FCC RF Test Report

APPLICANT	:	**Smawave Technology Co. ,Ltd**
EQUIPMENT	:	**5G ODU_NA**
BRAND NAME	:	**smawave**
MODEL NAME	:	**SRE620-b**
FCC ID	:	**2AU8HSRE620-B**
STANDARD	:	**47 CFR Part 2, 96**
CLASSIFICATION	:	**Citizens Band Category A and B Devices (CBD)**
EQUIPMENT TYPE	:	**CPE-CBSD (Category B)**
TEST DATE(S)	:	**Apr. 26, 2023 ~ May 13, 2023**

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.26 and shown compliance with the applicable technical standards.

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

Jason Jia

Approved by: Jason Jia

ACCREDITED Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China

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History of this test report

Report No.	Version	Description	Issued Date
FG342001C	01	Initial issue of report	May 31, 2023

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046	Conducted Output Power	Reporting only	-
3.3	§96.41	Peak-to-Average Ratio	Pass	-
3.4	§96.41	Maximum E.I.R.P	Pass	-
		Maximum Power Spectral Density	Pass	-
3.5	§2.1049 §96.41	Occupied Bandwidth	Reporting only	-
3.6	§2.1051 §96.41	Conducted Band Edge Measurement	Pass	-
3.7	§2.1051 §96.41	Conducted Spurious Emission	Pass	
3.8	§2.1055	Frequency Stability for Temperature & Voltage	Pass	-
4.4	§2.1051 §96.41	Radiated Spurious Emission	Pass	Under limit 20.00 dB at 14428.00 MHz

Conformity Assessment Condition:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

1 General Description

1.1 Applicant

Smawave Technology Co. ,Ltd
3/F, Building 8, 1001 North Qinzhou Road，Xuhui District, Shanghai, China

1.2 Manufacturer

Smawave Technology Co. ,Ltd
3/F, Building 8, 1001 North Qinzhou Road，Xuhui District, Shanghai, China

1.3 Feature of Equipment Under Test

Product Feature	
Equipment	5G ODU_NA
Brand Name	smawave
Model Name	SRE620-b
FCC ID	2AU8HSRE620-B
Tx Frequency	5G NR n48: 3550 MHz ~ 3700 MHz
Rx Frequency	5G NR n48: 3550 MHz ~ 3700 MHz
Bandwidth	10MHz / 20MHz / 40MHz
Maximum Output Power to Antenna	<Ant.0>: n48 : 19.93 dBm <Ant.0+3>: n48 UL MIMO : 19.25 dBm
Antenna Gain	<Ant.0>: 8.26 dBi <Ant.3>: 8.41 dBi
Type of Modulation	DFT-s-OFDM (PI/2 BPSK / QPSK / 16QAM / 64QAM / 256QAM) CP-OFDM (QPSK / 16QAM / 64QAM / 256QAM)
IMEI Code	Conducted: 863109050027817 Radiation: 863109050027833
HW Version	V1.0
SW Version	Codium_FW_5G_1.0.8

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. 5G NR n48 supports UL MIMO mode, and only supports CP-OFDM modulation in UL MIMO mode. The MIMO mode is completely uncorrelated, the directional gain is selected the maximum gain among Ant.0 & Ant.3.
3. 5G NR does not support NSA mode for LTE B41/B48 and 5G NR n41/48.

1.4 Maximum EIRP and Emission Designator

5G NR n48		PI/2 BPSK / QPSK		16QAM / 64QAM / 256QAM	
BW (MHz)	Frequency Range (MHz)	Maximum EIRP(W)	Emission Designator (99%OBW)	Maximum EIRP(W)	Emission Designator (99%OBW)
10	3555.00~3694.98	0.6353	8M77G7D	0.5164	8M79W7D
20	3560.01~3690.00	0.6531	18M2G7D	0.5152	18M3W7D
40	3570.00~3679.98	0.6592	37M8G7D	0.4989	38M0W7D
5G NR n48 MIMO		QPSK		16QAM / 64QAM / 256QAM	
BW (MHz)	Frequency Range (MHz)	Maximum EIRP(W)	Emission Designator (99%OBW)	Maximum EIRP(W)	Emission Designator (99%OBW)
10	3555.00~3694.98	0.5534	8M79G7D	0.5082	8M81W7D
20	3560.01~3690.00	0.5521	18M2G7D	0.5297	18M3W7D
40	3570.00~3679.98	0.5834	38M0G7D	0.5284	38M4W7D

Note: All modulations have been tested, only the worst test results of PSK & QAM are shown in the report.

1.5 Testing Site

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	03CH04-KS TH01-KS	CN1257	314309

1.6 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH04-KS	AUDIX	E3	6.2009-8-24al

1.7 Applied Standards

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

- ANSI C63.26-2015
- 47 CFR Part 2, 96
- FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- FCC KDB 940660 D01 Part 96 CBRS v03
- FCC KDB 412172 D01 Determining ERP and EIRP v01r01

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

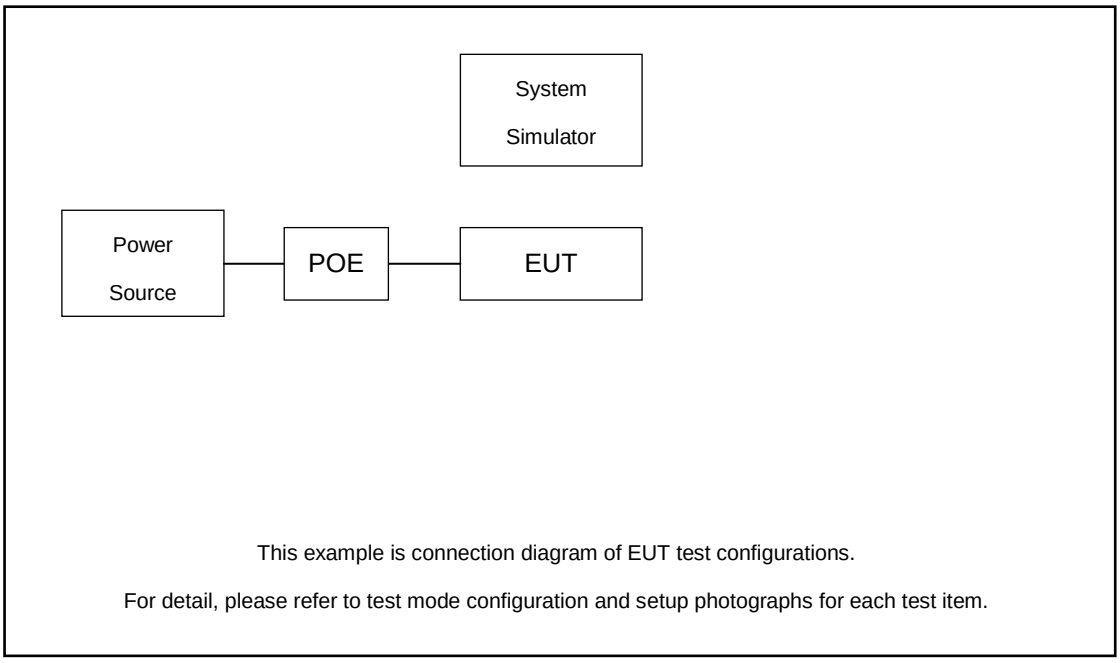
2.1 Test Mode

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 three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.

Test Items	5G NR	Bandwidth (MHz)				Modulation					RB #			Test Channel		
		10	15	20	40	PI/2 BPSK	QPSK	16QAM	64QAM	256QAM	1	Half	Full	L	M	H
Max. Output Power & E.I.R.P	n48	v	-	v	v	v	v	v	v	v	v	v	v	v	v	v
Peak-to-Average Ratio	n48		-		v	v	v						v		v	
26dB and 99% Bandwidth	n48	v	-	v	v		v	v	v	v			v		v	
Conducted Band Edge	n48	v	-	v	v	v	v	v	v	v	v		v	v	v	v
Conducted Spurious Emission	n48	v	-	v	v	v	v				v			v	v	v
Power Spectral Density	n48	v	-	v	v	v	v	v	v	v	v		v	v	v	v
Frequency Stability	n48	v	-				v						v		v	
Radiated Spurious Emission	n48	Worst Case													v	
Note	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.															

2.2 Connection Diagram of Test System



This example is connection diagram of EUT test configurations.

For detail, please refer to test mode configuration and setup photographs for each test item.

2.3 Support Unit used in test configuration

Item	Equipment	Trade Name	Model No.	FCC ID	Data Cable	Power Cord
1.	Power Supply	GWINSTEK	PSS-2002	N/A	N/A	Unshielded, 1.8 m
2.	NR Base Station	Anritsu	MT8000A	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 3.29 dB and 10dB attenuator.

Example :

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

= 3.29 + 10 = 13.29 (dB)

2.5 Frequency List of Low/Middle/High Channels

5G NR n48 Channel and Frequency List				
BW [MHz]	**Channel/Frequency(MHz)**	**Lowest**	**Middle**	**Highest**
40	Channel	638000	641666	645332
	Frequency	3570	3624.99	3679.98
20	Channel	637334	641666	646000
	Frequency	3560.01	3624.99	3690
10	Channel	637000	641666	646332
	Frequency	3555	3624.99	3694.98

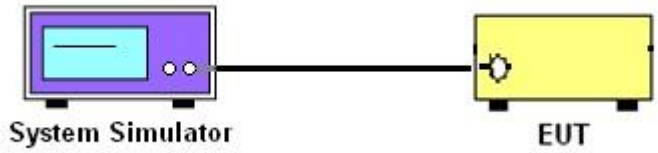
3 Conducted Test Items

3.1 Measuring Instruments

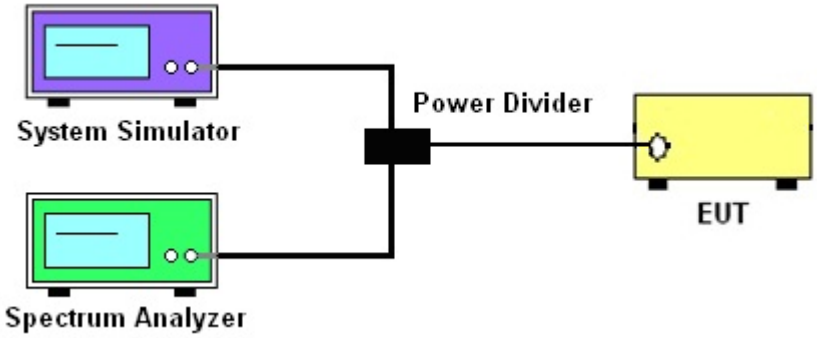
See list of measuring instruments of this test report.

3.1.1 Test Setup

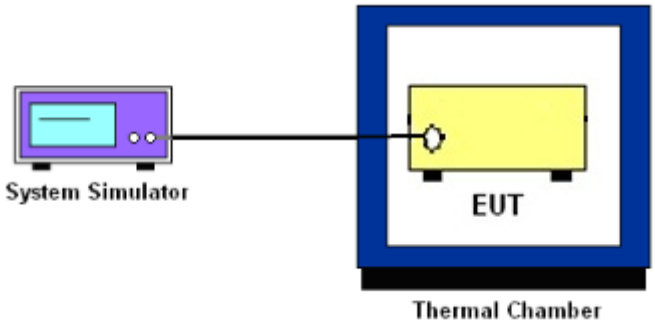
3.1.2 Conducted Output Power



3.1.3 PSD, Peak-to-Average Ratio, 26dB & 99% 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

3.2.1 Description of the Conducted Output Power 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.

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

1. The testing follows ANSI C63.26 Section 5.2.6 (PAPR).
2. The EUT was connected to spectrum and system simulator via a power divider.
3. Set EUT in maximum power output.
4. Set the RBW = 1MHz, VBW = 3MHz, Detector = Peak, Trace mode = max hold, Set span ≥ 2 × OBW in spectrum analyzer.
5. Set the RBW = 1MHz, VBW = 3MHz, Detector = power averaging, Trace mode = max hold, Set span ≥ 2 × OBW in spectrum analyzer.
6. Add [10 log (1/duty cycle)] to the measured maximum power level to compute the average power during continuous transmission.
7. PAPR (dB) = P_{Pk} (dBm) − P_{Avg} (dBm)
   where
   PAPR peak-to-average power ratio, in dB
   P_{Pk} measured peak power level, in dBm
   P_{Avg} measured average power level, in dBm
8. Record the deviation as Peak to Average Ratio.

3.4 EIRP and PSD

3.4.1 Description of the EIRP Measurement

EIRP and PSD limits for CBRS equipment as below table:

Device		Maximum EIRP (dBm/10 MHz)	Maximum PSD (dBm/MHz)
☐	**End User Device**	23	n/a
☐	**Category A CBSD**	30	20
Applied	**Category B CBSD**	47	37

Remark:

1. The worst case EIRP shown in this section is found with NR operating only using 1RB. As such, the EIRP/10MHz and full channel EIRP values will be identical since 1RB is fully contained within all available channel bandwidths for n48 (i.e. 10, 20, 40MHz)
2. Maximum PSD values are radiated. Measurements can be done conducted and add antenna gain back in.

3.4.2 Test Procedures for EIRP

1. Establishing a communications link with the call box (Base station) to measure the Maximum conducted power, the parameters were set to force the EUT transmitting at maximum output power level. Use the average power measurement function to measure total channel power of each channel bandwidth (per ANSI C63.26-2015 Section 5.2.1)

2. Determining ERP and/or EIRP from conducted RF output power measurements (Per ANSI C63.26-2015 Section 5.2.5.5)

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

3.4.3 Test Procedures for EIRP PSD

1. Set instrument center frequency to OBW center frequency.
2. Set span to at least 2 times the OBW.
3. Set the RBW to the specified reference bandwidth (often 1 MHz).
4. Set VBW ≥ 3 × RBW.
5. Detector = RMS (power averaging).
6. Ensure that the number of measurement points in the sweep ≥ 2 × span/RBW.
7. Sweep time = auto couple.
8. Employ trace averaging (RMS) mode over a minimum of 100 traces.
9. Use the peak marker function to determine the maximum amplitude level within the reference bandwidth (PSD).
10. Determine the EIRP by adding the effective antenna gain to the adjusted power level.
11. Add 10 log (1/duty cycle) to the measured power level to compute the average power during continuous transmission.

The testing follows ANSI C63.26-2015 Section 5.2.5.5

According to KDB 412172 D01 Power Approach,

EIRP = $P_T + G_T – L_C$, where

P_T = transmitter output power in dBm

G_T = gain of the transmitting antenna in dBi

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

3.5 Occupied Bandwidth

3.5.1 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.

3.5.2 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.

3.6 Conducted Band Edge

3.6.1 Description of Conducted Band Edge Measurement

Part 96.41 (e) (1) (i)

For CBSD the emission limits outside the fundamental are as follows:

Within 0 MHz to 10 MHz above and below the assigned channel ≤ −13 dBm/MHz

Greater than 10 MHz above and below the assigned channel ≤ −25 dBm/MHz

Part 96.41 (e) (2)

For CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz

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 band edges of low and high channels for the highest RF powers were measured.
3. Set RBW >= 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. Offset has included the duty factor for LTE Band 48. Duty factor =10 log (1/x), where x is the measured duty cycle.
6. Set spectrum analyzer with RMS detector.
7. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.7 Conducted Spurious Emission

3.7.1 Description of Conducted Spurious Emission Measurement

96.41 (e)(2)

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

3.7.2 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 −40dBm/MHz.

3.8 Frequency Stability

3.8.1 Description of Frequency Stability Measurement

The frequency stability shall be measured by variation of ambient temperature and variation of primary supply voltage to ensure that the fundamental emission stays within the authorized frequency block.

3.8.2 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.

3.8.3 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 25±5° 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.

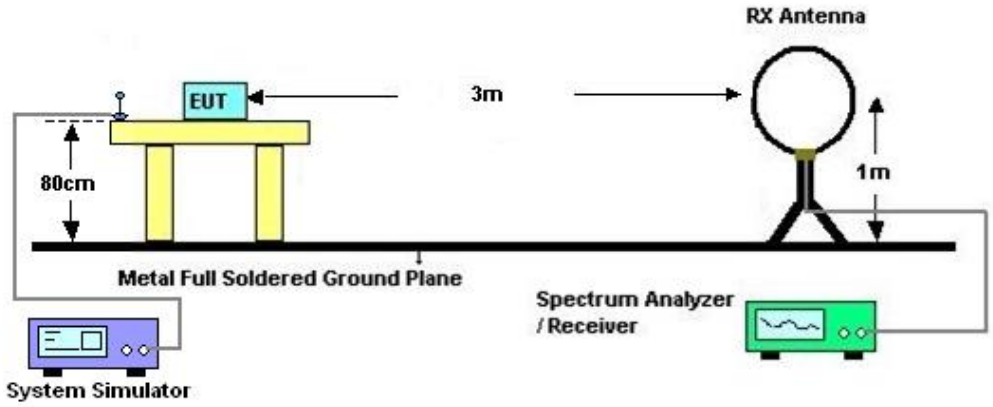
4 Radiated Test Items

4.1 Measuring Instruments

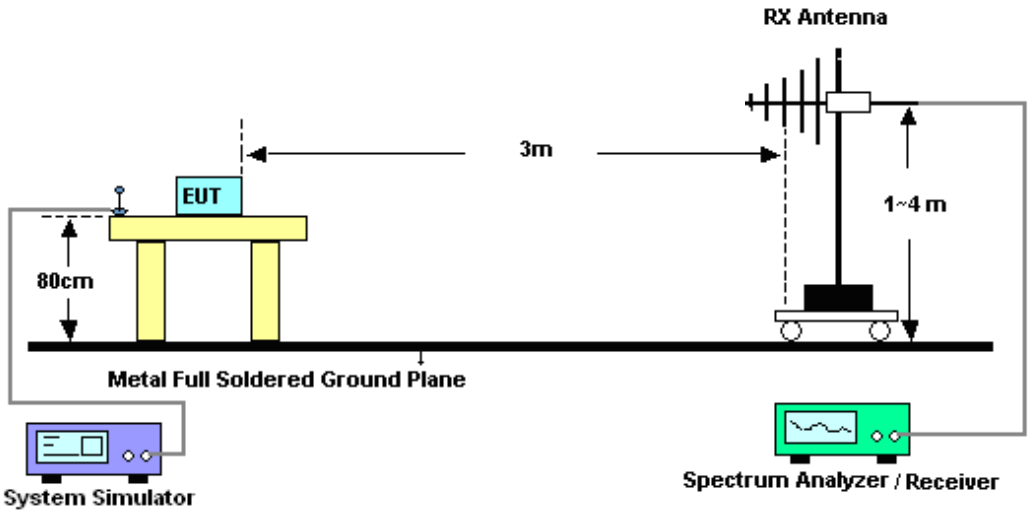
See list of measuring instruments of this test report.

4.2 Test Setup

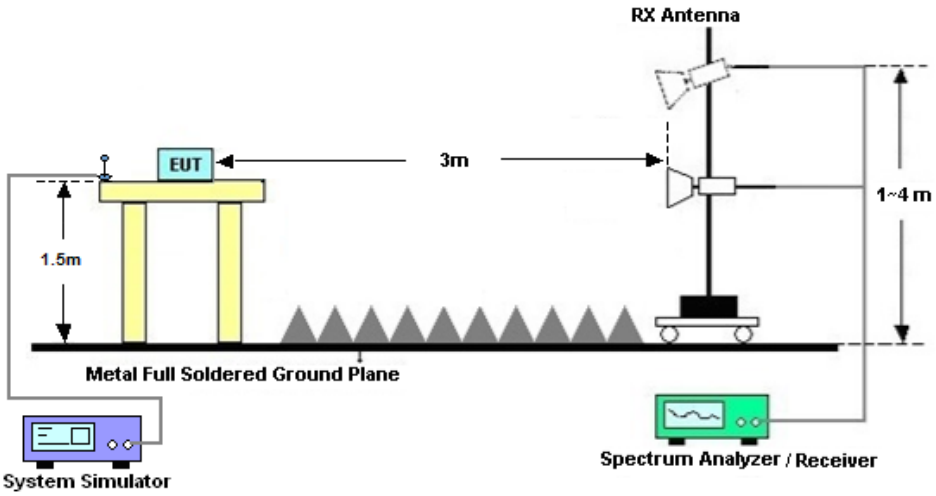
4.2.1 For radiated test below 30MHz



4.2.2 For radiated test from 30MHz to 1GHz



4.2.3 For radiated test above 1GHz



4.3 Test Result of Radiated Test

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.

Please refer to Appendix B.

4.4 Radiated Spurious Emission

4.4.1 Description of Radiated Spurious Emission Measurement

The radiated spurious emission was measured by substitution method according to ANSI C63.26. 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 -40dBm / MHz.

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

4.4.2 Test Procedures

1. The EUT was placed on a turntable with 0.8 meter height for frequency below 1GHz and 1.5 meter height for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the receiving antenna 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 1m to 4m to search the maximum spurious emission for both horizontal and vertical polarizations.
5. During the measurement, the system simulator parameters were set to force the EUT transmitting at maximum output power.
6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
7. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
   Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
   EIRP (dBm) = S.G. Power – Tx Cable Loss + Tx Antenna Gain
   ERP (dBm) = EIRP - 2.15
8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
   The limit line is −40dBm/MHz

5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 12, 2022	Apr.26, 2023~ May 11, 2023	Oct. 11, 2023	Conducted (TH01-KS)
Power divider	STI	STI08-0055	-	0.5~40GHz	NCR	Apr.26, 2023~ May 11, 2023	NCR	Conducted (TH01-KS)
Temperature &humidity chamber	Hongzhan	LP-150U	H2014011440	-40~+150°C 20%~95%RH	Jul. 15, 2022	Apr.26, 2023~ May 11, 2023	Jul. 14, 2023	Conducted (TH01-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY57471079	10Hz-44G,MAX 30dB	Oct. 12, 2022	May 13, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 16, 2022	May 13, 2023	Oct. 15, 2023	Radiation (03CH04-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	May 24, 2022	May 13, 2023	May 23, 2023	Radiation (03CH04-KS)
Horn Antenna	Schwarzbeck	BBHA9120D	1284	1GHz~18GHz	Oct. 16, 2022	May 13, 2023	Oct. 15, 2023	Radiation (03CH04-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 08, 2023	May 13, 2023	Jan. 07, 2024	Radiation (03CH04-KS)
Amplifier	SONOMA	310N	187289	9KHz-1GHz	May 24, 2022	May 13, 2023	May 23, 2023	Radiation (03CH04-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 05, 2023	May 13, 2023	Jan. 04, 2024	Radiation (03CH04-KS)
high gain Amplifier	EM	EM01G18GA	060840	1Ghz-18Ghz	Oct. 12, 2022	May 13, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
Amplifier	Agilent	8449B	3008A02370	1Ghz-18Ghz	Oct. 12, 2022	May 13, 2023	Oct. 11, 2023	Radiation (03CH04-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	May 13, 2023	NCR	Radiation (03CH04-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	May 13, 2023	NCR	Radiation (03CH04-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	May 13, 2023	NCR	Radiation (03CH04-KS)

NCR: No Calibration Required

6 Measurement Uncertainty

Uncertainty of Conducted Measurement

Test Item	Uncertainty
Conducted Power	±0.46 dB
Conducted Emissions	±0.48 dB
Occupied Channel Bandwidth	±0.1 %
Conducted Power Spectral Density	±0.40 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.82 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.56 dB

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.54 dB

---------- THE END ----------

Appendix A. Test Results of Conducted Test

Test Engineer :	Simle Wang	Temperature :	22~23℃
		Relative Humidity :	40~42%

Conducted Output Power(Average power) and EIRP

5G NR n48 (Ant.0):

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Gain	EIRP （W）		
Channel				638000	641666	645332		L	M	H
Frequency (MHz)				3570	3624.99	3679.98				
40	PI/2 BPSK	1	1	19.54	19.75	19.66	8.26	0.6026	0.6324	0.6194
40	PI/2 BPSK	1	104	19.67	19.68	19.93	8.26	0.6209	0.6223	0.6592
40	PI/2 BPSK	1	105	16.16	16.25	16.40	8.26	0.2767	0.2825	0.2924
40	PI/2 BPSK	1	0	16.05	16.20	16.22	8.26	0.2698	0.2793	0.2805
40	PI/2 BPSK	50	25	19.51	19.84	19.82	8.26	0.5984	0.6457	0.6427
40	PI/2 BPSK	100	0	17.53	17.76	17.83	8.26	0.3793	0.3999	0.4064
40	QPSK	1	1	19.53	19.76	19.77	8.26	0.6012	0.6339	0.6353
40	QPSK	1	104	19.57	19.87	19.92	8.26	0.6067	0.6501	0.6577
40	QPSK	1	105	18.60	18.66	19.02	8.26	0.4853	0.4920	0.5346
40	QPSK	1	0	18.70	18.77	18.80	8.26	0.4966	0.5047	0.5082
40	QPSK	50	25	19.54	19.88	19.86	8.26	0.6026	0.6516	0.6486
40	QPSK	100	0	17.75	17.76	17.84	8.26	0.3990	0.3999	0.4074
40	16QAM	1	1	18.65	18.72	18.67	8.26	0.4909	0.4989	0.4932
40	64QAM	1	1	17.16	17.21	17.03	8.26	0.3483	0.3524	0.3381
40	256QAM	1	1	15.10	15.18	15.23	8.26	0.2168	0.2208	0.2234
Channel				637334	641666	646000	Gain	EIRP （W）		
Frequency (MHz)				3560.01	3624.99	3690				
20	PI/2 BPSK	1	1	19.60	19.84	19.89	8.26	0.6109	0.6457	0.6531
20	QPSK	1	1	19.56	19.78	19.87	8.26	0.6053	0.6368	0.6501
20	16QAM	1	1	18.56	18.68	18.86	8.26	0.4808	0.4943	0.5152
Channel				637000	641666	646332	Gain	EIRP （W）		
Frequency (MHz)				3555	3624.99	3694.98				
10	PI/2 BPSK	1	1	19.43	19.57	19.77	8.26	0.5875	0.6067	0.6353
10	QPSK	1	1	19.34	19.49	19.70	8.26	0.5754	0.5957	0.6252
10	16QAM	1	1	18.33	18.56	18.87	8.26	0.4560	0.4808	0.5164

5G NR n48 UL MIMO (Ant.0+3):

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Gain	EIRP （W）		
Channel				638000	641666	645332		L	M	H
Frequency (MHz)				3570	3624.99	3679.98				
40	QPSK	1	1	18.96	19.25	19.05	8.41	0.5458	0.5834	0.5572
40	QPSK	1	104	18.84	19.01	19.08	8.41	0.5309	0.5521	0.5610
40	QPSK	1	105	17.45	17.57	17.66	8.41	0.3855	0.3963	0.4046
40	QPSK	1	0	17.69	17.66	17.47	8.41	0.4074	0.4046	0.3873
40	QPSK	50	25	18.90	19.20	18.95	8.41	0.5383	0.5768	0.5445
40	QPSK	100	0	14.46	14.66	14.45	8.41	0.1936	0.2028	0.1932
40	16QAM	1	1	18.78	18.82	18.67	8.41	0.5236	0.5284	0.5105
40	64QAM	1	1	16.94	17.00	16.85	8.41	0.3428	0.3475	0.3357
40	256QAM	1	1	14.09	14.21	14.03	8.41	0.1778	0.1828	0.1754
Channel				637334	641666	646000	Gain	EIRP （W）		
Frequency (MHz)				3560.01	3624.99	3690				
20	QPSK	1	1	18.95	19.01	18.91	8.41	0.5445	0.5521	0.5395
20	16QAM	1	1	18.73	18.83	18.57	8.41	0.5176	0.5297	0.4989
Channel				637000	641666	646332	Gain	EIRP （W）		
Frequency (MHz)				3555	3624.99	3694.98				
10	QPSK	1	1	18.78	19.02	18.95	8.41	0.5236	0.5534	0.5445
10	16QAM	1	1	18.31	18.65	18.56	8.41	0.4699	0.5082	0.4977

EIRP Power Density

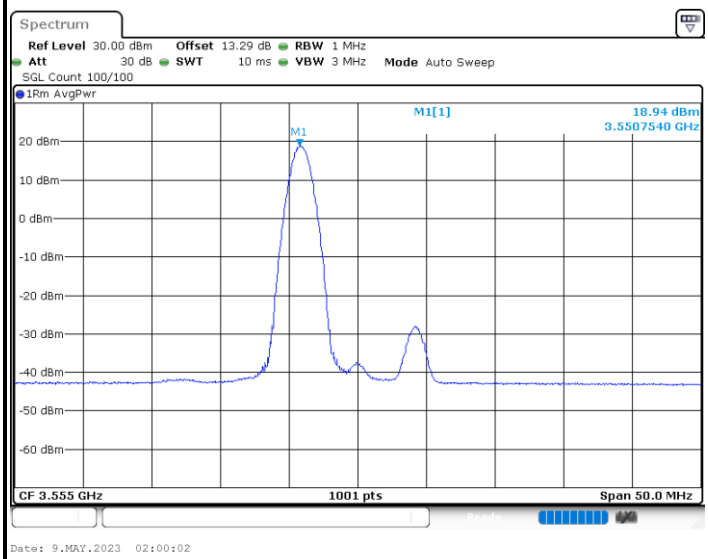
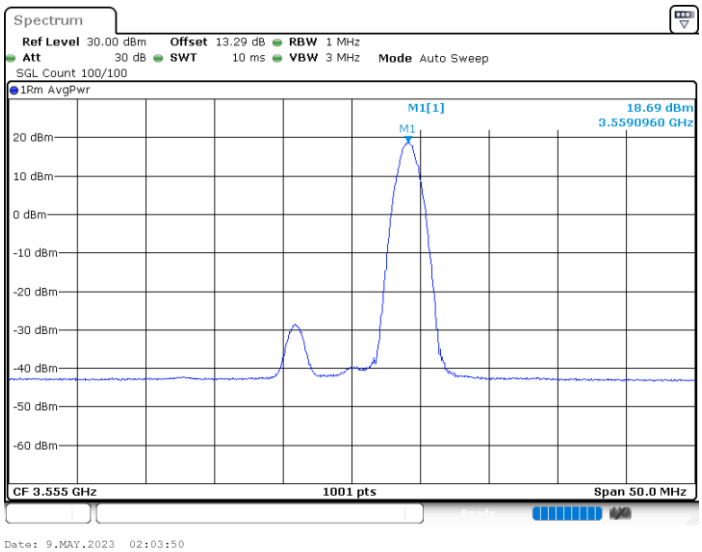
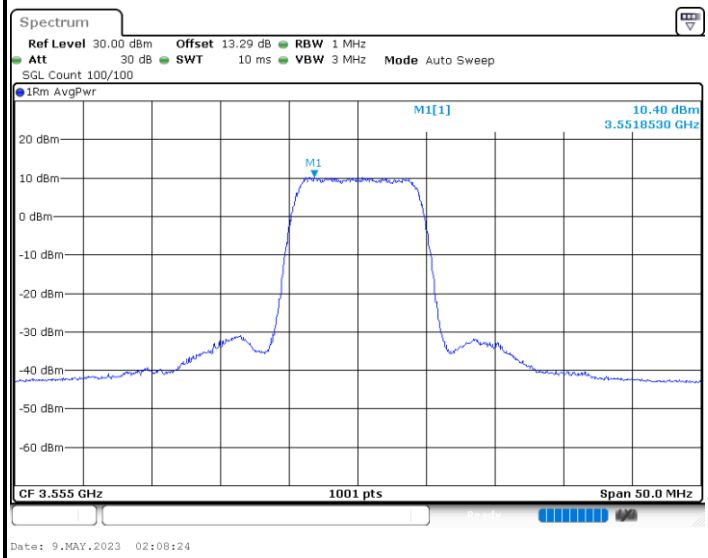
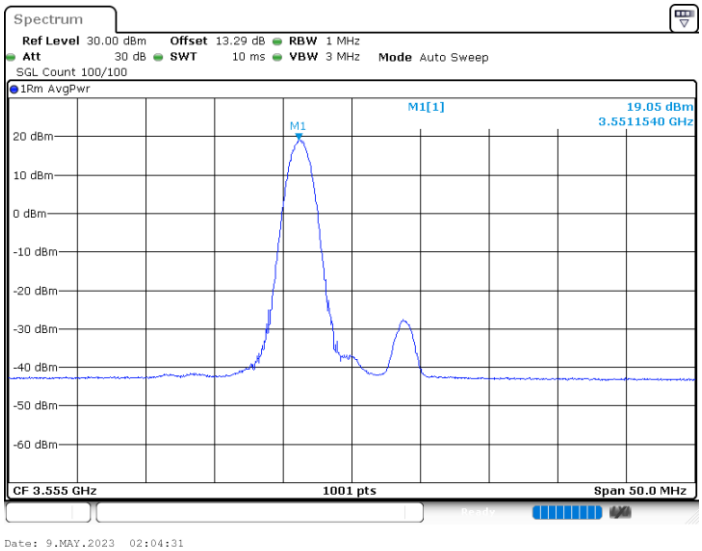
5G NR n48 (Ant.0):

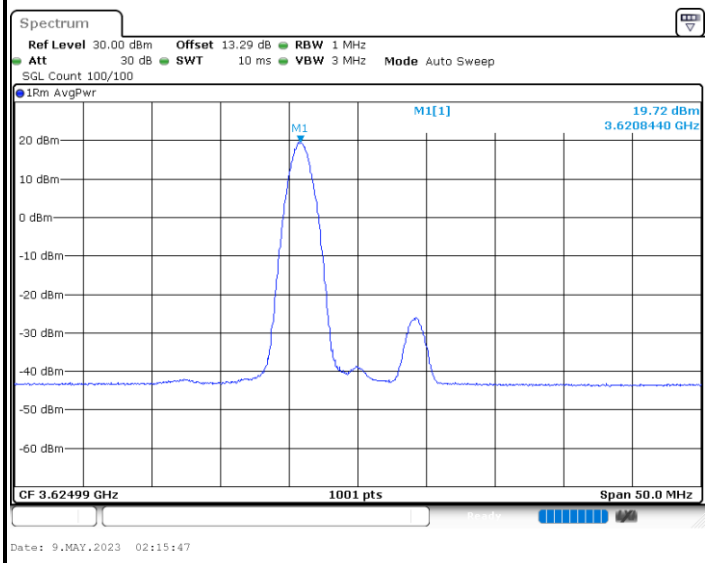
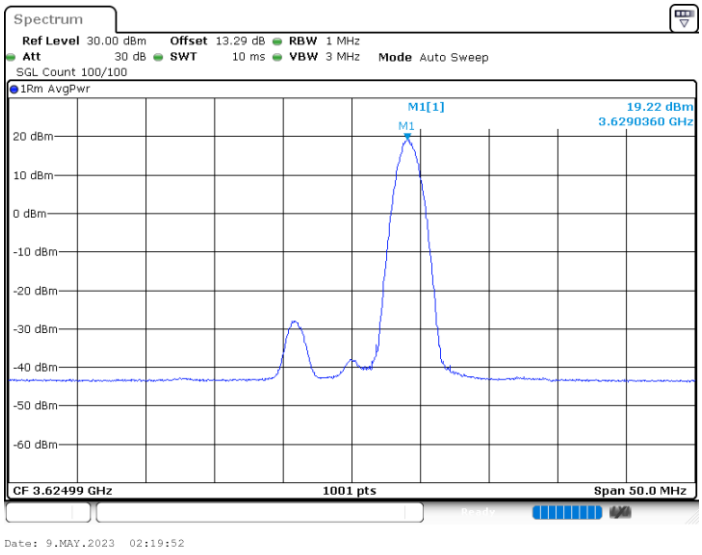
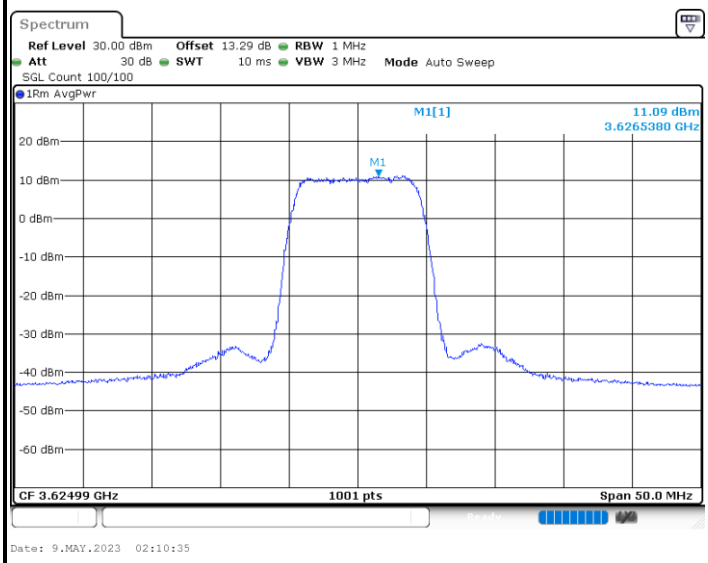
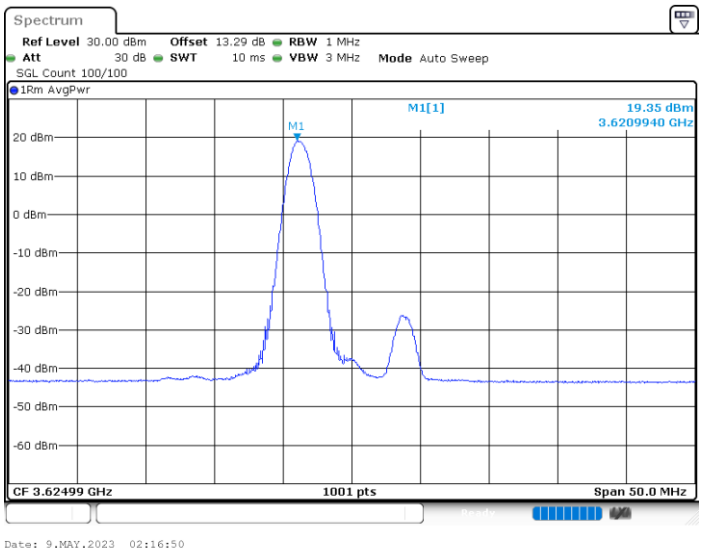
Mode	FR1 Part96 N48 : EIRP Power Density (dBm/1MHz)				
BW	10M (1RB1)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	26.83	27.08	26.97	25.22	23.59
Middle CH	26.98	27.03	26.70	25.96	24.17
Highest CH	28.01	27.57	27.44	25.80	23.97
BW	20M (1RB1)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	27.61	27.73	27.11	25.14	23.31
Middle CH	27.25	26.89	26.50	25.27	23.16
Highest CH	27.76	27.24	27.21	25.83	23.24
BW	40M (1RB1)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	27.13	26.85	26.02	25.00	22.89
Middle CH	27.61	26.94	27.58	25.56	25.21
Highest CH	27.42	26.33	27.14	24.62	23.56
Limit	37dBm /1MHz				
Gain	8.26				
Result	Pass				

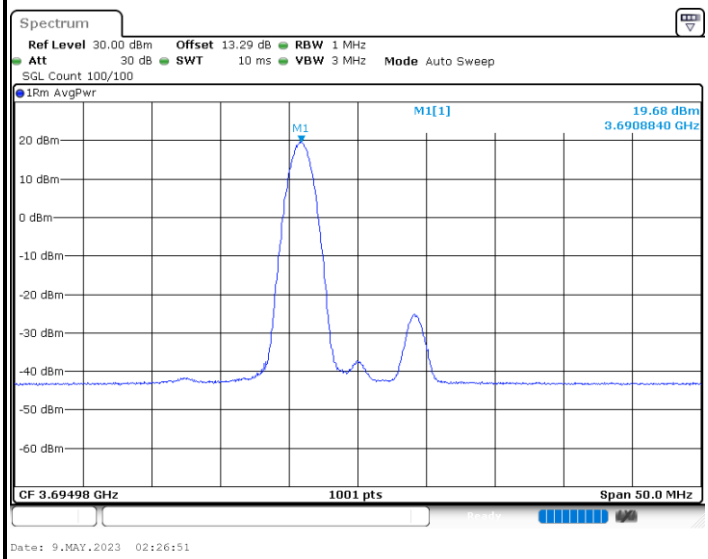
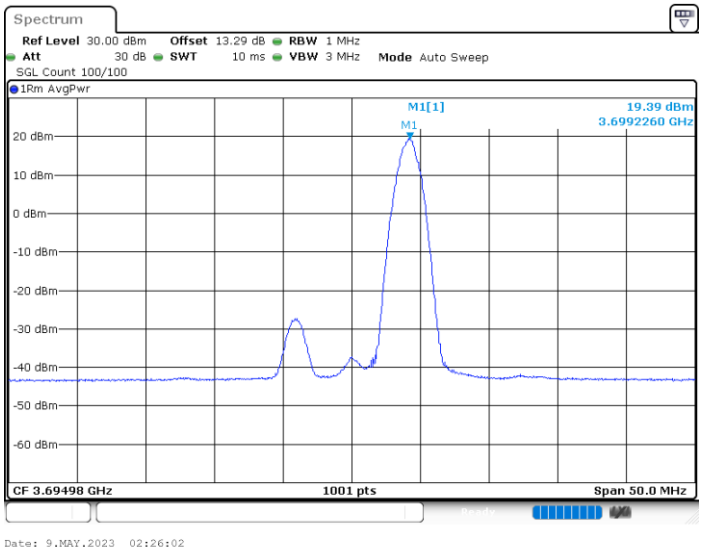
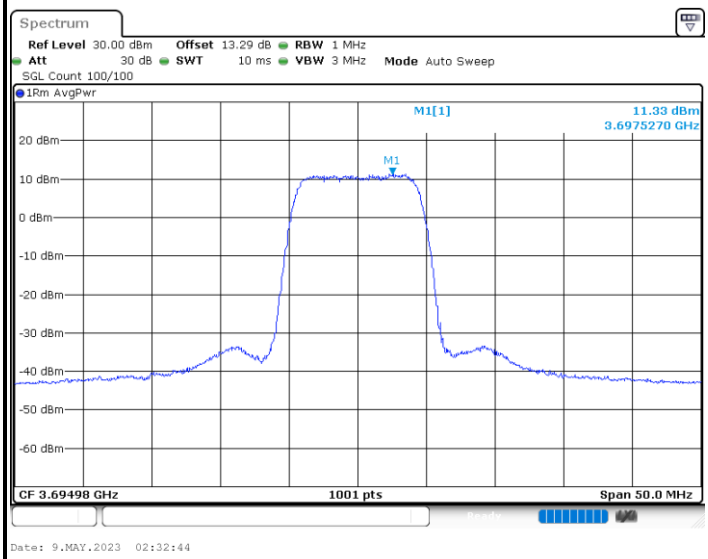
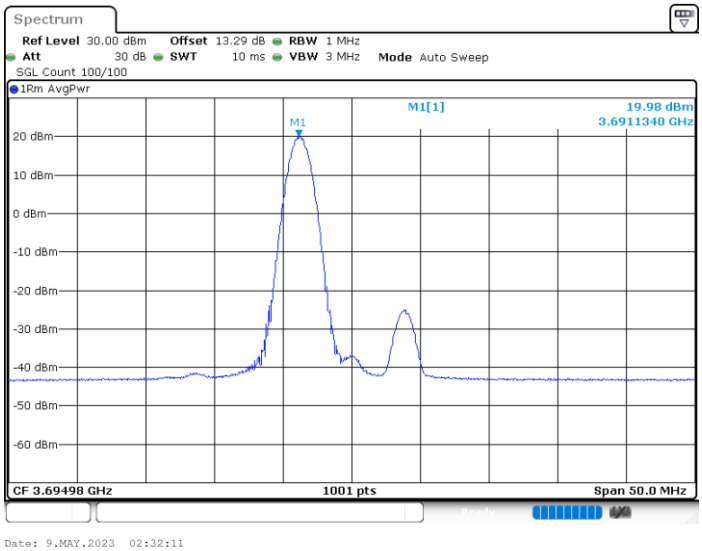
BW	10M (1RB0)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	27.20	26.67	25.66	24.87	23.38
Middle CH	27.98	27.29	26.36	25.34	23.63
Highest CH	27.94	27.31	26.33	26.15	23.94
BW	20M (1RB0)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	27.69	26.57	25.77	25.24	23.75
Middle CH	28.01	27.33	26.00	25.54	23.78
Highest CH	27.23	27.59	26.05	25.49	23.99
BW	40M (1RB0)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	23.15	25.70	24.19	23.92	22.24
Middle CH	25.70	26.72	26.08	24.76	22.30
Highest CH	24.93	26.35	26.09	25.24	23.49
Limit	37dBm /1MHz				
Gain	8.26				
Result	Pass				
BW	10M (1RBMax)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	26.95	26.56	25.91	24.37	22.97
Middle CH	27.48	27.09	26.44	25.60	24.27
Highest CH	27.65	26.87	25.84	25.30	23.97
BW	20M (1RBMax)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	24.04	26.47	25.53	24.64	23.01
Middle CH	24.33	26.86	25.10	24.93	22.08
Highest CH	24.51	27.33	26.76	24.84	23.18
BW	40M (1RBMax)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	26.71	26.68	25.98	24.88	23.56
Middle CH	27.39	26.81	26.30	25.56	23.90
Highest CH	27.95	27.52	25.83	25.80	24.18
Limit	37dBm /1MHz				
Gain	8.26				
Result	Pass				

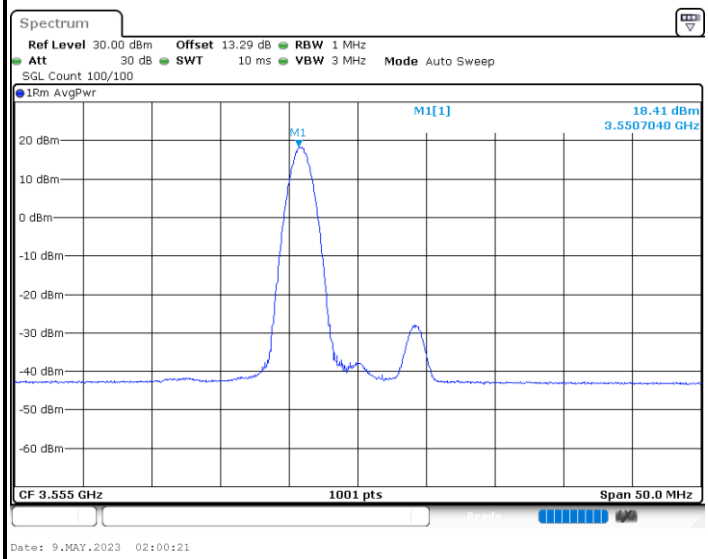
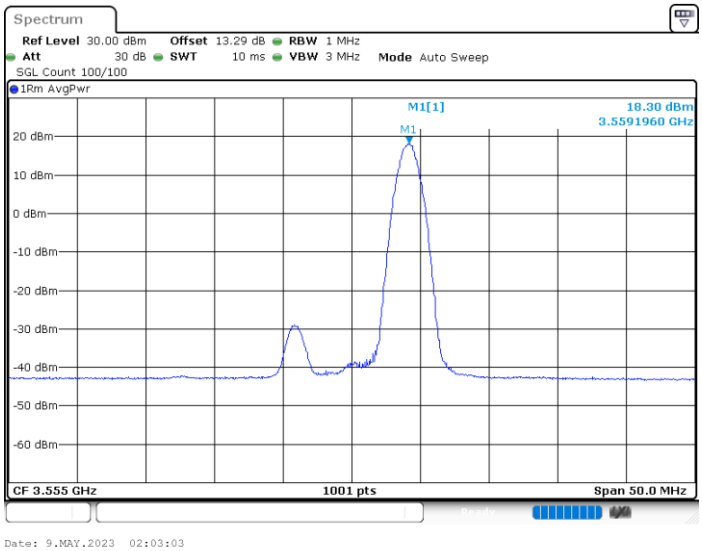
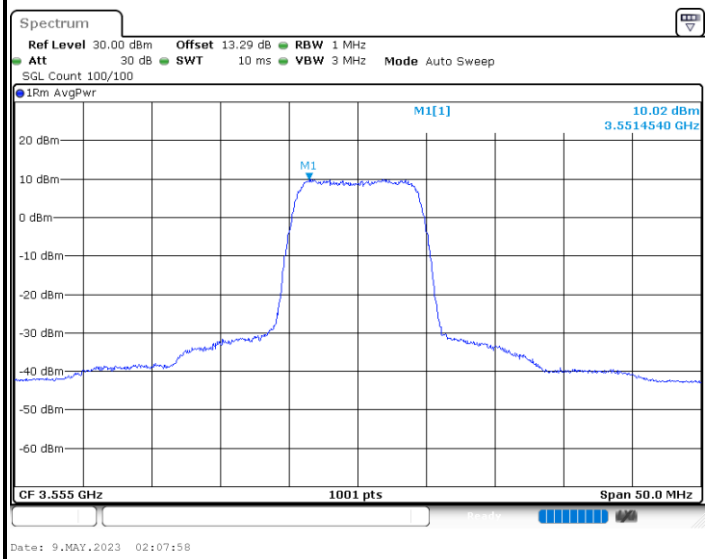
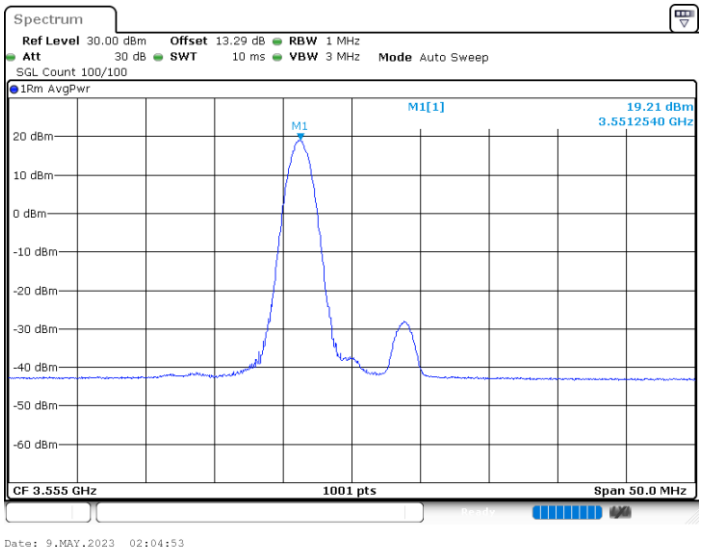
BW	10M (FULL)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	18.66	18.28	17.13	16.98	15.18
Middle CH	19.35	18.99	17.68	17.56	15.22
Highest CH	19.59	19.16	18.23	17.64	15.41
BW	20M (FULL)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	15.95	15.37	14.34	13.72	12.05
Middle CH	16.58	15.92	15.36	14.66	12.35
Highest CH	16.45	16.04	14.97	14.56	12.63
BW	40M (FULL)				
Mod.	BPSK	QPSK	16QAM	64QAM	256QAM
Lowest CH	11.64	11.44	10.69	10.00	8.25
Middle CH	12.52	12.51	11.92	11.74	9.19
Highest CH	12.80	12.60	12.07	10.83	8.85
Limit	37dBm /1MHz				
Gain	8.26				
Result	Pass				

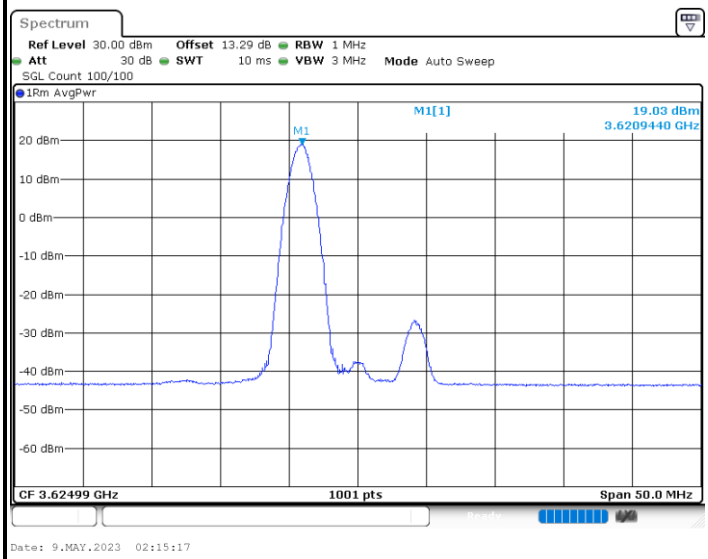
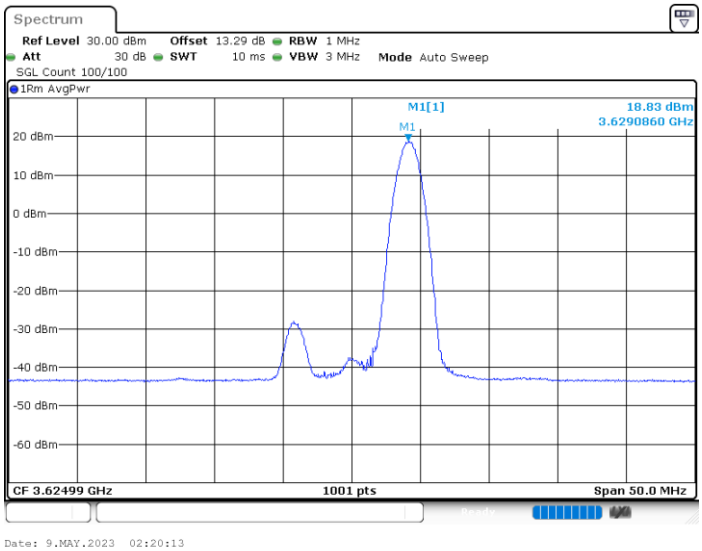
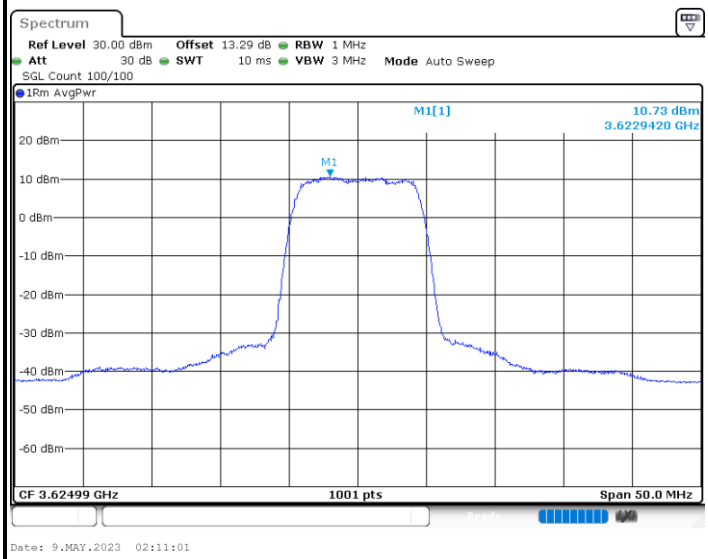
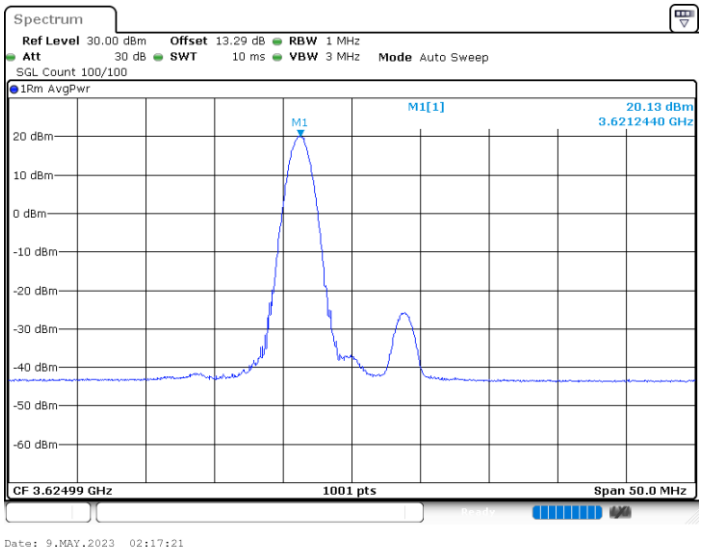
Conducted PSD

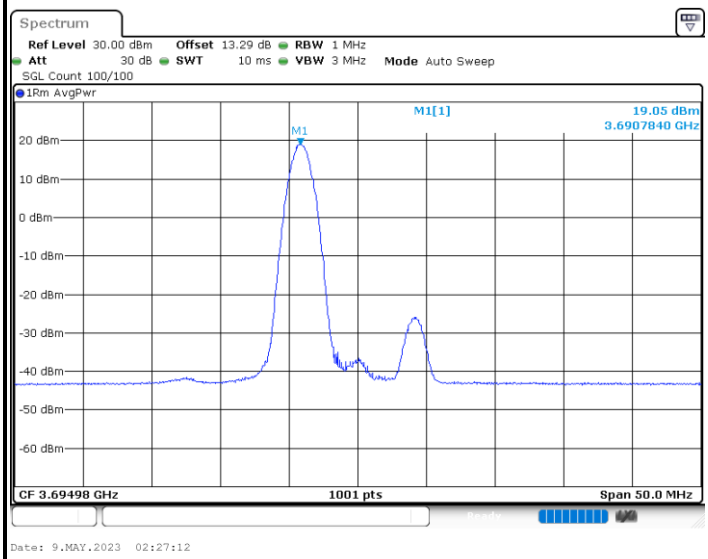
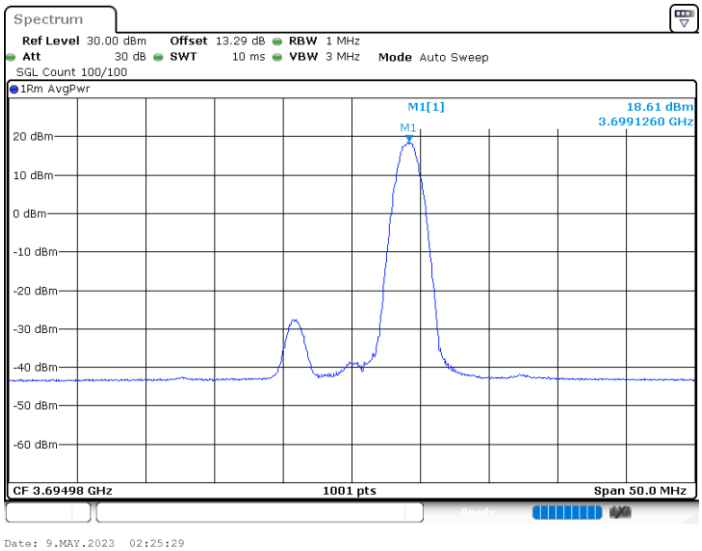
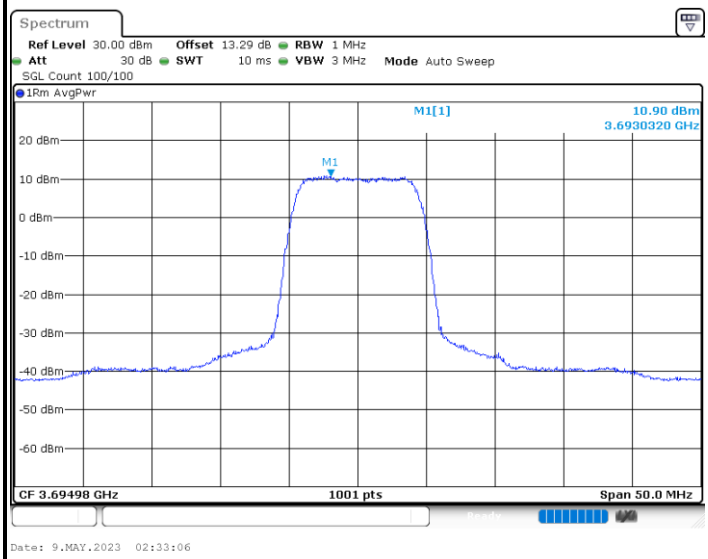
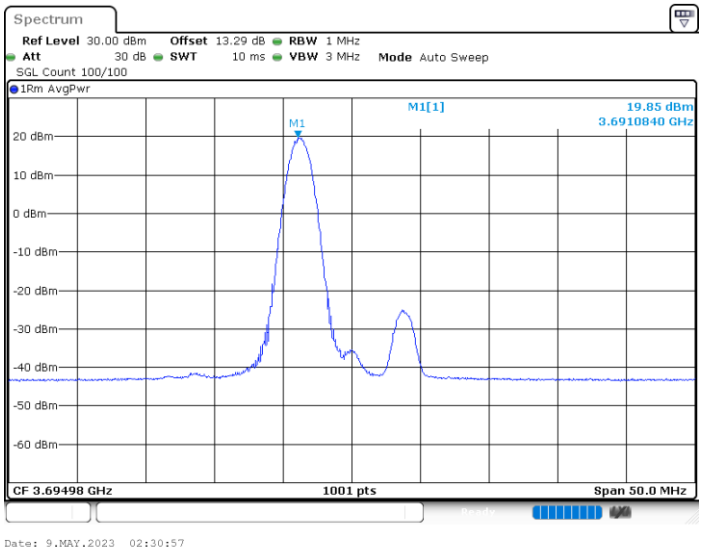
FR1 Part 96 n48 / 10MHz	
BPSK	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

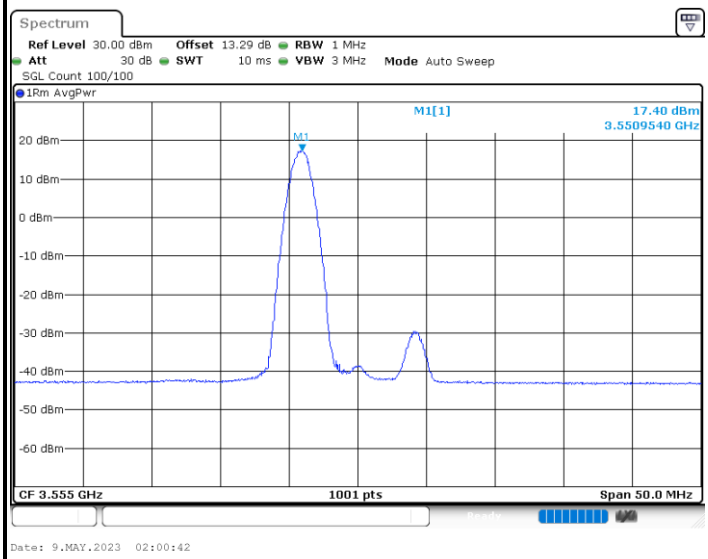
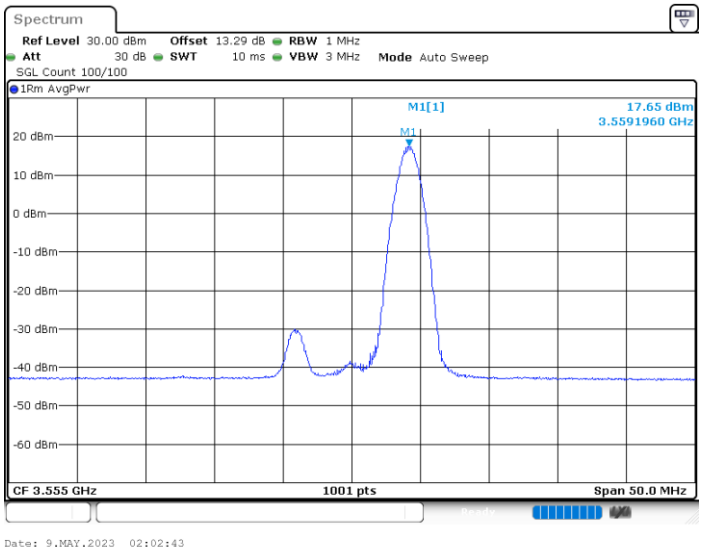
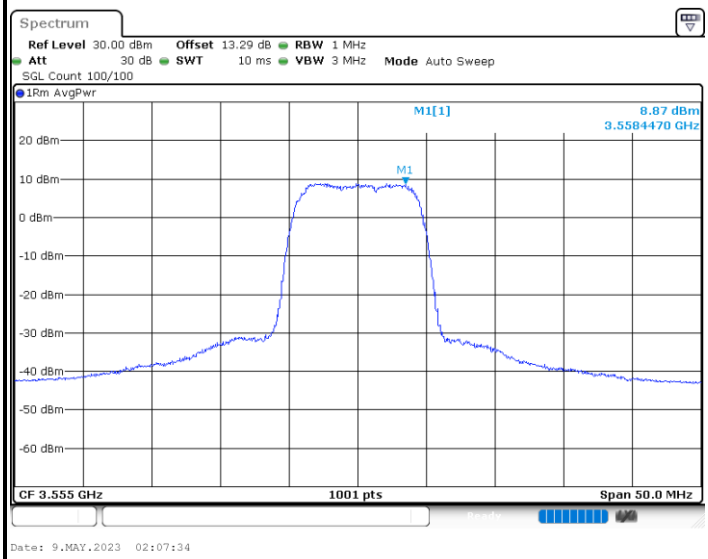
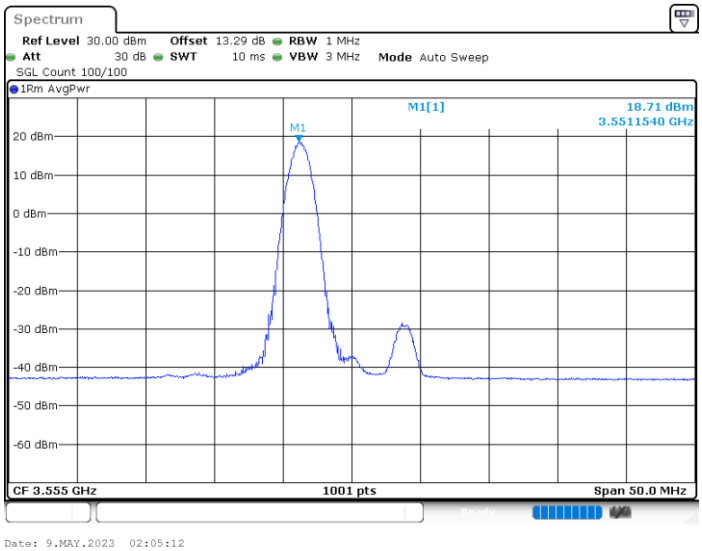
FR1 Part 96 n48 / 10MHz	
BPSK	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

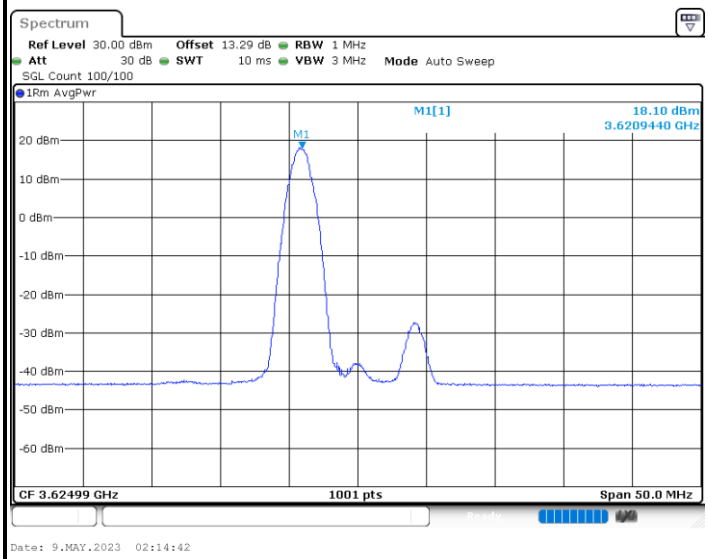
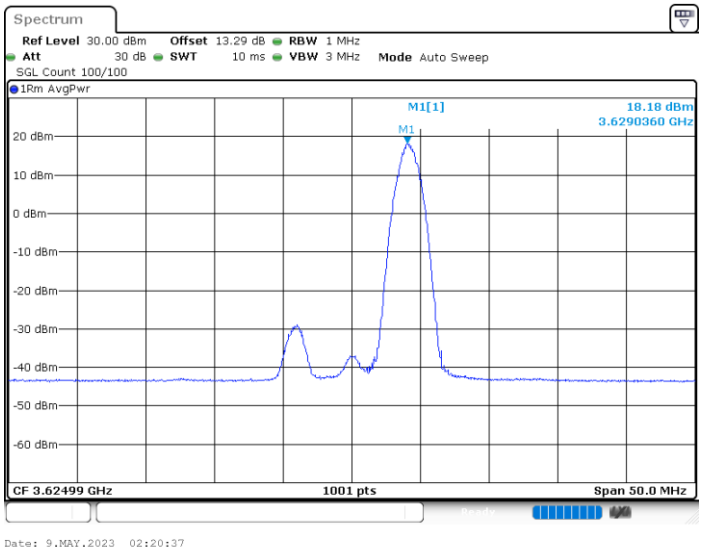
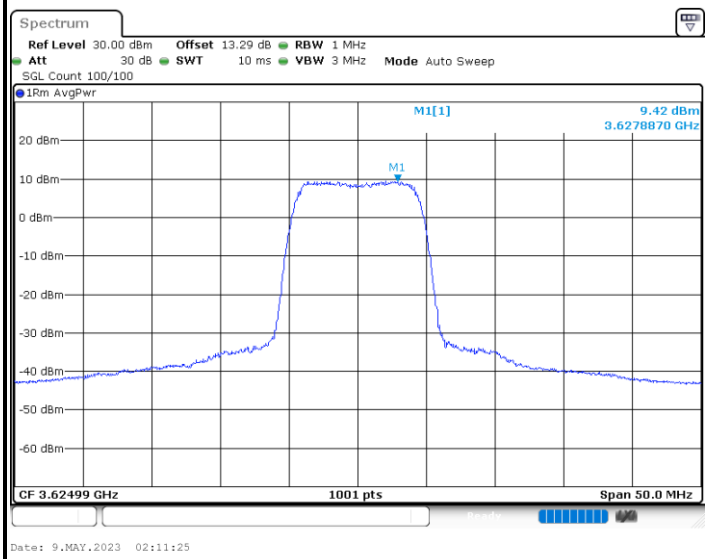
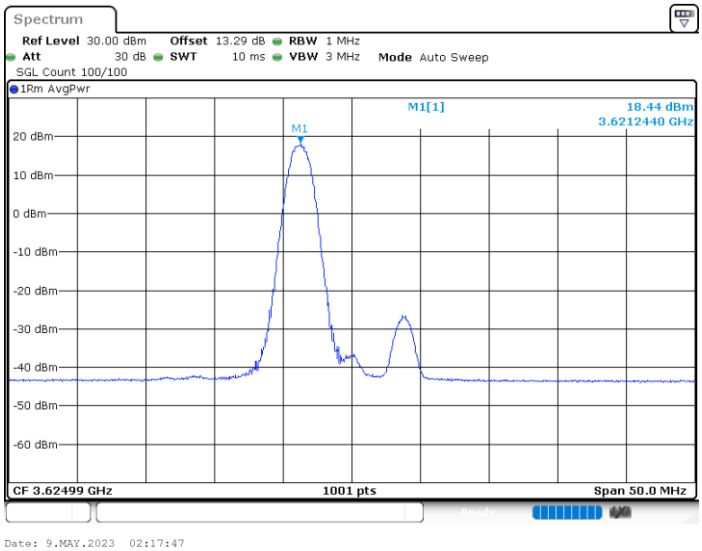
FR1 Part 96 n48 / 10MHz	
BPSK	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

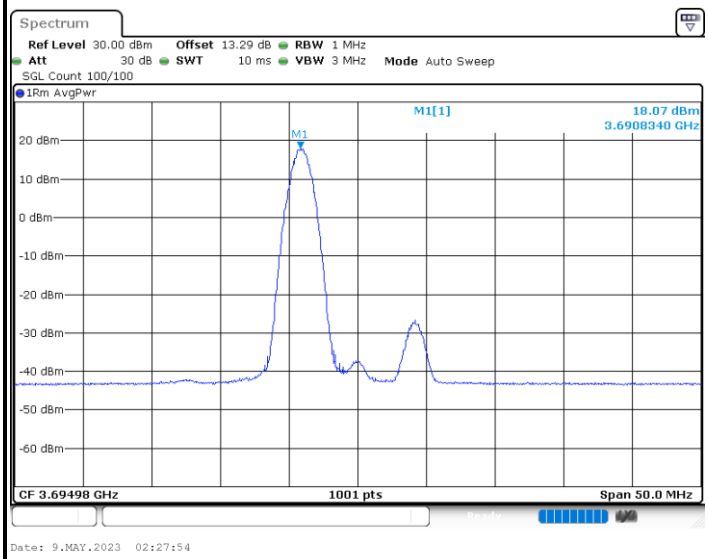
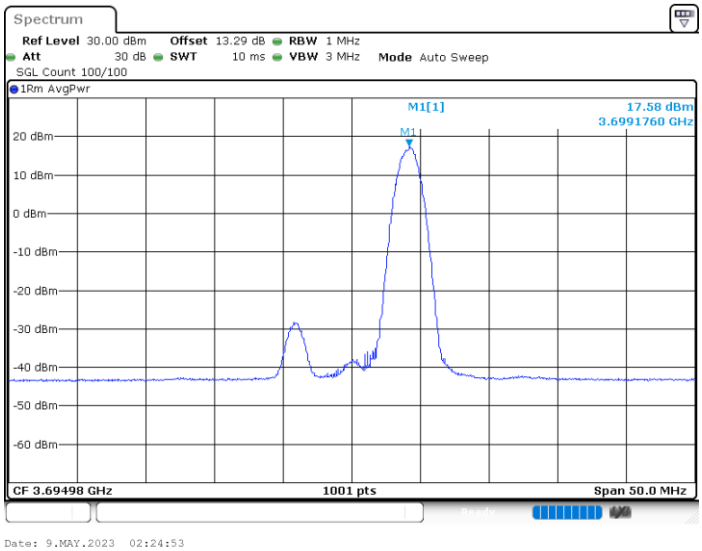
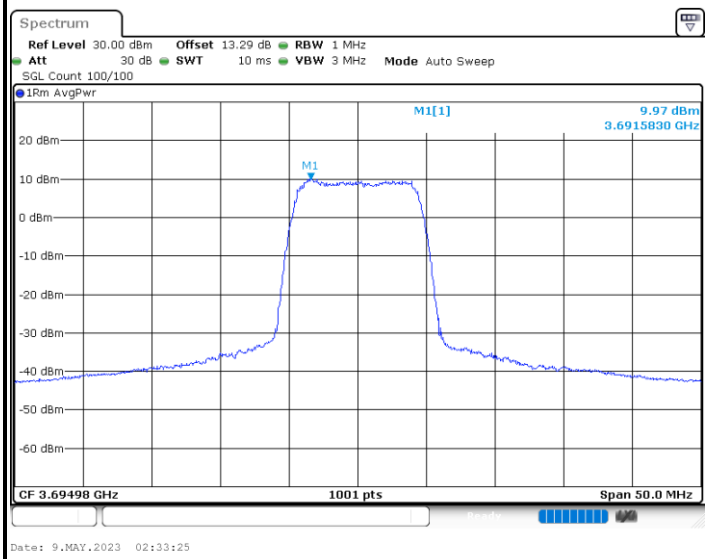
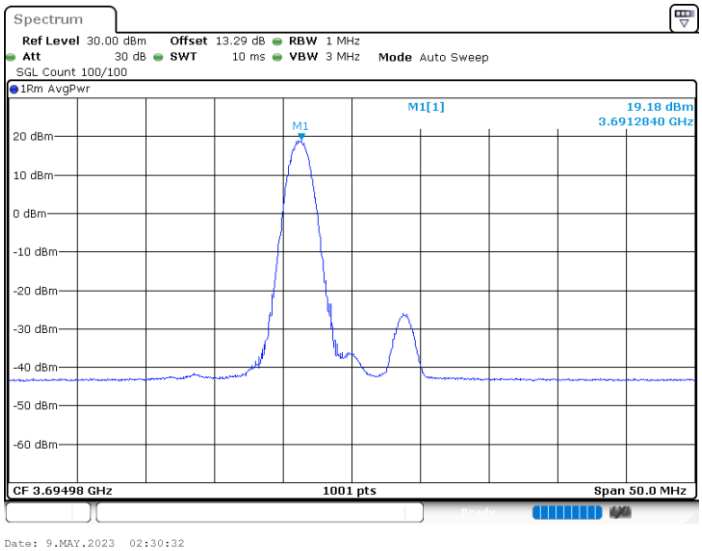
FR1 Part 96 n48 / 10MHz	
QPSK	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

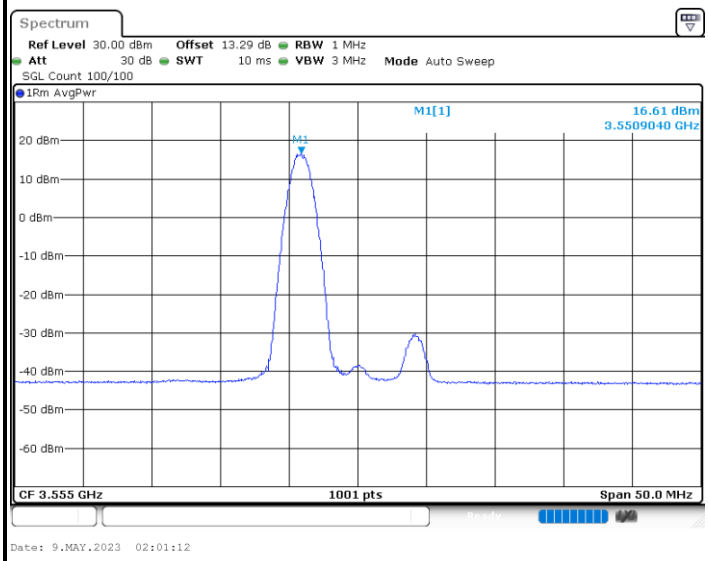
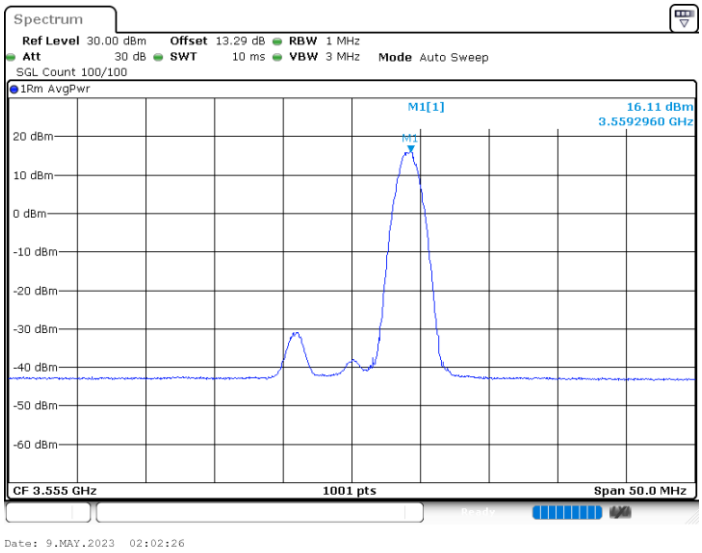
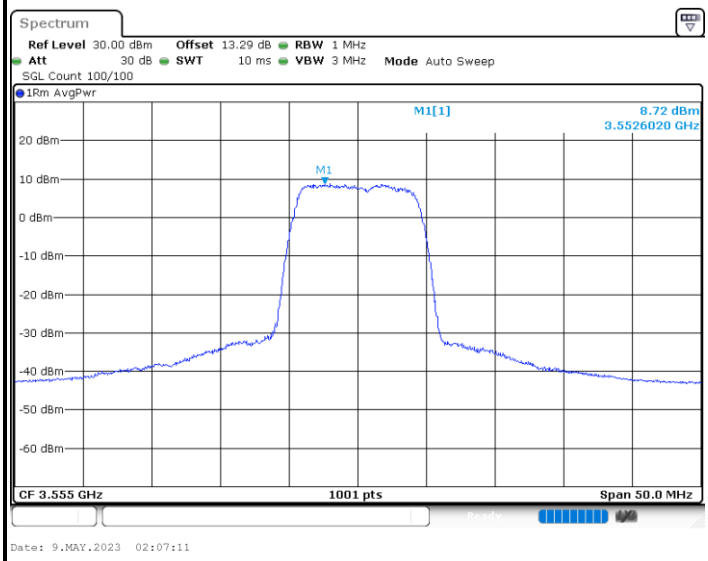
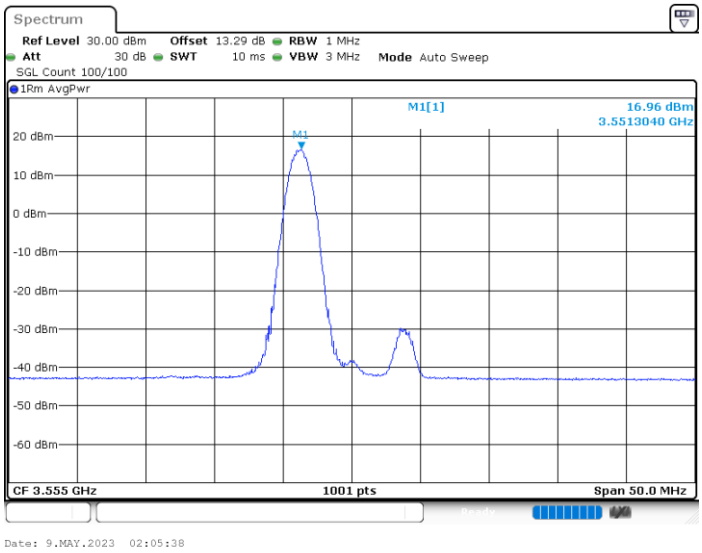
FR1 Part 96 n48 / 10MHz	
QPSK	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

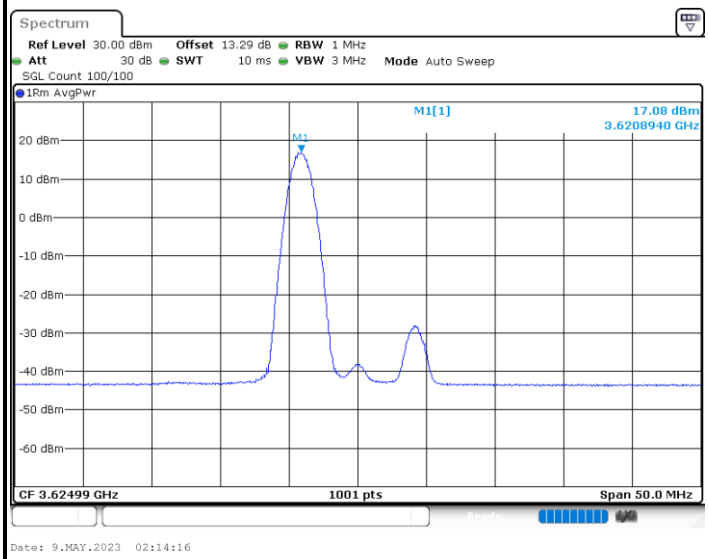
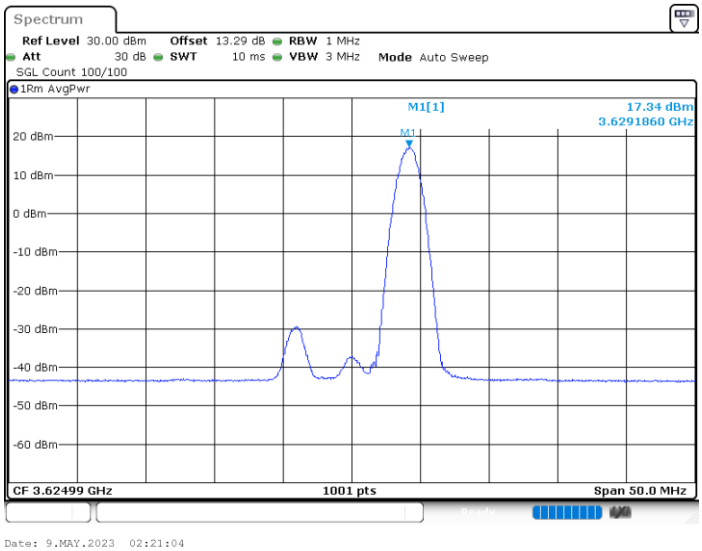
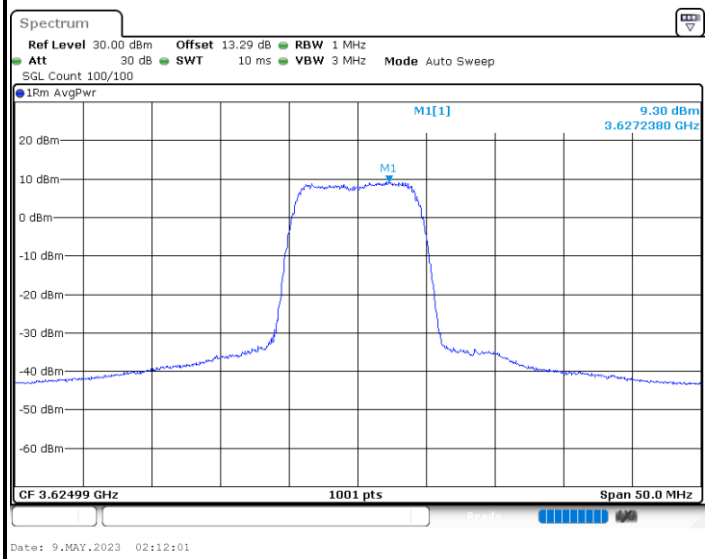
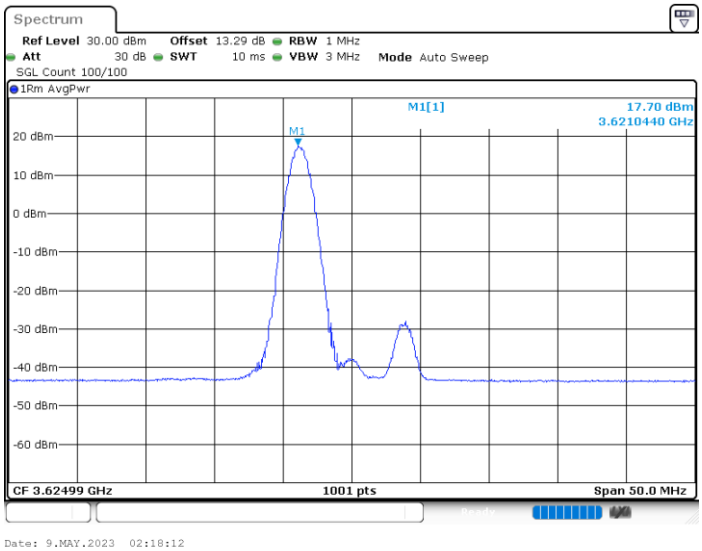
FR1 Part 96 n48 / 10MHz	
QPSK	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

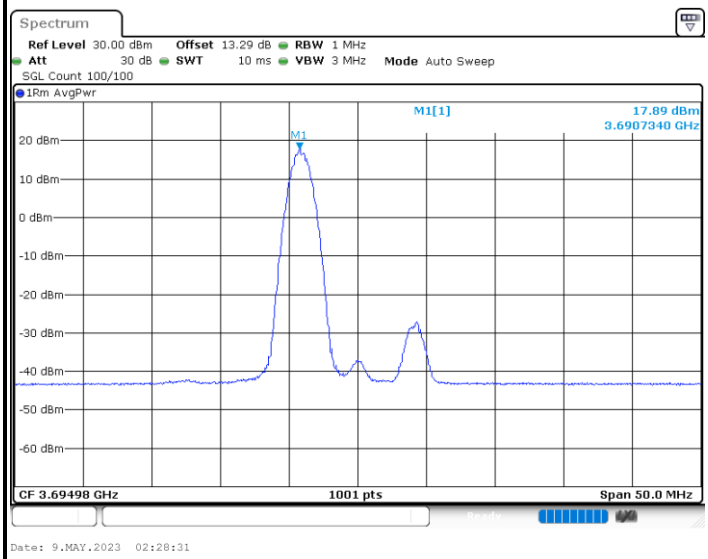
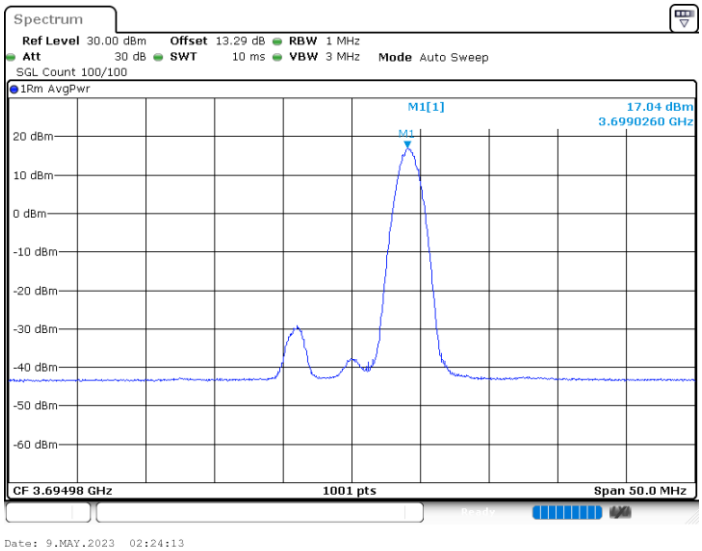
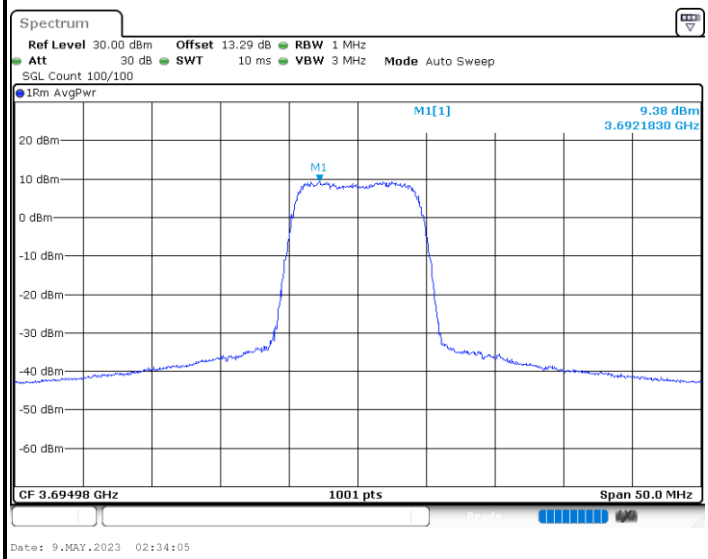
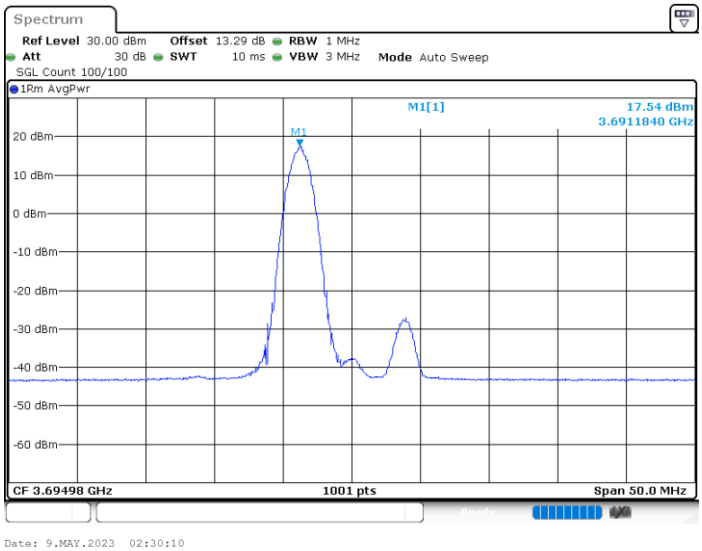
FR1 Part 96 n48 / 10MHz	
16QAM	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

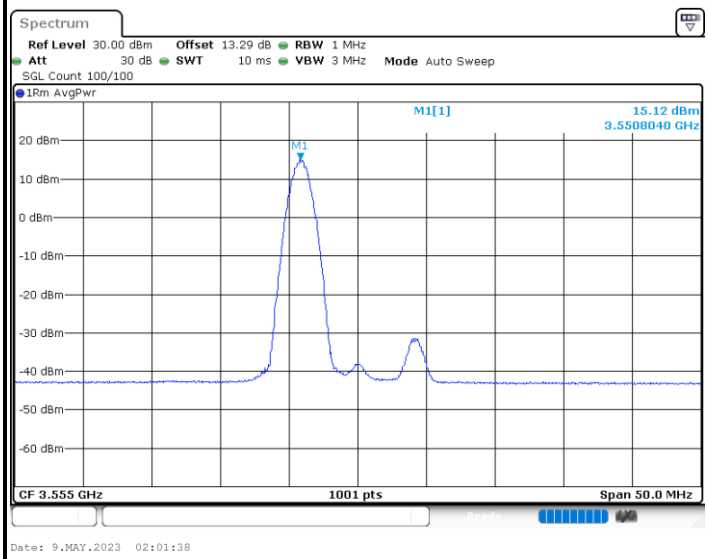
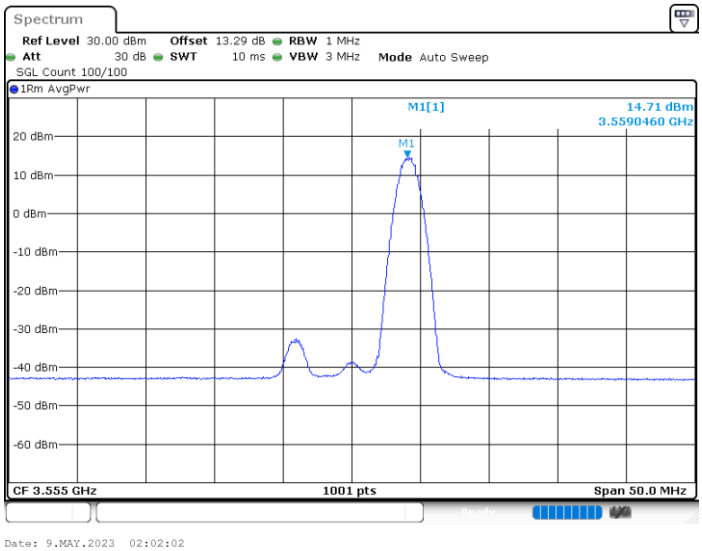
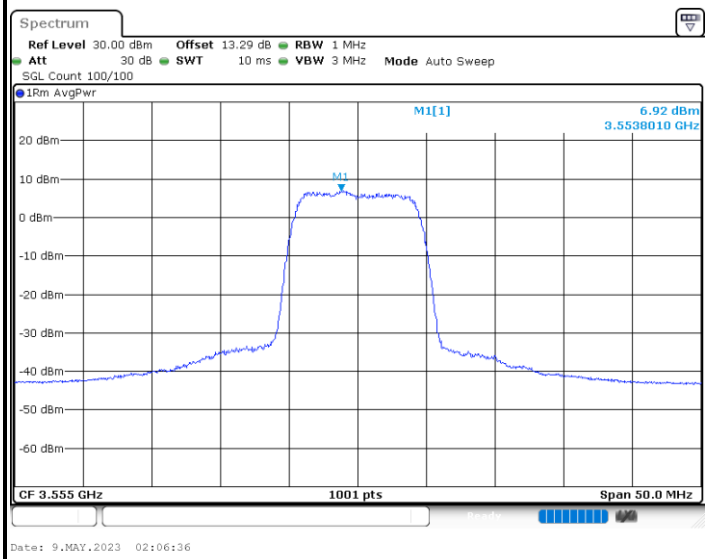
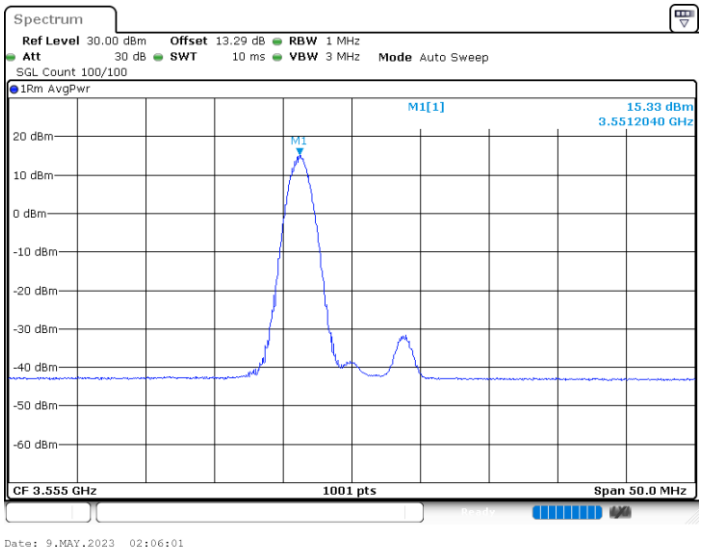
FR1 Part 96 n48 / 10MHz	
16QAM	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

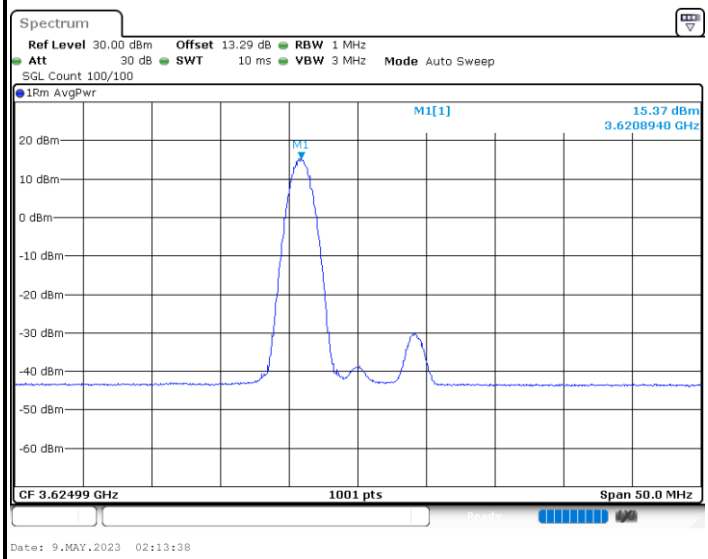
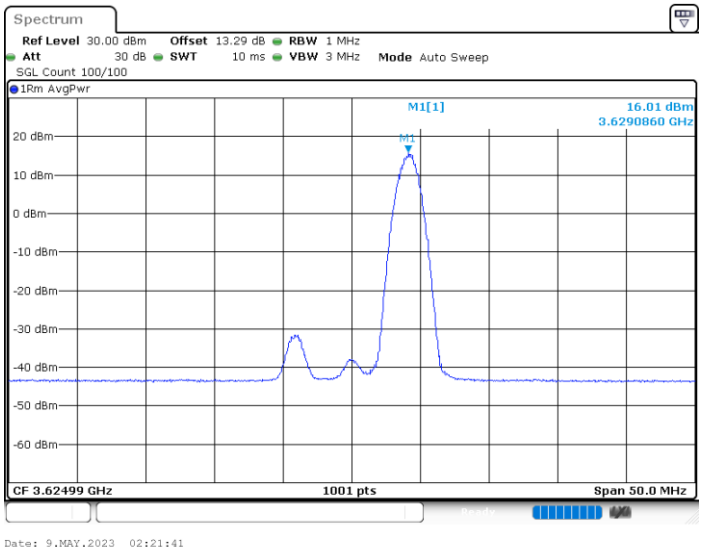
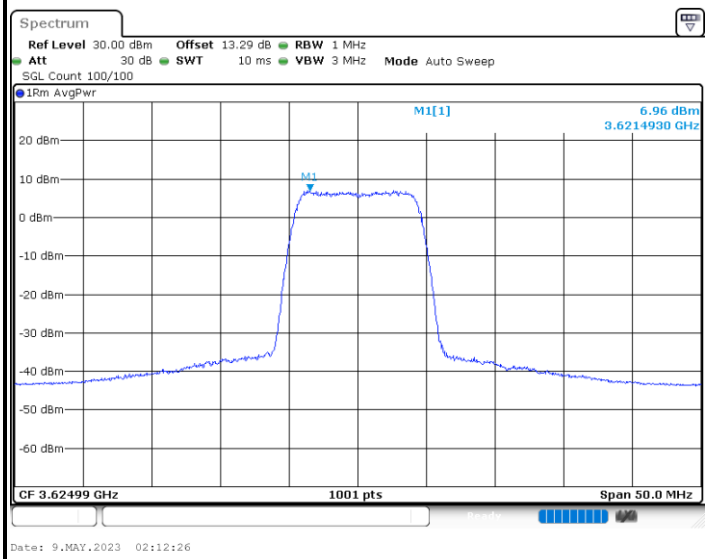
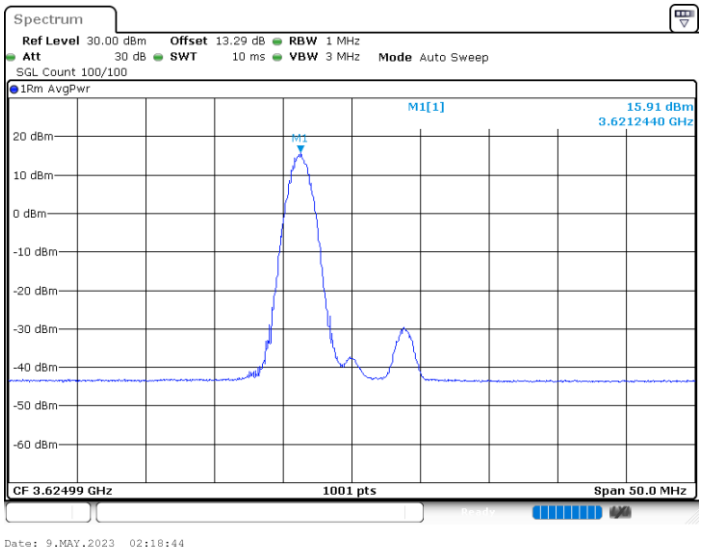
FR1 Part 96 n48 / 10MHz	
16QAM	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

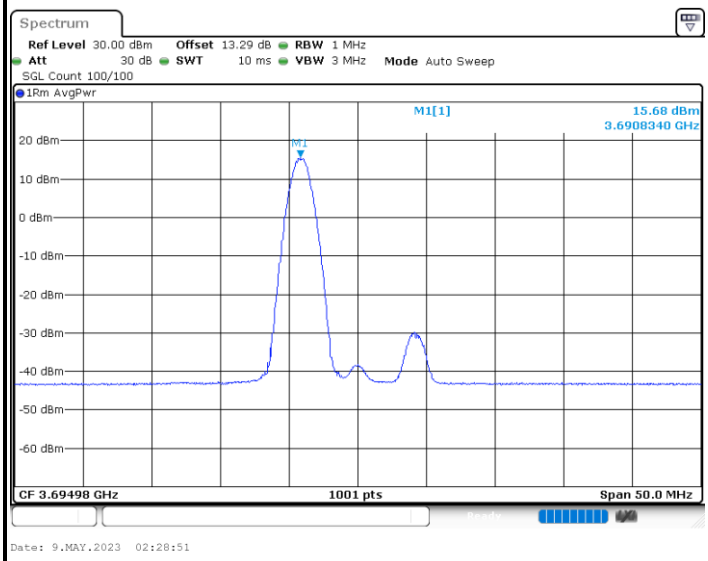
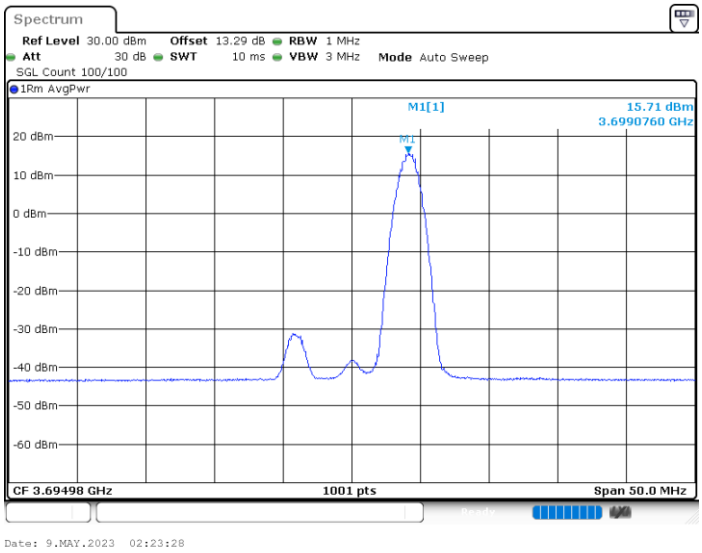
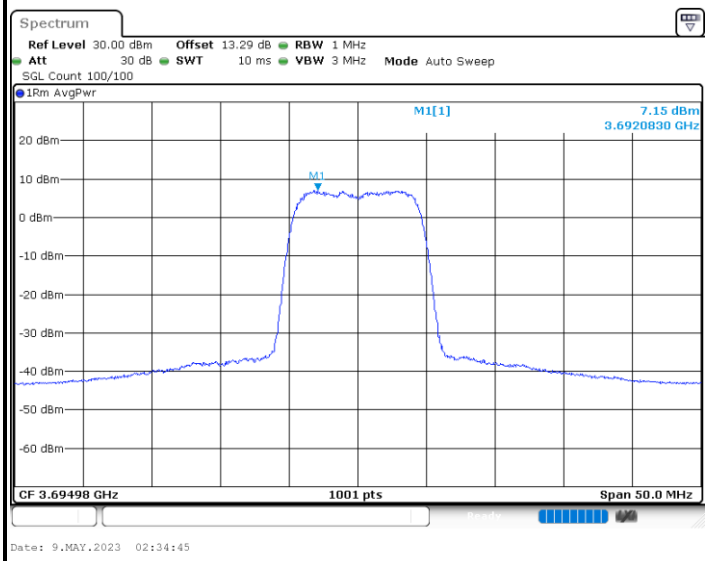
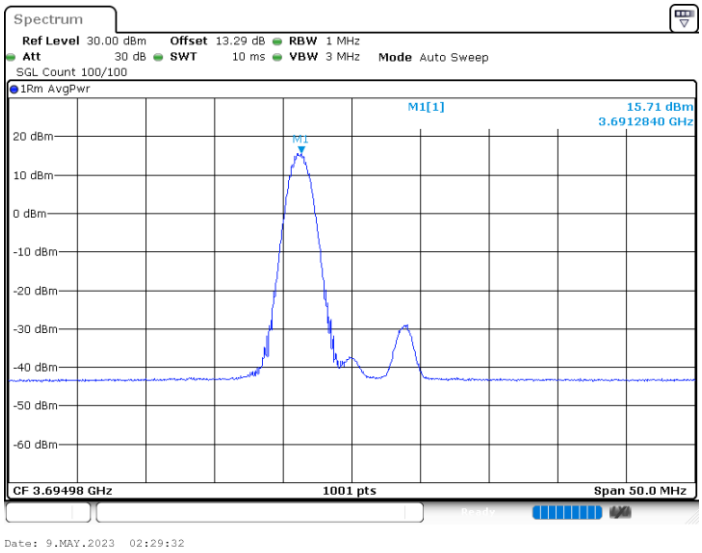
FR1 Part 96 n48 / 10MHz	
64QAM	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

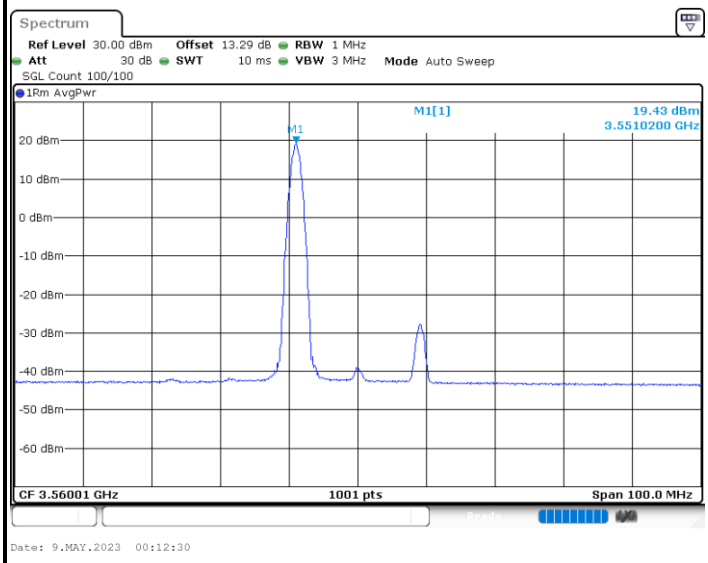
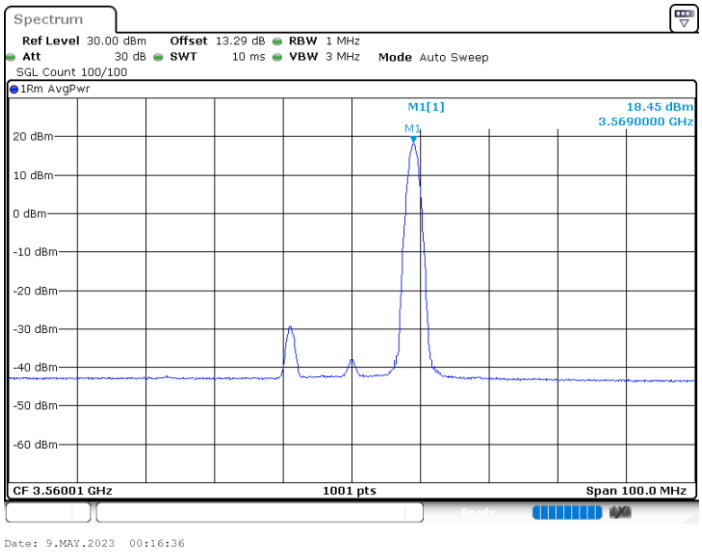
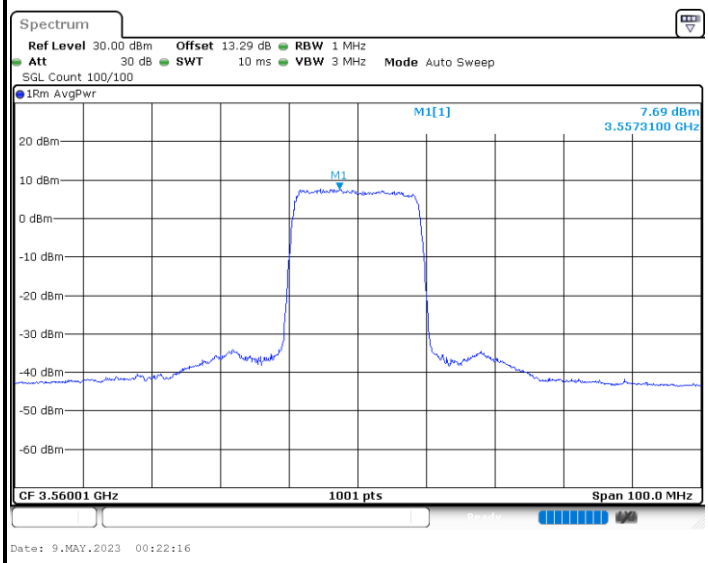
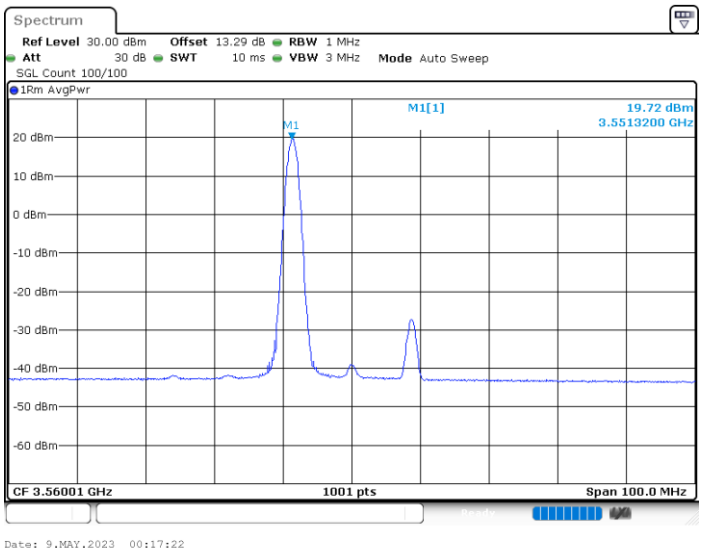
FR1 Part 96 n48 / 10MHz	
64QAM	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

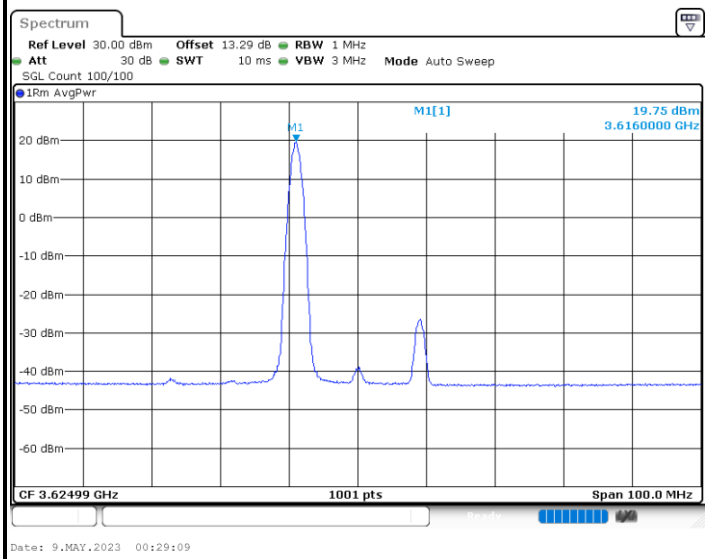
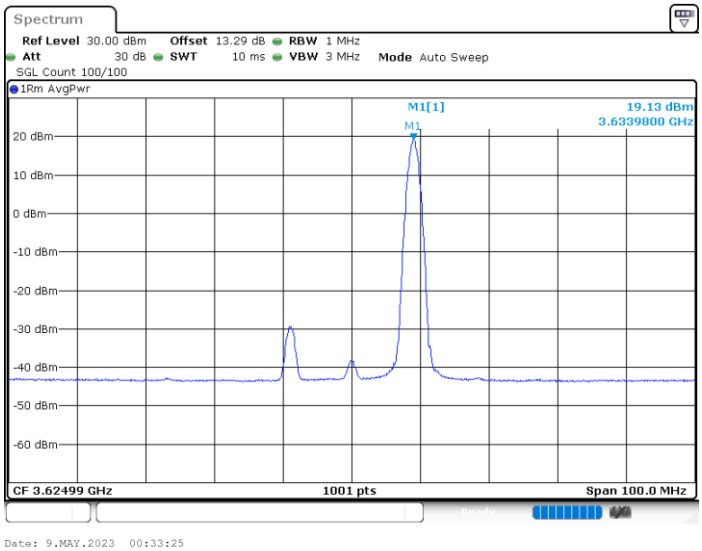
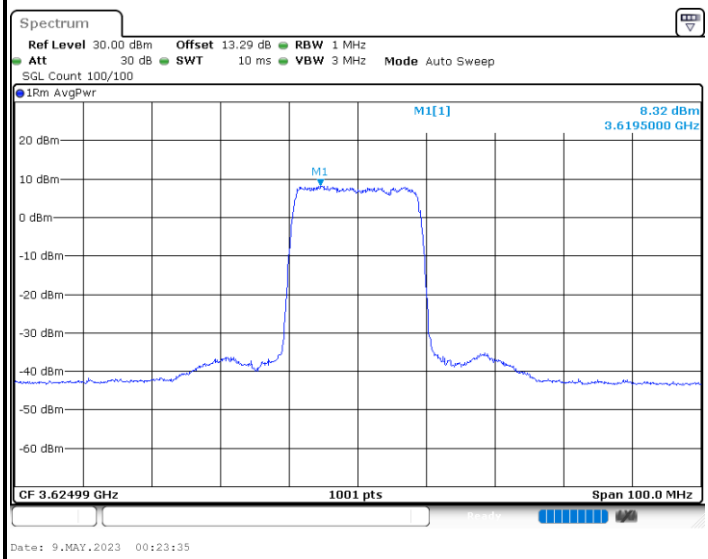
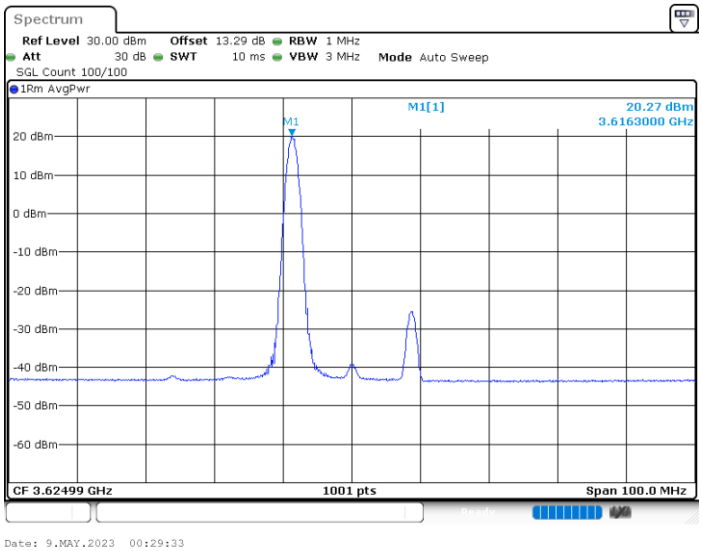
FR1 Part 96 n48 / 10MHz	
64QAM	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

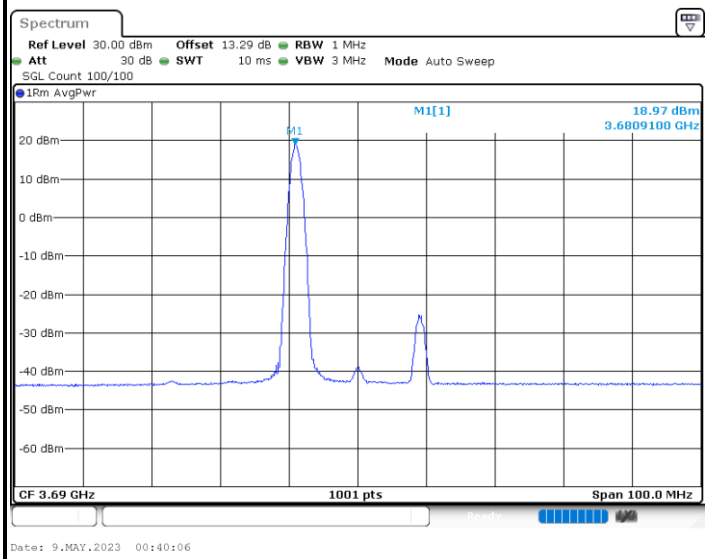
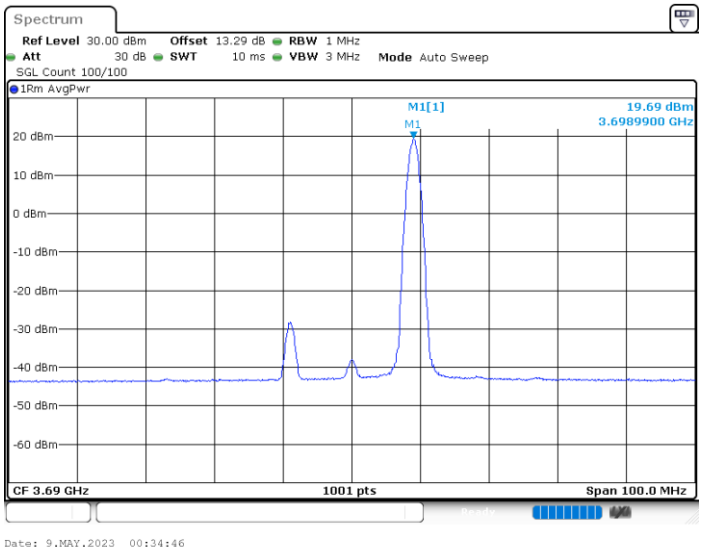
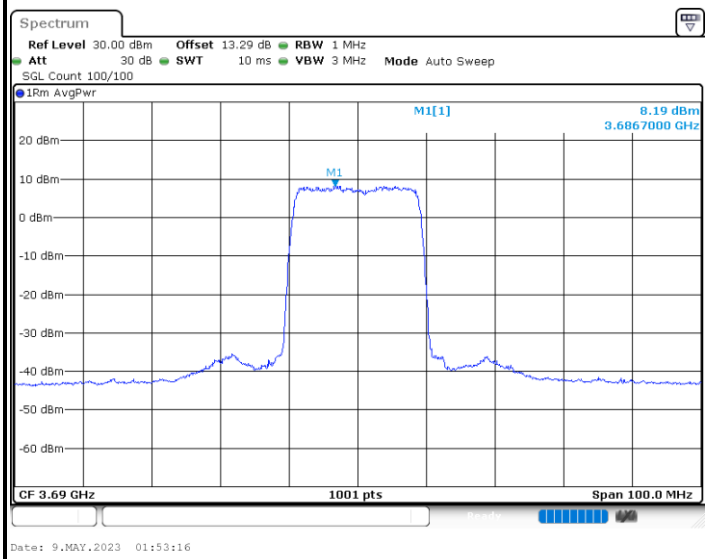
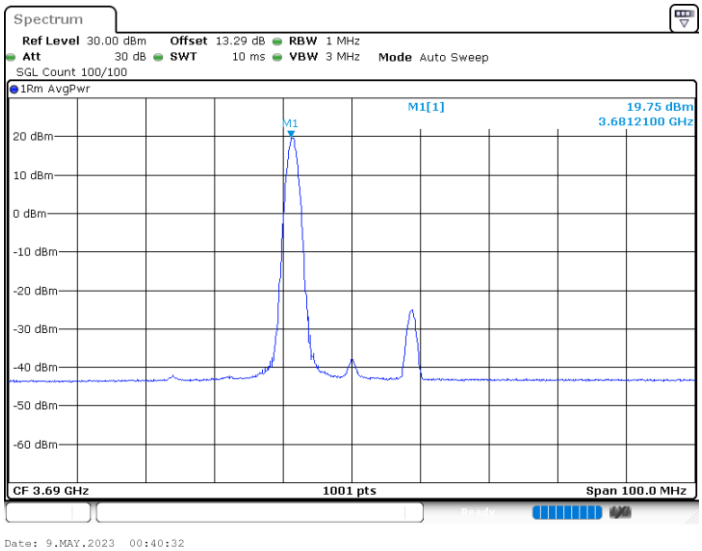
FR1 Part 96 n48 / 10MHz	
256QAM	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

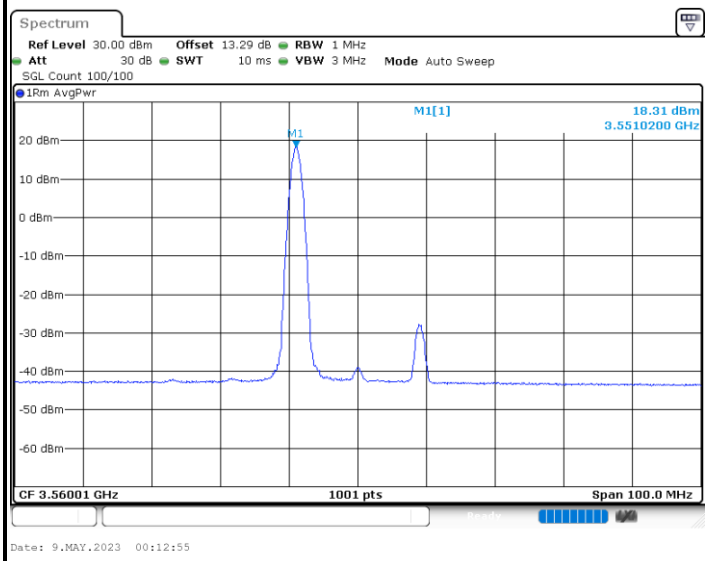
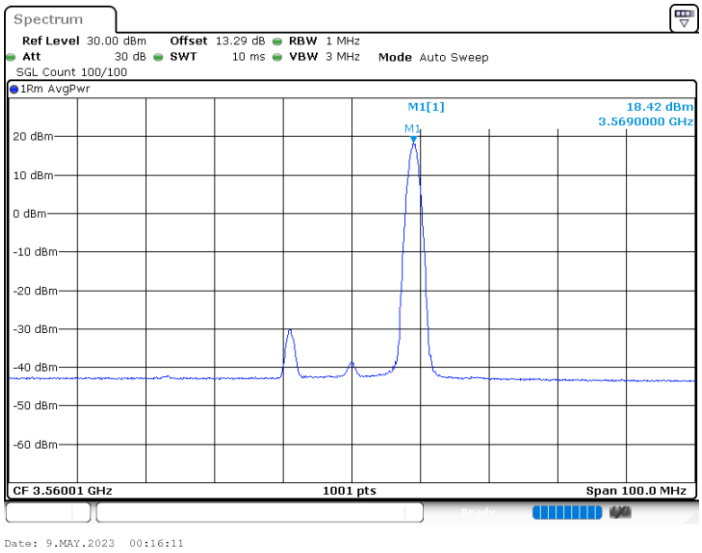
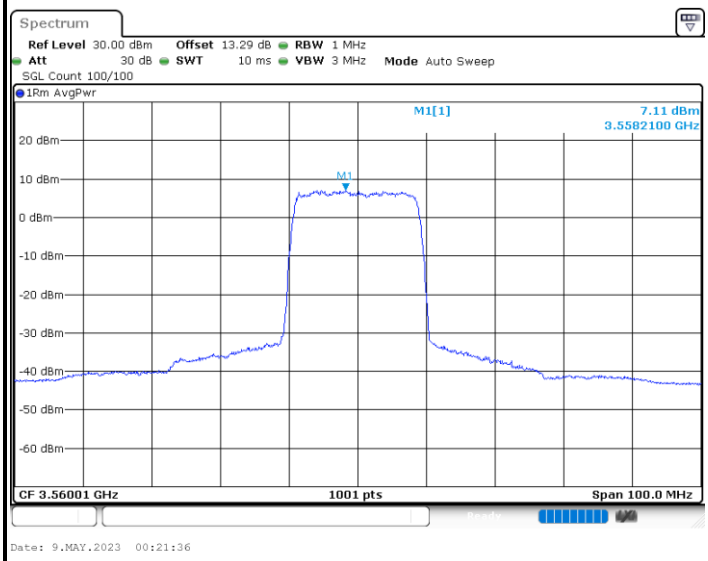
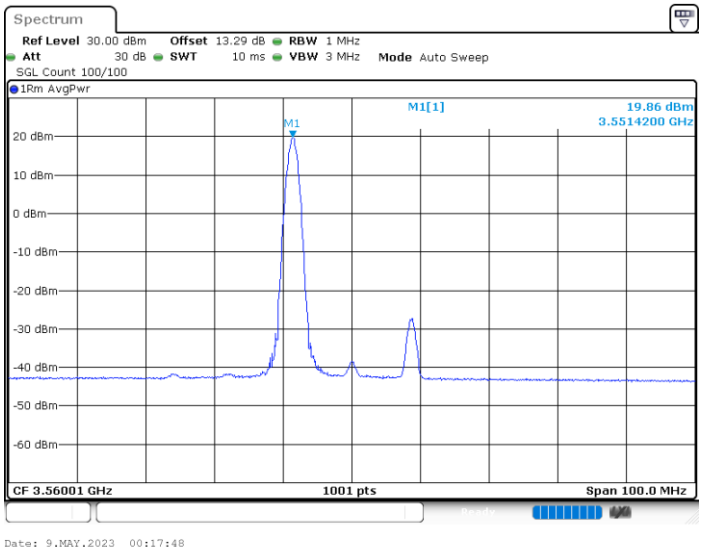
FR1 Part 96 n48 / 10MHz	
256QAM	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

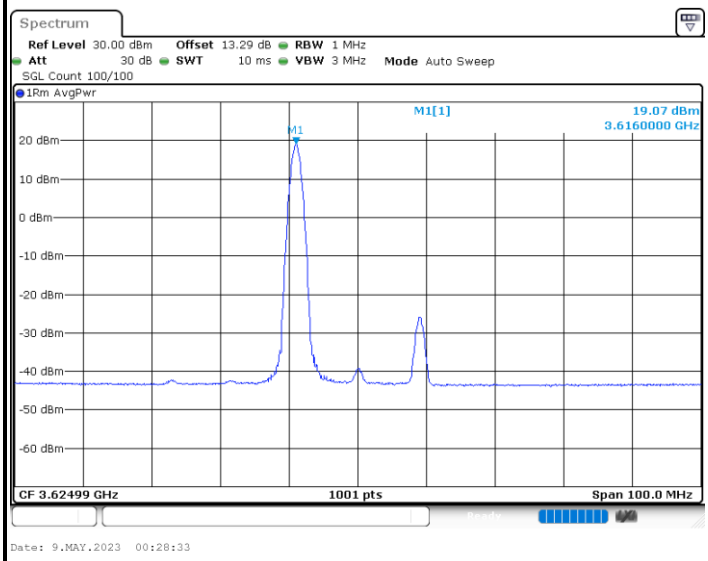
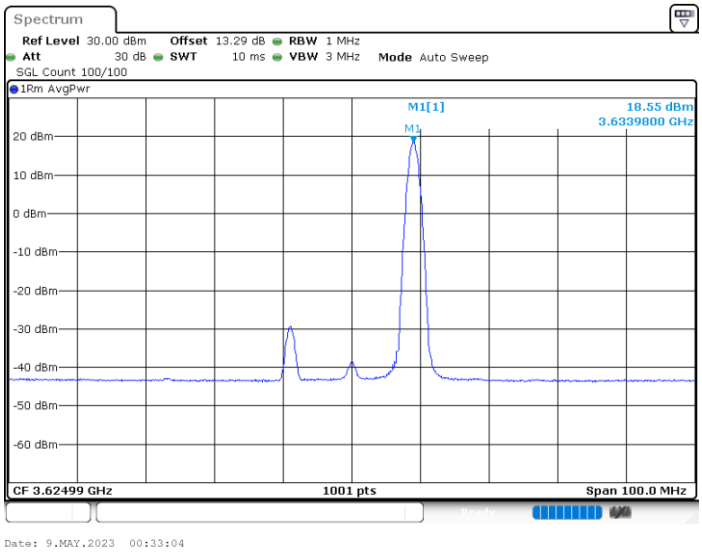
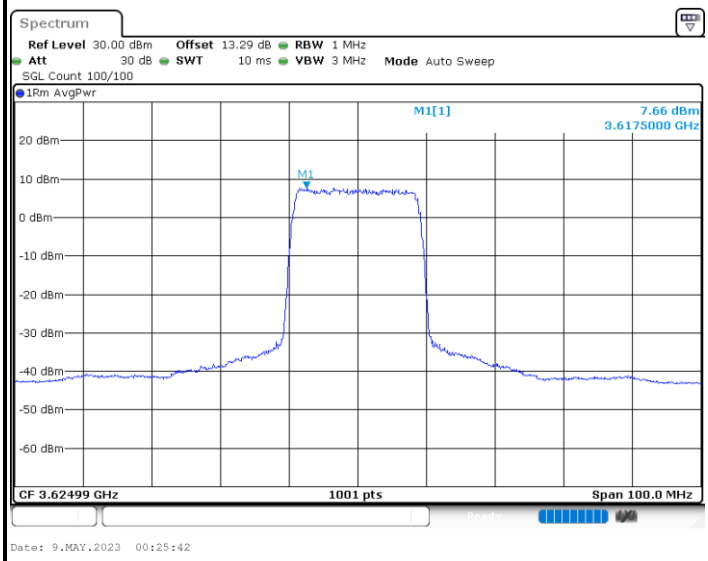
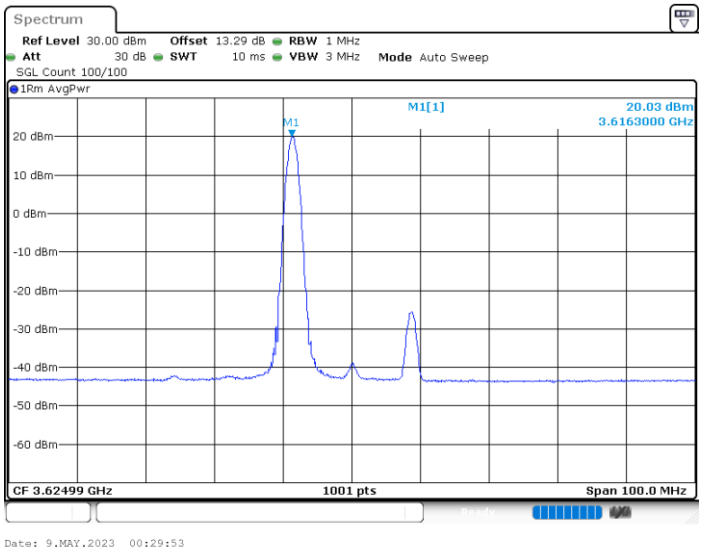
FR1 Part 96 n48 / 10MHz	
256QAM	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

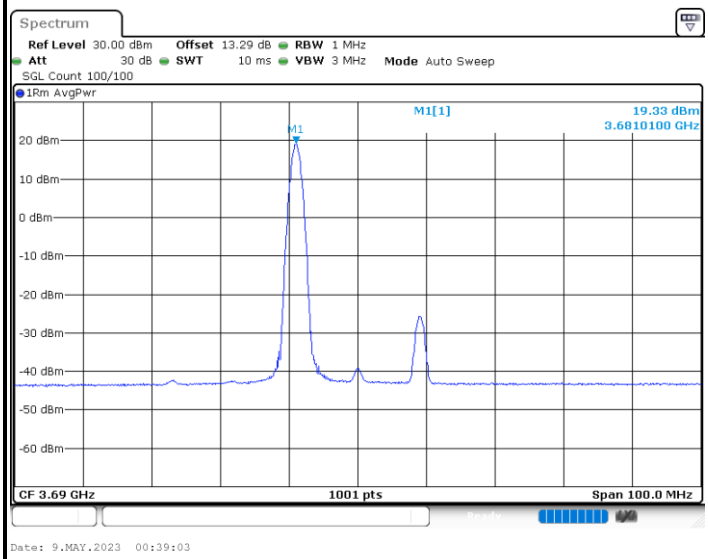
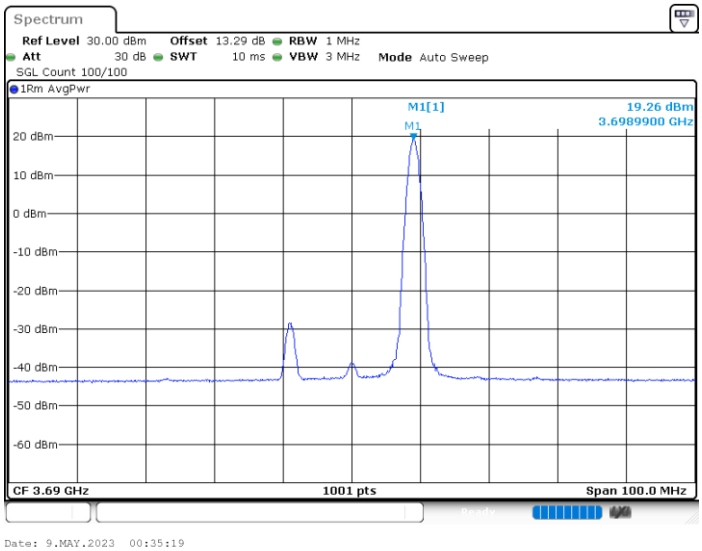
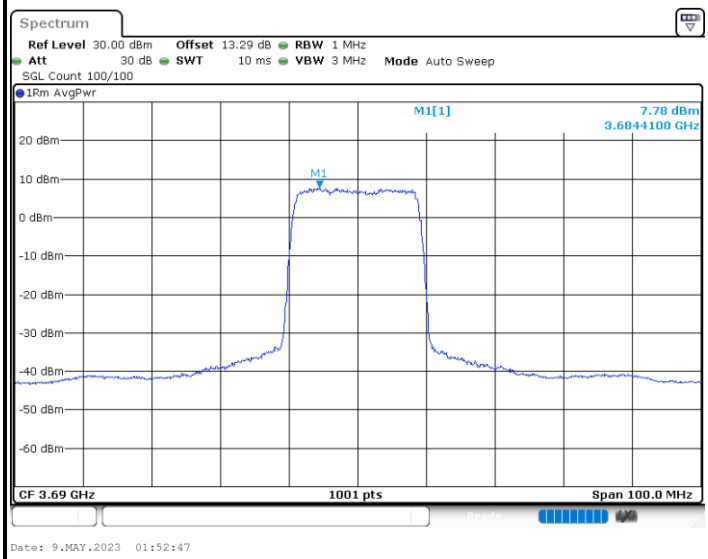
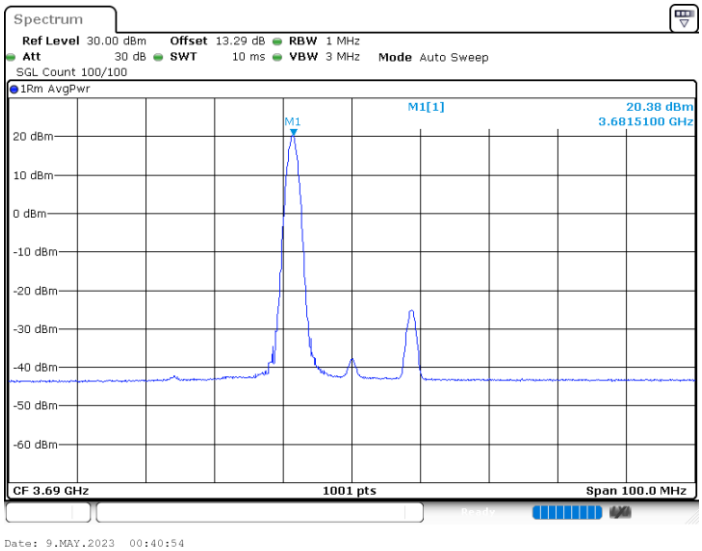
FR1 Part 96 n48 / 20MHz	
BPSK	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

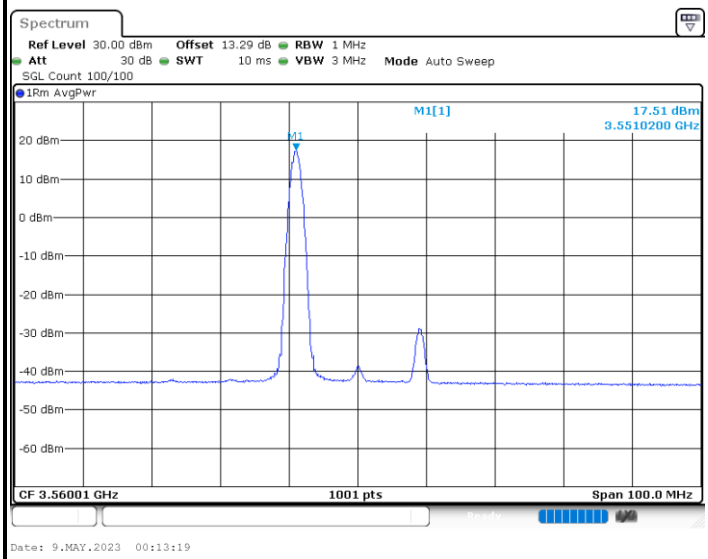
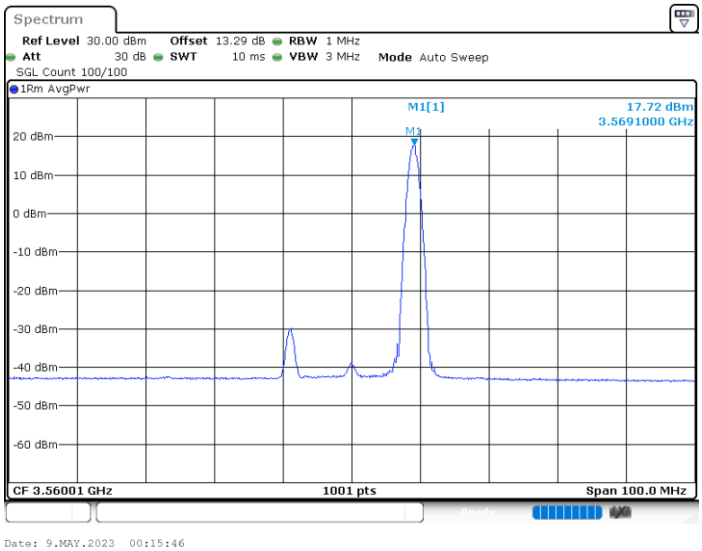
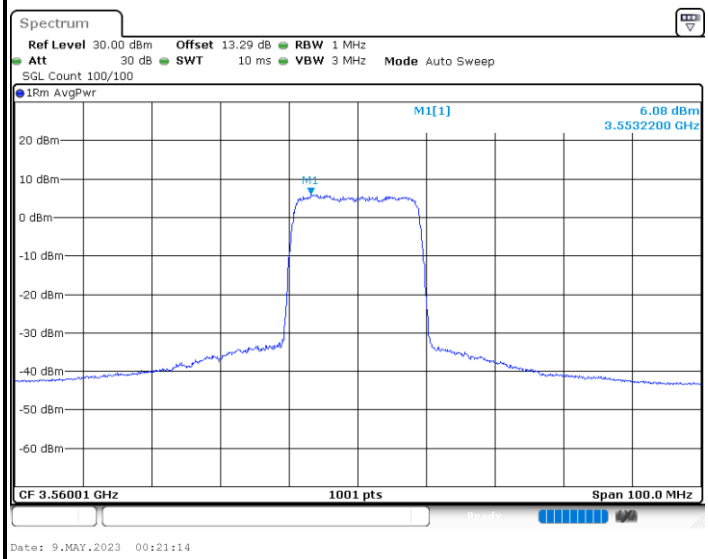
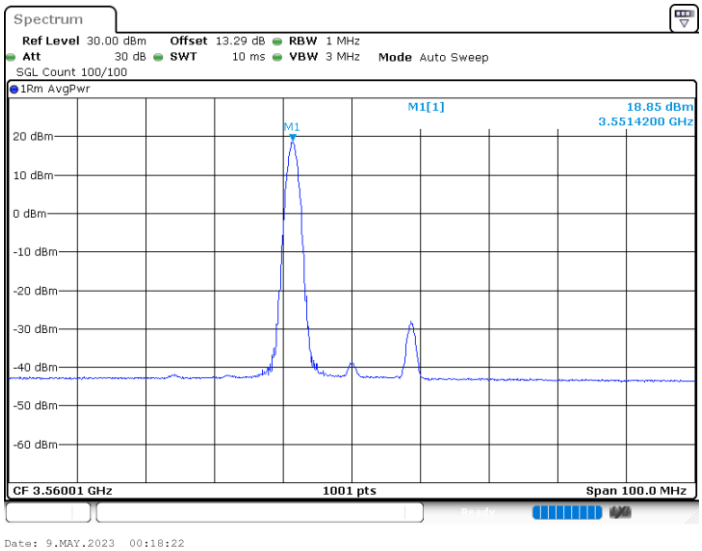
FR1 Part 96 n48 / 20MHz	
BPSK	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

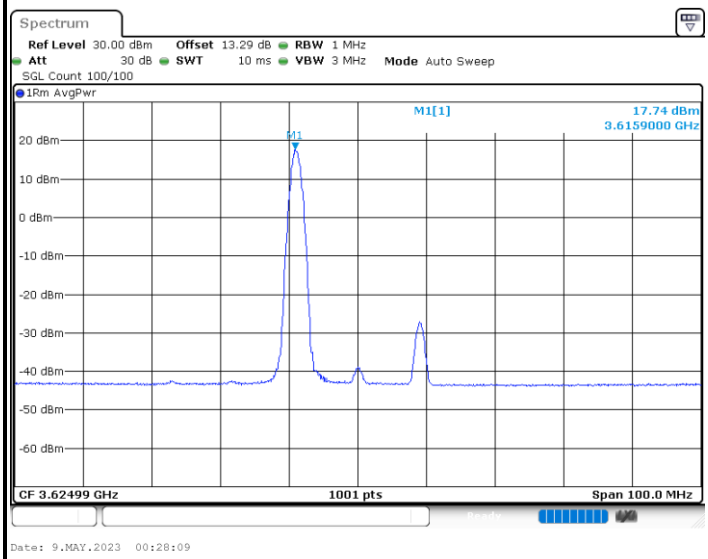
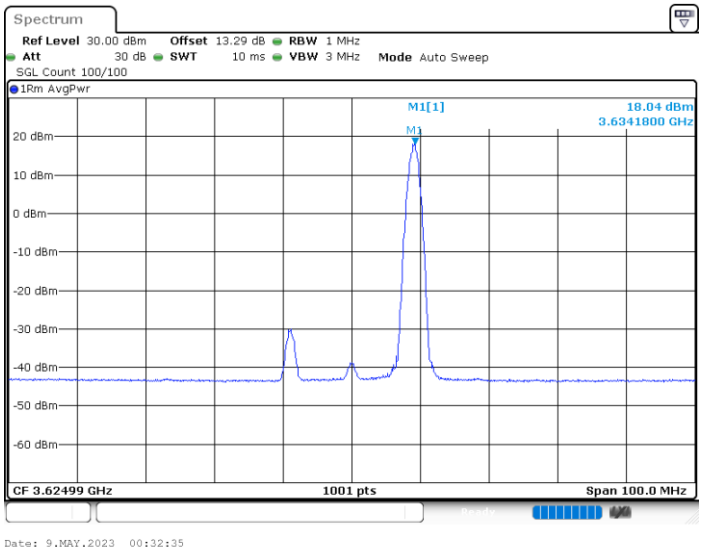
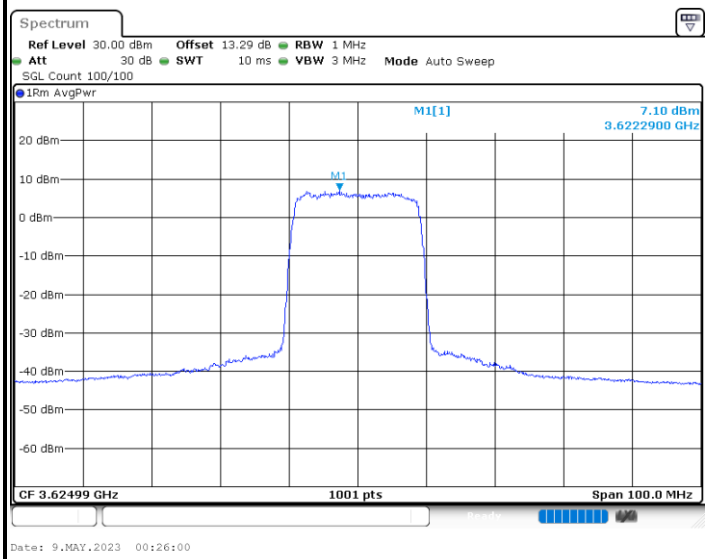
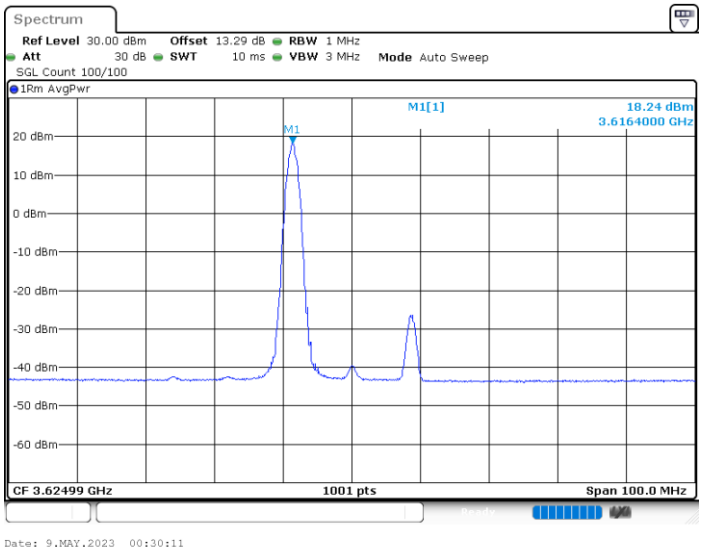
FR1 Part 96 n48 / 20MHz	
BPSK	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

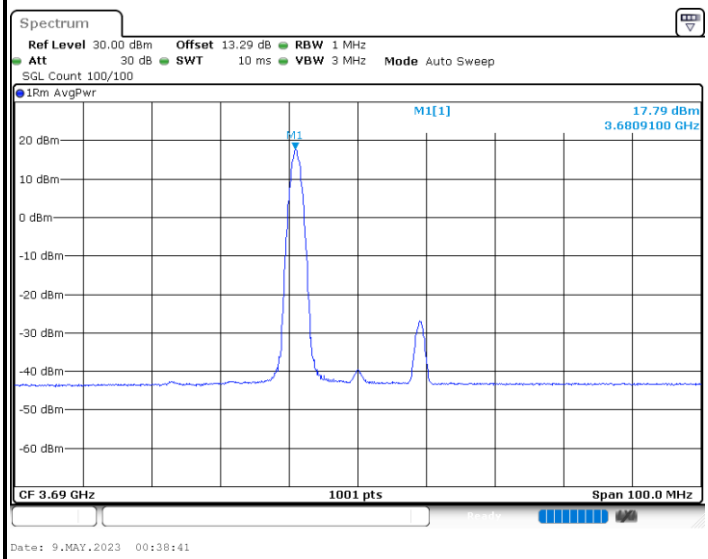
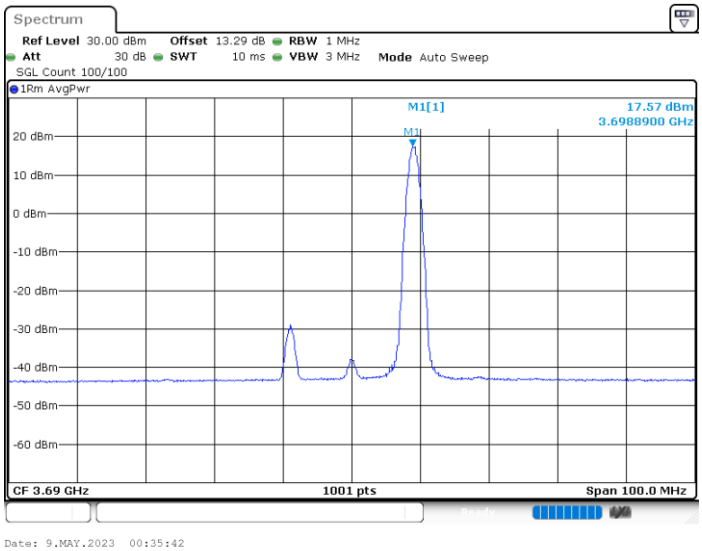
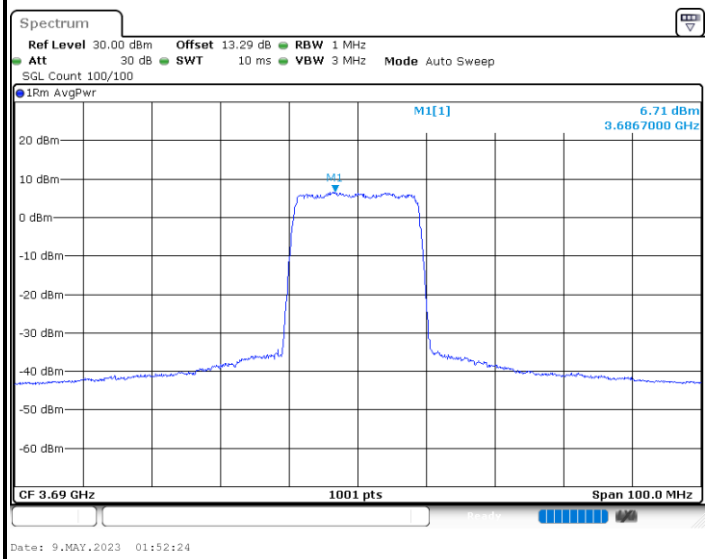
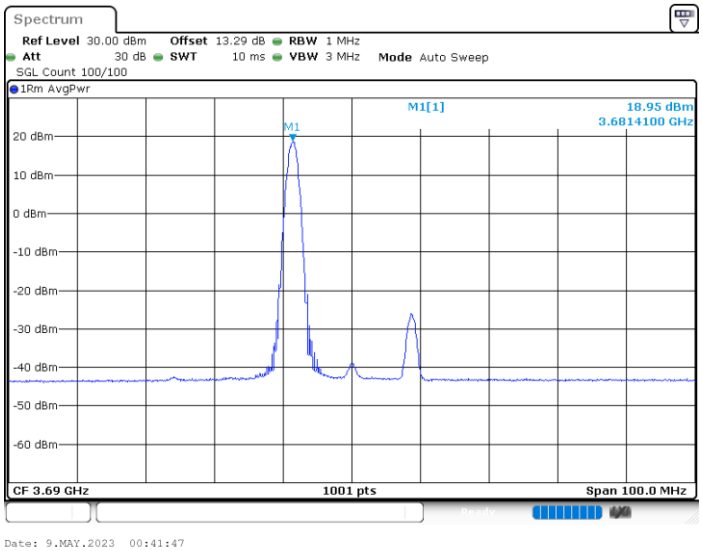
FR1 Part 96 n48 / 20MHz	
QPSK	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

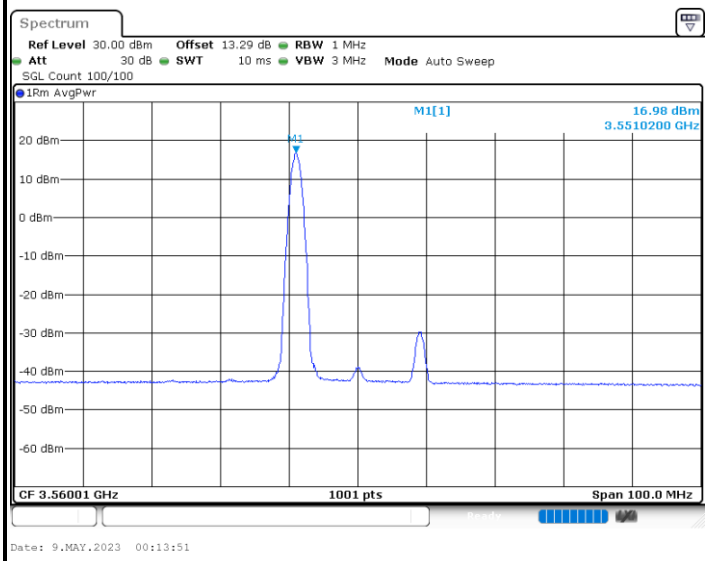
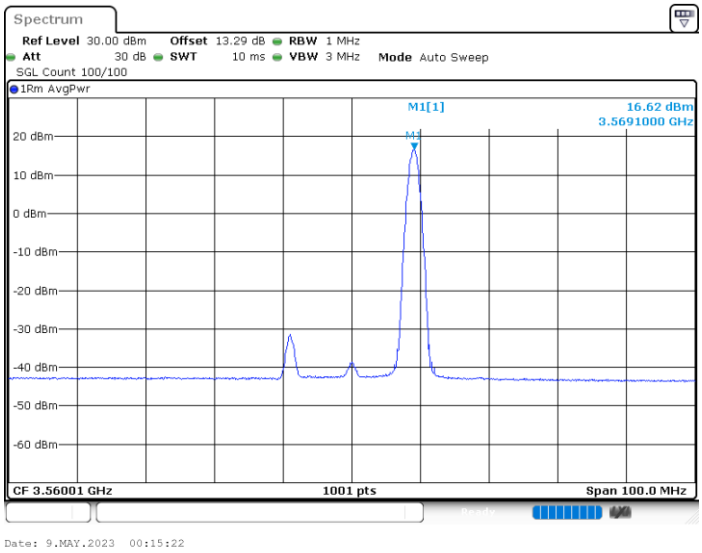
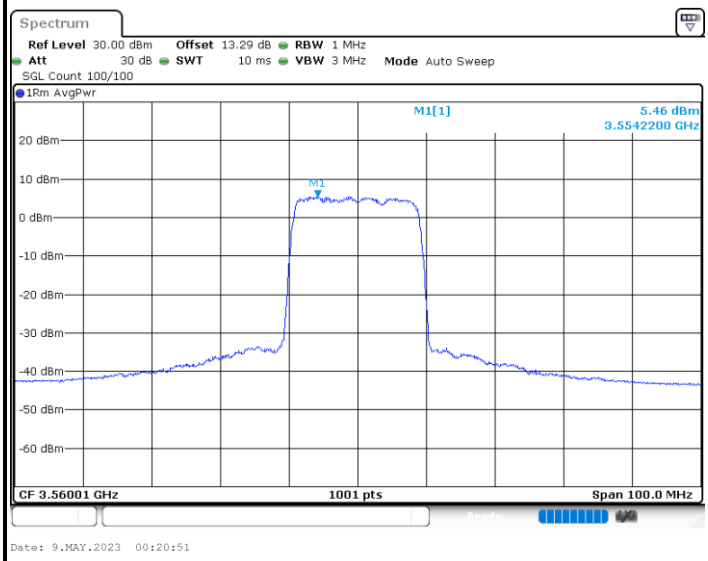
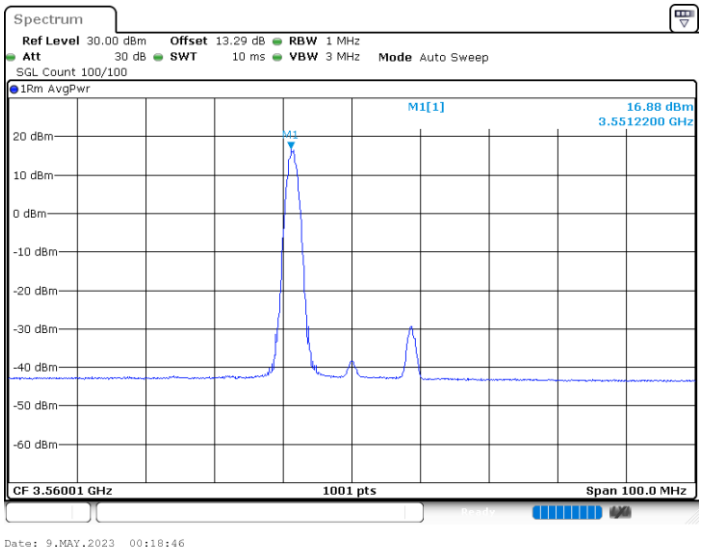
FR1 Part 96 n48 / 20MHz	
QPSK	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

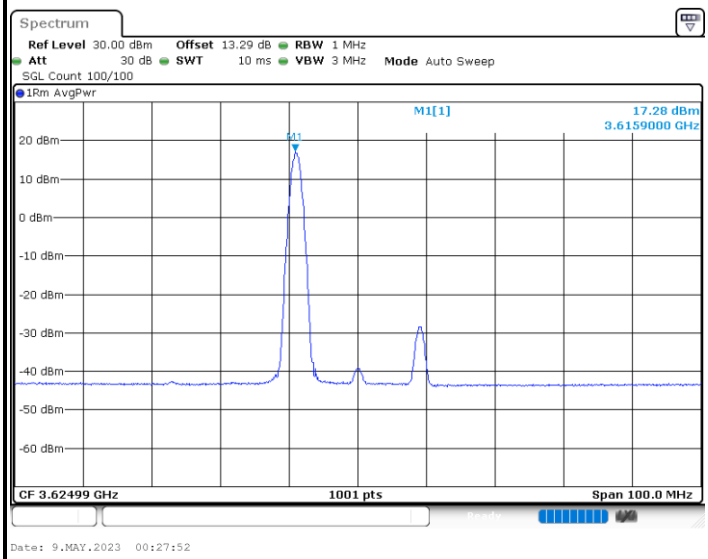
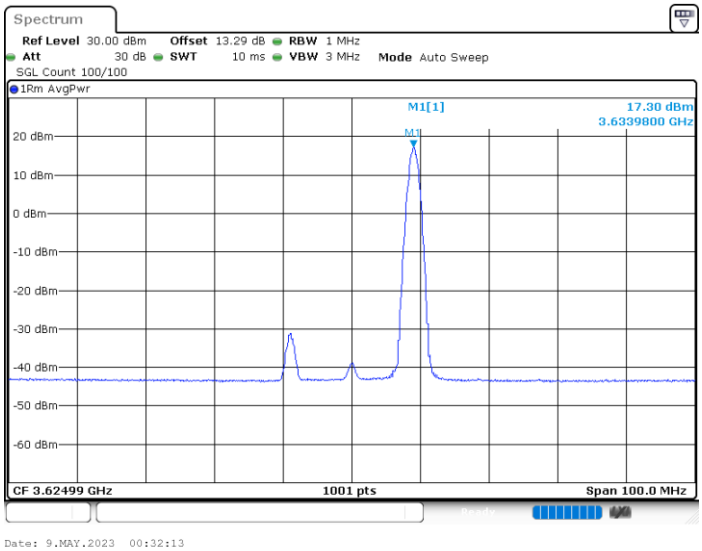
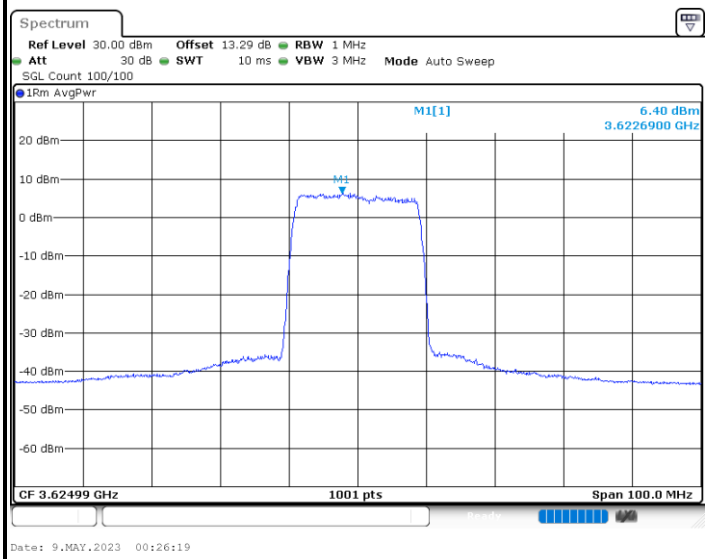
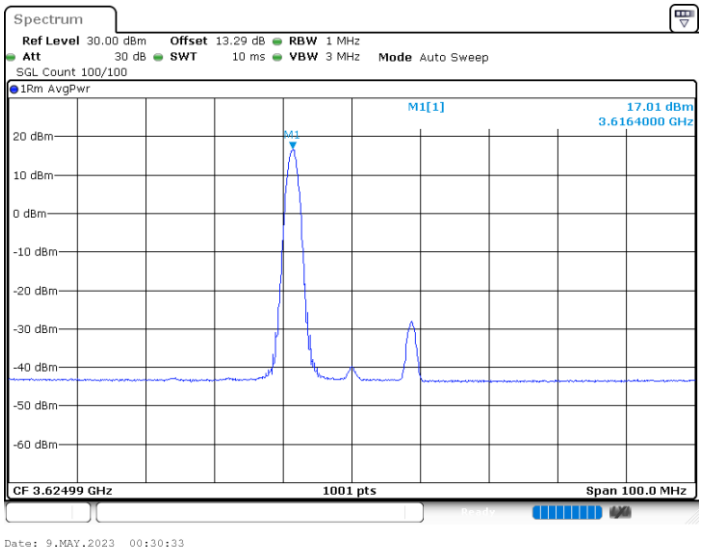
FR1 Part 96 n48 / 20MHz	
QPSK	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

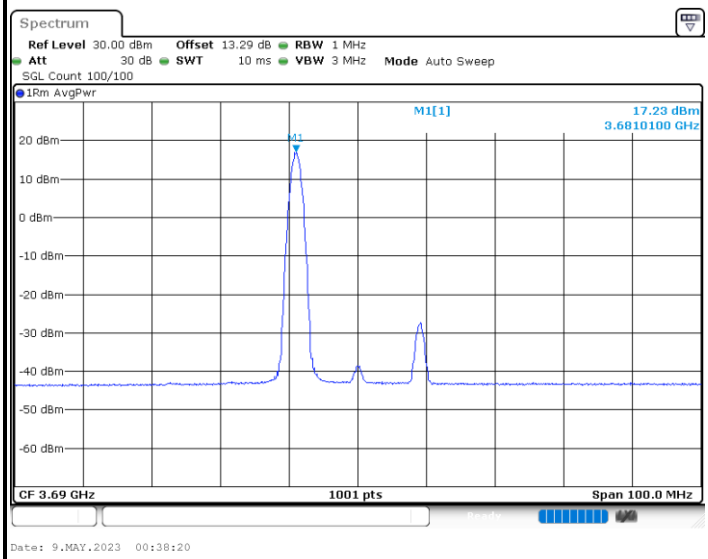
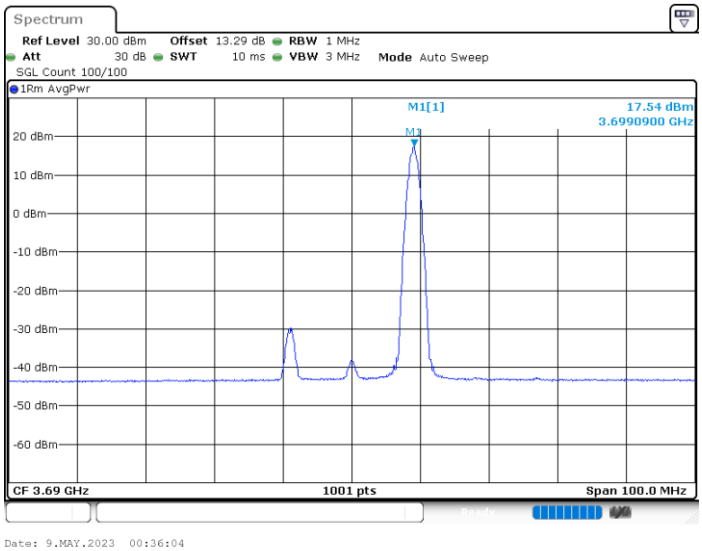
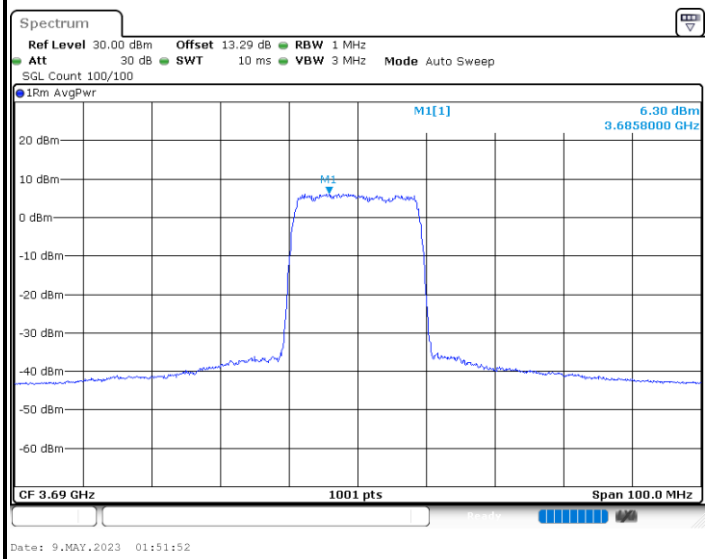
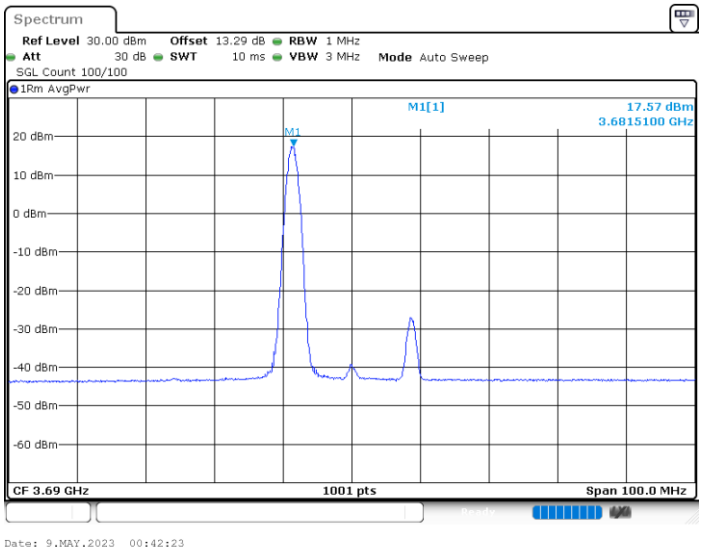
FR1 Part 96 n48 / 20MHz	
16QAM	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

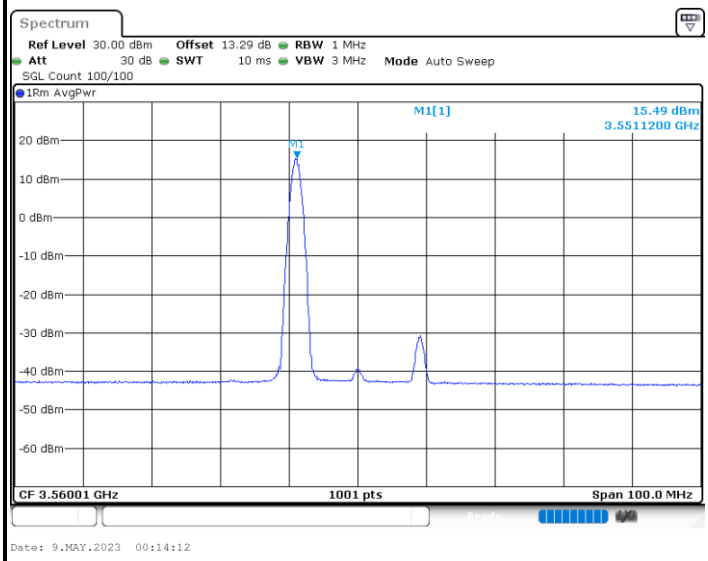
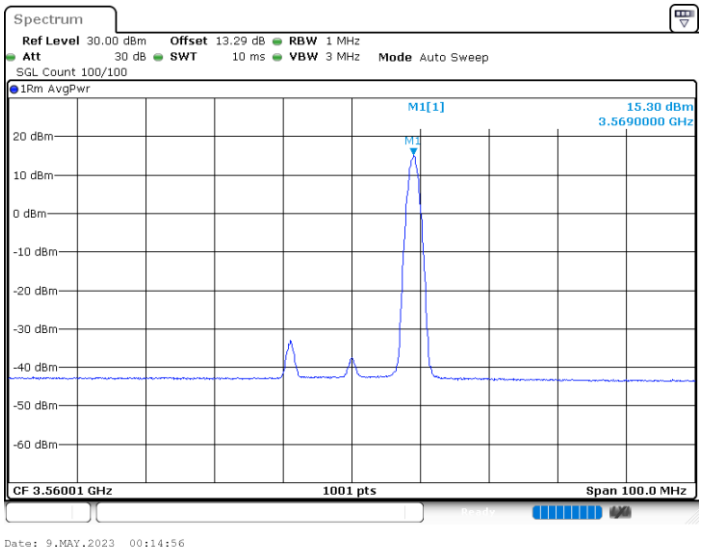
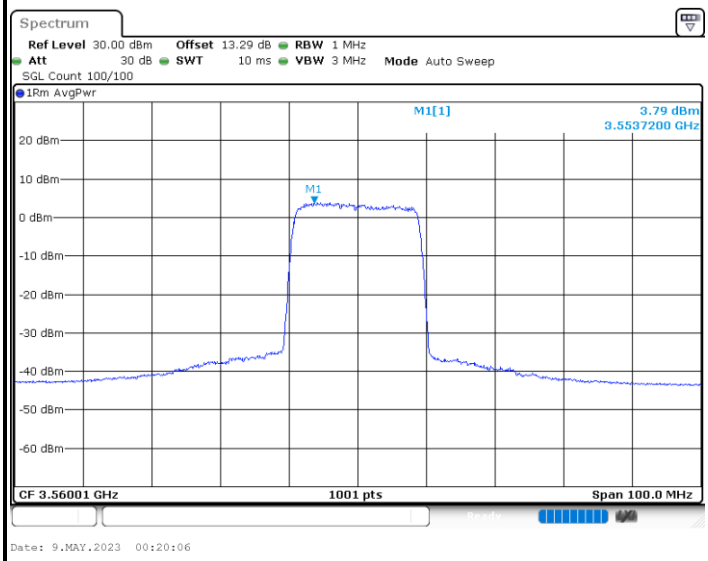
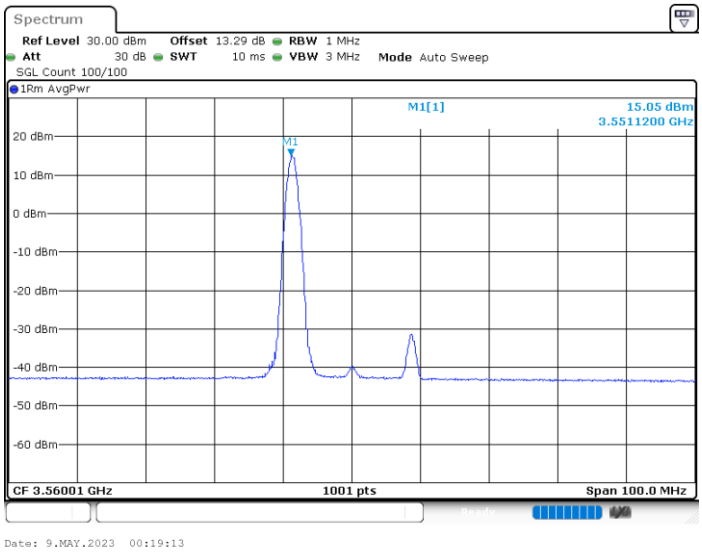
FR1 Part 96 n48 / 20MHz	
16QAM	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

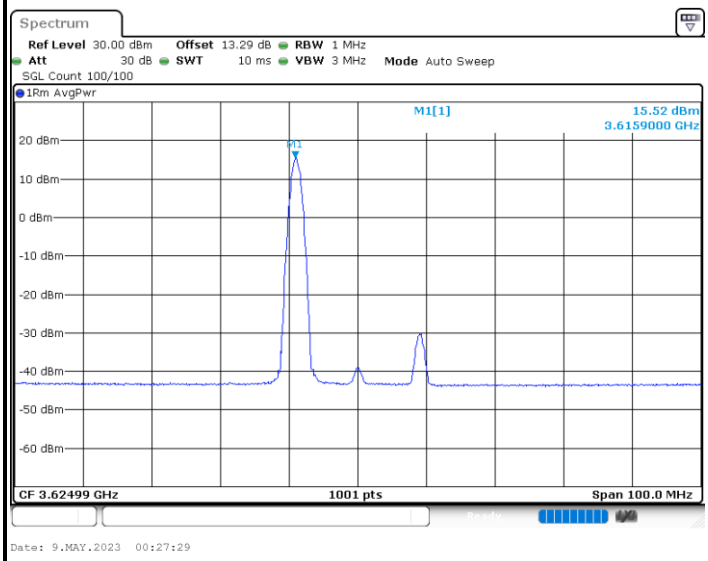
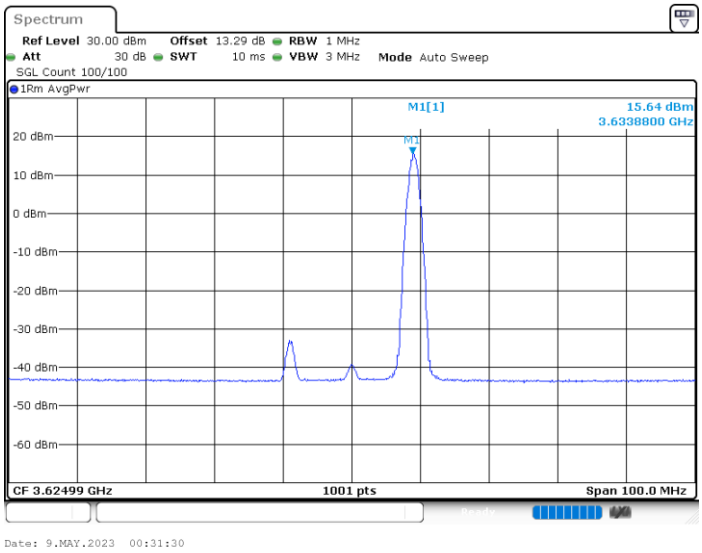
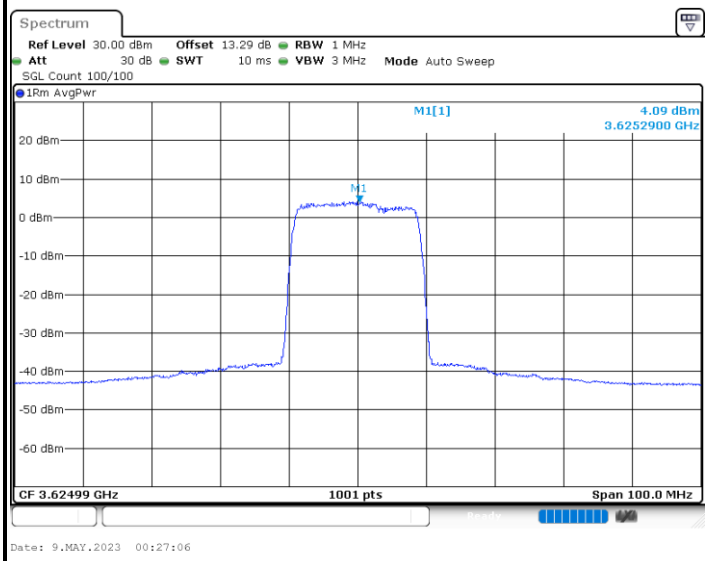
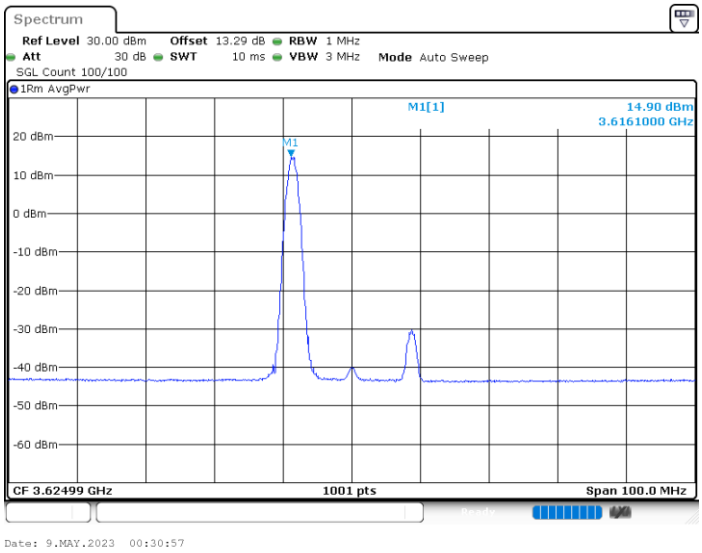
FR1 Part 96 n48 / 20MHz	
16QAM	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

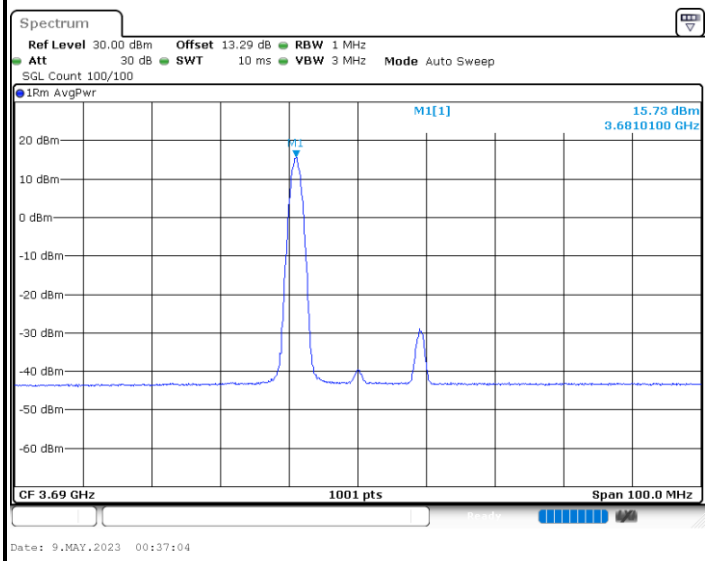
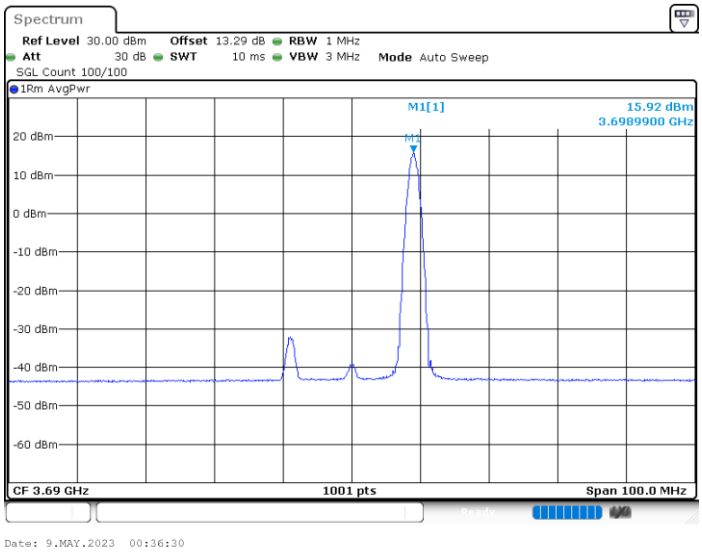
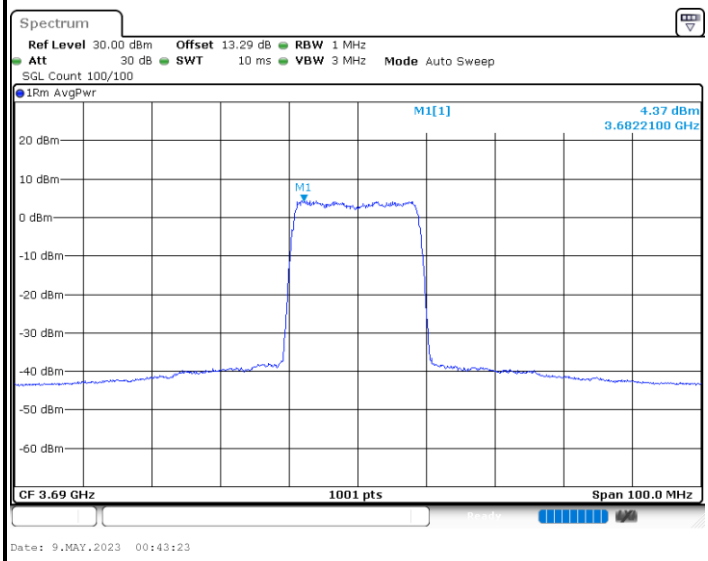
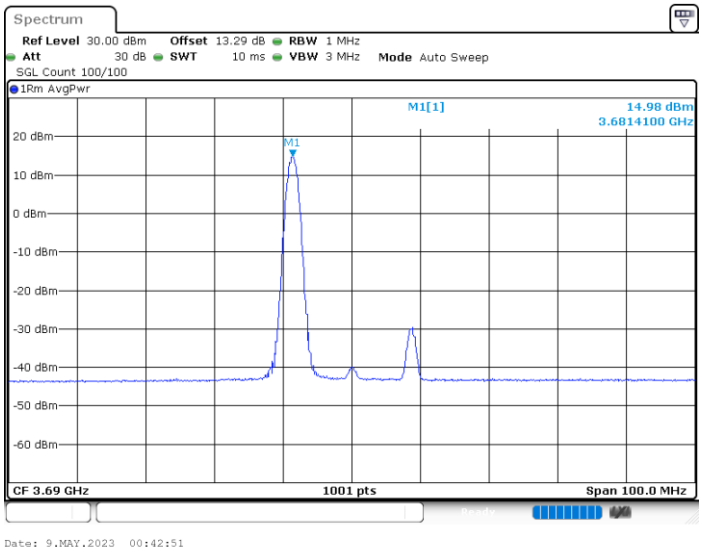
FR1 Part 96 n48 / 20MHz	
64QAM	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

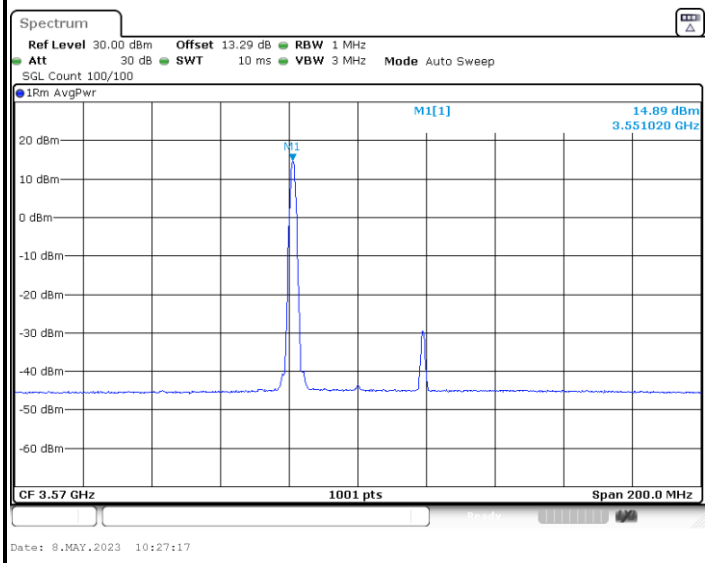
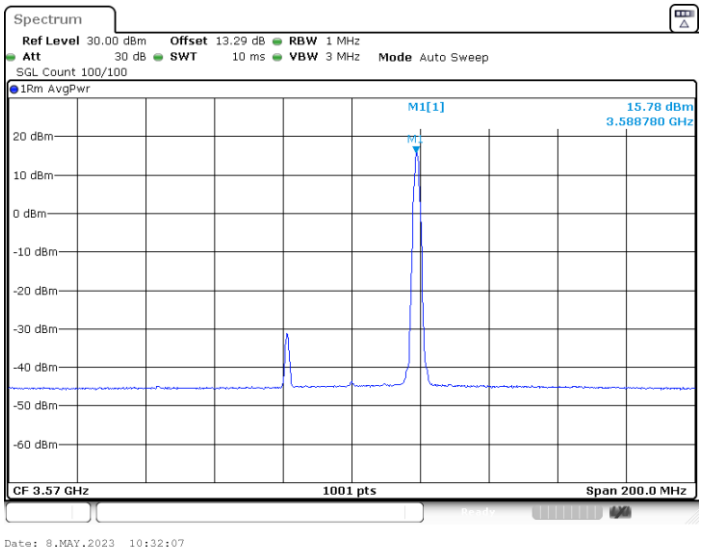
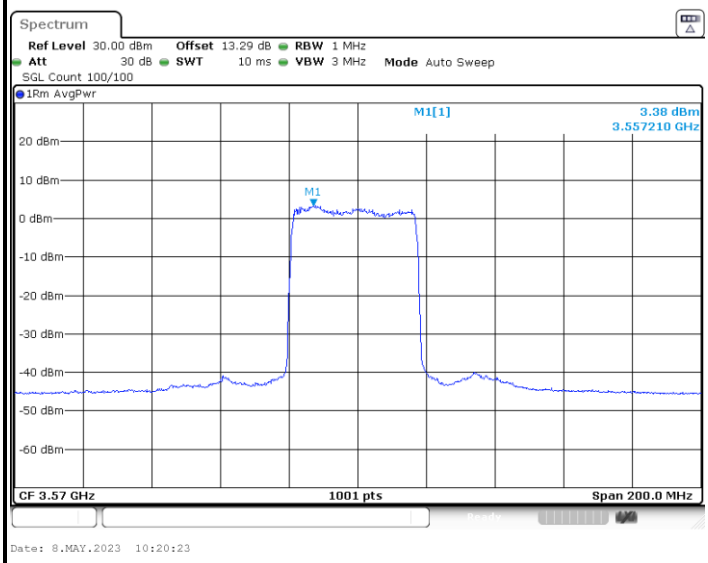
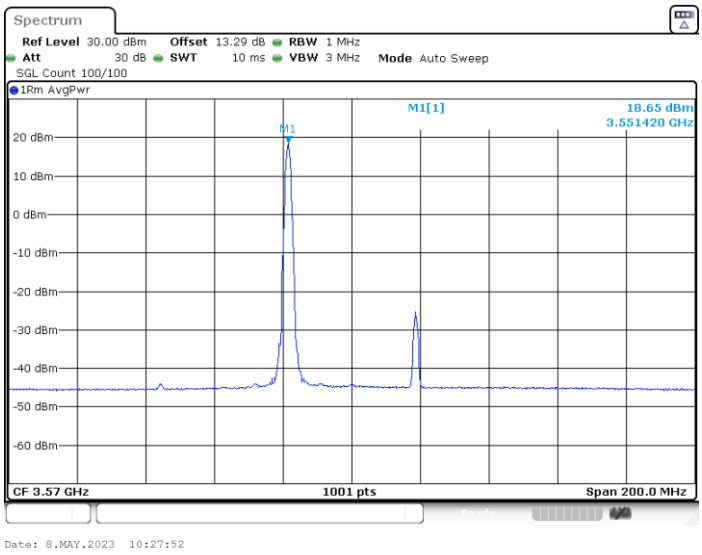
FR1 Part 96 n48 / 20MHz	
64QAM	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

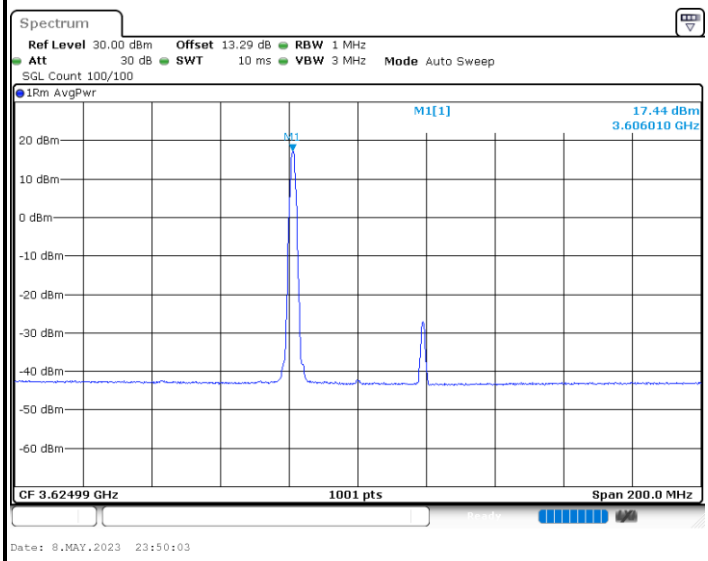
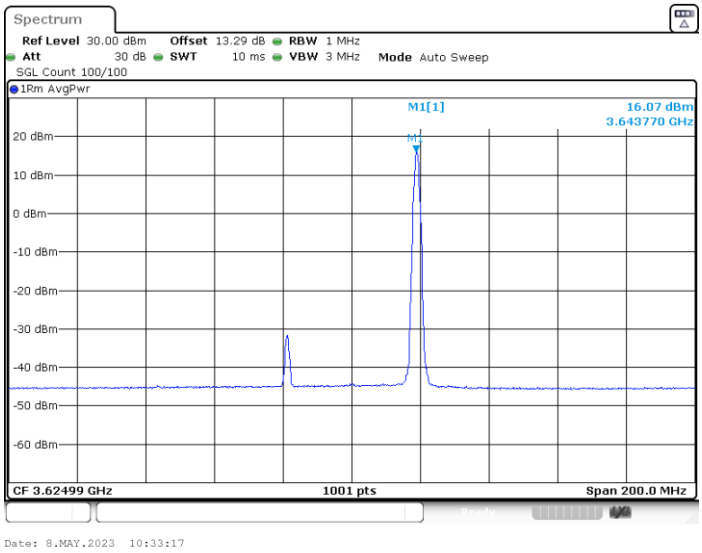
FR1 Part 96 n48 / 20MHz	
64QAM	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

FR1 Part 96 n48 / 20MHz	
256QAM	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

FR1 Part 96 n48 / 20MHz	
256QAM	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1
	

FR1 Part 96 n48 / 20MHz	
256QAM	
Highest Channel / 1RB0	Highest Channel / 1RBmax
	
Highest Channel / FullRB	Highest Channel / 1RB1
	

FR1 Part 96 n48 / 40MHz	
BPSK	
Lowest Channel / 1RB0	Lowest Channel / 1RBmax
	
Lowest Channel / FullRB	Lowest Channel / 1RB1
	

FR1 Part 96 n48 / 40MHz	
BPSK	
Middle Channel / 1RB0	Middle Channel / 1RBmax
	
Middle Channel / FullRB	Middle Channel / 1RB1