



FCC RADIO TEST REPORT

FCC ID : PKRISGMD2000
Equipment : Wireless Module
Brand Name : Inseego
Model Name : MD2000
Applicant : Inseego Corporation
9710 Scranton Road Suite 200, San Diego,, CA 92121
Manufacturer : Inseego Corporation
9710 Scranton Road Suite 200, San Diego,, CA 92121
Standard : FCC 47 CFR Part 2, 24(E), 27

The product was received on Dec. 28, 2020 and testing was started from Mar. 22, 2021 and completed on May 12, 2021. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI / TIA-603-E and has been in compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory

No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)



Table of Contents

History of this test report.....	3
Summary of Test Result.....	4
1 General Description	6
1.1 Product Feature of Equipment Under Test.....	6
1.2 Modification of EUT	6
1.3 Testing Location	7
1.4 Applicable Standards.....	7
2 Test Configuration of Equipment Under Test	8
2.1 Test Mode.....	8
2.2 Connection Diagram of Test System.....	9
2.3 Support Unit used in test configuration and system	9
2.4 Measurement Results Explanation Example.....	9
2.5 Frequency List of Low/Middle/High Channels	10
3 Conducted Test Items.....	11
3.1 Measuring Instruments	11
3.2 Conducted Output Power and ERP/EIRP	12
3.3 Peak-to-Average Ratio	13
3.4 Occupied Bandwidth.....	14
3.5 Conducted Band Edge	15
3.6 Conducted Spurious Emission	16
3.7 Frequency Stability	17
4 Radiated Test Items	18
4.1 Measuring Instruments	18
4.2 Radiated Spurious Emission Measurement	20
5 List of Measuring Equipment.....	21
6 Uncertainty of Evaluation.....	23
Appendix A. Test Results of Conducted Test	
Appendix B. Test Results of Radiated Test	
Appendix C. Test Setup Photographs	



History of this test report

Report No.	Version	Description	Issued Date
FG090125-03	01	Initial issue of report	May 14, 2021



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046	Conducted Output Power	Reporting only	-
	§22.913 (a)(5)	Effective Radiated Power (n5)	Pass	
	§27.50 (c)(10)	Effective Radiated Power (n12) (n71)		
	§24.232 (c) §27.50 (h)(2)	Equivalent Isotropic Radiated Power (n2) (n25) (n7) (n38) (n41)		
	§27.50 (d)(4)	Equivalent Isotropic Radiated Power (n66)		
3.3	§24.232 (d) §27.50 (d)(5)	Peak-to-Average Ratio	Pass	-
3.4	§2.1049	Occupied Bandwidth	Reporting only	-
3.5	§2.1051 §22.917 (a) §24.238 (a) §27.53 (g) §27.53 (h)	Conducted Band Edge Measurement (n2) (n5) (n12) (n25) (n66) (n71)	Pass	-
	§2.1051 §27.53 (m)(4)	Conducted Band Edge Measurement (n7) (n38) (n41)		
3.6	§2.1051 §22.917 (a) §24.238 (a) §27.53 (g) §27.53 (h)	Conducted Spurious Emission (n2) (n5) (n12) (n25) (n66) (n71)	Pass	-
	§2.1051 §27.53 (m)(4)	Conducted Spurious Emission (n7) (n38) (n41)		
3.7	§2.1055 §24.235 §27.54	Frequency Stability Temperature & Voltage	Pass	-
4.2	§2.1053 §22.917 (a) §24.238 (a) §27.53 (g) §27.53 (h)	Radiated Spurious Emission (n2) (n5) (n12) (n25) (n66) (n71)	Pass	Under limit 0.20 dB at 5172.000 MHz
	§2.1051 §27.53 (m)(4)	Radiated Spurious Emission (n7) (n38) (n41)		

Remark: This is a variant report by adding n7, n38 SA mode and new NSA mode. All the test cases were performed on original report which can be referred to Sporton Report Number FG090125-02B.



Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Wii Chang

Report Producer: Lucy Wu



1 General Description

1.1 Product Feature of Equipment Under Test

WCDMA/LTE/5G NR, Wi-Fi 2.4GHz 802.11b/g/n/ac/ax, Wi-Fi 5GHz 802.11a/n/ac/ax, and GNSS.

Product Specification subjective to this standard	
Antenna Type	WWAN: Monopole Antenna WLAN: <Ant. 0>: Monopole Antenna <Ant. 1>: Monopole Antenna GPS/BDS/Galileo/GLONASS: Monopole Antenna
Antenna Gain	<Ant. 0> 5G NR n7: 5.0 dBi 5G NR n38: 5.0 dBi 5G NR n66: 5.8 dBi <Ant. 1> 5G NR n5: 3.6 dBi <Ant. 8> 5G NR n7: 5.0 dBi 5G NR n38: 5.0 dBi 5G NR n41: 5.0 dBi

Remark: The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Modification of EUT

No modifications are made to the EUT during all test items.



1.3 Testing Location

Test Site	Sporton International Inc. Wensan Laboratory	
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855	
Test Site No.	Sporton Site No.	
	TH05-HY	03CH12-HY
Test Engineer	HAO SYU and Howard Lin	Jack Cheng, Lance Chiang and Chuan Chu
Temperature	23.4~25.2°C	21~24°C
Relative Humidity	50.7~58.3%	52~67%

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC Designation No.: TW3786

1.4 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ ANSI C63.26-2015
- ♦ ANSI / TIA-603-E
- ♦ FCC 47 CFR Part 2, 22(H), 24(E), 27
- ♦ FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- ♦ FCC KDB 412172 D01 Determining ERP and EIRP v01r01
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01.

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.



2 Test Configuration of Equipment Under Test

2.1 Test Mode

Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas. License Digital Systems v03r01 with maximum output power.

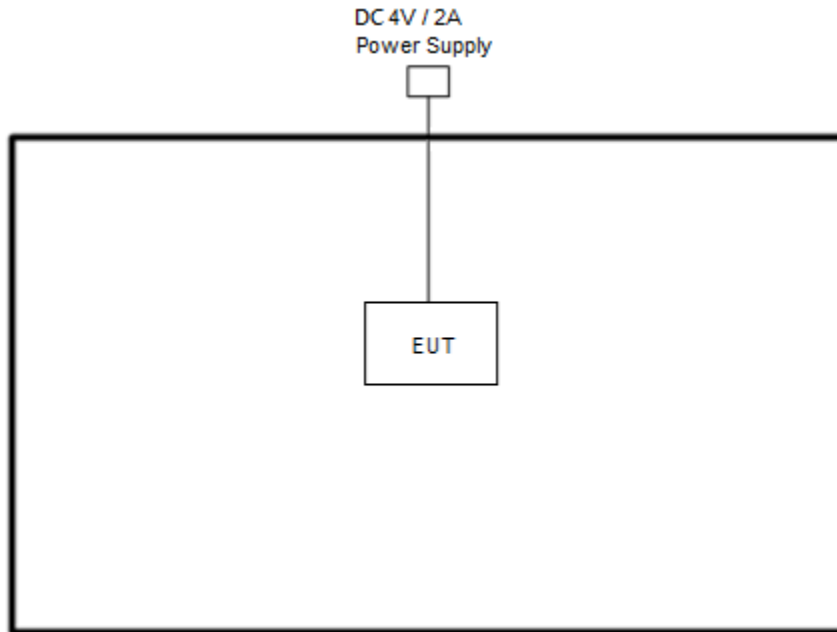
For radiated measurement, pre-scanned in two config (Ant. Horizontal and Ant. Vertical). The worst cases (<Ant. 0>: Ant. Vertical for 5G NR n7, n38; <Ant. 0+1>: Ant. Vertical for EN-DC 7A-n5A; <Ant. 0+8>: Ant. Vertical for EN-DC 5A-n7A, EN-DC 12A-n7A, EN-DC 66A-n7A, EN-DC 4A-n41A; <Ant. 4+0>: Ant. Vertical for EN-DC 48C-n66A; <Ant. 0+8>: Ant. Horizontal for EN-DC 5A-n38A, EN-DC 12A-n38A, EN-DC 71A-n38A,) were recorded in this report.

Test Items	NR Band	Bandwidth (MHz)										Modulation					RB #			Test Channel		
		5	10	15	20	40	50	60	80	90	100	PI/2 BPSK	QPSK	16QAM	64QAM	256QAM	1	Half	Full	L	M	H
Max. Output Power	n7	v	v	v	v	-	-	-	-	-	-	v	v	v	v	v	v	v	v	v	v	v
	n38	-			v		-	-	-	-	-	v	v	v	v	v	v	v	v	v	v	v
Peak-to-Average Ratio	n7				v	-	-	-	-	-	-	v	v	v	v	v			v	v		
	n38	-			v		-	-	-	-	-	v	v	v	v	v			v	v		
26dB and 99% Bandwidth	n7	v	v	v	v	-	-	-	-	-	-	v	v	v	v	v			v	v		
	n38	-			v		-	-	-	-	-	v	v	v	v	v			v	v		
Conducted Band Edge	n7	v	v	v	v	-	-	-	-	-	-	v	v	v	v	v	v		v	v		v
	n38	-			v		-	-	-	-	-	v	v	v	v	v	v		v	v		v
Conducted Spurious Emission	n7	v				-	-	-	-	-	-		v				v			v	v	v
	n38	-			v		-	-	-	-	-		v				v			v	v	v
Frequency Stability	n7				v	-	-	-	-	-	-	v							v		v	
	n38	-			v		-	-	-	-	-	v							v		v	
E.I.R.P	n7	v	v	v	v	-	-	-	-	-	-	v	v	v	v	v	Max Power					
	n38	-			v		-	-	-	-	-	v	v	v	v	v						
Radiated Spurious Emission	n7				v	-	-	-	-	-	-	v					v			v	v	v
	n38	-			v		-	-	-	-	-	v					v			v	v	v

Remark

1. The mark "v" means that this configuration is chosen for testing
2. The mark "-" means that this bandwidth is not supported.
3. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are reported.
4. Test combination is EN-DC 7A-n5A, EN-DC 5A-n7A, EN-DC 12A-n7A, EN-DC 66A-n7A, EN-DC 5A-n38A, EN-DC 12A-n38A, EN-DC 71A-n38A, EN-DC 4A-n41A, EN-DC 48C-n66A.
5. For radiated measurement, pre-scanned in two modes, DFT-s OFDM and CP OFDM. The worst cases (DFT-s OFDM) were recorded in this report, and the worst modes of FR1 and LTE for simultaneous transmission were verified and compliant.
6. The NR radio operation is controlled via software tool QRCT FTM mode (SW: Version 4.0.00153.0) under 100% duty cycle transmission, expect that the frequency stability is tested by system simulator.

2.2 Connection Diagram of Test System



2.3 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model No.	FCC ID	Data Cable	Power Cord
1.	Power Supply	GWINSTEK	GPE-2323	N/A	N/A	Unshielded, 1.8 m

2.4 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

Example :

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

$$= 4.2 + 10 = 14.2 \text{ (dB)}$$



2.5 Frequency List of Low/Middle/High Channels

5G NR Band n7 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
20	Channel	502000	507000	512000
	Frequency	2510	2535	2560
15	Channel	501500	507000	512500
	Frequency	2507.5	2535	2562.5
10	Channel	501000	507000	513000
	Frequency	2505	2535	2565
5	Channel	500500	507000	513500
	Frequency	2502.5	2535	2567.5

5G NR Band n38 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
20	Channel	516000	519000	522000
	Frequency	2580	2595	2610

3 Conducted Test Items

3.1 Measuring Instruments

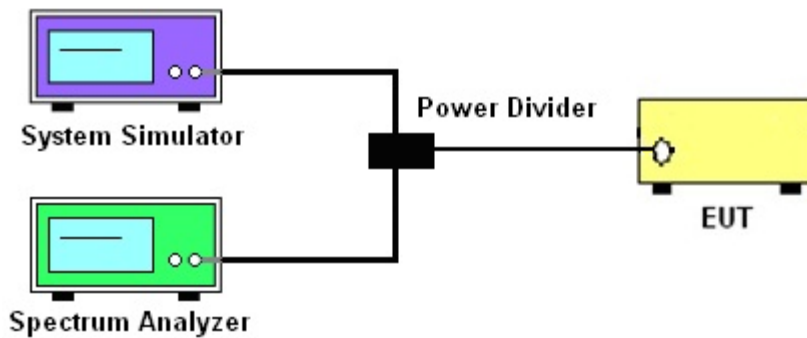
See list of measuring instruments of this test report.

3.1.1 Test Setup

3.1.2 Conducted Output Power



3.1.3 Peak-to-Average Ratio, Occupied Bandwidth ,Conducted Band-Edge and Conducted Spurious Emission



3.1.4 Frequency Stability



3.1.5 Test Result of Conducted Test

Please refer to Appendix A.



3.2 Conducted Output Power and ERP/EIRP

3.2.1 Description of the Conducted Output Power Measurement and ERP/EIRP Measurement

A system simulator was used to establish communication with the EUT. Its parameters were set to force the EUT transmitting at maximum output power. The measured power in the radio frequency on the transmitter output terminals shall be reported.

The EIRP of mobile transmitters must not exceed 2 Watts for 5G NR n7 and n38

According to KDB 412172 D01 Power Approach,

$EIRP = P_T + G_T - L_C$, $ERP = EIRP - 2.15$, where

P_T = transmitter output power in dBm

G_T = gain of the transmitting antenna in dBi

L_C = signal attenuation in the connecting cable between the transmitter and antenna in dB

3.2.2 Test Procedures

1. The transmitter output port was connected to the system simulator.
2. Set EUT at maximum power through the system simulator.
3. Select lowest, middle, and highest channels for each band and different modulation.
4. Measure and record the power level from the system simulator.



3.3 Peak-to-Average Ratio

3.3.1 Description of the PAR Measurement

Power Complementary Cumulative Distribution Function (CCDF) curves provide a means for characterizing the power peaks of a digitally modulated signal on a statistical basis. A CCDF curve depicts the probability of the peak signal amplitude exceeding the average power level. Most contemporary measurement instrumentation include the capability to produce CCDF curves for an input signal provided that the instrument's resolution bandwidth can be set wide enough to accommodate the entire input signal bandwidth. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

3.3.2 Test Procedures

The testing follows ANSI C63.26-2015 Section 5.2.6

1. The EUT was connected to spectrum and system simulator via a power divider.
2. Set the CCDF (Complementary Cumulative Distribution Function) option in spectrum analyzer.
3. The highest RF powers were measured and recorded the maximum PAPR level associated with a probability of 0.1 %.
4. Record the deviation as Peak to Average Ratio.



3.4 Occupied Bandwidth

3.4.1 Description of Occupied Bandwidth Measurement

The 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 a specified percentage 0.5% of the total mean transmitted power.

The 26 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 26 dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth equal to approximately 1.0% of the emission bandwidth.

3.4.2 Test Procedures

The testing follows ANSI C63.26-2015 Section 5.4.3 (26dB) and Section 5.4.4 (99OB)

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be between two and five times the anticipated OBW.
3. The nominal resolution bandwidth (RBW) shall be in the range of 1 to 5 % of the anticipated OBW, and the VBW shall be at least 3 times the RBW.
4. Set the detection mode to peak, and the trace mode to max hold.
5. Determine the reference value: Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace.
(this is the reference value)
6. Determine the “-26 dB down amplitude” as equal to (Reference Value – X).
7. Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the “-X dB down amplitude” determined in step 6. If a marker is below this “-X dB down amplitude” value it shall be placed as close as possible to this value. The OBW is the positive frequency difference between the two markers.
8. Use the 99 % power bandwidth function of the spectrum analyzer and report the measured bandwidth.



3.5 Conducted Band Edge

3.5.1 Description of Conducted Band Edge Measurement

27.53(m)(4)

For mobile digital stations, the attenuation factor shall be not less than $40 + 10 \log (P)$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge, $43 + 10 \log (P)$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and $55 + 10 \log (P)$ dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that $43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz and $55 + 10 \log (P)$ dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

3.5.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 6.1.

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The band edges of low and high channels for the highest RF powers were measured.
3. Set RBW \geq 1% EBW in the 1MHz band immediately outside and adjacent to the band edge.
4. Beyond the 1 MHz band from the band edge, RBW=1MHz was used.
5. Set spectrum analyzer with RMS detector.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
7. Checked that all the results comply with the emission limit line.

The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power P(Watts)

For 5G NR n7, n38

The other 40 dB, and 55 dB have additionally applied same calculation above.



3.6 Conducted Spurious Emission

3.6.1 Description of Conducted Spurious Emission Measurement

For 5G NR n7, n38

The power of any emission outside of the authorized operating frequency ranges must be lower than the transmitter power (P) by a factor of at least $55 + 10 \log (P)$ dB.

It is measured by means of a calibrated spectrum analyzer and scanned from 30 MHz up to a frequency including its 10th harmonic.

3.6.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 6.1.

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. The middle channel for the highest RF power within the transmitting frequency was measured.
4. The conducted spurious emission for the whole frequency range was taken.
5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz.
6. Set spectrum analyzer with RMS detector.
7. Taking the record of maximum spurious emission.
8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
9. The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power P(Watts)

For 5G NR n7, n38

The limit line is derived from $55 + 10\log(P)$ dB below the transmitter power P(Watts)



3.7 Frequency Stability

3.7.1 Description of Frequency Stability Measurement

27.54

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

3.7.2 Test Procedures for Temperature Variation

The testing follows FCC KDB 971168 D01 v03r01 Section 9.0.

1. The EUT was set up in the thermal chamber and connected with the system simulator.
2. With power OFF, the temperature was decreased to -30°C and the EUT was stabilized before testing. Power was applied and the maximum change in frequency was recorded within one minute.
3. With power OFF, the temperature was raised in 10°C step up to 50°C . The EUT was stabilized at each step for at least half an hour. Power was applied and the maximum frequency change was recorded within one minute.

3.7.3 Test Procedures for Voltage Variation

The testing follows FCC KDB 971168 D01 v03r01 Section 9.0.

1. The EUT was placed in a temperature chamber at $20\pm 5^{\circ}\text{C}$ and connected with the system simulator.
2. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value measured at the input to the EUT.
3. The variation in frequency was measured for the worst case.

4 Radiated Test Items

4.1 Measuring Instruments

See list of measuring instruments of this test report.

4.1.1 Test Setup

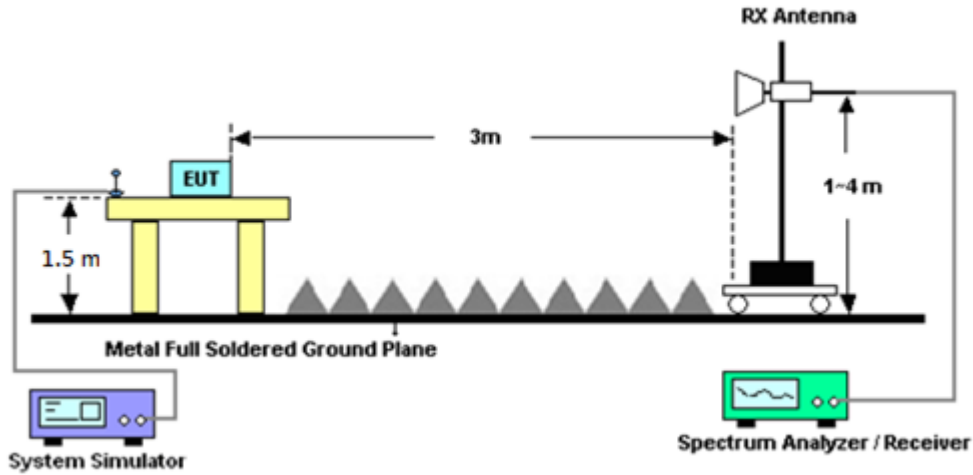
For radiated emissions below 30MHz



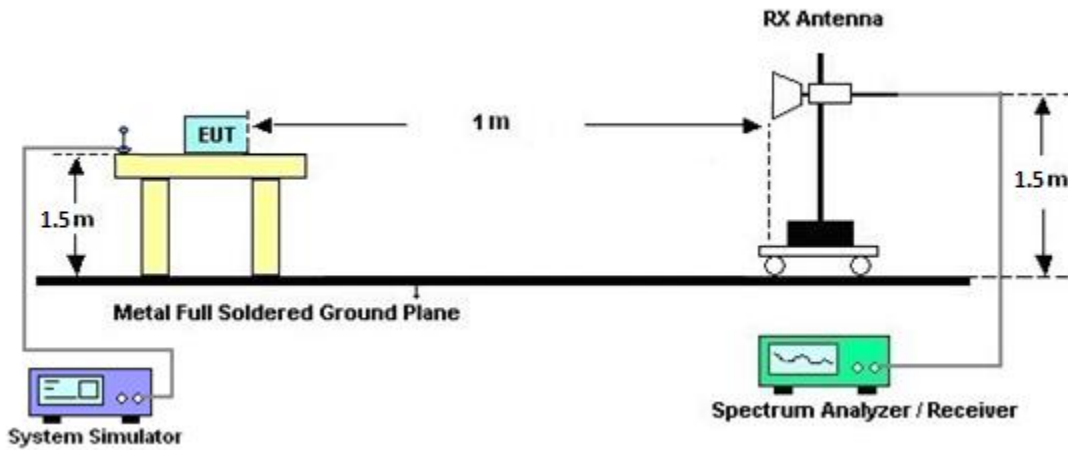
For radiated test from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



4.1.2 Test Result of Radiated Test

Please refer to Appendix B.

Note:

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.



4.2 Radiated Spurious Emission Measurement

4.2.1 Description of Radiated Spurious Emission Measurement

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB.

For 5G NR n7, n38, n41

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least $55 + 10 \log (P)$ dB.

The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

4.2.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 7 and ANSI / TIA-603-E Section 2.2.12.

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest spurious emission.
4. The height of the receiving antenna is varied between one meter and four meters to search the maximum spurious emission for both horizontal and vertical polarizations.
5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
6. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
7. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
8. Taking the record of output power at antenna port.
9. Repeat step 7 to step 8 for another polarization.
10. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power P(Watts)

For 5G NR n7, n38, n41

The limit line is derived from $55 + 10\log(P)$ dB below the transmitter power P(Watts)

EIRP (dBm) = S.G. Power – Tx Cable Loss + Tx Antenna Gain

ERP (dBm) = EIRP - 2.15



5 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Jul. 14, 2020	Mar. 30, 2021~ May 12, 2021	Jul. 13, 2021	Radiation (03CH12-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N -06	37059 & 01	30MHz~1GHz	Oct. 11, 2020	Mar. 30, 2021~ May 12, 2021	Oct. 10, 2021	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-1328	1GHz~18GHz	Nov. 23, 2020	Mar. 30, 2021~ May 12, 2021	Nov. 22, 2021	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-1212	1GHz~18GHz	May 20, 2020	Mar. 30, 2021~ May 12, 2021	May 19, 2021	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	00993	18GHz~40GHz	Dec. 19, 2020	Mar. 30, 2021~ May 12, 2021	Dec. 18, 2021	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA917057 6	18GHz~40GHz	May 22, 2020	Mar. 30, 2021~ May 12, 2021	May 21, 2021	Radiation (03CH12-HY)
Preamplifier	COM-POWER	PA-103	161075	10MHz~1GHz	Mar. 24, 2021	Mar. 30, 2021~ May 12, 2021	Mar. 23, 2022	Radiation (03CH12-HY)
Preamplifier	Keysight	83017A	MY57280120	1GHz~26.5GHz	Jul. 20, 2020	Mar. 30, 2021~ May 12, 2021	Jul. 19, 2021	Radiation (03CH12-HY)
Preamplifier	E-INSTRUME NT TECH LTD.	ERA-100M-18 G-56-01-A70	EC1900249	1GHz~18GHz	Dec. 05, 2020	Mar. 30, 2021~ May 12, 2021	Dec. 04, 2021	Radiation (03CH12-HY)
Preamplifier	EMEC	EM18G40G	060801	18GHz~40GHz	Jun. 15, 2020	Mar. 30, 2021~ May 12, 2021	Jun. 14, 2021	Radiation (03CH12-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz~40GHz	Dec. 11, 2020	Mar. 30, 2021~ May 12, 2021	Dec. 10, 2021	Radiation (03CH12-HY)
Spectrum Analyzer	Agilent	N9010A	MY53470118	10Hz~44GHz	Sep. 14, 2020	Mar. 30, 2021~ May 12, 2021	Sep. 13, 2021	Radiation (03CH12-HY)
Signal Generator	Rohde & Schwarz	SMB100A	101107	100kHz~40GHz	Dec. 04, 2020	Mar. 30, 2021~ May 12, 2021	Dec. 03, 2021	Radiation (03CH12-HY)
Filter	Wainwright	WHKX12-2700 -3000-18000-6 0ST	SN2	3GHz High Pass Filter	Jul. 14, 2020	Mar. 30, 2021~ May 12, 2021	Jul. 13, 2021	Radiation (03CH12-HY)
Filter	Wainwright	WHKX8-5872. 5-6750-18000- 40ST	SN2	6.75GHz High Pass Filter	Mar. 17, 2021	Mar. 30, 2021~ May 12, 2021	Mar. 16, 2022	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0058/126E	30MHz~18GHz	Dec. 11, 2020	Mar. 30, 2021~ May 12, 2021	Dec. 10, 2021	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30MHz~40GHz	Feb. 22, 2021	Mar. 30, 2021~ May 12, 2021	Feb. 21, 2022	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30MHz~40GHz	Feb. 22, 2021	Mar. 30, 2021~ May 12, 2021	Feb. 21, 2022	Radiation (03CH12-HY)
Hygrometer	TECPEL	DTM-303B	TP140349	N/A	Oct. 02, 2020	Mar. 30, 2021~ May 12, 2021	Oct. 01, 2021	Radiation (03CH12-HY)
Controller	EMEC	EM1000	N/A	Control Turn table & Ant Mast	N/A	Mar. 30, 2021~ May 12, 2021	N/A	Radiation (03CH12-HY)
Antenna Mast	EMEC	AM-BS-4500-B	N/A	1m~4m	N/A	Mar. 30, 2021~ May 12, 2021	N/A	Radiation (03CH12-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Mar. 30, 2021~ May 12, 2021	N/A	Radiation (03CH12-HY)
Software	Audix	E3 6.2009-8-24	RK-000989	N/A	N/A	Mar. 30, 2021~ May 12, 2021	N/A	Radiation (03CH12-HY)



Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
DC Power Supply	GW Instek	GPE-2323	GEU871219	0V~64V ; 0A~6A	Aug. 19, 2020	Mar. 22, 2021~ Apr. 29, 2021	Aug. 18, 2021	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV3044	101104	10Hz~44GHz	Feb. 02, 2021	Mar. 22, 2021~ Apr. 29, 2021	Feb. 01, 2022	Conducted (TH05-HY)
Hygrometer	TECPEL	DTM-303B	TP200886	N/A	Mar. 09, 2021	Mar. 22, 2021~ Apr. 29, 2021	Mar. 08, 2022	Conducted (TH05-HY)
Temperature Chamber	ESPEC	SH-641	92013720	-40℃ ~90℃	Sep. 14, 2020	Mar. 22, 2021~ Apr. 29, 2021	Sep. 13, 2021	Conducted (TH05-HY)
USB Power Sensor	DARE	RPR3006W	13I00030SN O31	9kHz~6GHz	Dec. 30, 2020	Mar. 22, 2021~ Apr. 29, 2021	Dec. 29, 2021	Conducted (TH05-HY)



6 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.07
---	------

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.21
---	------

Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.80
---	------



Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power) and EIRP

NR n7 Maximum Average Power [dBm] (GT - LC = 5 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP(W)
5	1	1	PI/2 BPSK	23.89	23.92	23.76	28.92	0.7798
5	1	23		23.46	23.82	23.62		
5	12	6		23.54	23.69	23.77		
5	1	0		23.83	23.74	23.65		
5	1	24		23.56	23.57	23.60		
5	25	0		23.67	23.86	23.62		
5	1	1	QPSK	23.68	23.70	23.68		
5	1	23		23.57	23.84	23.73		
5	12	6		23.87	23.74	23.72		
5	1	0		23.77	23.85	23.63		
5	1	24		23.55	23.90	23.71		
5	25	0		23.67	23.76	23.75		
5	1	1	16-QAM	23.26	23.64	23.66	28.66	0.7345
5	1	1	64-QAM	22.62	22.65	22.56		
5	1	1	256-QAM	19.83	19.95	19.73		
Limit	EIRP < 2W			Result			Pass	

NR n7 Maximum Average Power [dBm] (GT - LC = 5 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP(W)
10	1	1	PI/2 BPSK	23.91	23.76	23.81	28.91	0.7780
10	1	50		23.67	23.56	23.55		
10	25	12		23.80	23.58	23.71		
10	1	0		23.77	23.69	23.79		
10	1	51		23.71	23.63	23.51		
10	50	0		23.69	23.87	23.60		
10	1	1	QPSK	23.72	23.66	23.71		
10	1	50		23.54	23.81	23.63		
10	25	12		23.62	23.74	23.63		
10	1	0		23.74	23.84	23.66		
10	1	51		23.63	23.81	23.52		
10	50	0		23.61	23.71	23.65		
10	1	1	16-QAM	23.20	23.79	23.61	28.79	0.7568
10	1	1	64-QAM	22.34	22.63	22.42		
10	1	1	256-QAM	19.80	19.90	19.72		
Limit	EIRP < 2W			Result			Pass	



NR n7 Maximum Average Power [dBm] (GT - LC = 5 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP(W)
15	1	1	PI/2 BPSK	23.82	23.88	23.55	28.88	0.7727
15	1	77		23.47	23.81	23.57		
15	36	18		23.67	23.75	23.74		
15	1	0		23.73	23.70	23.65		
15	1	78		23.58	23.57	23.70		
15	75	0		23.55	23.67	23.50		
15	1	1	QPSK	23.72	23.62	23.60		
15	1	77		23.72	23.70	23.50		
15	36	18		23.75	23.65	23.54		
15	1	0		23.75	23.74	23.75		
15	1	78		23.66	23.85	23.72		
15	75	0		23.71	23.63	23.53		
15	1	1	16-QAM	23.22	23.82	23.65	28.82	0.7621
15	1	1	64-QAM	22.34	22.51	22.41		
15	1	1	256-QAM	19.62	19.95	19.55		
Limit	EIRP < 2W			Result			Pass	

NR n7 Maximum Average Power [dBm] (GT - LC = 5 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP(W)
20	1	1	PI/2 BPSK	23.92	23.93	23.85	28.93	0.7816
20	1	104		23.75	23.85	23.75		
20	50	25		23.82	23.84	23.81		
20	1	0		23.91	23.84	23.84		
20	1	105		23.85	23.82	23.74		
20	100	0		23.85	23.90	23.80		
20	1	1	QPSK	23.92	23.86	23.83		
20	1	104		23.80	23.91	23.74		
20	50	25		23.89	23.89	23.76		
20	1	0		23.90	23.92	23.83		
20	1	105		23.83	23.92	23.73		
20	100	0		23.85	23.83	23.77		
20	1	1	16-QAM	23.44	23.91	23.85	28.91	0.7780
20	1	1	64-QAM	22.62	22.69	22.56		
20	1	1	256-QAM	19.87	19.98	19.83		
Limit	EIRP < 2W			Result			Pass	



NR n38 Maximum Average Power [dBm] (GT - LC = 5 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP(W)
20	1	1	PI/2 BPSK	23.93	23.87	23.67	28.93	0.7816
20	1	49		23.77	23.67	23.57		
20	25	12		23.87	23.67	23.67		
20	1	0		23.87	23.77	23.67		
20	1	50		23.67	23.57	23.47		
20	50	0		21.17	23.67	23.67		
20	1	1	QPSK	23.87	23.77	23.57		
20	1	49		23.67	23.67	23.47		
20	25	12		23.87	23.67	23.67		
20	1	0		23.87	23.77	23.67		
20	1	50		23.57	23.57	23.47		
20	50	0		23.77	23.67	23.67		
20	1	1	16-QAM	23.67	23.47	23.37	28.67	0.7362
20	1	1	64-QAM	22.37	22.27	22.17		
20	1	1	256-QAM	20.47	20.17	20.07		
Limit	EIRP < 2W			Result			Pass	



FR1 n7

Peak-to-Average Ratio

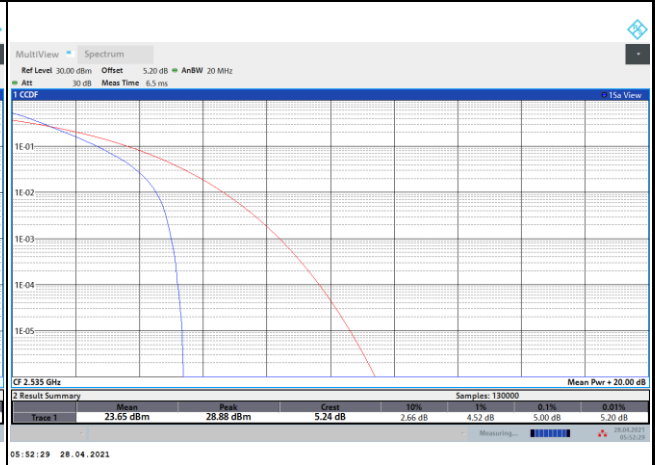
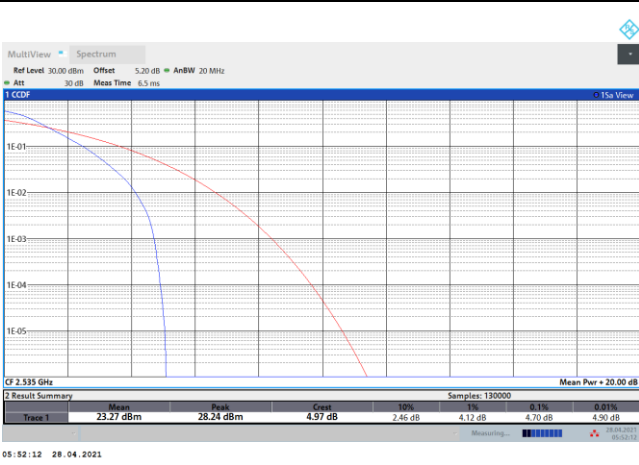
Mode	FR1 n7 / 20MHz / DFT-S OFDM				
Mod.	PI/2 BPSK	QPSK	16QAM	64QAM	Limit: 13dB
RB Size	Full RB	Full RB	Full RB	Full RB	Result
Middle CH	4.70	5.00	5.68	6.06	PASS
Mode	FR1 n7 / 20MHz / DFT-S OFDM				
Mod.	256QAM				Limit: 13dB
RB Size	Full RB				Result
Middle CH	6.76				PASS



FR1 n7 / 20MHz / DFT-S OFDM / Middle Channel / Full RB

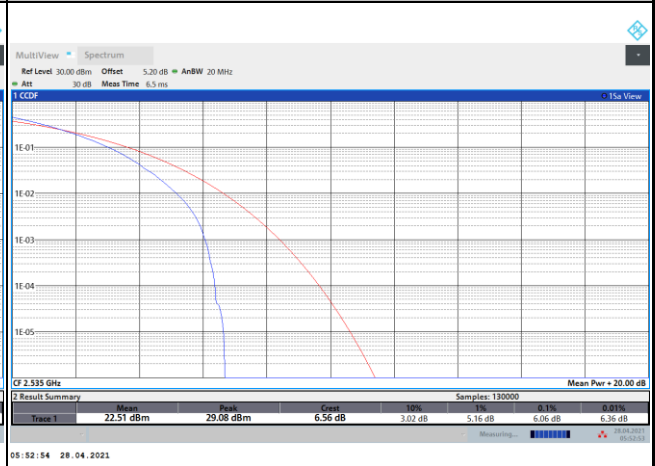
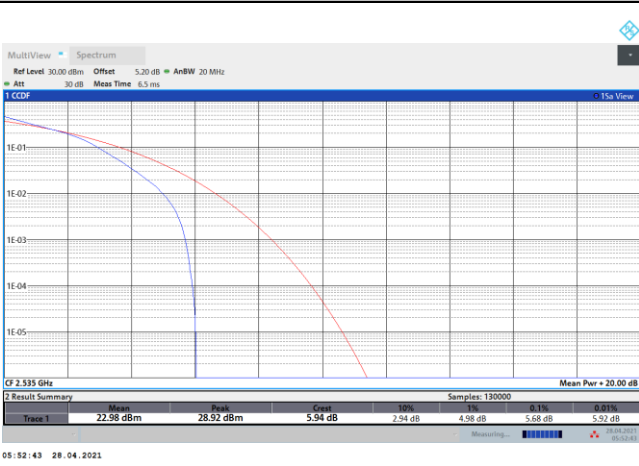
PI/2 BPSK

QPSK

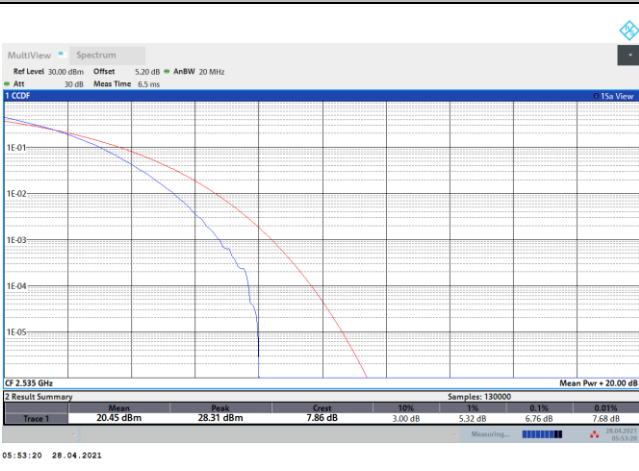


16QAM

64QAM



256QAM





26dB Bandwidth

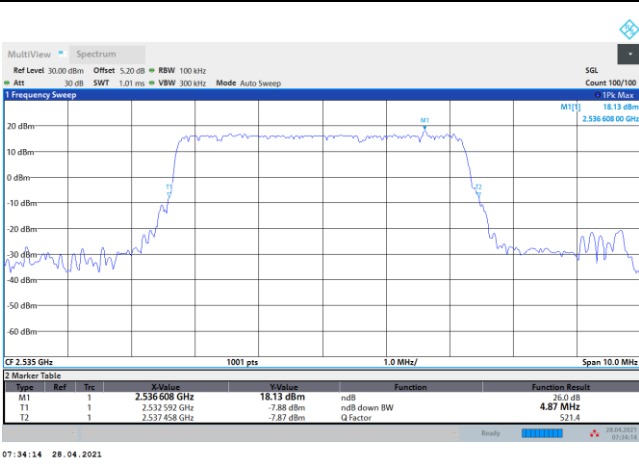
Mode	FR1 n7 : 26dB BW(MHz) / DFT-S OFDM							
BW	5MHz		10MHz		15MHz		20MHz	
Mod.	PI/2 BPSK		PI/2 BPSK		PI/2 BPSK		PI/2 BPSK	
Middle CH	4.87		9.43		14.24		18.86	

Mode	FR1 n7 : 26dB BW(MHz) / CP OFDM							
BW	5MHz		10MHz		15MHz		20MHz	
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Middle CH	4.91	4.89	9.77	9.79	14.93	15.04	19.82	19.90
Mod.	64QAM	256QAM	64QAM	256QAM	64QAM	256QAM	64QAM	256QAM
Middle CH	4.93	4.84	9.83	9.87	15.13	14.87	19.82	19.90



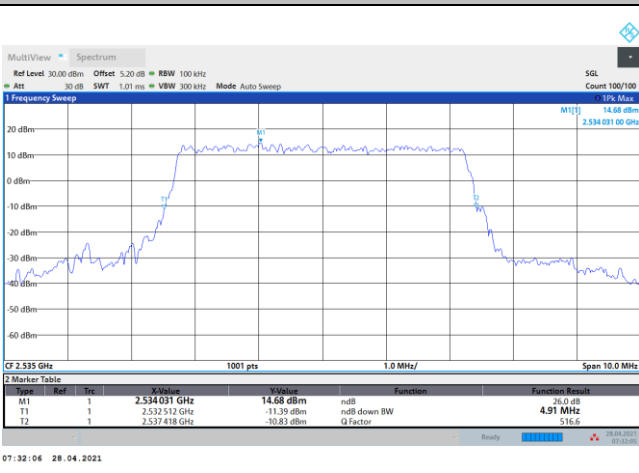
FR1 n7 / 5MHz / DFT-S OFDM / Middle Channel / Full RB

PI/2 BPSK

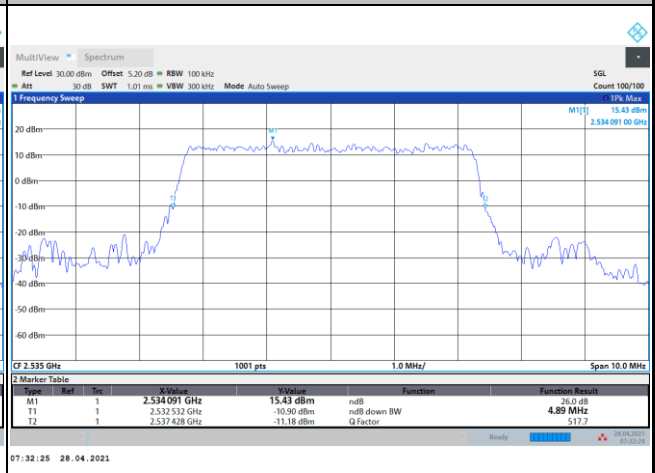


FR1 n7 / 5MHz / CP OFDM / Middle Channel / Full RB

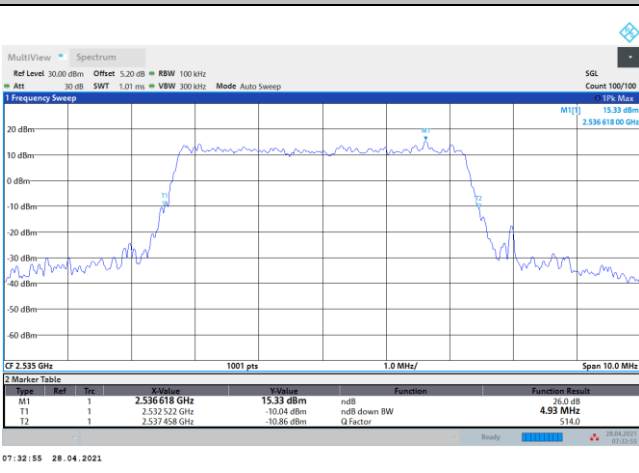
QPSK



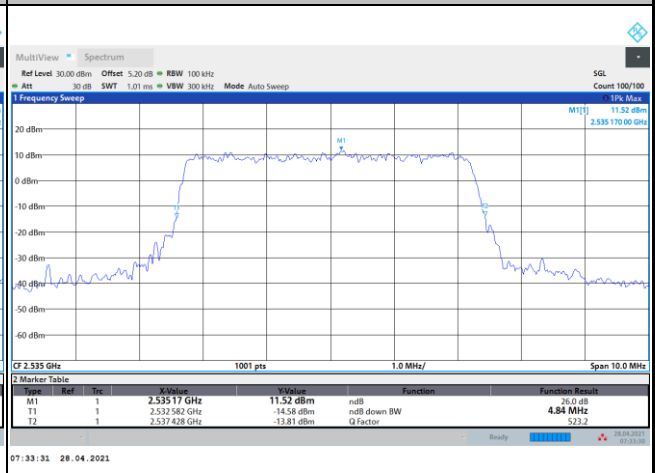
16QAM



64QAM



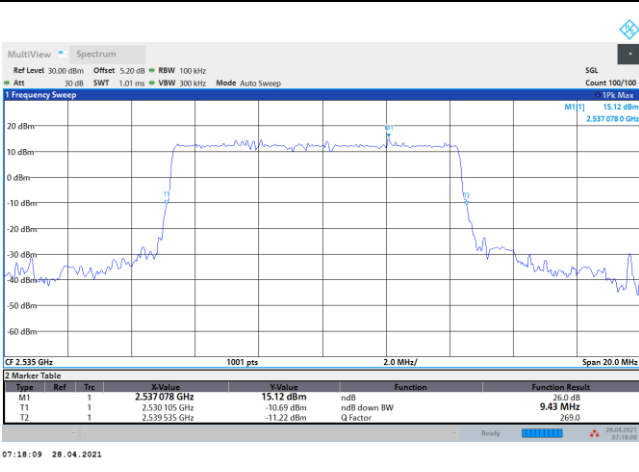
256QAM





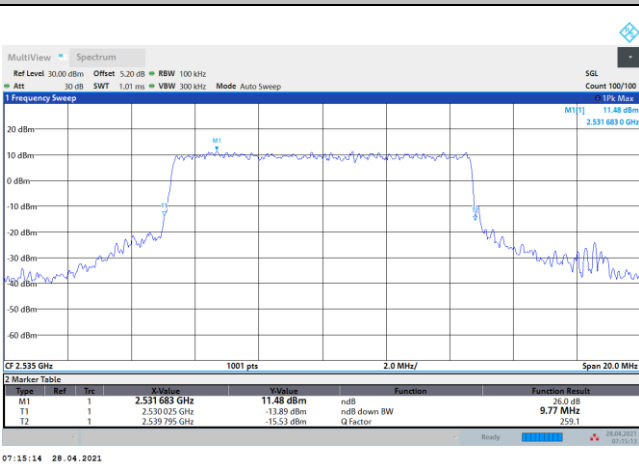
FR1 n7 / 10MHz / DFT-S OFDM / Middle Channel / Full RB

PI/2 BPSK

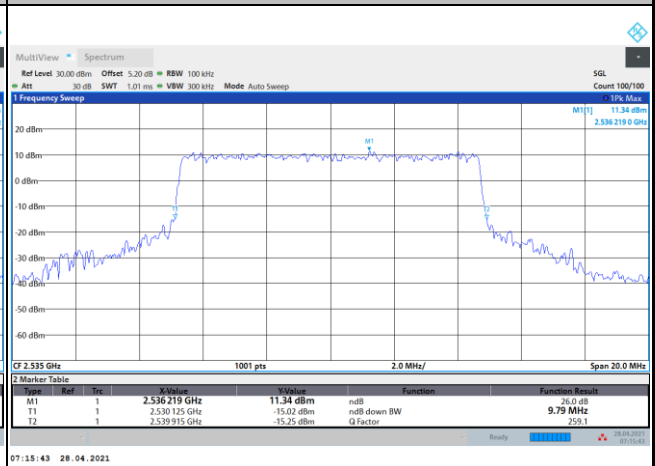


FR1 n7 / 10MHz / CP OFDM / Middle Channel / Full RB

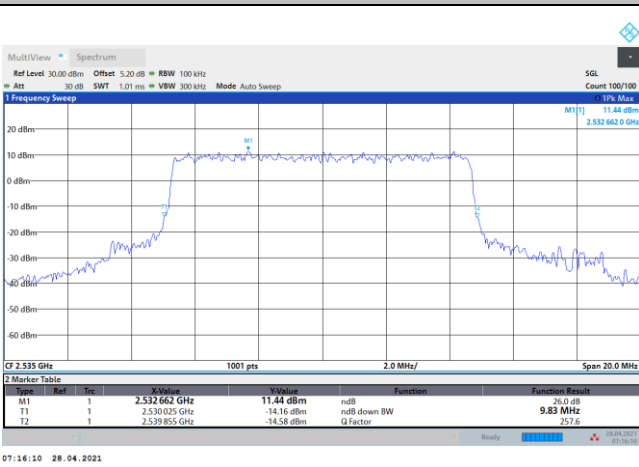
QPSK



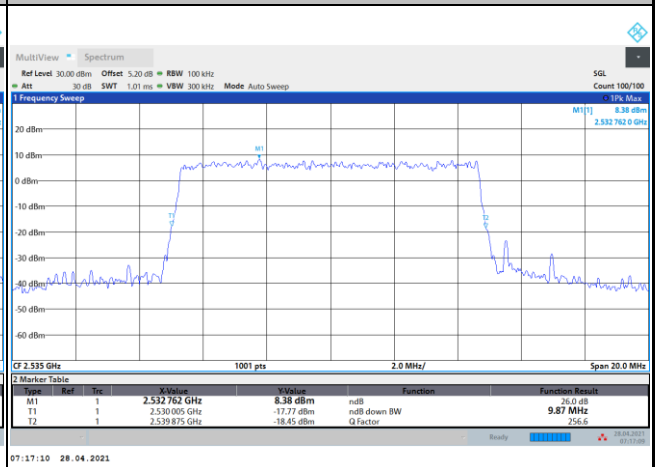
16QAM



64QAM



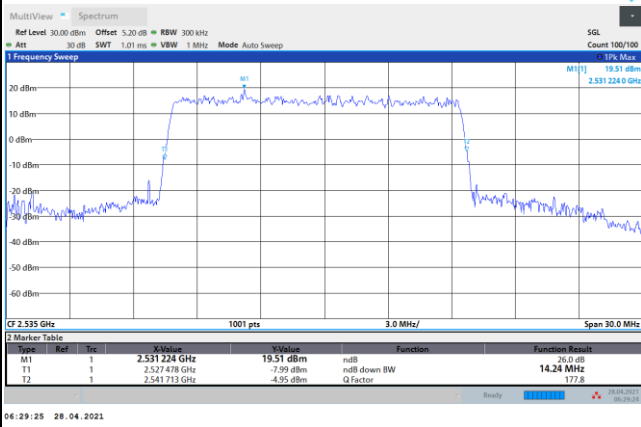
256QAM





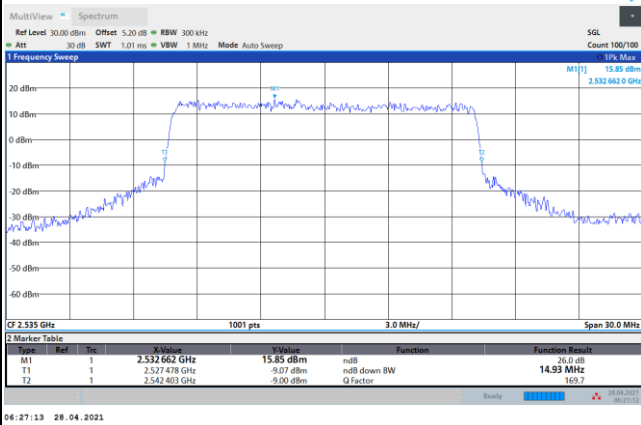
FR1 n7 / 15MHz / DFT-S OFDM / Middle Channel / Full RB

PI/2 BPSK

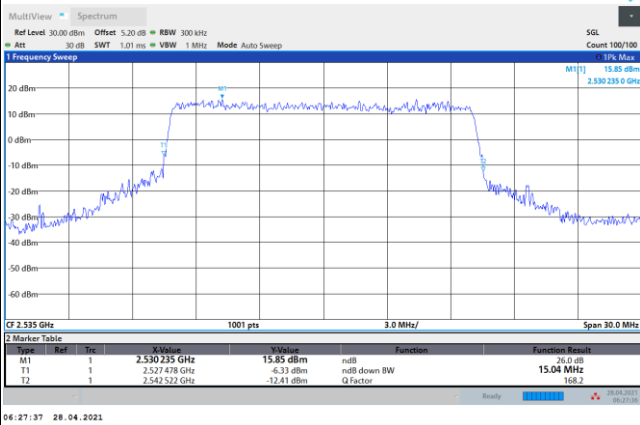


FR1 n7 / 15MHz / CP OFDM / Middle Channel / Full RB

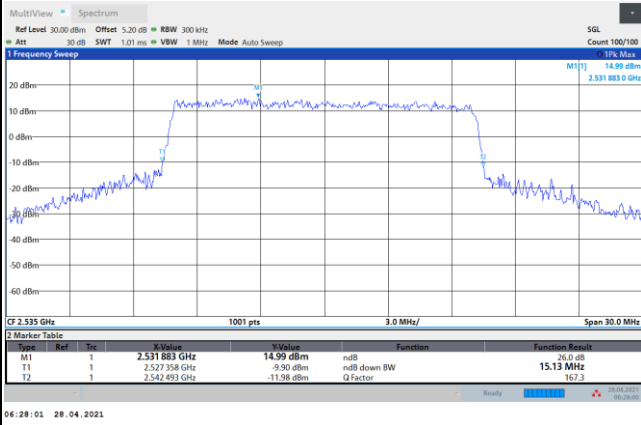
QPSK



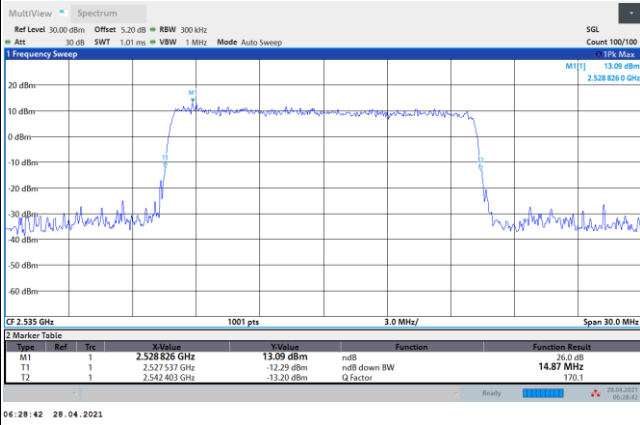
16QAM



64QAM



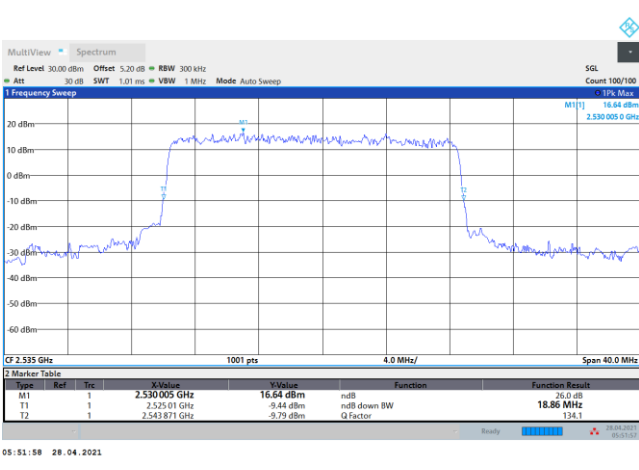
256QAM





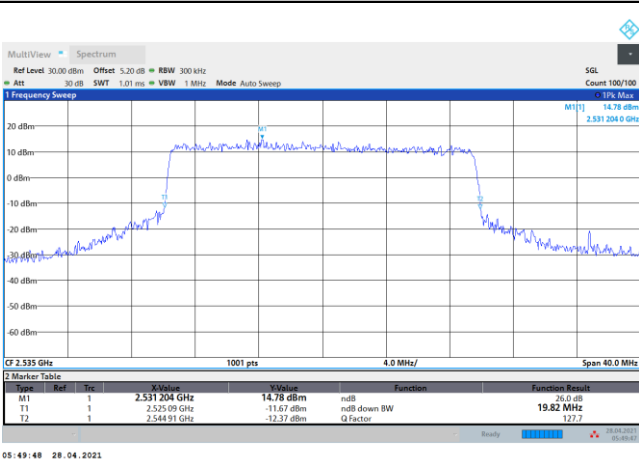
FR1 n7 / 20MHz / DFT-S OFDM / Middle Channel / Full RB

PI/2 BPSK

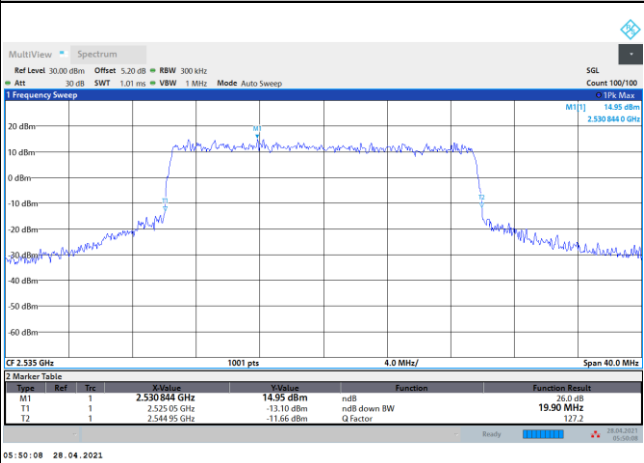


FR1 n7 / 20MHz / CP OFDM / Middle Channel / Full RB

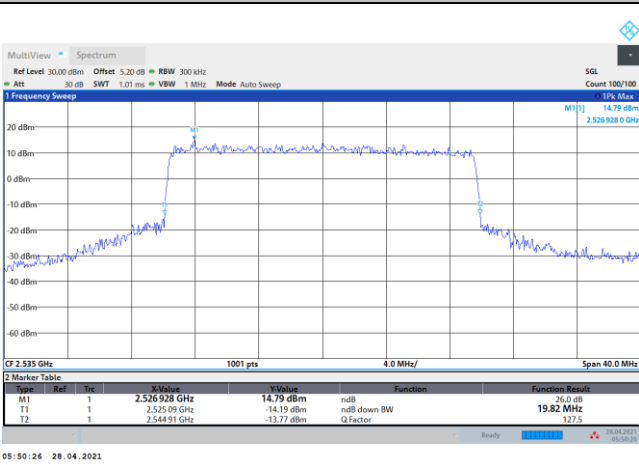
QPSK



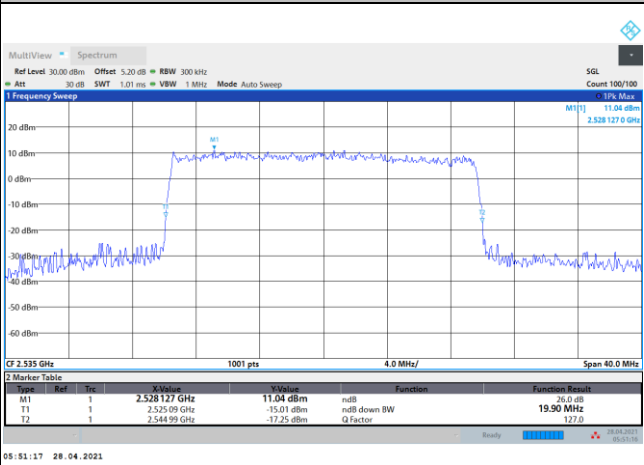
16QAM



64QAM



256QAM





Occupied Bandwidth

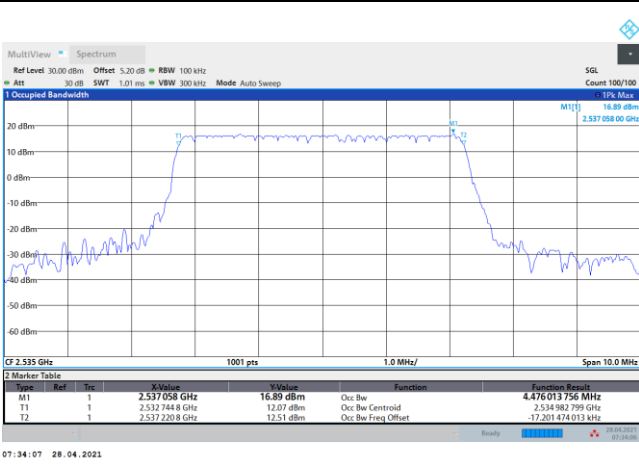
Mode	FR1 n7 : 99%OBW(MHz) / DFT-S OFDM							
BW	5MHz		10MHz		15MHz		20MHz	
Mod.	PI/2 BPSK		PI/2 BPSK		PI/2 BPSK		PI/2 BPSK	
Middle CH	4.48		8.91		13.47		17.89	

Mode	FR1 n7 : 99%OBW (MHz) / CP OFDM							
BW	5MHz		10MHz		15MHz		20MHz	
Mod.	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Middle CH	4.49	4.52	9.28	9.26	14.16	14.13	18.90	18.98
Mod.	64QAM	256QAM	64QAM	256QAM	64QAM	256QAM	64QAM	256QAM
Middle CH	4.49	4.48	9.24	9.29	14.15	14.16	18.91	18.90



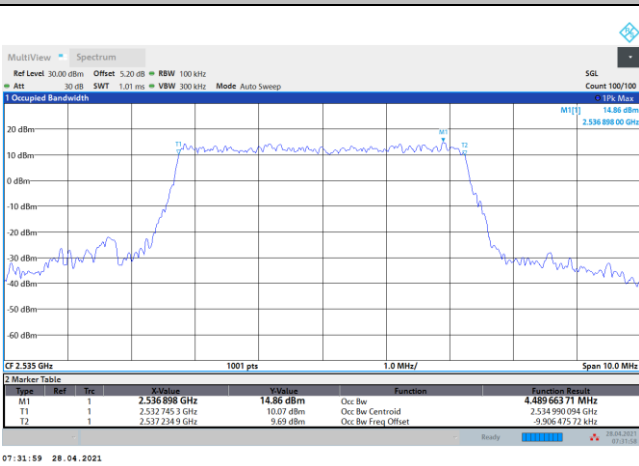
FR1 n7 / 5MHz / DFT-S OFDM / Middle Channel / Full RB

PI/2 BPSK

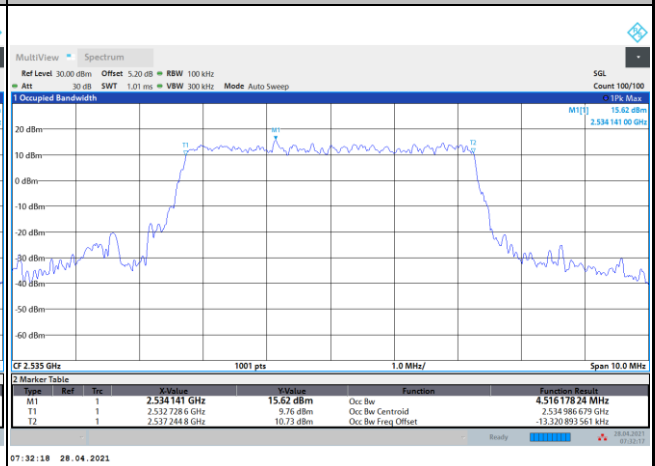


FR1 n7 / 5MHz / CP OFDM / Middle Channel / Full RB

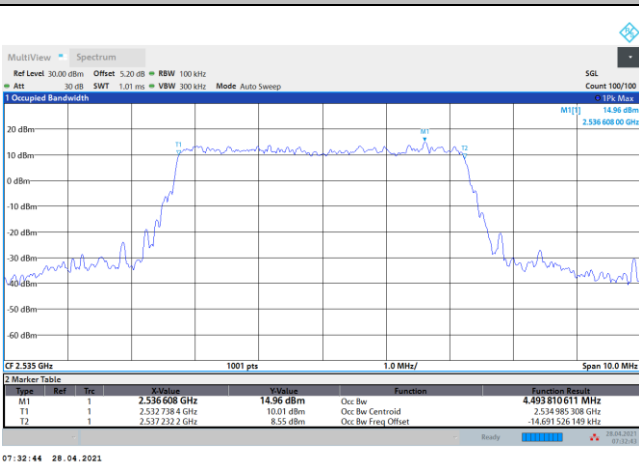
QPSK



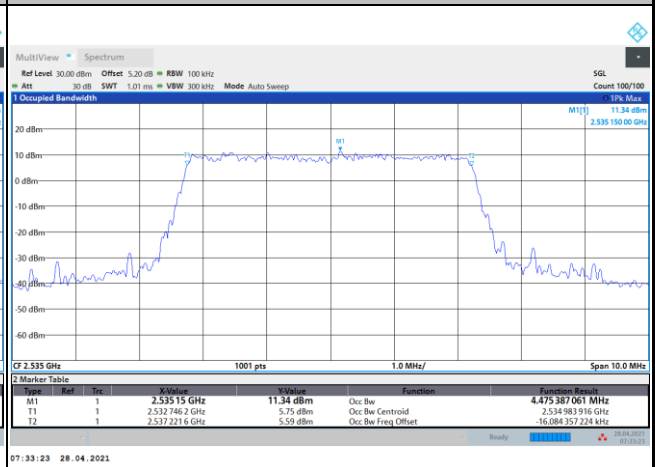
16QAM



64QAM



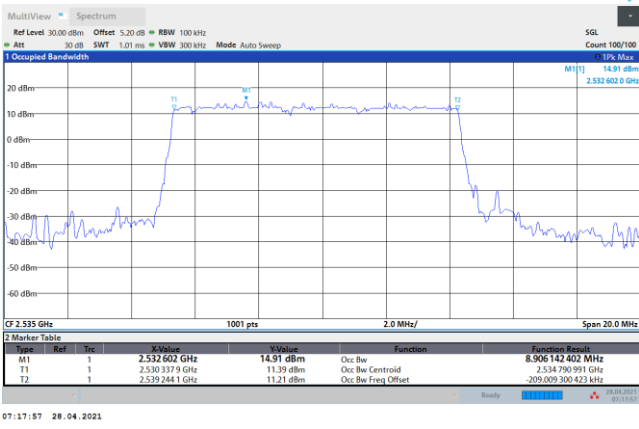
256QAM





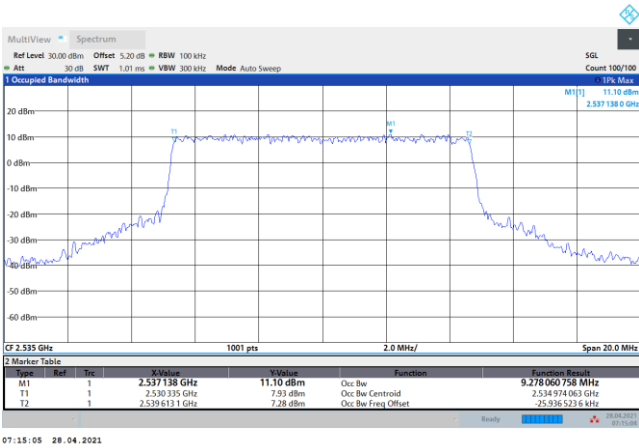
FR1 n7 / 10MHz / DFT-S OFDM / Middle Channel / Full RB

PI/2 BPSK

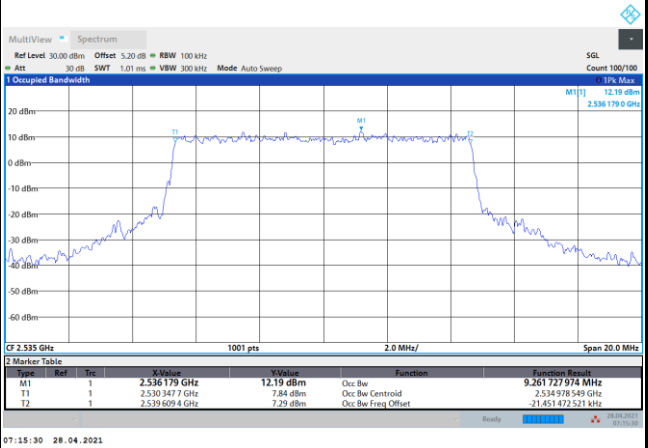


FR1 n7 / 10MHz / CP OFDM / Middle Channel / Full RB

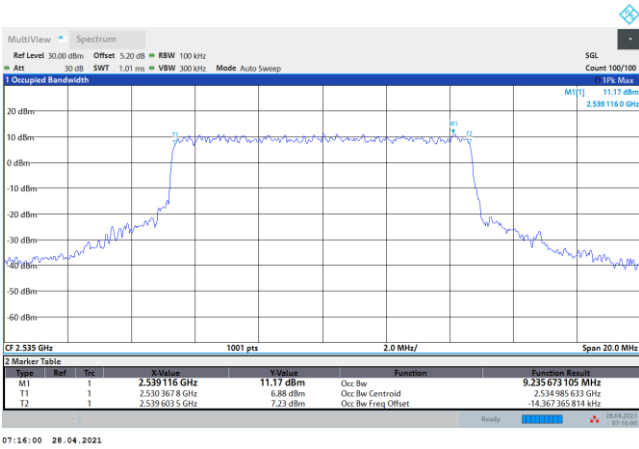
QPSK



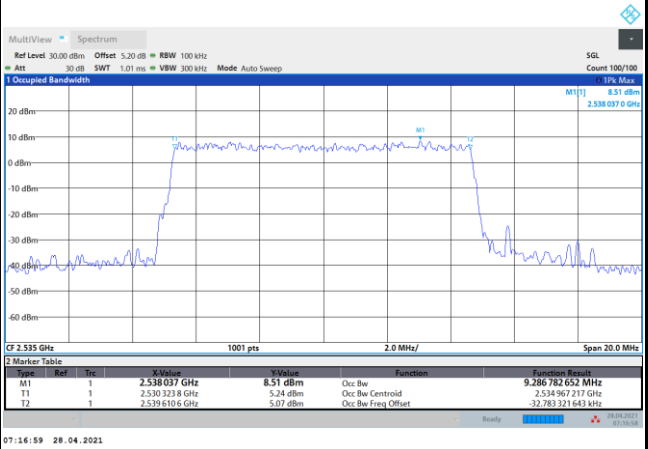
16QAM



64QAM



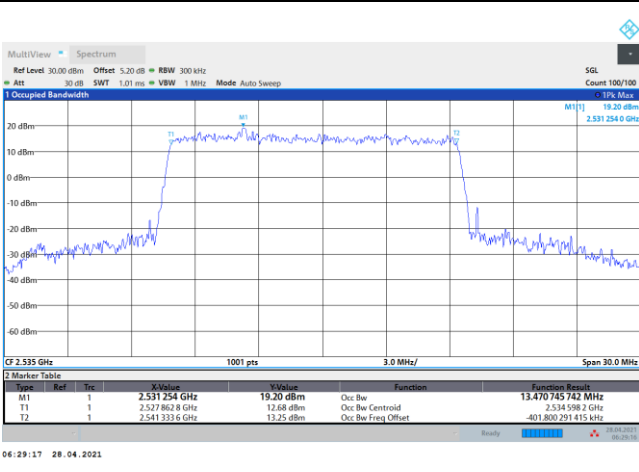
256QAM





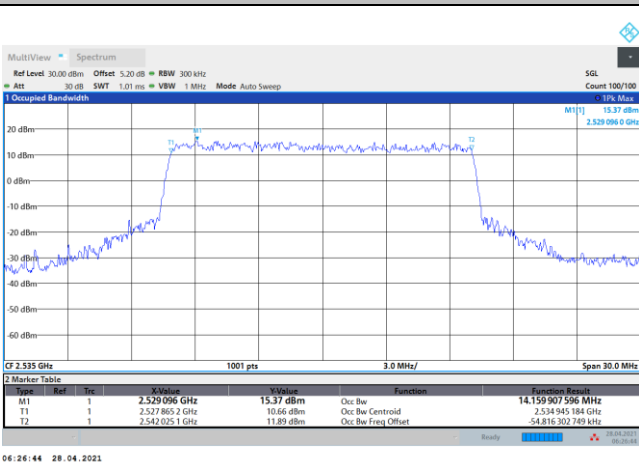
FR1 n7 / 15MHz / DFT-S OFDM / Middle Channel / Full RB

PI/2 BPSK

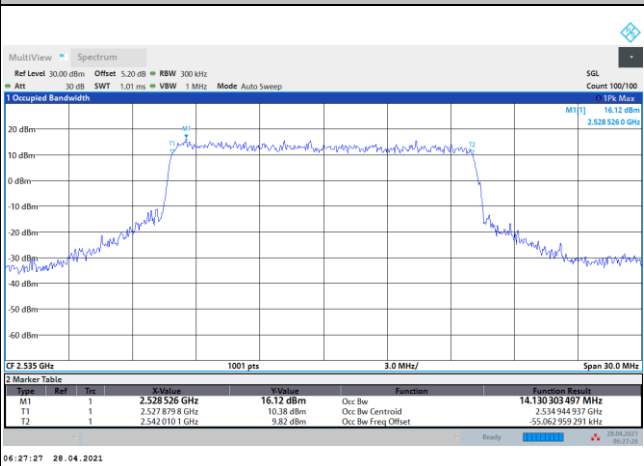


FR1 n7 / 15MHz / CP OFDM / Middle Channel / Full RB

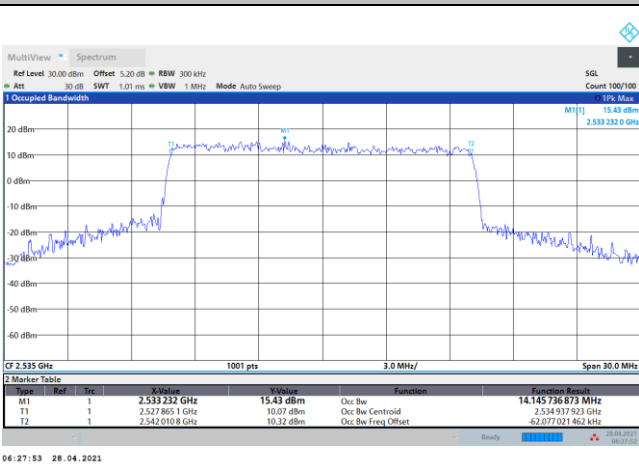
QPSK



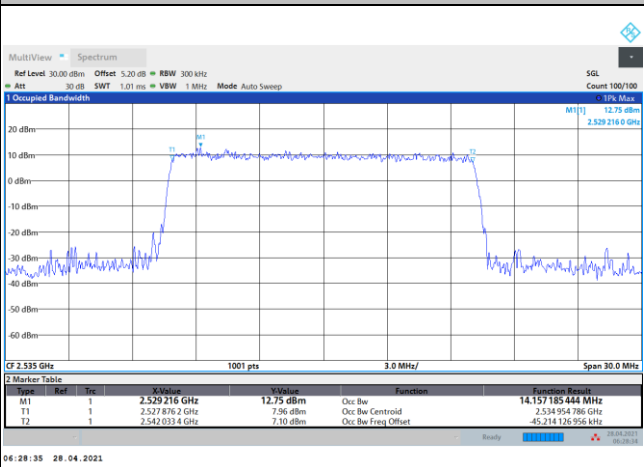
16QAM



64QAM



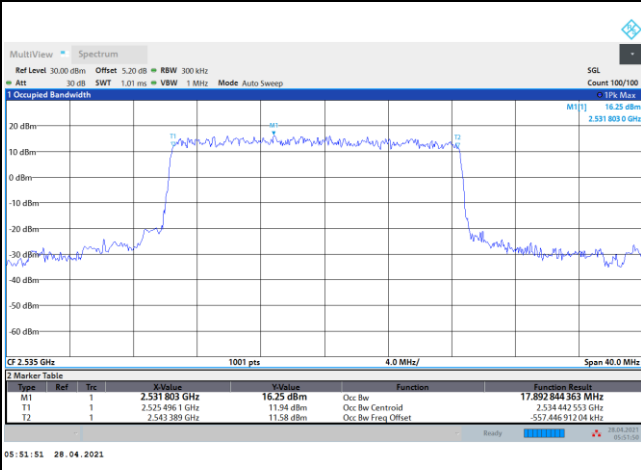
256QAM





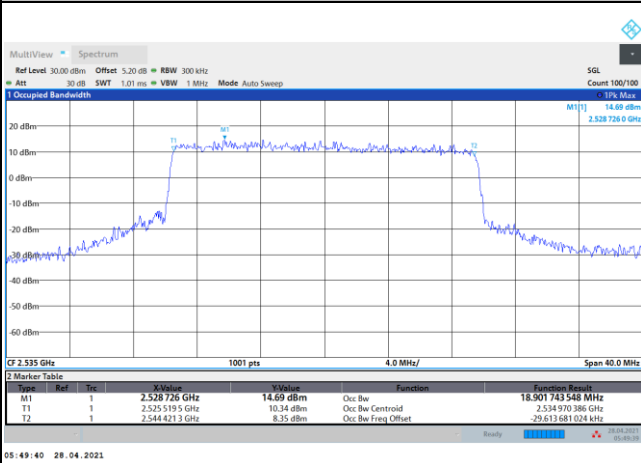
FR1 n7 / 20MHz / DFT-S OFDM / Middle Channel / Full RB

PI/2 BPSK

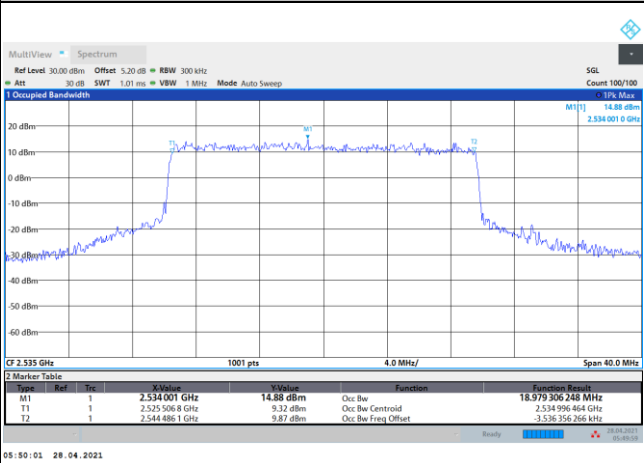


FR1 n7 / 20MHz / CP OFDM / Middle Channel / Full RB

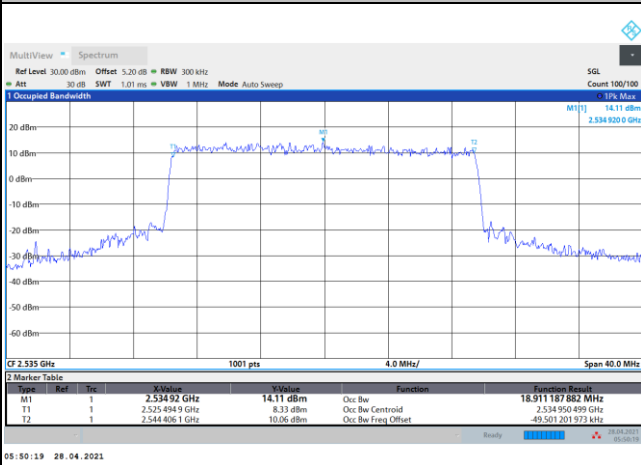
QPSK



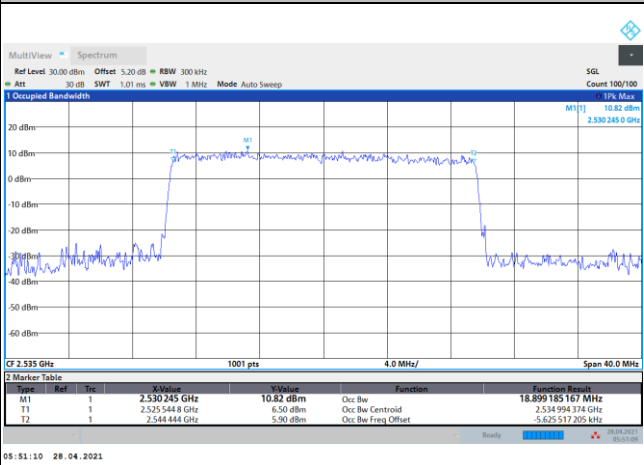
16QAM



64QAM



256QAM



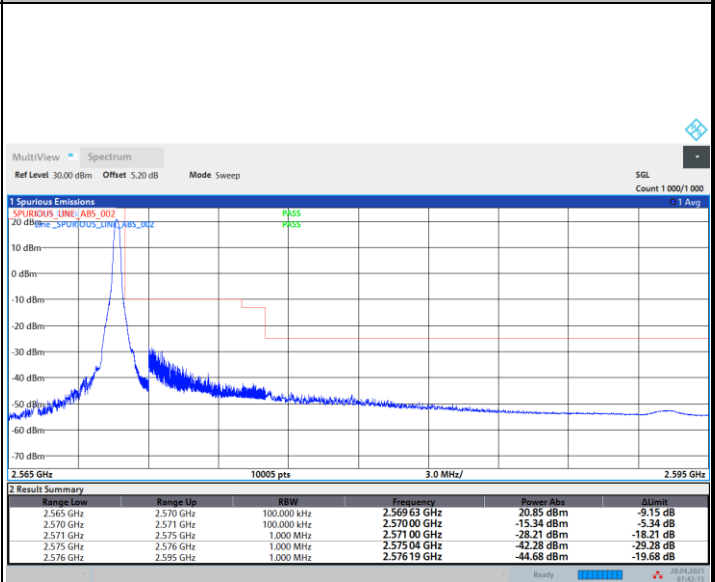
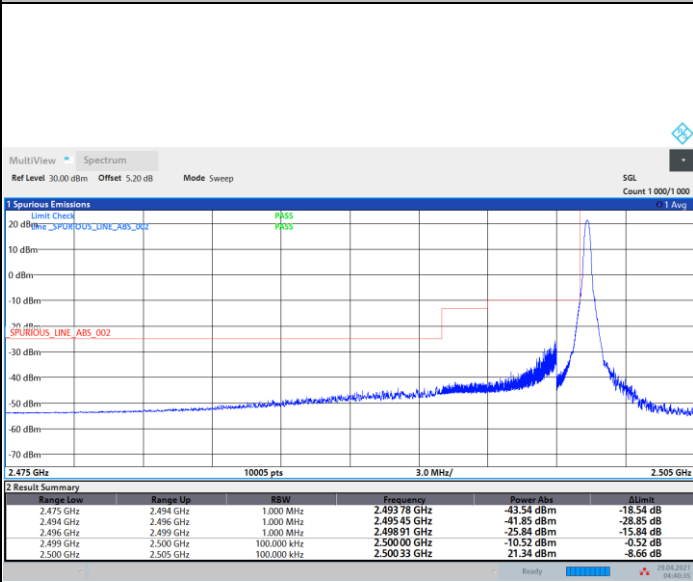


Conducted Band Edge

FR1 n7 / 5MHz / DFT-S OFDM / PI/2 BPSK

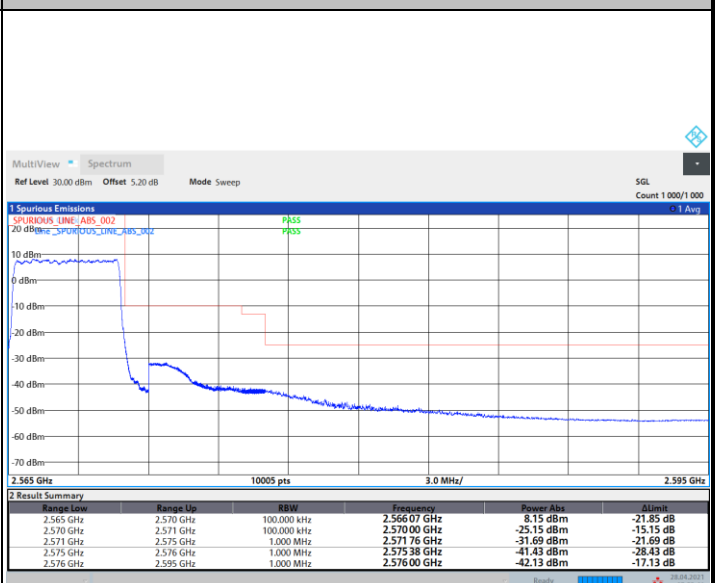
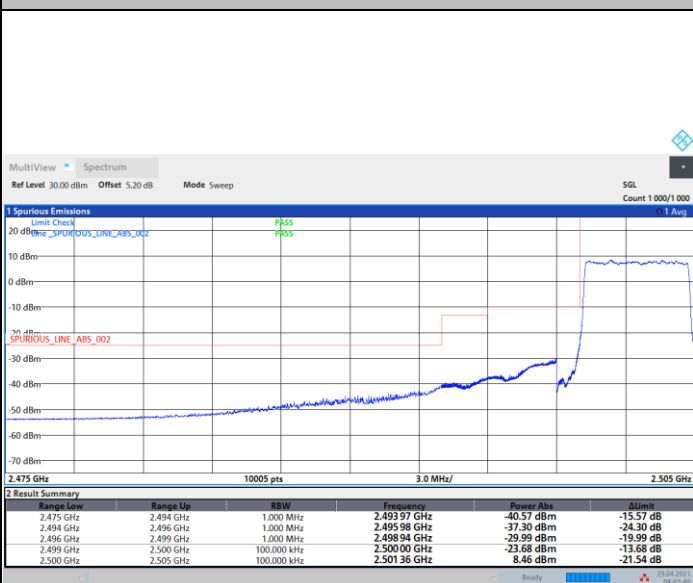
Lowest Band Edge / 1RB0

Highest Band Edge / 1RBmax



Lowest Band Edge / Full RB

Highest Band Edge / Full RB

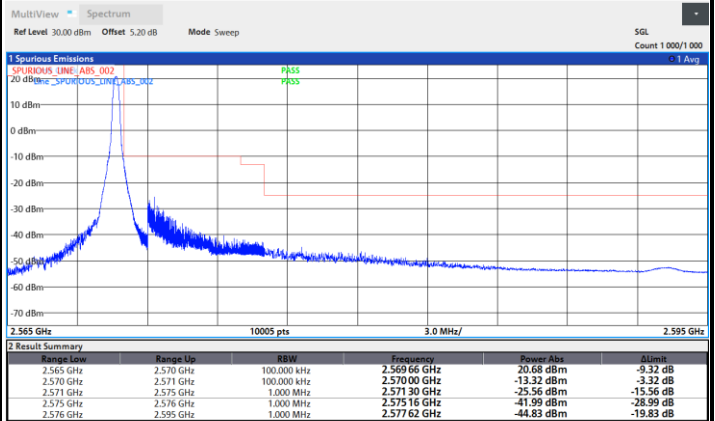
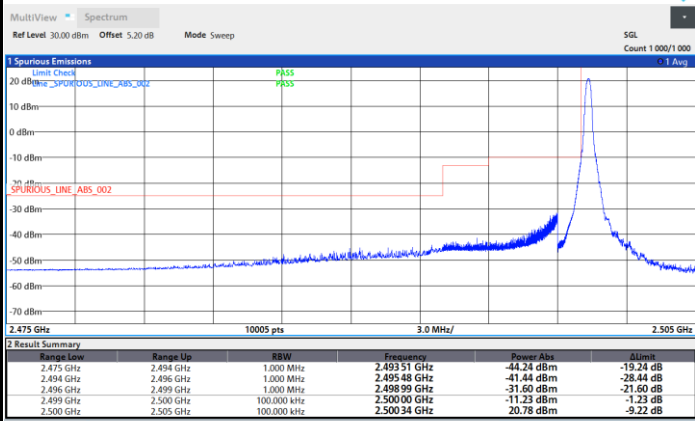




FR1 n7 / 5MHz / DFT-S OFDM / QPSK

Lowest Band Edge / 1RB0

Highest Band Edge / 1RBmax

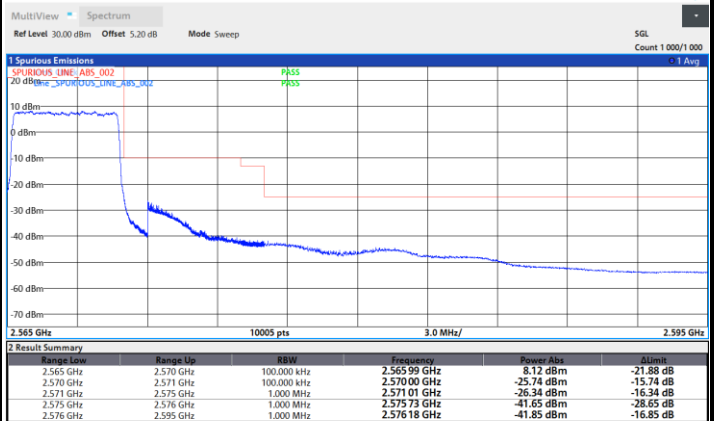
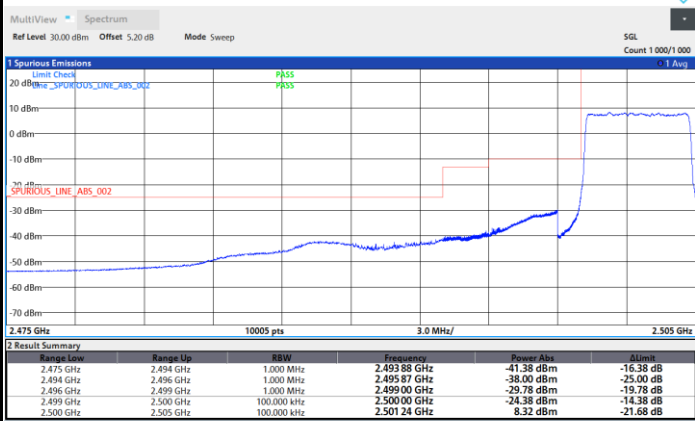


04:19:29 29.04.2021

07:43:29 28.04.2021

Lowest Band Edge / Full RB

Highest Band Edge / Full RB



04:03:52 29.04.2021

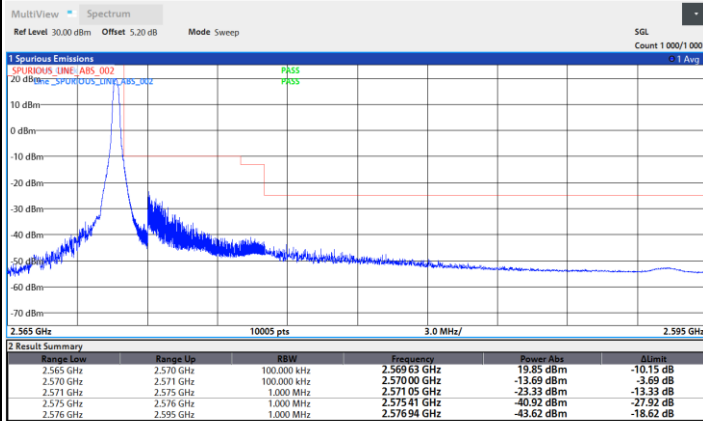
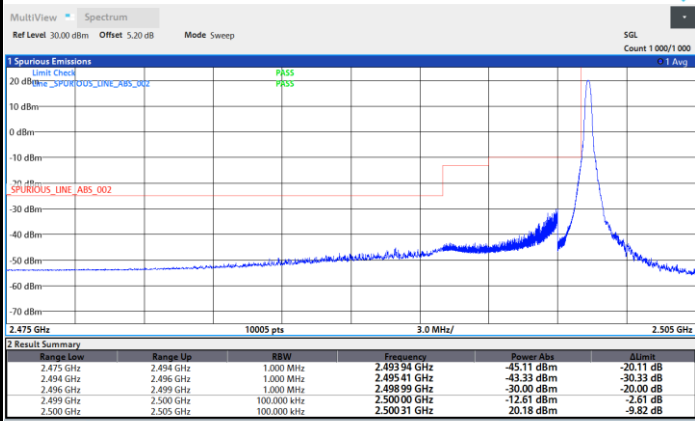
07:51:39 28.04.2021



FR1 n7 / 5MHz / DFT-S OFDM / 16QAM

Lowest Band Edge / 1RB0

Highest Band Edge / 1RBmax

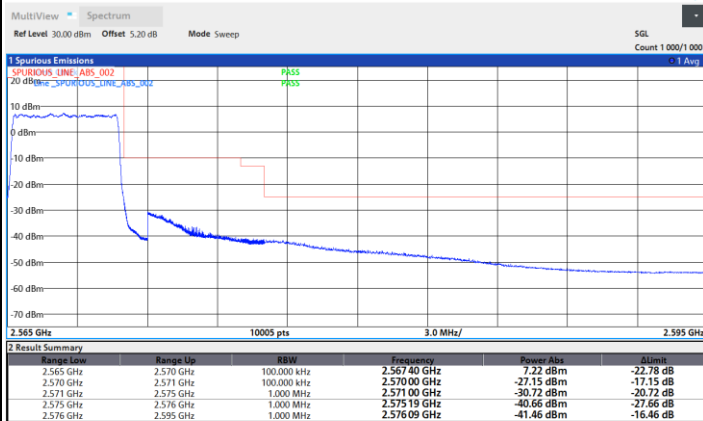
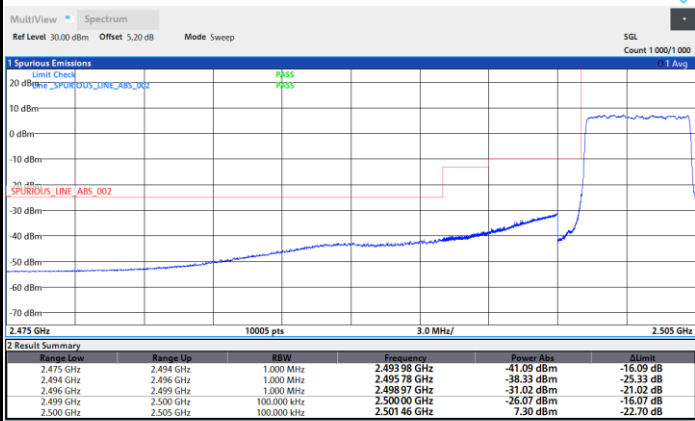


04:16:55 29.04.2021

07:44:29 28.04.2021

Lowest Band Edge / Full RB

Highest Band Edge / Full RB



04:05:05 29.04.2021

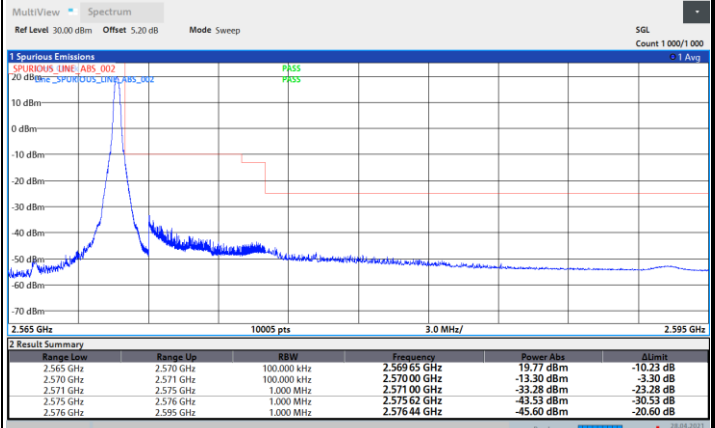
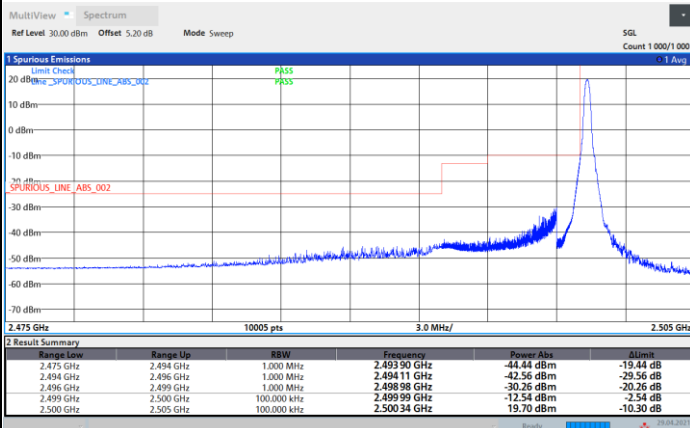
07:50:33 28.04.2021



FR1 n7 / 5MHz / DFT-S OFDM / 64QAM

Lowest Band Edge / 1RB0

Highest Band Edge / 1RBmax

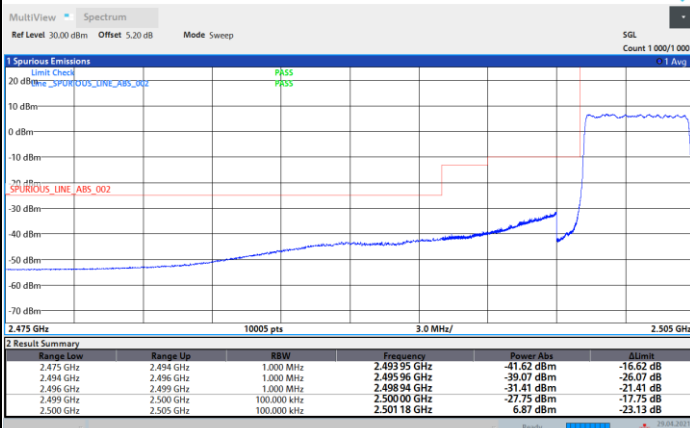


04:35:47 29.04.2021

07:45:48 28.04.2021

Lowest Band Edge / Full RB

Highest Band Edge / Full RB



04:31:24 29.04.2021

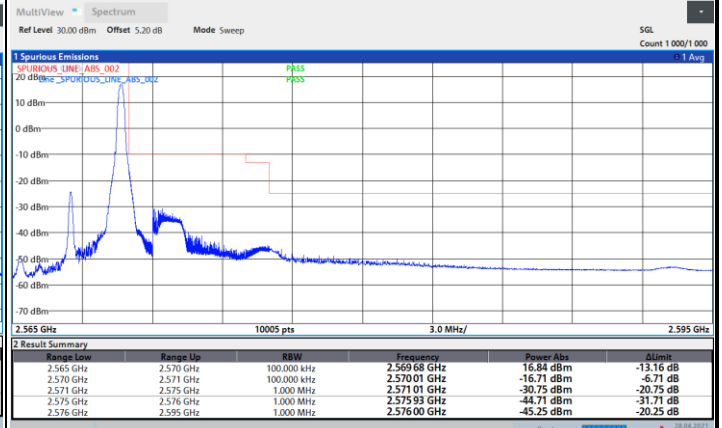
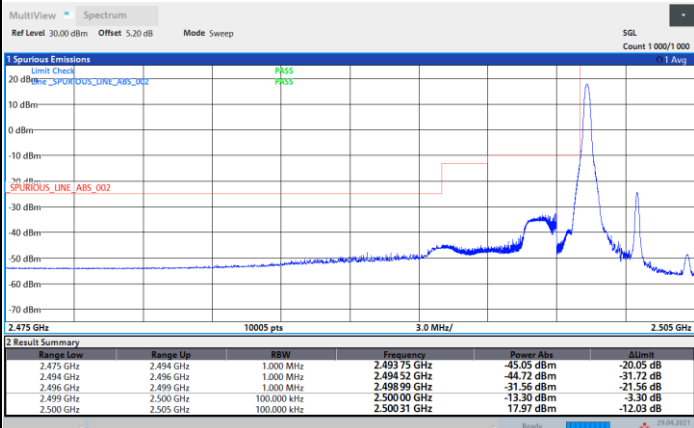
07:46:49 28.04.2021



FR1 n7 / 5MHz / DFT-S OFDM / 256QAM

Lowest Band Edge / 1RB0

Highest Band Edge / 1RBmax

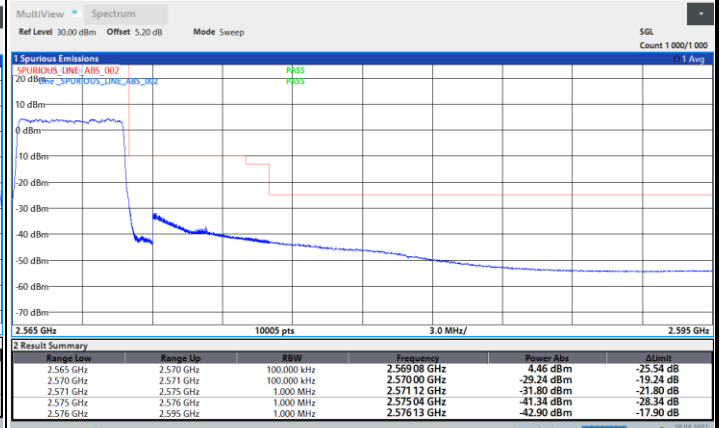
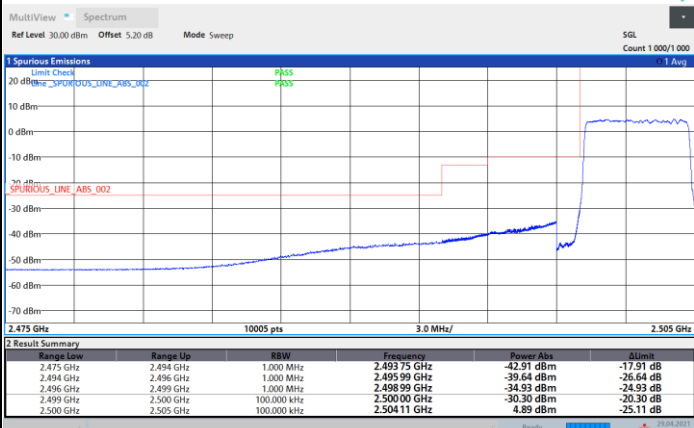


04:34:36 29.04.2021

07:55:17 28.04.2021

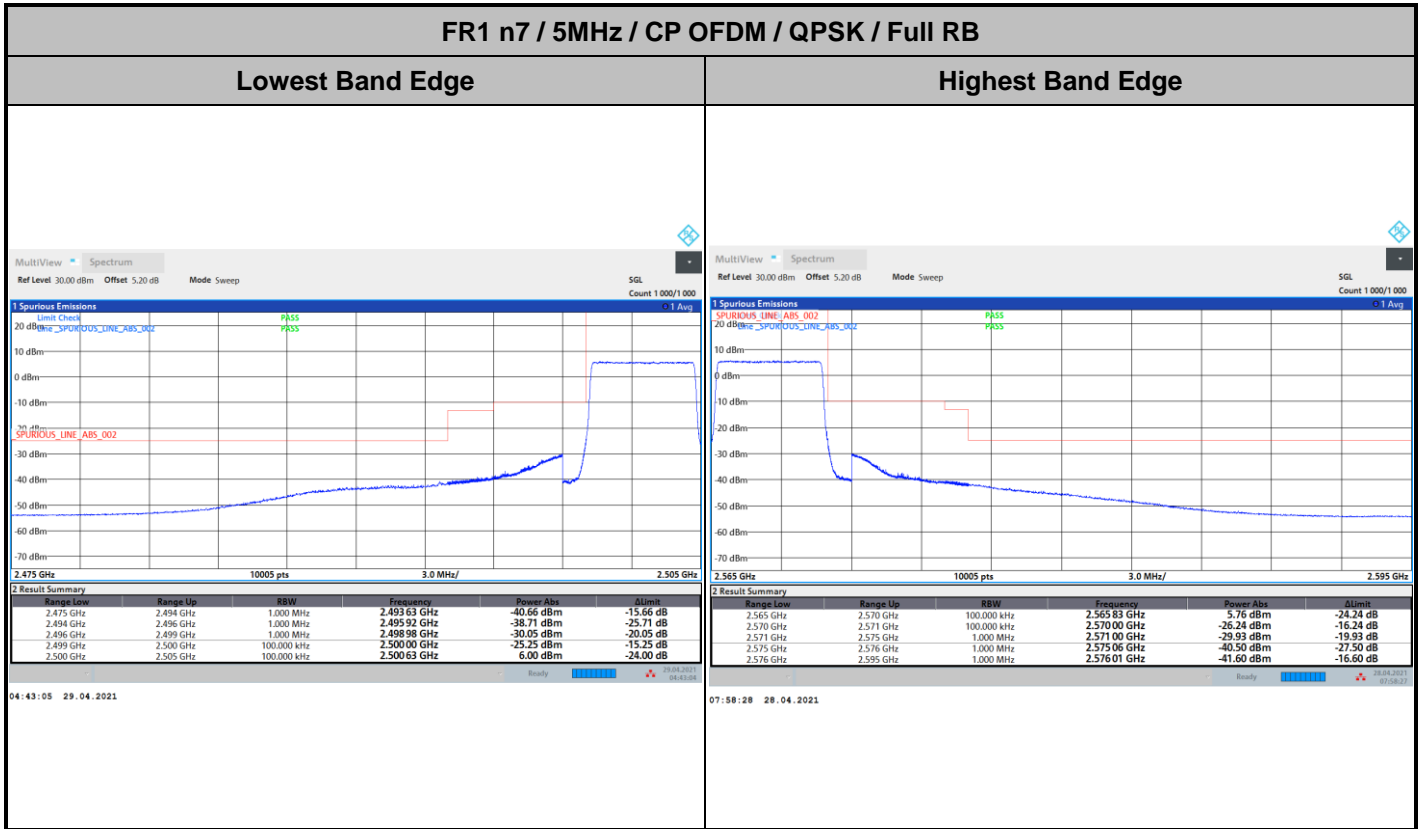
Lowest Band Edge / Full RB

Highest Band Edge / Full RB



04:33:25 29.04.2021

07:56:34 28.04.2021

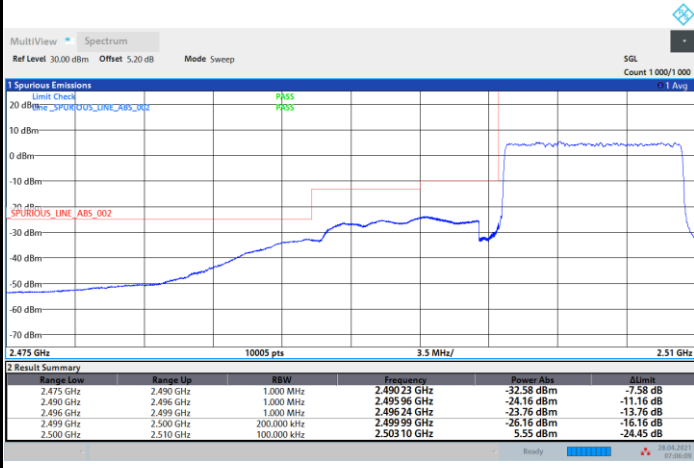




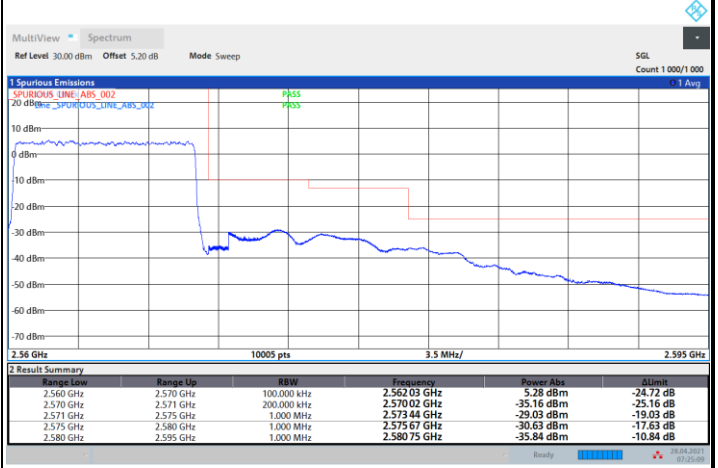
FR1 n7 / 10MHz / DFT-s-OFDM / PI/2 BPSK / Full RB

Lowest Band Edge

Highest Band Edge



07:06:09 28.04.2021



07:25:10 28.04.2021

