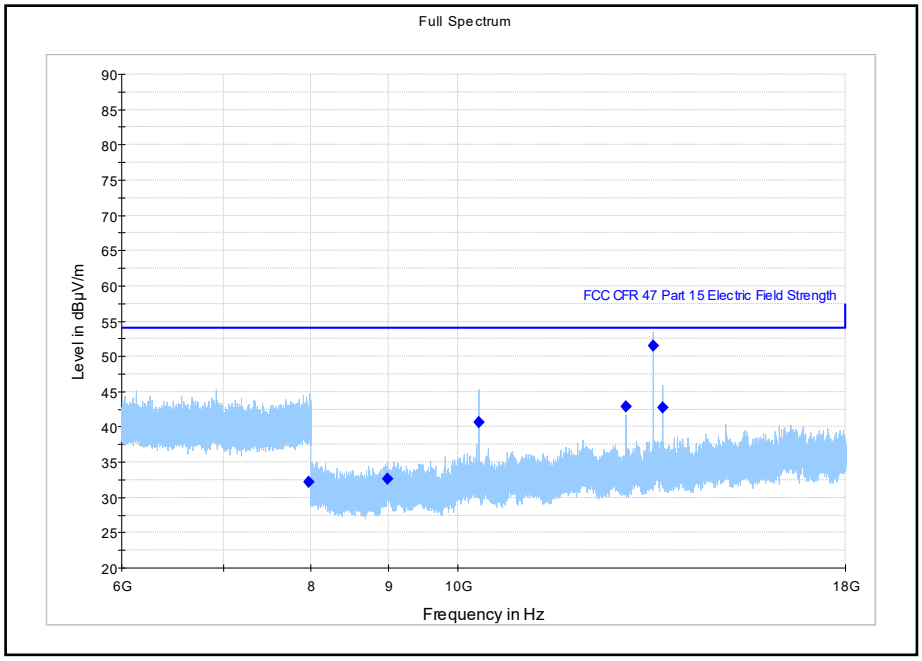


Figure 49 Field Strength of Spurious Radiation (6 GHz – 18 GHz) – QPSK (2593.005 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
7971.234166	32.18	54.00	21.82	100.0	V	285.0
8977.532640	32.58	54.00	21.42	350.0	V	17.0
10312.462560	40.69	54.00	13.31	107.0	V	336.0
12890.618760	42.88	54.00	11.12	104.0	V	15.0
13452.496628	51.58	54.00	2.42	240.0	V	1.0
13632.062240	42.81	54.00	11.19	107.0	V	271.0

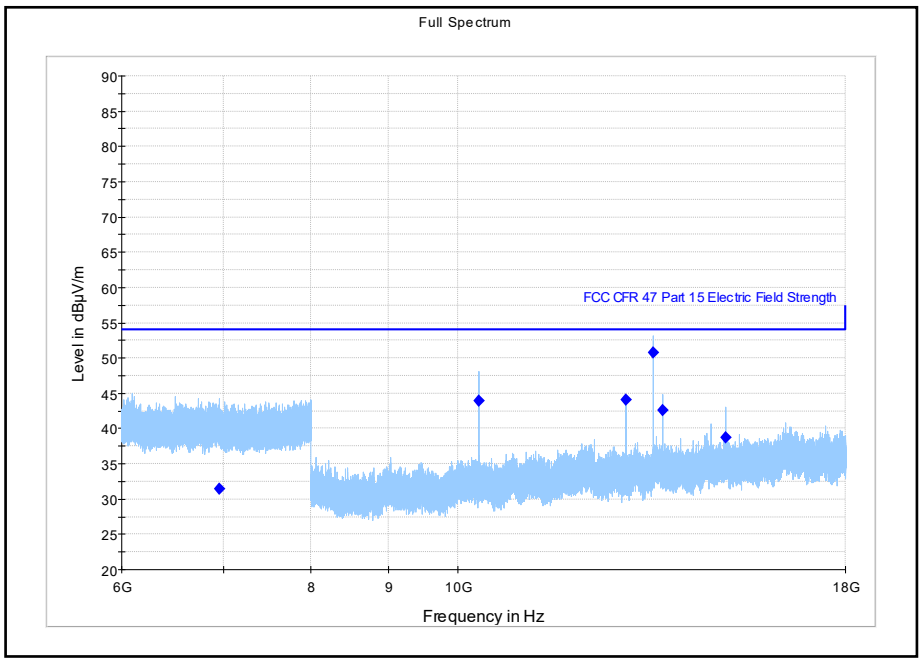


Figure 50 Field Strength of Spurious Radiation (6 GHz – 18 GHz) – QPSK (2665.249 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
6956.719667	31.49	54.00	22.51	231.0	H	180.0
10312.462680	43.96	54.00	10.04	107.0	V	330.0
12890.619812	44.08	54.00	9.92	165.0	V	2.0
13452.496628	50.74	54.00	3.26	241.0	V	2.0
13632.076708	42.66	54.00	11.34	111.0	V	272.0
14999.940600	38.75	54.00	15.25	192.0	V	1.0

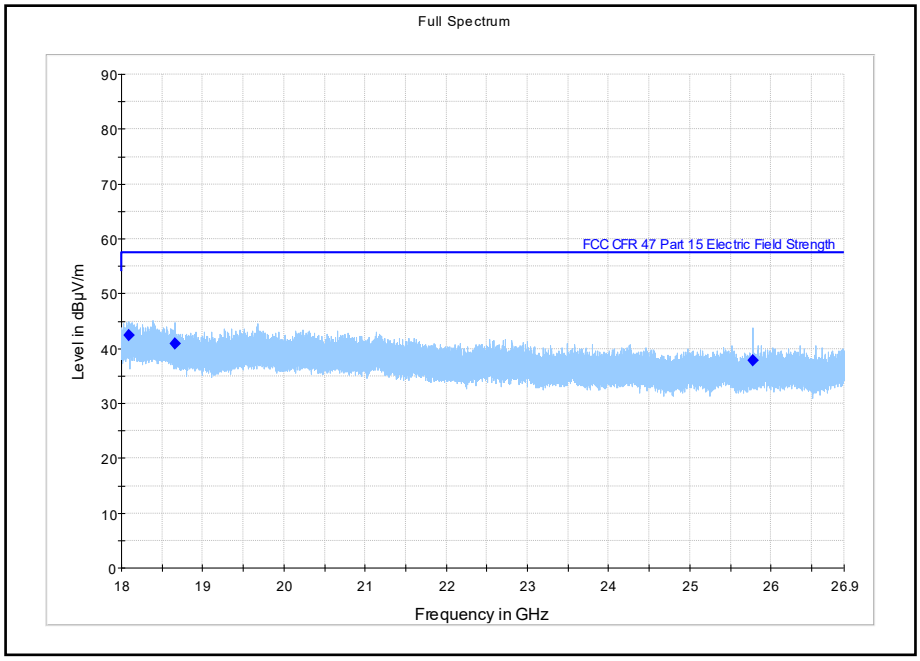


Figure 51 Field Strength of Spurious Radiation (18 GHz – 26.9 GHz) – QPSK (2520.75 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
18091.030108	42.42	57.50	15.08	104.0	V	75.0
18652.880372	40.85	57.50	16.65	113.0	V	71.0
25780.740708	37.87	57.50	19.63	100.0	H	29.0

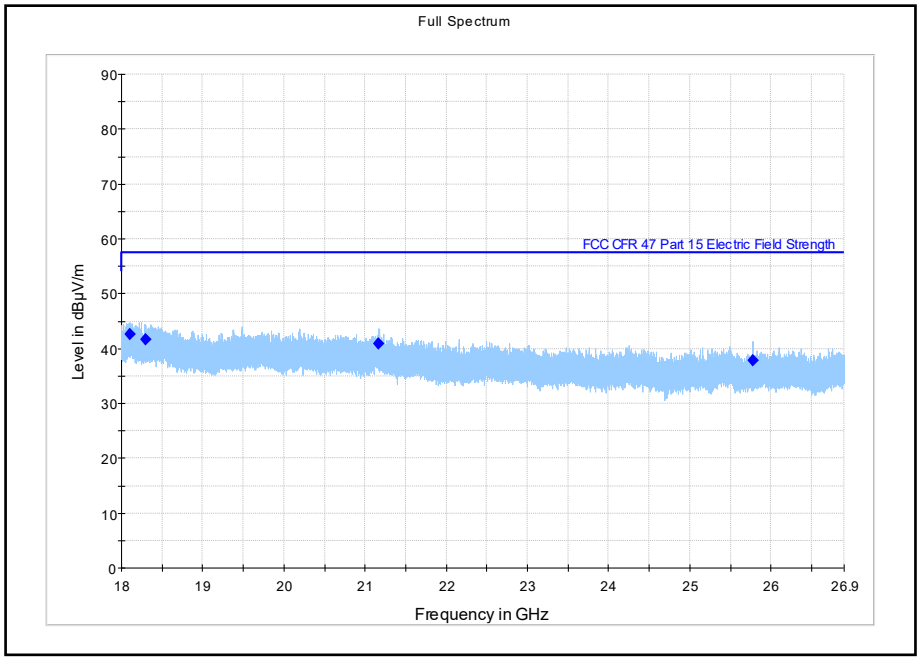


Figure 52 Field Strength of Spurious Radiation (18 GHz – 26.9 GHz) – QPSK (2593.005 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
18106.558160	42.55	57.50	14.95	132.0	V	225.0
18291.555920	41.63	57.50	15.87	250.0	V	105.0
21167.248040	40.91	57.50	16.59	265.0	V	9.0
25780.661148	37.74	57.50	19.76	195.0	H	47.0

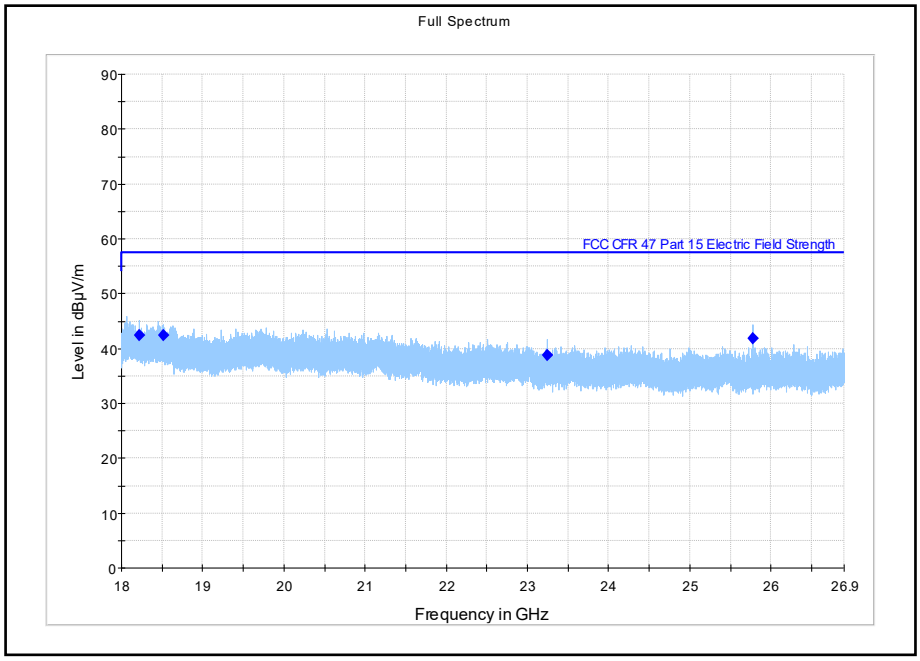


Figure 53 Field Strength of Spurious Radiation (18 GHz – 26.9 GHz) – QPSK (2665.249 MHz) (49.5 MHz Channel BW)

Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Polarisation	Angle (°)
18217.177012	42.48	57.50	15.02	285.0	V	114.0
18514.590572	42.51	57.50	14.99	350.0	V	161.0
23245.637280	38.83	57.50	18.67	200.0	V	48.0
25781.172468	41.91	57.50	15.59	104.0	V	174.0

Appendix A: AWHHJ EIRP calculations

EIRP Calculations for Four Port MIMO Operations for Band 41 Single Carriers

EIRP calculations are needed at each transmitter location to optimize base station operational performance while meeting regulatory requirements. Each cell site installation needs to consider the power measurements in the radio certification report as well as site specific regulatory requirements (such as antenna height, population density, etc.), site installation parameters (line loss between antenna and radio, antenna parameters, etc.) and base station operational parameters (MIMO operational setup, carrier power level, channel bandwidth, modulation type, etc.) to optimize performance. Transmitter output power may be reduced (from maximum) by base station setup parameters. Base station antennas are selected by the customer.

The base station antenna is selected by the customer. This EIRP calculation is based upon Nokia antenna assembly model "AAHM". The maximum Band 41 gain (12.0dBi) for this antenna was used for the EIRP calculation. This antenna assembly has a pair of ±45° cross-polarized radiators used for Band 41. Four AWHHJ transmitter outputs are connected to the antenna assembly RF inputs.

Equivalent Isotropically Radiated Power (EIRP) is calculated (as specified in ANSI C63.26-2015 section 6.4 for uncorrelated output signals) from the results of power measurements (highest measured power for each channel bandwidth type). The maximum antenna gain was used for this calculation. The cable loss between the antenna and transmitter is site dependent. The cable loss 0 dB was used in this calculation since AAHM can be installed directly into the AWHHJ. Calculations of worst-case EIRP for four port MIMO are as follows:

Parameter	NR 15 MHz Ch BW	NR 49.5 MHz Ch BW
Worst Case Power Output per Antenna Port	45.76 dBm	45.68 dBm
Number of Ant Ports per Polarization	2	2
Total Power per Polarization **10Log 2 = + 3dB**	48.76 dBm	48.68 dBm
Cable Loss (site dependent) **= 0.0dB**	48.76 dBm	48.68 dBm
Dir Gain = Max Ant Gain (G_{Ant}) **See Note 1**	12.0 dBi	12.0 dBi
EIRP per Polarization	60.76 dBm	60.68 dBm
Number of Polarizations	2	2
EIRP Total = **Y1 ±45°and Y2 ±45°** **See Note 2**	60.76 dBm	60.68 dBm
Passing FCC EIRP Limit **See Note 3**	74.41 dBm	79.60 dBm

Note 1: The directional gain is equal to antenna gain since the transmit signals are completely uncorrelated. See ANSI C63.26 sections 6.4.5.2.3b) and 6.4.5.3.1b) for guidance.
Note 2: The EIRP per antenna polarity is required to be below the regulatory limit as described in ANSI C63.26-2015 section 6.4.6.3 b)2) and KDB 662911 D02v01 page 3 example (2) since the two transmitter outputs to each antenna are 90 degree-phase shifted relative to each other (cross-polarized radiators).
Note 3: The EIRP limit is defined by FCC part 27.50(h)(ii) as 33dBW+ 10Log(X/Y) dBW + 10 log(360/beamwidth) dBW where X is the channel width in MHz and Y is 5.5 or 6MHz. The Nokia AAHM antenna has a horizontal beamwidth of 65 degrees for the 2490 to 2690MHz frequency range. Y was selected to be 6MHz.

EIRP Calculation Summary

The worst case AWHHJ Band 41 four port MIMO EIRP levels using antenna assembly model “AAHM” are less than the FCC EIRP Regulatory Limits.

Appendix B: AWHHJ Emission Designators

FCC Emission Designators for Band 41/n41 (2496MHz to 2690MHz) Single Carrier	
Ch BW	**5G-NR**
	FCC
15MHz	14M83G7W
49.5MHz	49M78G7W
Note: FCC emission designators are based on 26dB emission bandwidth.	