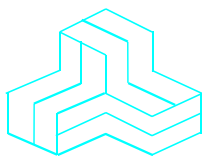


ENGINEERING TEST REPORT



RFID Module
Model: LS-M6E-M
FCC ID: PQG-MERCURY6E-M

Applicant:

Lyngsoe Systems Ltd.
101 Simona Dr., Unit 2
Bolton, Ontario
Canada L7E 4E8

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247 (902–928 MHz Band)

UltraTech's File No.: 23LYI-213_FCC15C247

This Test report is Issued under the Authority of
Tri M. Luu
Vice President of Engineering
UltraTech Group of Labs

Date: October 19, 2023

Report Prepared by: Dan Huynh

Tested by: Angus Au

Issued Date: October 19, 2023

Test Dates:
August 21 – September 29, 2023

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*
- *This test report shall not be reproduced, except in full, without a written approval from UltraTech*

UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050

Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com



0685



APEC TEL CA0001



1309



CA 0001/2049



AT-1945



SL2-IN-E-1119R



Korea KCC-RRR

CA0001

TABLE OF CONTENTS

EXHIBIT 1.	INTRODUCTION.....	1
1.1.	SCOPE	1
1.2.	RELATED SUBMITTAL(S)/GRANT(S)	1
1.3.	NORMATIVE REFERENCES	1
EXHIBIT 2.	PERFORMANCE ASSESSMENT	2
2.1.	CLIENT INFORMATION	2
2.2.	EQUIPMENT UNDER TEST (EUT) INFORMATION	2
2.3.	EUT'S TECHNICAL SPECIFICATIONS.....	3
2.4.	ASSOCIATED ANTENNA DESCRIPTION	3
2.5.	LIST OF EUT'S PORTS.....	3
2.6.	ANCILLARY EQUIPMENT	4
EXHIBIT 3.	EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS	5
3.1.	CLIMATE TEST CONDITIONS	5
3.2.	OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS.....	5
EXHIBIT 4.	SUMMARY OF TEST RESULTS.....	6
4.1.	LOCATION OF TESTS	6
4.2.	APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS	6
4.3.	MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES	6
EXHIBIT 5.	TEST DATA	7
5.1.	MAXIMUM PEAK CONDUCTED OUTPUT POWER [§ 15.247(b)(2)].....	7
5.2.	TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]	22
5.3.	RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]	40
EXHIBIT 6.	TEST EQUIPMENT LIST	42
EXHIBIT 7.	MEASUREMENT UNCERTAINTY	43

EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
Purpose of Test:	Class II Permissive Change to add new antenna type
Test Procedures:	▪ ANSI C63.4 ▪ ANSI C63.10 ▪ FCC KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02
Environmental Classification:	☒ Commercial, industrial or business environment ☐ Residential environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2023	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
FCC, KDB Publication No. 558074 D01 15.247 Meas Guidance v05r02	2019	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

Applicant	
Name:	Lyngsoe Systems Ltd.
Address:	101 Simona Dr., Unit 2 Bolton, Ontario Canada L7E 4E8

Manufacturer	
Name:	Lyngsoe Systems Ltd.
Address:	101 Simona Dr., Unit 2 Bolton, Ontario Canada L7E 4E8

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Lyngsoe Systems Ltd.
Product Name:	RFID Module
Model Name or Number:	LS-M6E-M
Serial Number:	Test Sample
Type of Equipment:	Spread Spectrum Transmitter
Input Power Supply Type:	External DC Power Supply
Primary User Functions of EUT:	RFID Module

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	- Mobile - Base Station (fixed use)
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	5 VDC
RF Output Power Rating:	1.0 W
Operating Frequency Range:	902.75 - 927.25 MHz 917.4 - 927.2 MHz 917.5 - 922.5 MHz 902.625 - 921.0 MHz
RF Output Impedance:	50 Ω
Modulation Type:	ASK
Antenna Connector Type:	U.FL

2.4. ASSOCIATED ANTENNA DESCRIPTION

Manufacturer:	Laird
Type:	Patch antennas -circular Polarized
Model:	S9028PCRJ / S9028PCLJ
Part Number:	S9028PCRJ36RTNB / S9028PCLJ36RTNB
Frequency:	902 - 928 MHz
Max. Gain:	6.9 dBi

2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Antenna	2	U.FL	Shielded
2	Digital Connector	1	Molex	Non-shielded

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: 23LYI-213_FCC15C247
October 19, 2023

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Test Jig
Brand name:	Lyngsoe Systems Ltd.
Model Name or Number:	N/A
Serial Number:	N/A
Connected to EUT's Port:	Edge vias

Ancillary Equipment # 2	
Description:	Laptop
Brand name:	HP
Model Name or Number:	EliteBook 820
Serial Number:	N/A
Connected to EUT's Port:	EUT Test Jig

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 °C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	5 VDC

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The transmitter was operated in a continuous transmission mode/frequency hopping mode with the carrier modulated as specified in the Test Data.
Special Test Software & Hardware:	Test software provided by the Applicant to operate the EUT at each channel frequency continuously/frequency hopping mode and in the range of typical modes of operation.
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as external antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	902.75 - 927.25 MHz 917.4 - 927.2 MHz 917.5 - 922.5 MHz 902.625 - 921.0 MHz
Frequency(ies) Tested: (Near lowest & near highest frequencies in the frequency range of operation.)	902.75 MHz, 915.25 MHz and 927.25 MHz 917.4 MHz, 922.4 MHz and 927.2 MHz 917.5 MHz, 920.1 MHz and 922.5 MHz 902.625 MHz, 912.000 MHz and 921.000 MHz
RF Power Output: (measured maximum output power at antenna terminals)	28.95 dBm
Normal Test Modulation:	ASK
Modulating Signal Source:	Internal

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: 23LYI-213_FCC15C247
October 19, 2023

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements for Hybrid System	Compliance (Yes/No)
15.203	Antenna requirements	Yes ¹
15.207(a)	AC Power Line Conducted Emissions	N/A
15.247(a)	Provisions for Frequency Hopping Systems	N/A
15.247(b)(2)	Maximum Peak Conducted Output Power	Yes
15.247(d), 15.209 & 15.205	Band-Edge and Transmitter Spurious Radiated Emissions	Yes
15.247(i), 1.1307, 1.1310, 2.1091	RF Exposure	Yes

* The EUT complies with the requirement; it employs unique antenna connector.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. TEST DATA

5.1. MAXIMUM PEAK CONDUCTED OUTPUT POWER [§ 15.247(b)(2)]

5.1.1. Limits

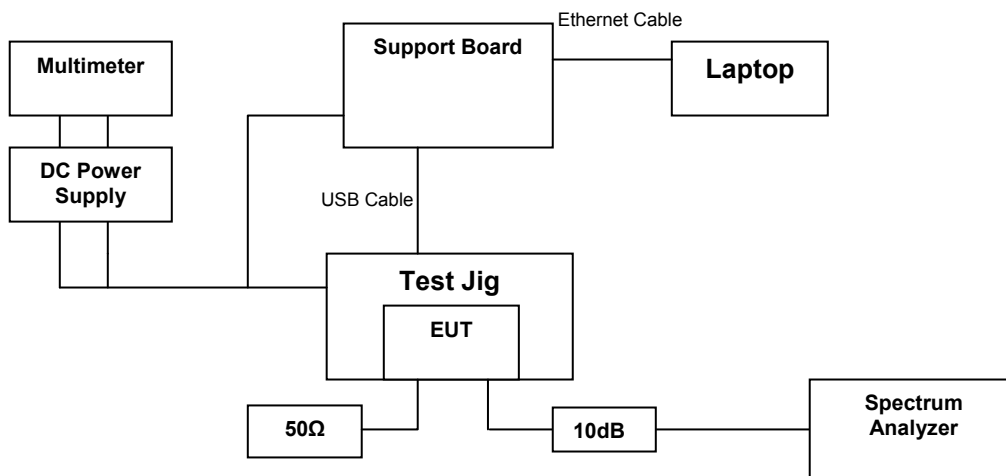
§15.247(b)(2) For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under [paragraph \(a\)\(1\)\(i\)](#) of this section.

§15.247(b)(4) The conducted output power limit specified in [paragraph \(b\)](#) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in [paragraph \(c\)](#) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in [paragraphs \(b\)\(1\)](#), [\(b\)\(2\)](#), and [\(b\)\(3\)](#) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1.2. Method of Measurements

Subclause 7.8.5 of ANSI C63.10.

5.1.3. Test Arrangement



5.1.4. Test Data

Remark: Test conducted at reduced power setting at 29 dBm for antenna gain between 6 and 7 dBi.

Maximum Peak Conducted Output Power at Power Setting 29 dBm, Port 1			
Operating Mode	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	Peak Power Limit (dBm)
Mode 1(NA), 500 kHz Channel Spacing	902.75	28.74	30
	915.25	28.84	30
	927.25	28.84	30
Mode 2(NA2), 200 kHz Channel Spacing	917.4	28.70	30
	922.4	28.83	30
	927.2	28.86	30
Mode 3(NA3), 100 kHz Channel Spacing	917.5	28.68	30
	920.1	28.78	30
	922.5	28.95	30
Mode 4(NA4), 375 kHz Channel Spacing	902.625	28.91	30
	912.000	28.81	30
	921.000	28.86	30

Maximum Peak Conducted Output Power at Power Setting 29 dBm, Port 2			
Operating Mode	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	Peak Power Limit (dBm)
Mode 1(NA), 500 kHz Channel Spacing	902.75	28.91	30
	915.25	28.73	30
	927.25	28.88	30
Mode 2(NA2), 200 kHz Channel Spacing	917.4	28.77	30
	922.4	28.87	30
	927.2	28.90	30
Mode 3(NA3), 100 kHz Channel Spacing	917.5	28.80	30
	920.1	28.84	30
	922.5	28.78	30
Mode 4(NA4), 375 kHz Channel Spacing	902.625	28.86	30
	912.000	28.90	30
	921.000	28.79	30

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: 23LYI-213_FCC15C247
October 19, 2023

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Power Level, Antenna Details and Resulting EIRP

Maximum Peak Conducted Output Power: 28.95 dBm					
Assembly #	Antenna Type	Maximum Gain (dBi)	Minimum Insertion / Cable Loss (dBm)	Antenna Assembly Gain (dBm)	EIRP (dBm)
1	Patch Antenna	6.9	0	6.9	35.85

ULTRATECH GROUP OF LABS

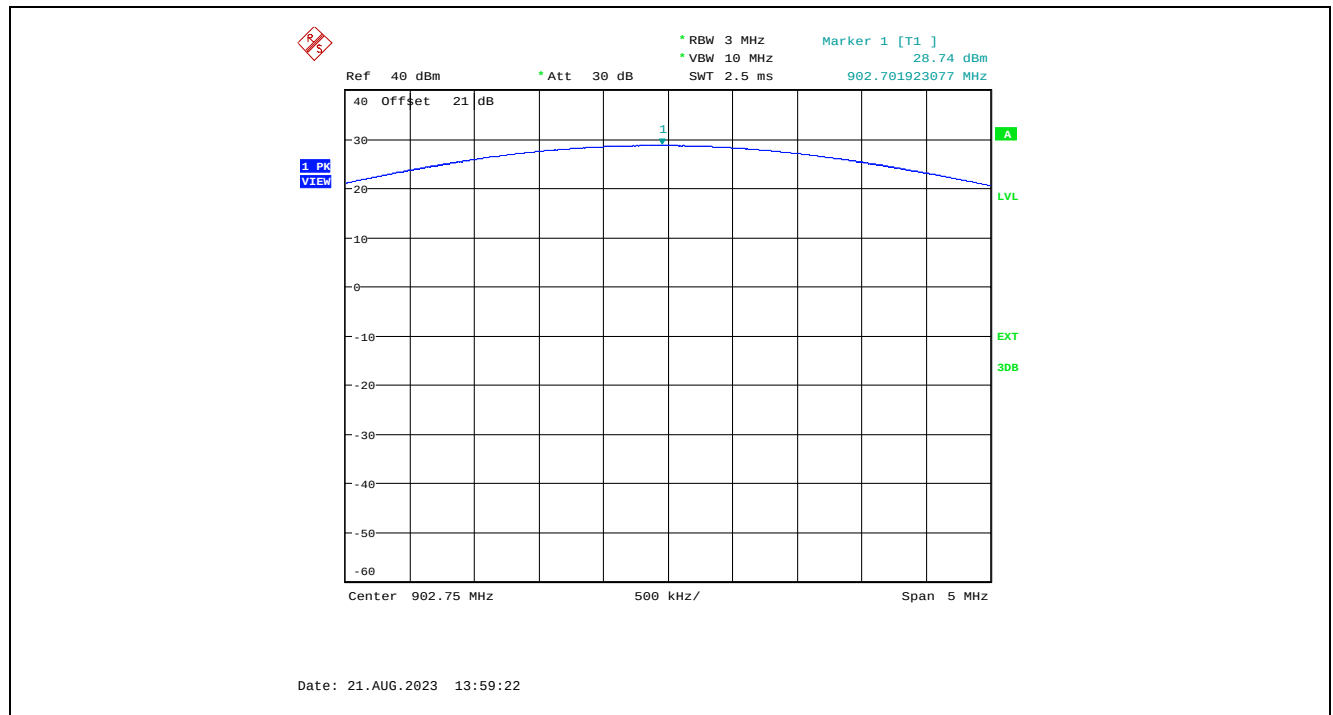
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: 23LYI-213_FCC15C247

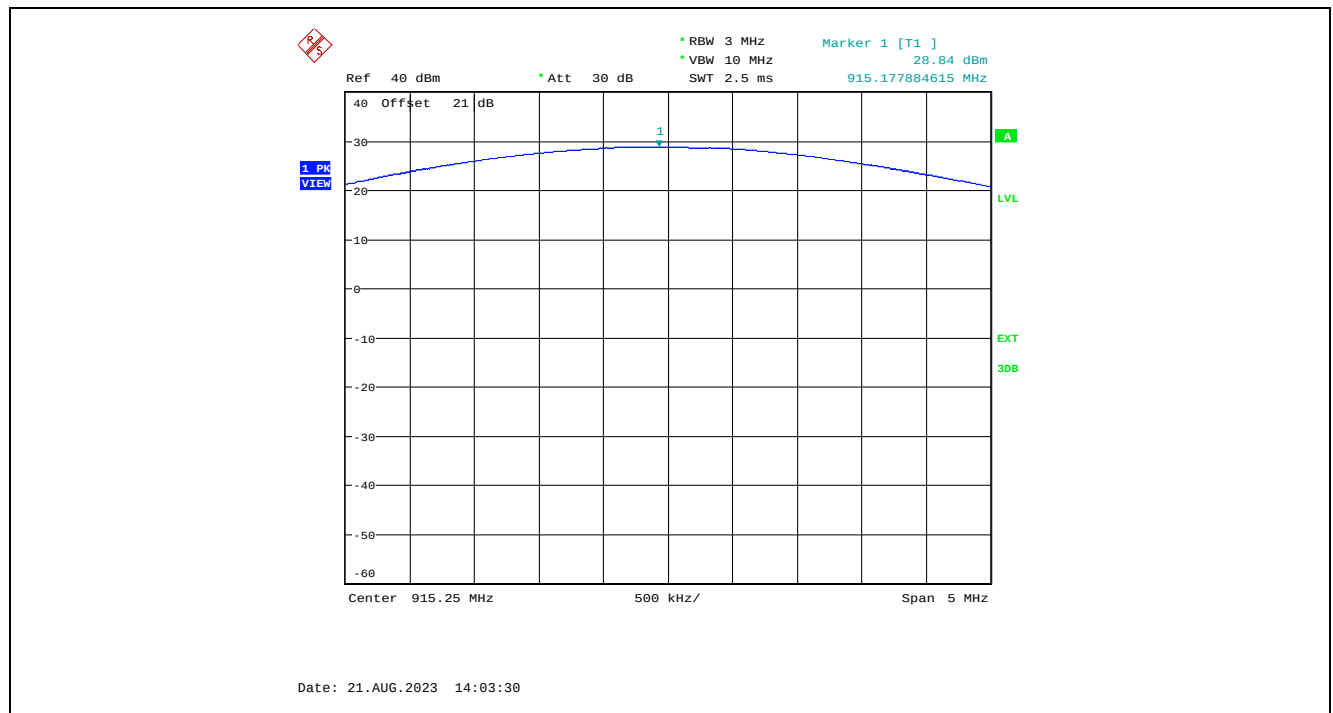
October 19, 2023

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

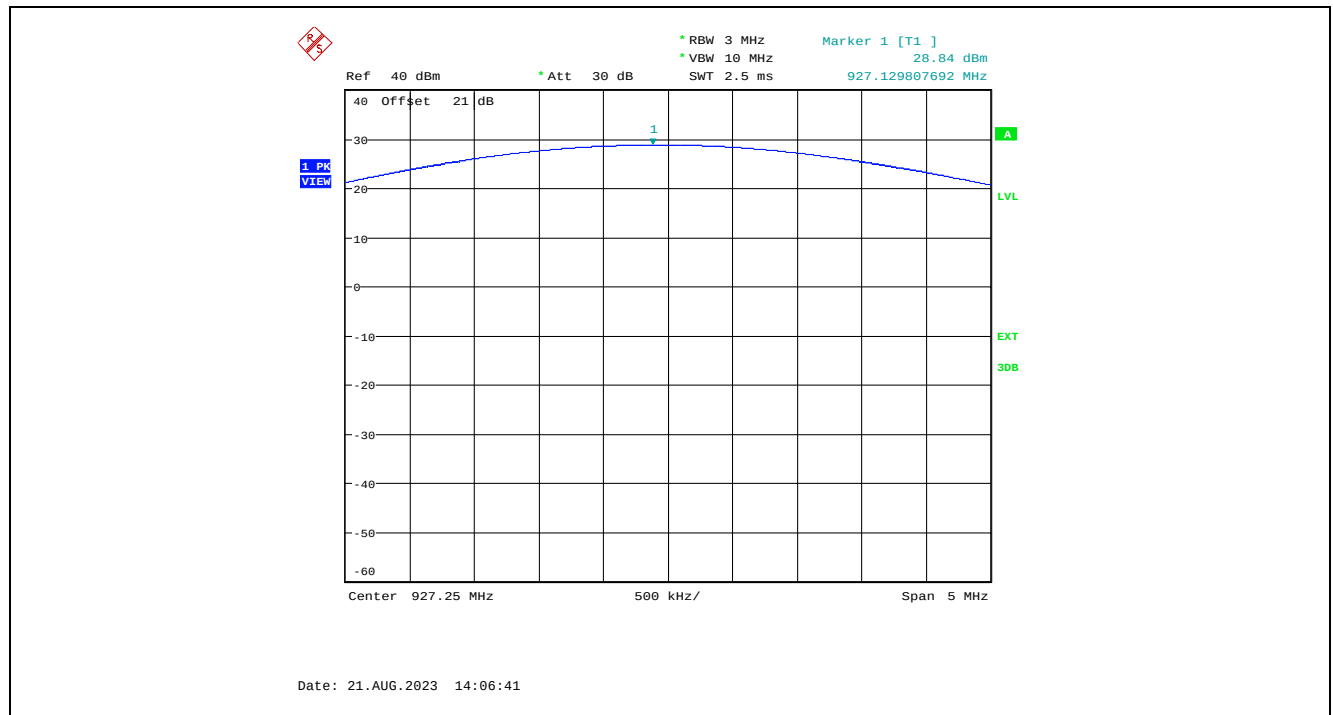
Plot 5.1.4.1. Maximum Conducted Output Power, Mode 1(NA), Port 1, 902.75 MHz



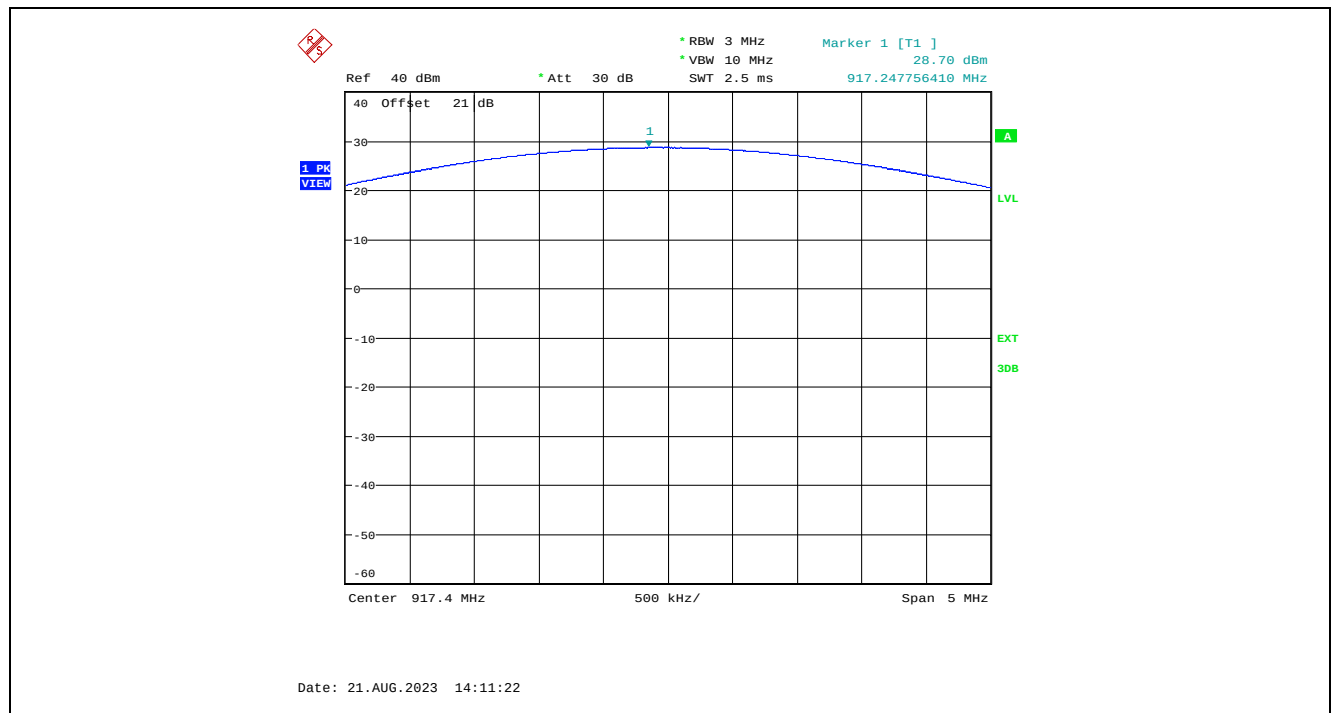
Plot 5.1.4.2. Maximum Conducted Output Power, Mode 1(NA), Port 1, 915.25 MHz



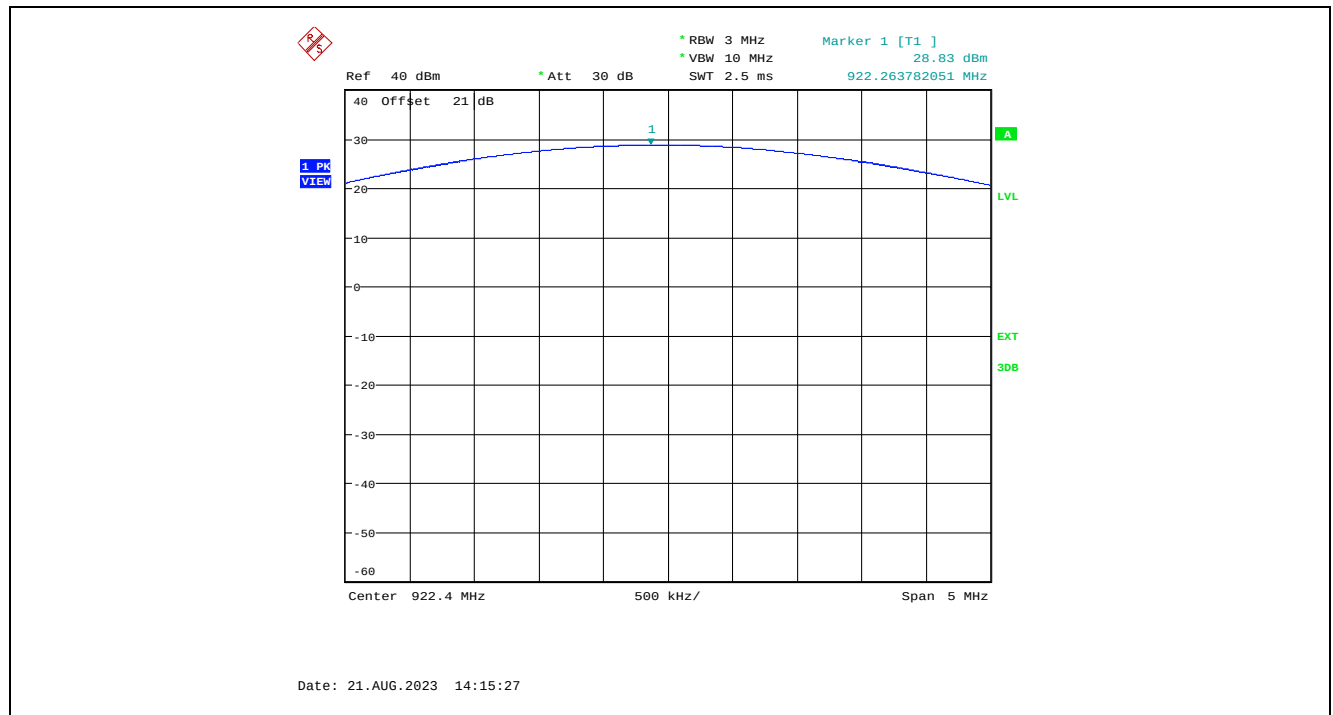
Plot 5.1.4.3. Maximum Conducted Output Power, Mode 1(NA), Port 1, 927.25 MHz



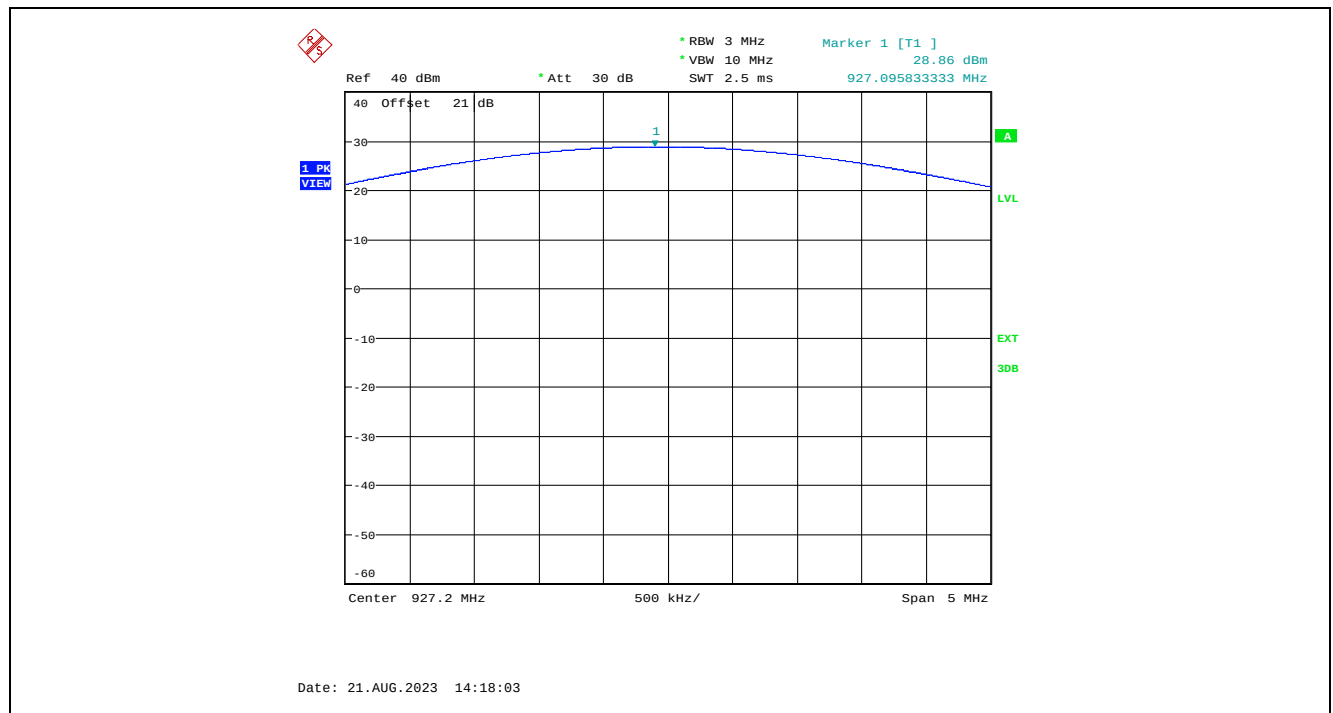
Plot 5.1.4.4. Maximum Conducted Output Power, Mode 2(NA2), Port 1, 917.4 MHz



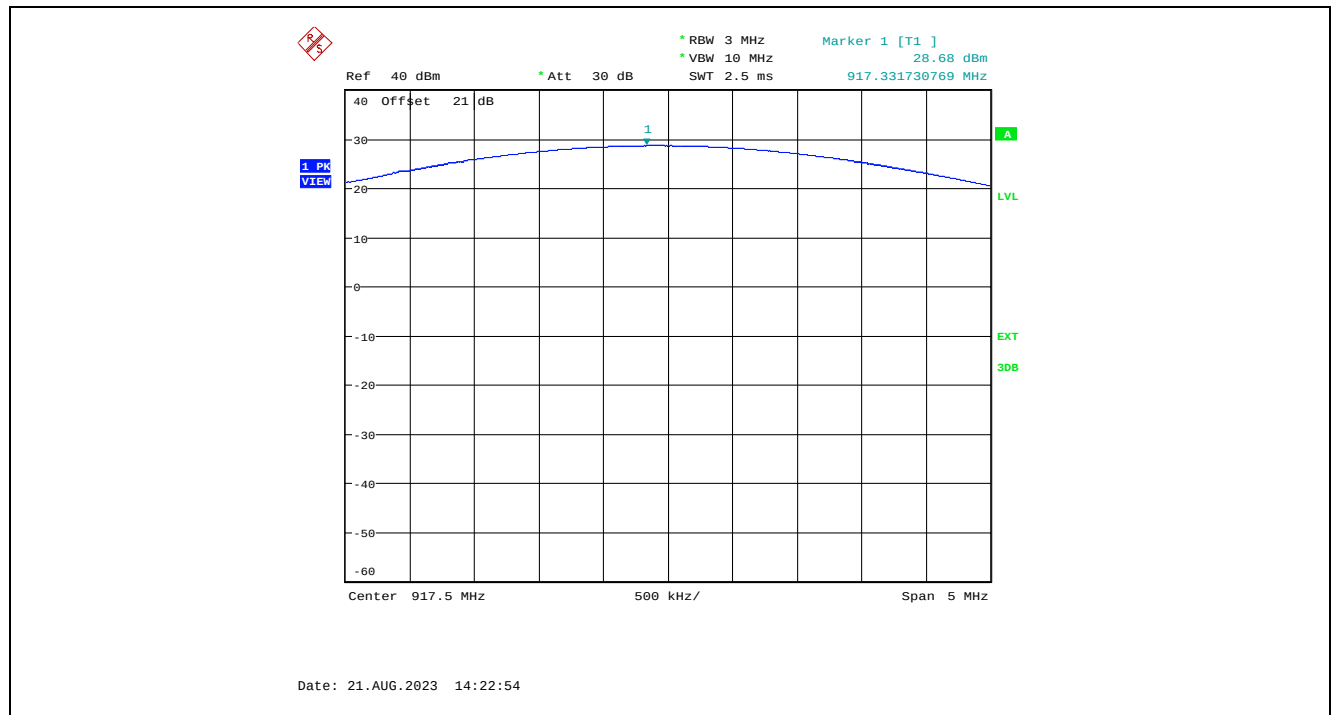
Plot 5.1.4.5. Maximum Conducted Output Power, Mode 2(NA2), Port 1, 922.4 MHz



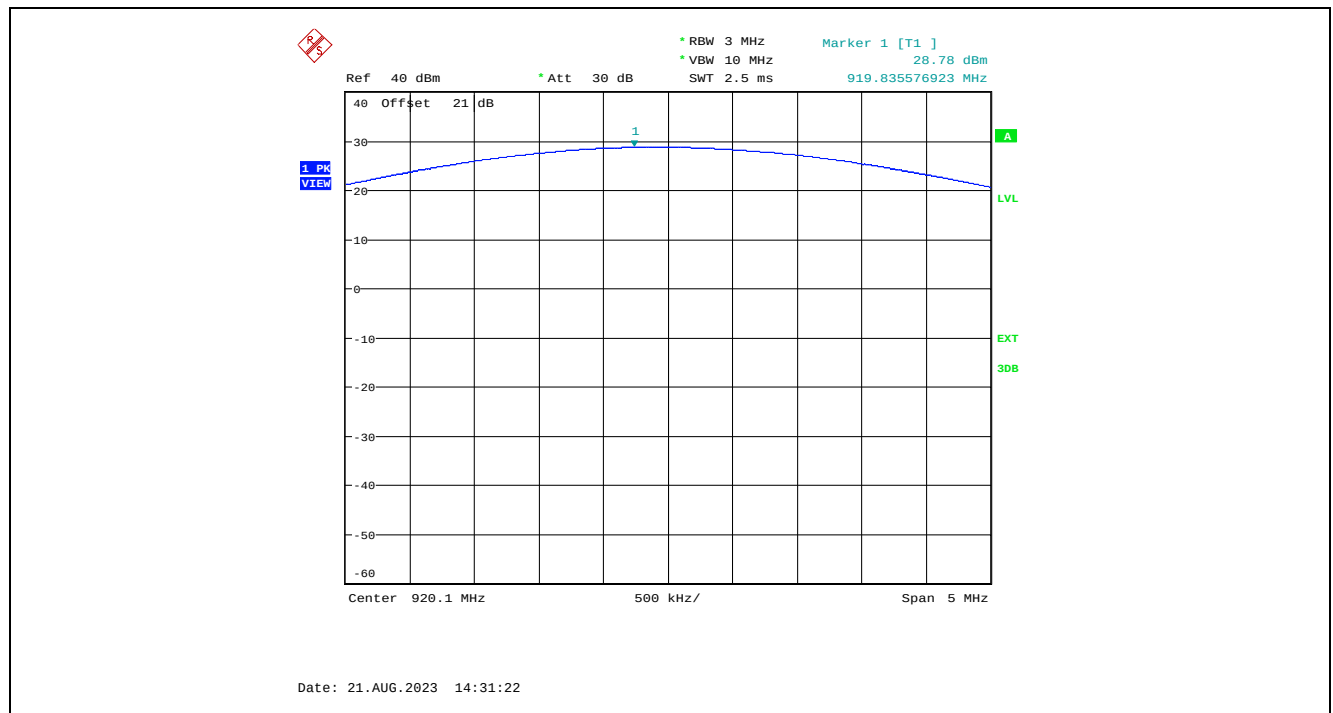
Plot 5.1.4.6. Maximum Conducted Output Power, Mode 2(NA2), Port 1, 927.2 MHz



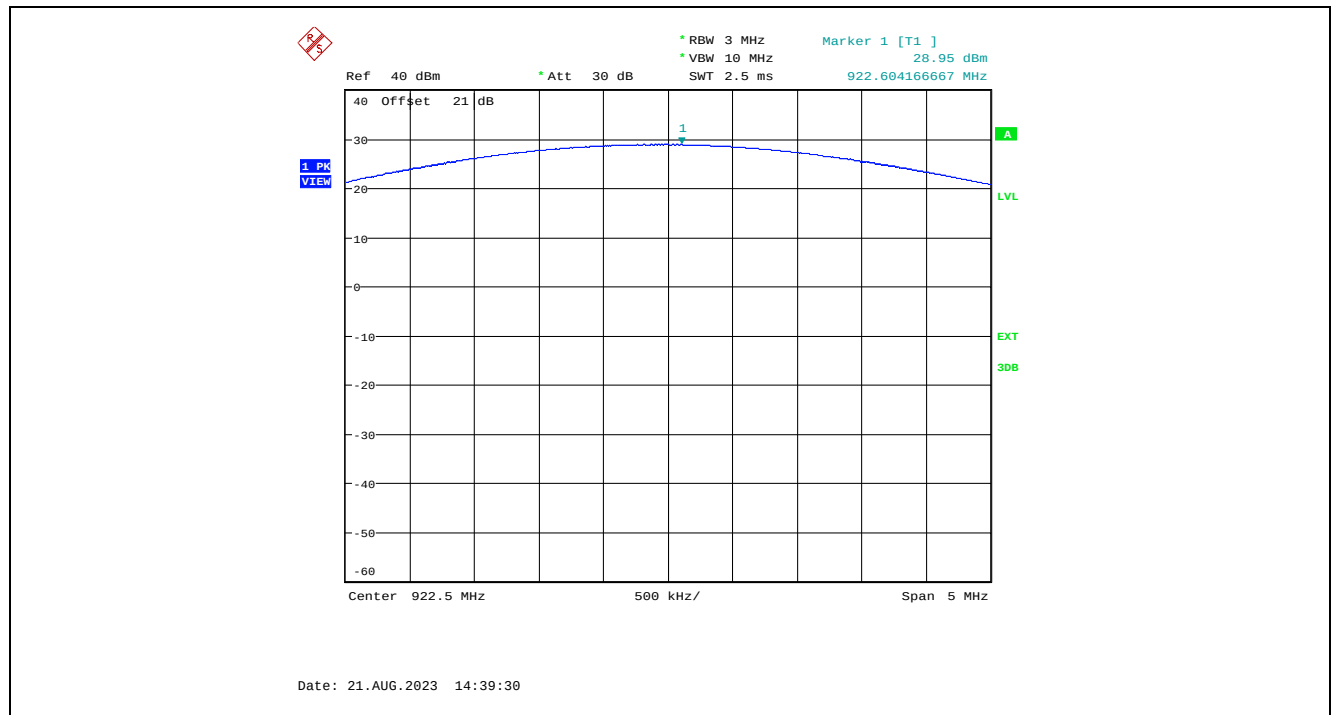
Plot 5.1.4.7. Maximum Conducted Output Power, Mode 3(NA3), Port 1, 917.5 MHz



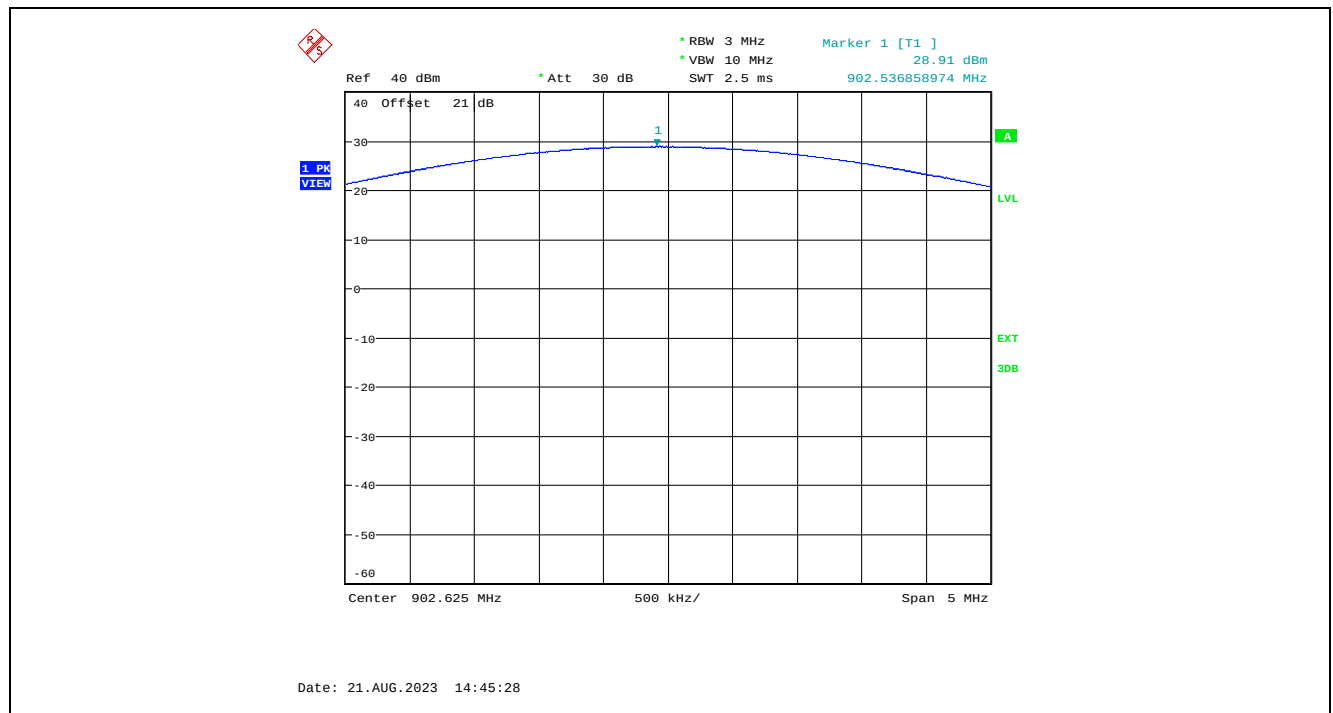
Plot 5.1.4.8. Maximum Conducted Output Power, Mode 3(NA3), Port 1, 920.1 MHz



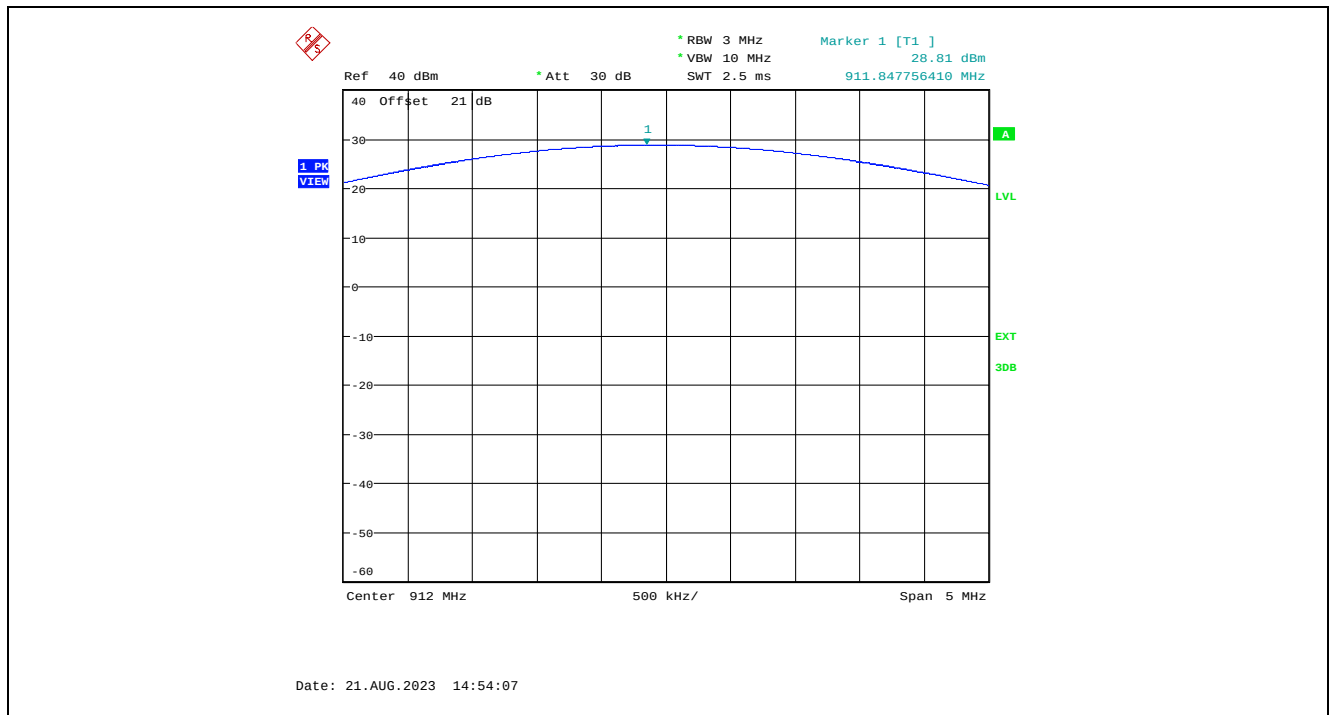
Plot 5.1.4.9. Maximum Conducted Output Power, Mode 3(NA3), Port 1, 922.5 MHz



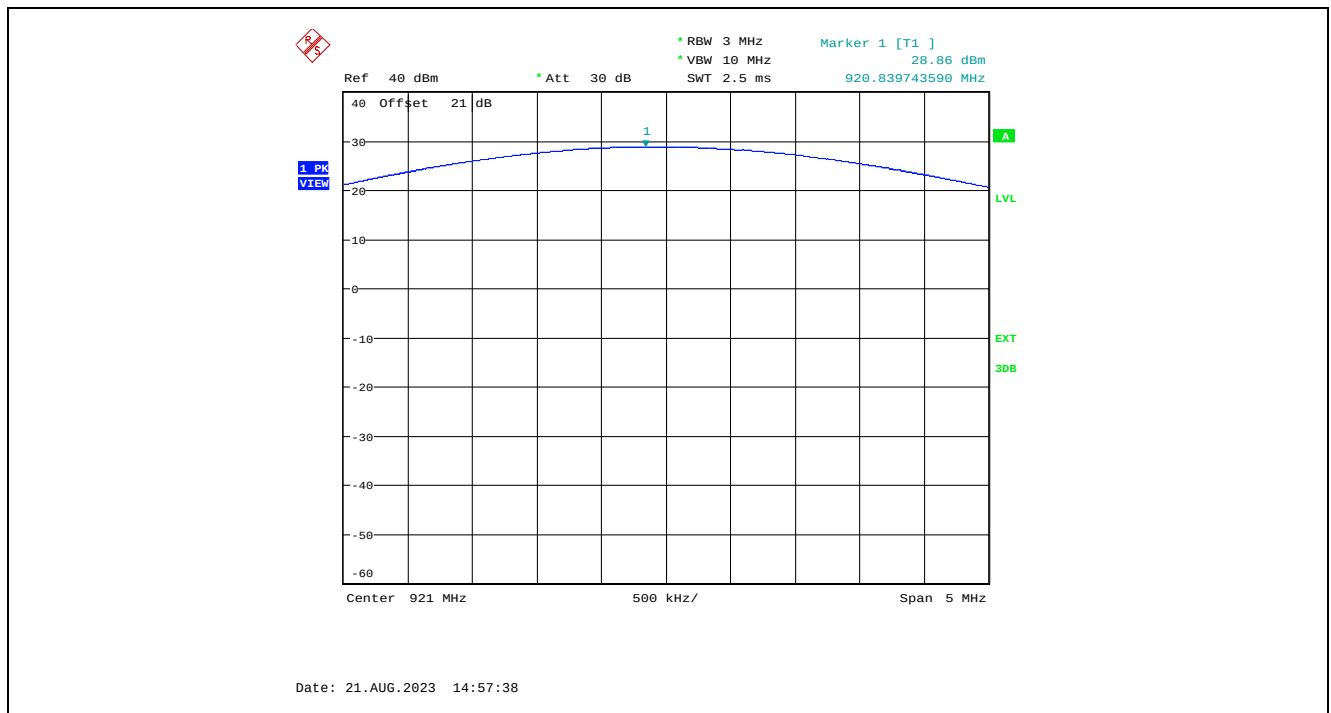
Plot 5.1.4.10. Maximum Conducted Output Power, Mode 4(NA4), Port 1, 902.625 MHz



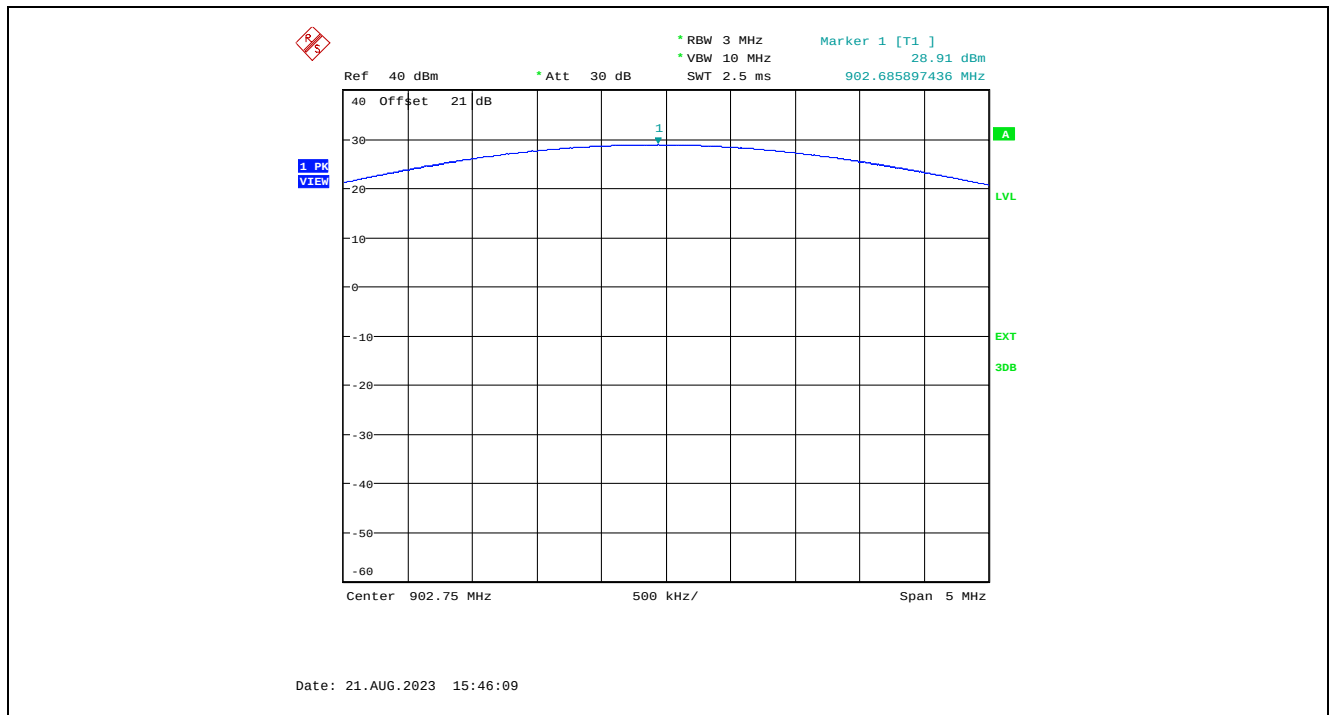
Plot 5.1.4.11. Maximum Conducted Output Power, Mode 4(NA4), Port 1, 912.000 MHz



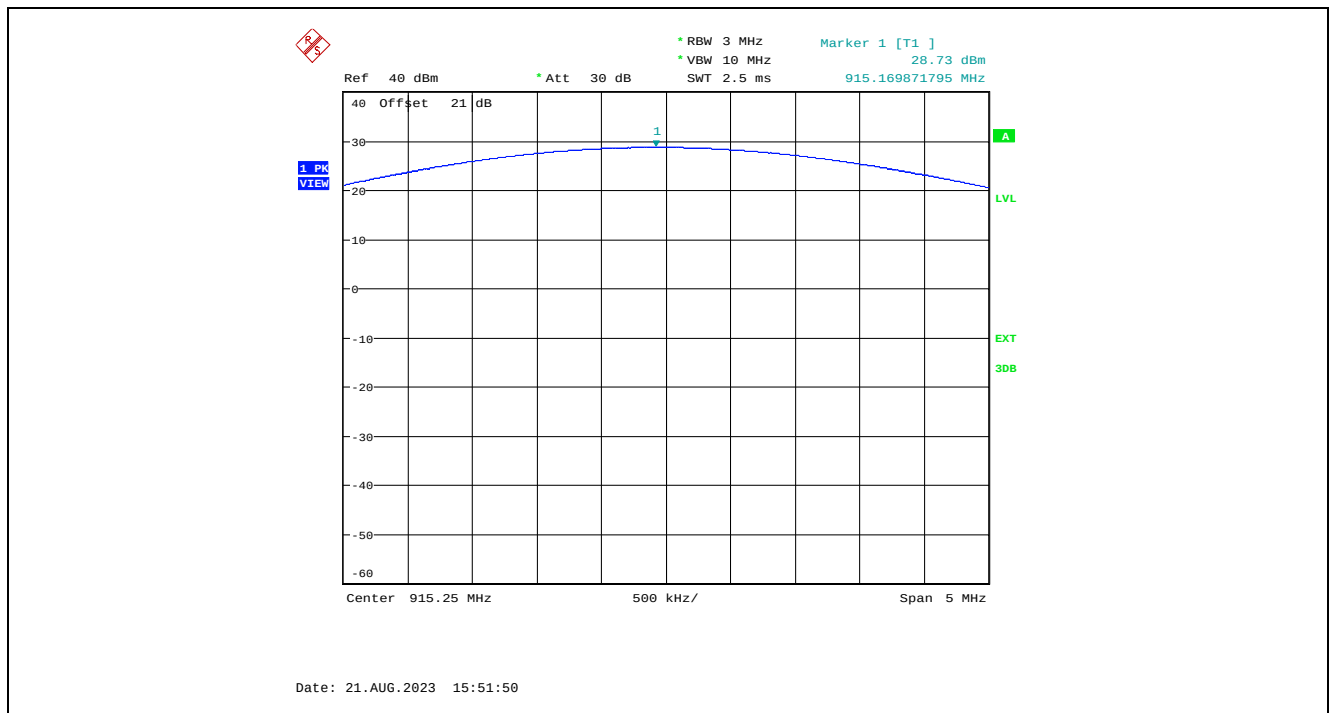
Plot 5.1.4.12. Maximum Conducted Output Power, Mode 4(NA4), Port 1, 921.000 MHz



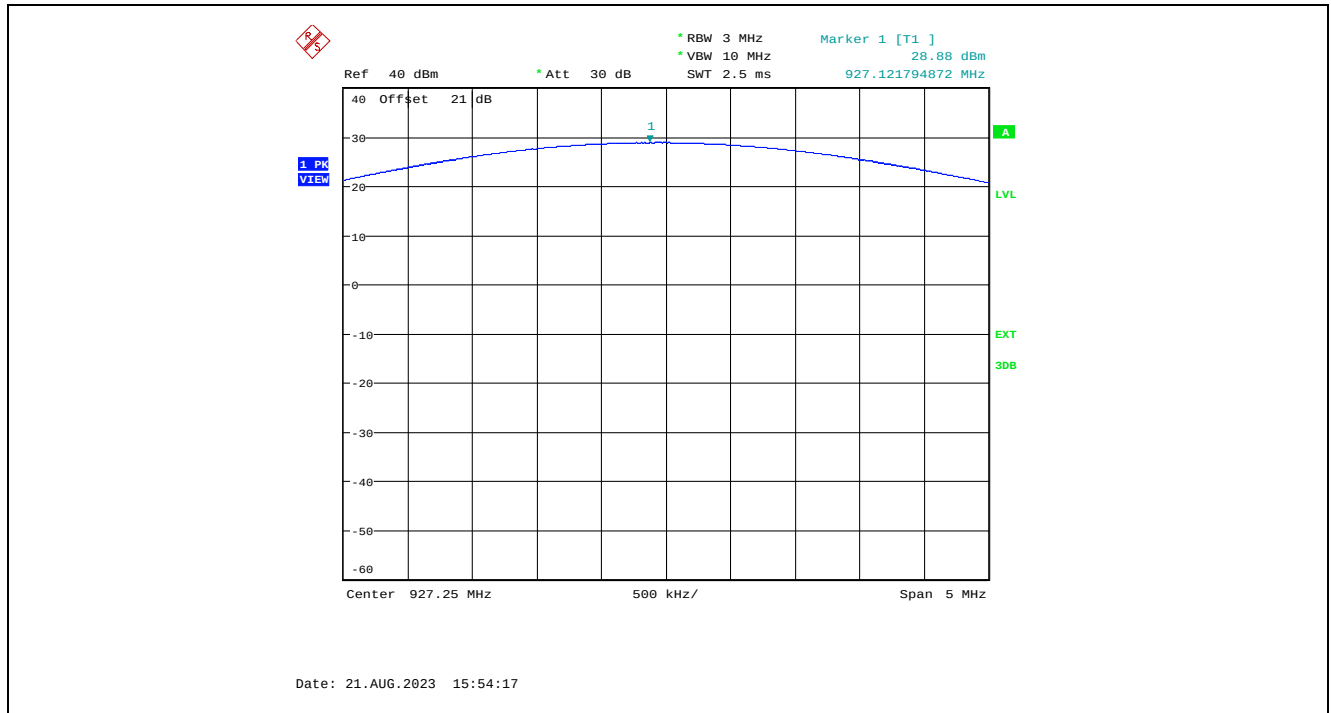
Plot 5.1.4.13. Maximum Conducted Output Power, Mode 1(NA), Port 2, 902.75 MHz



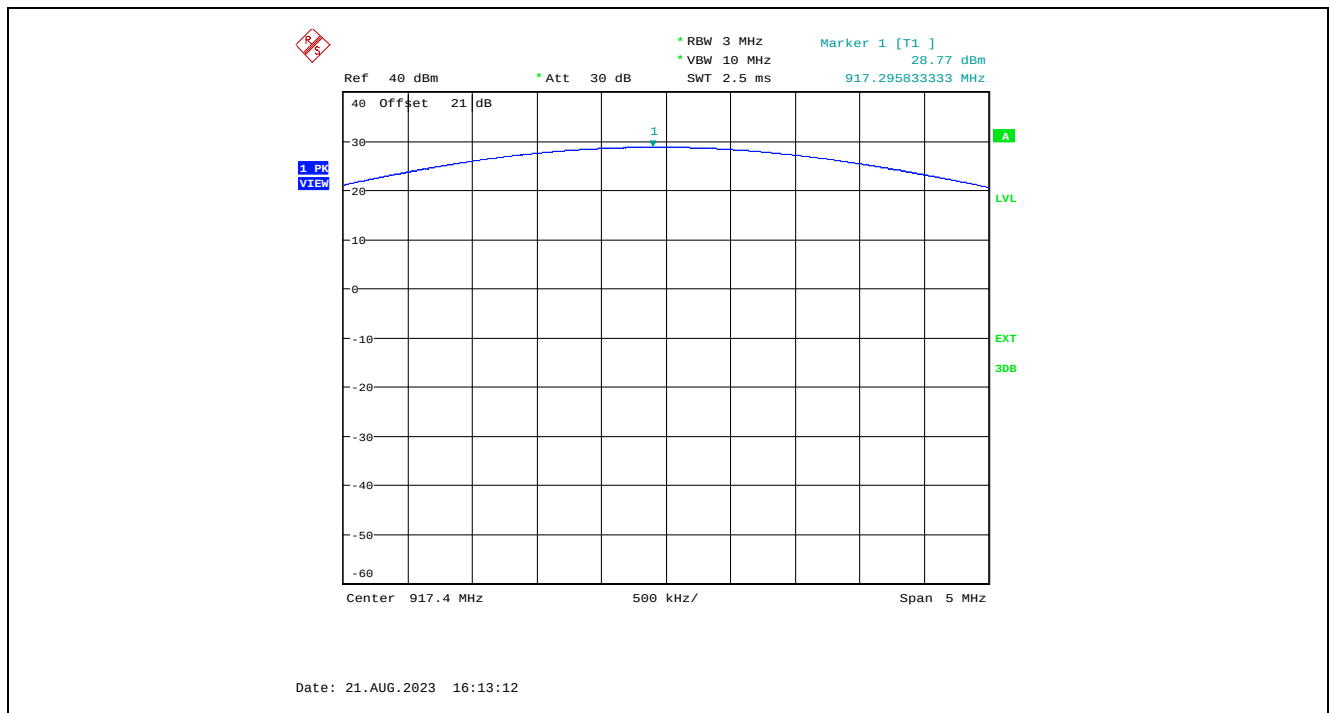
Plot 5.1.4.14. Maximum Conducted Output Power, Mode 1(NA), Port 2, 915.25 MHz



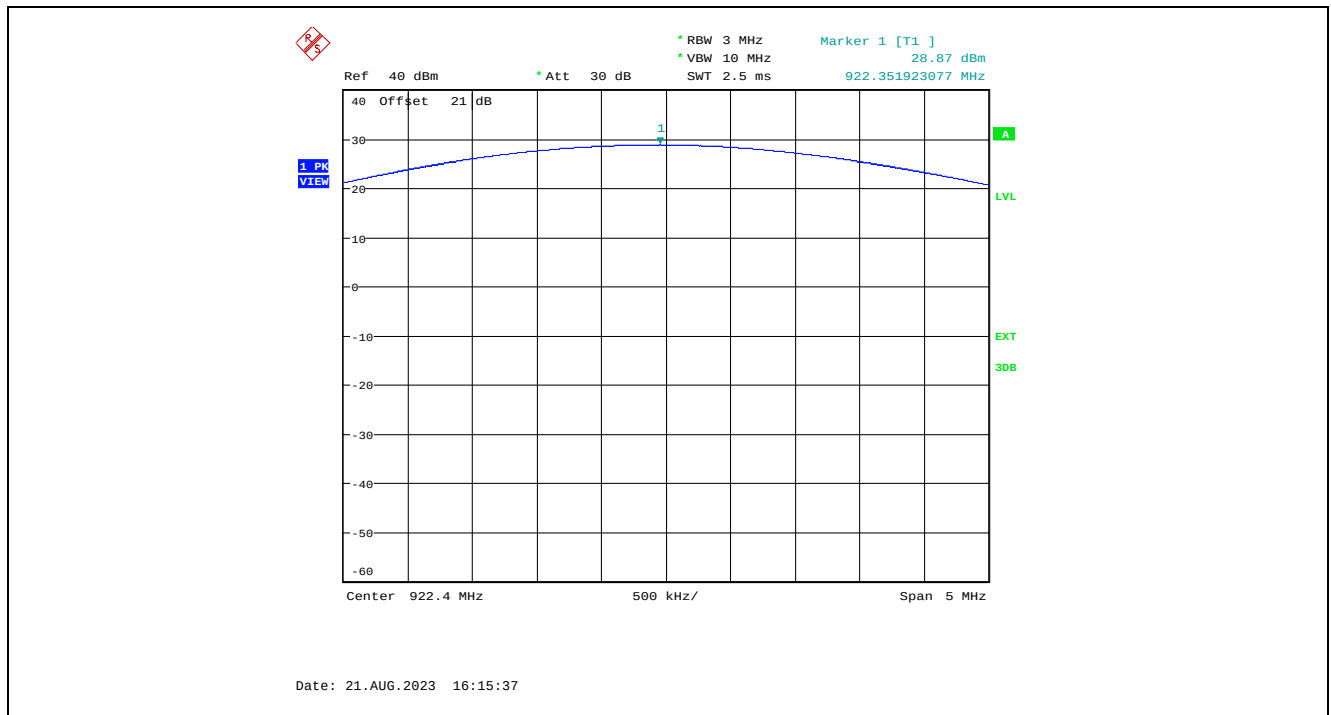
Plot 5.1.4.15. Maximum Conducted Output Power, Mode 1(NA), Port 2, 927.25 MHz



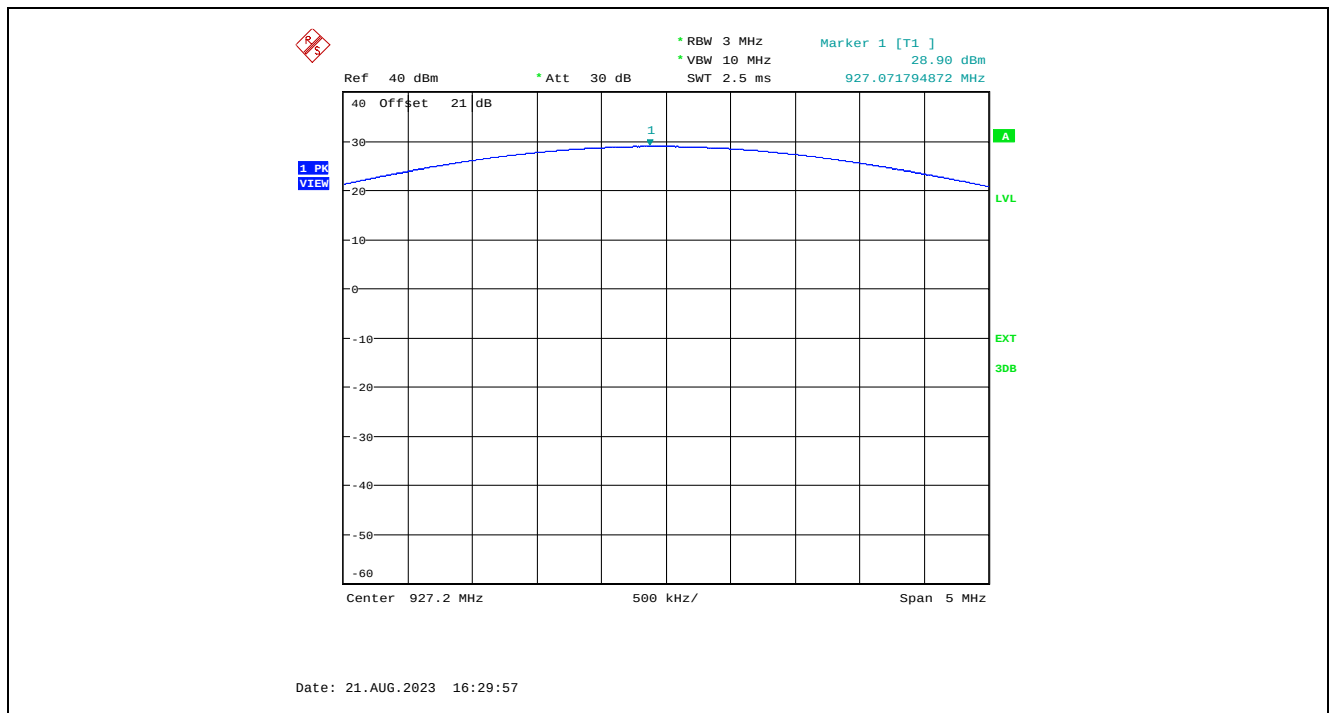
Plot 5.1.4.16. Maximum Conducted Output Power, Mode 2(NA2), Port 2, 917.4 MHz



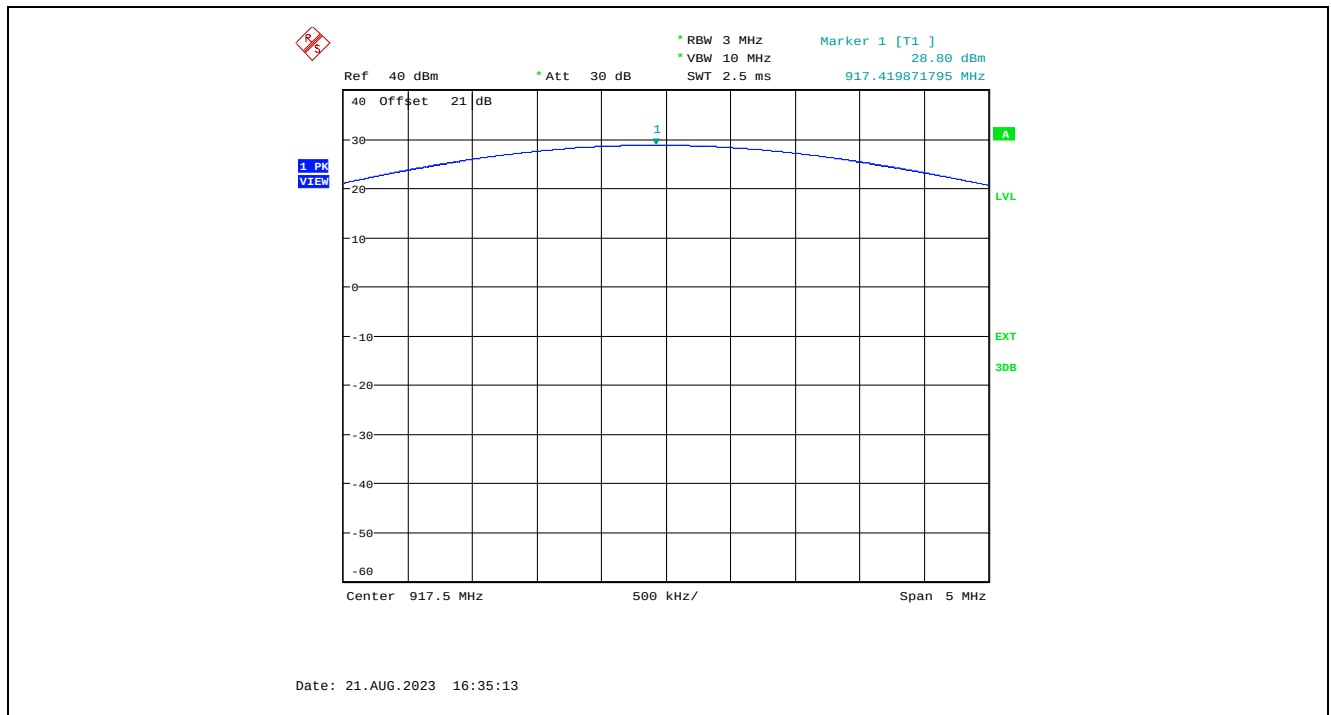
Plot 5.1.4.17. Maximum Conducted Output Power, Mode 2(NA2), Port 2, 922.4 MHz



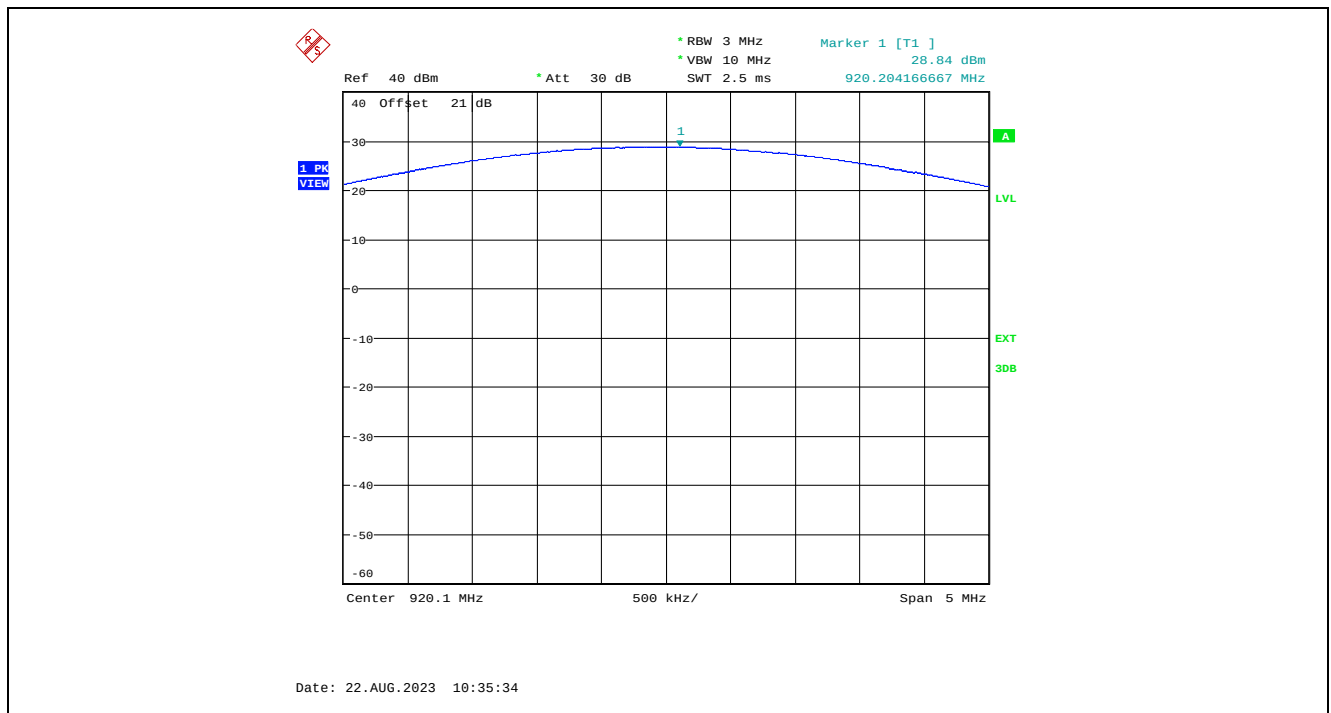
Plot 5.1.4.18. Maximum Conducted Output Power, Mode 2(NA2), Port 2, 927.2 MHz



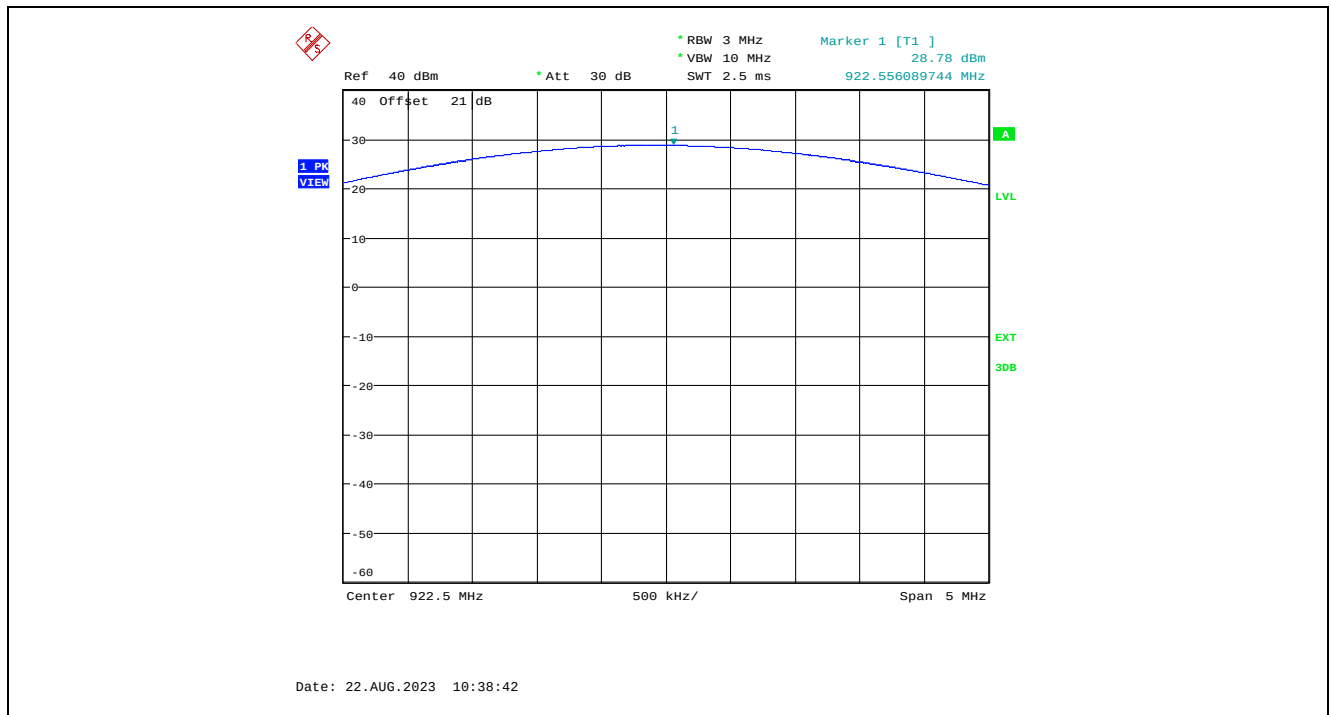
Plot 5.1.4.19. Maximum Conducted Output Power, Mode 3(NA3), Port 2, 917.5 MHz



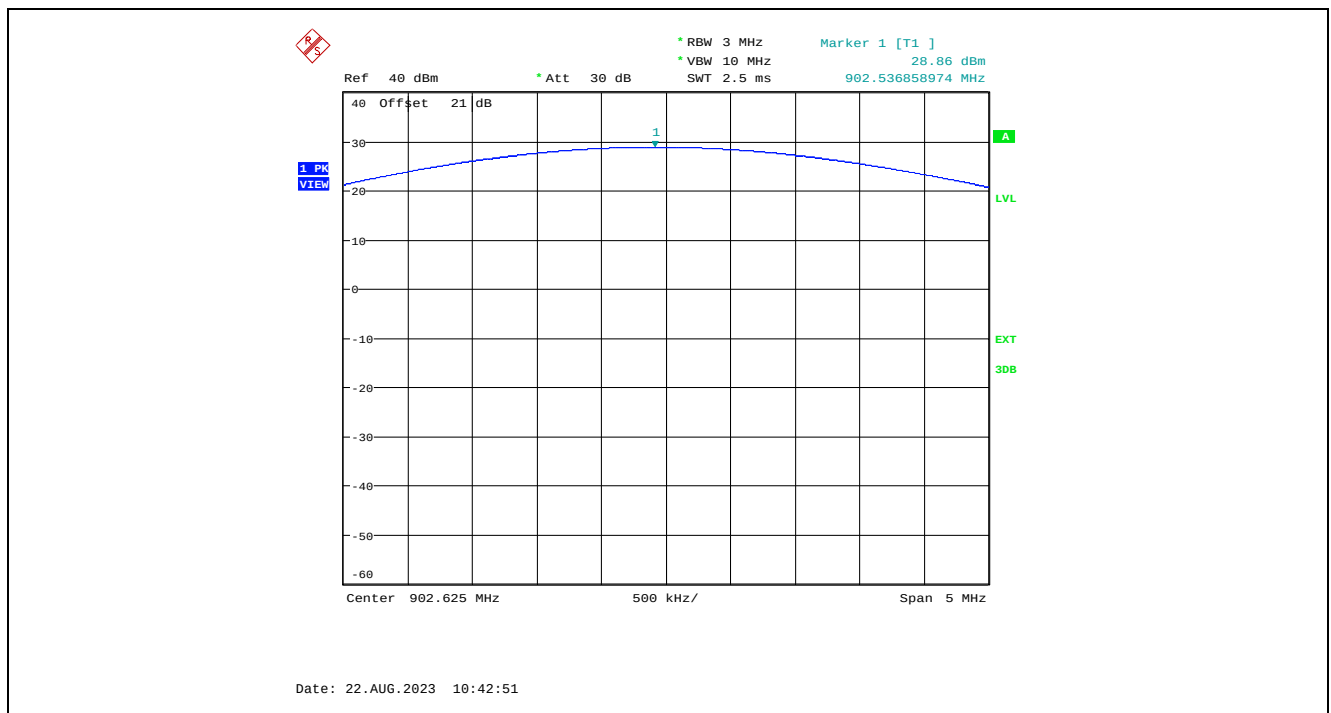
Plot 5.1.4.20. Maximum Conducted Output Power, Mode 3(NA3), Port 2, 920.1 MHz



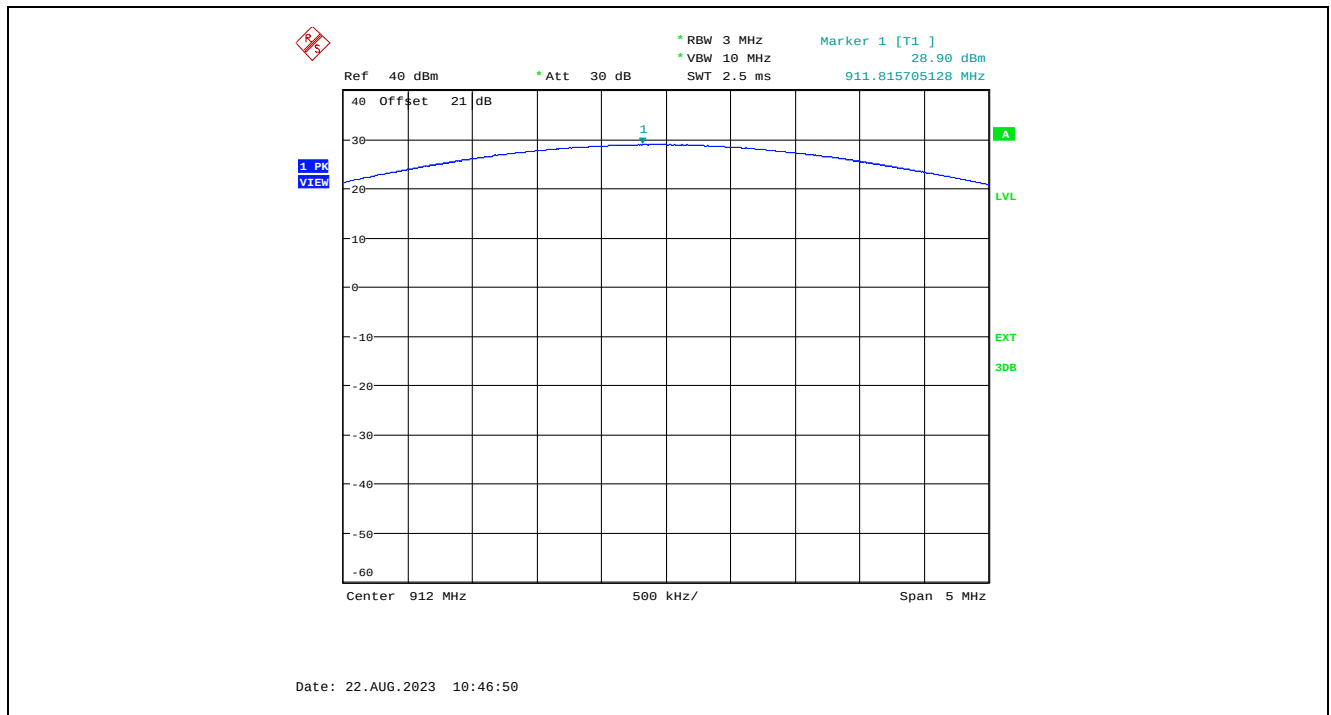
Plot 5.1.4.21. Maximum Conducted Output Power, Mode 3(NA3), Port 2, 922.5 MHz



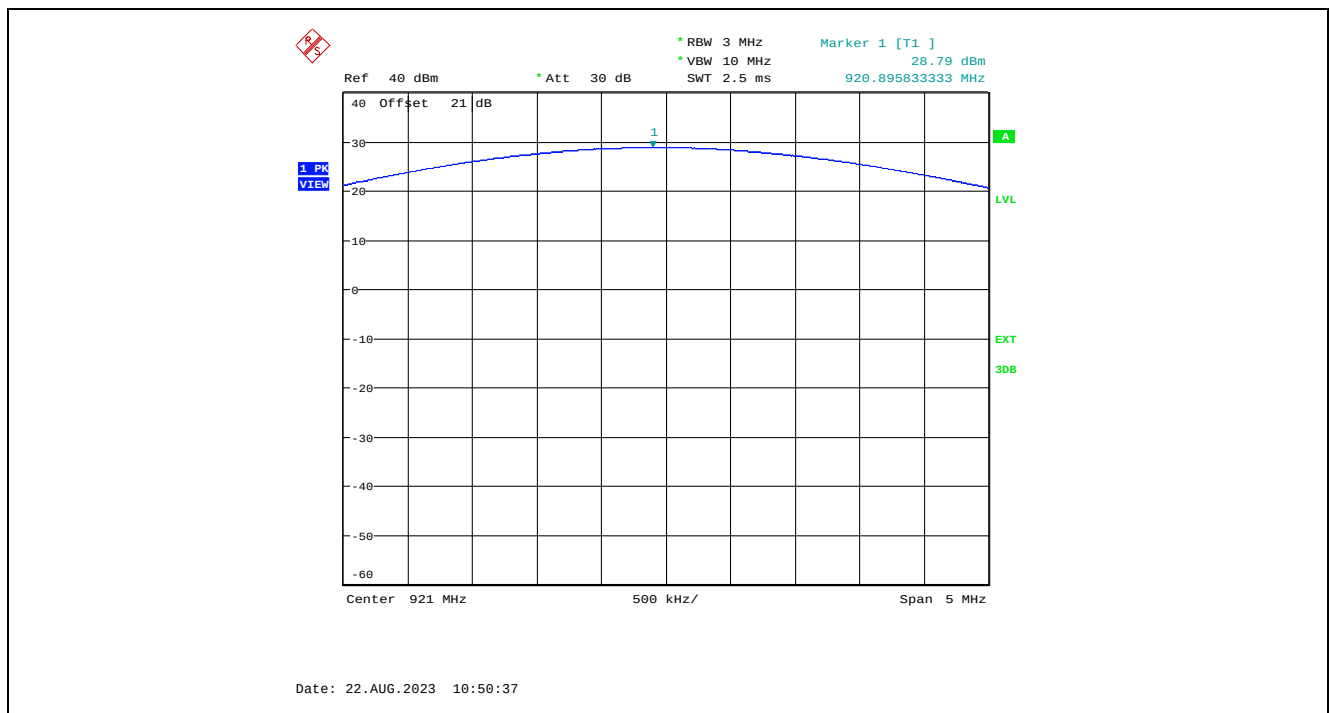
Plot 5.1.4.22. Maximum Conducted Output Power, Mode 4(NA4), Port 2, 902.625 MHz



Plot 5.1.4.23. Maximum Conducted Output Power, Mode 4(NA4), Port 2, 912.000 MHz



Plot 5.1.4.24. Maximum Conducted Output Power, Mode 4(NA4), Port 2, 921.000 MHz



5.2. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

5.2.1. Limit

§ 15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
¹ 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(²)
13.36–13.41.			

¹ Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

² Above 38.6

Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

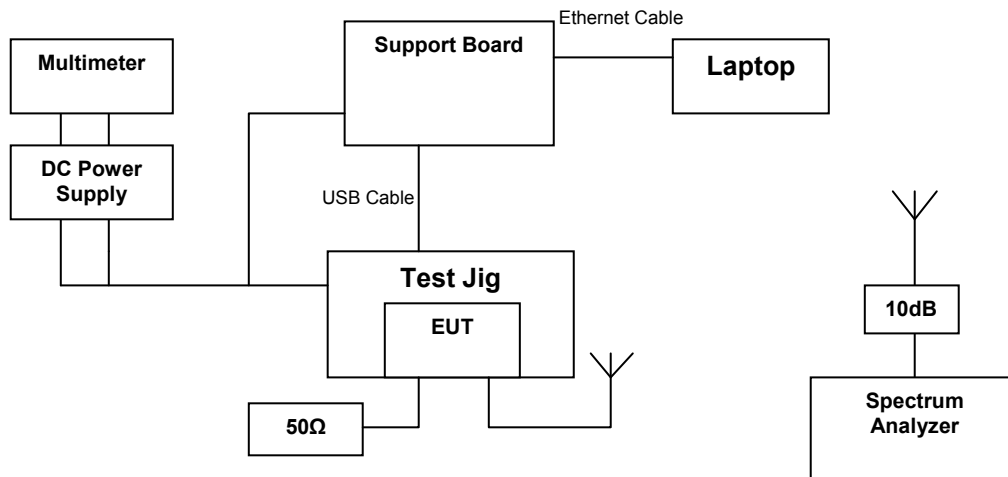
Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

5.2.2. Method of Measurements

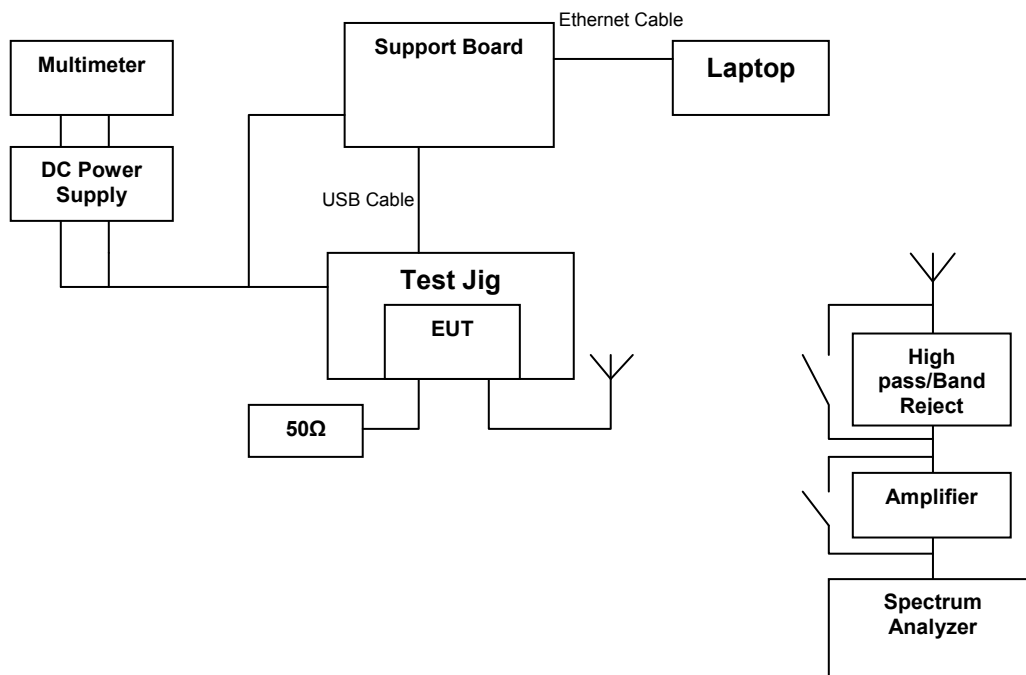
Subclause 6.10 of ANSI C63.10.

5.2.3. Test Arrangement

Band-Edge Radiated Emissions



Transmitter Radiated Emissions



5.2.4. Test Data

Remark(s):

- The following test data represent the worst-case derived from exploratory tests.
- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- Worst case: EUT with ANT1 Port connected to test antenna.

5.2.4.1. Mode 1(NA)

5.2.4.1.1. Spurious Radiated Emission

Fundamental Frequency:		902.75 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
902.75	130.40	--	V	--	--	--	--
902.75	126.02	--	H	--	--	--	--
2708.25	53.42	47.47	V	54.0	110.4	-6.5	Pass*
2708.25	54.16	48.06	H	54.0	110.4	-5.9	Pass*
3611.00	48.54	38.41	V	54.0	110.4	-15.6	Pass*
3611.00	47.88	38.01	H	54.0	110.4	-16.0	Pass*
4513.75	59.18	51.30	V	54.0	110.4	-2.7	Pass*
4513.75	57.07	49.59	H	54.0	110.4	-4.4	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:		915.25 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
915.25	130.27	--	V	--	--	--	--
915.25	125.72	--	H	--	--	--	--
2745.75	52.40	47.61	V	54.0	110.3	-6.4	Pass*
2745.75	51.68	46.50	H	54.0	110.3	-7.5	Pass*
4576.25	56.35	50.48	V	54.0	110.3	-3.5	Pass*
4576.25	54.75	48.70	H	54.0	110.3	-5.3	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: 23LYI-213_FCC15C247
October 19, 2023

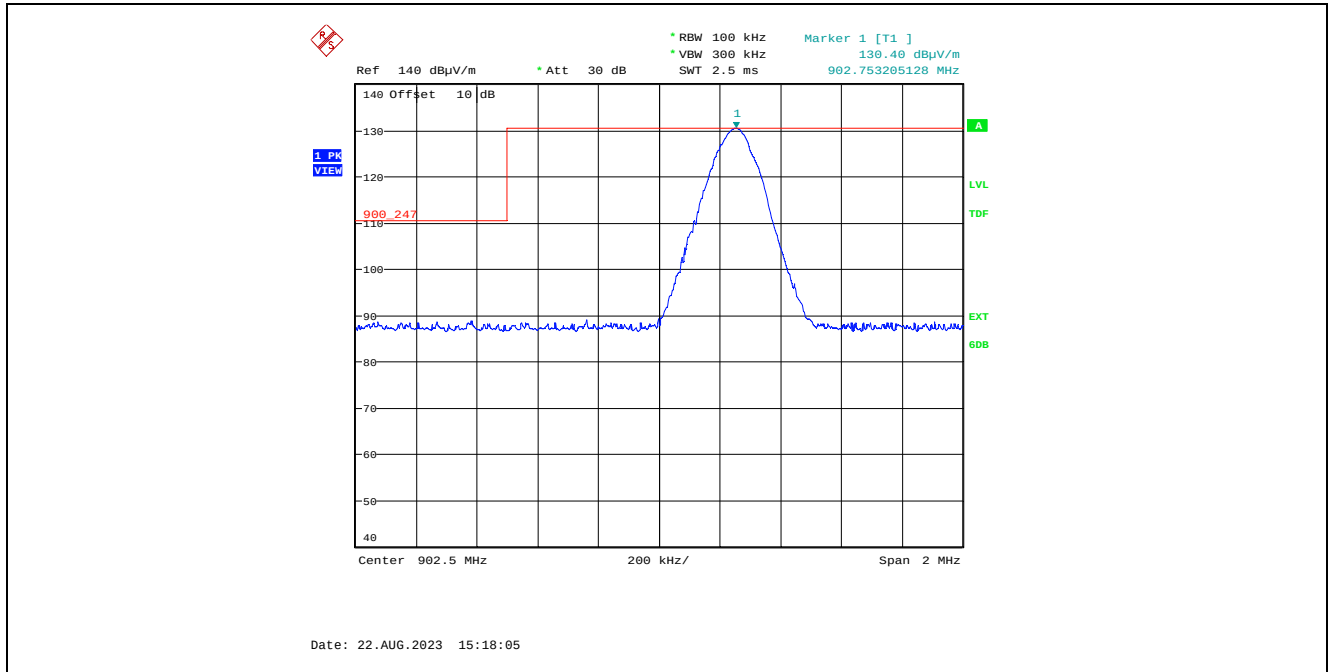
All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Fundamental Frequency:		927.25 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
927.25	130.67	--	V	--	--	--	--
927.25	123.40	--	H	--	--	--	--
2781.75	50.54	43.41	V	54.0	110.7	-10.6	Pass*
2781.75	50.75	44.41	H	54.0	110.7	-9.6	Pass*
4636.25	54.88	48.78	V	54.0	110.7	-5.2	Pass*
4636.25	52.19	45.69	H	54.0	110.7	-8.3	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

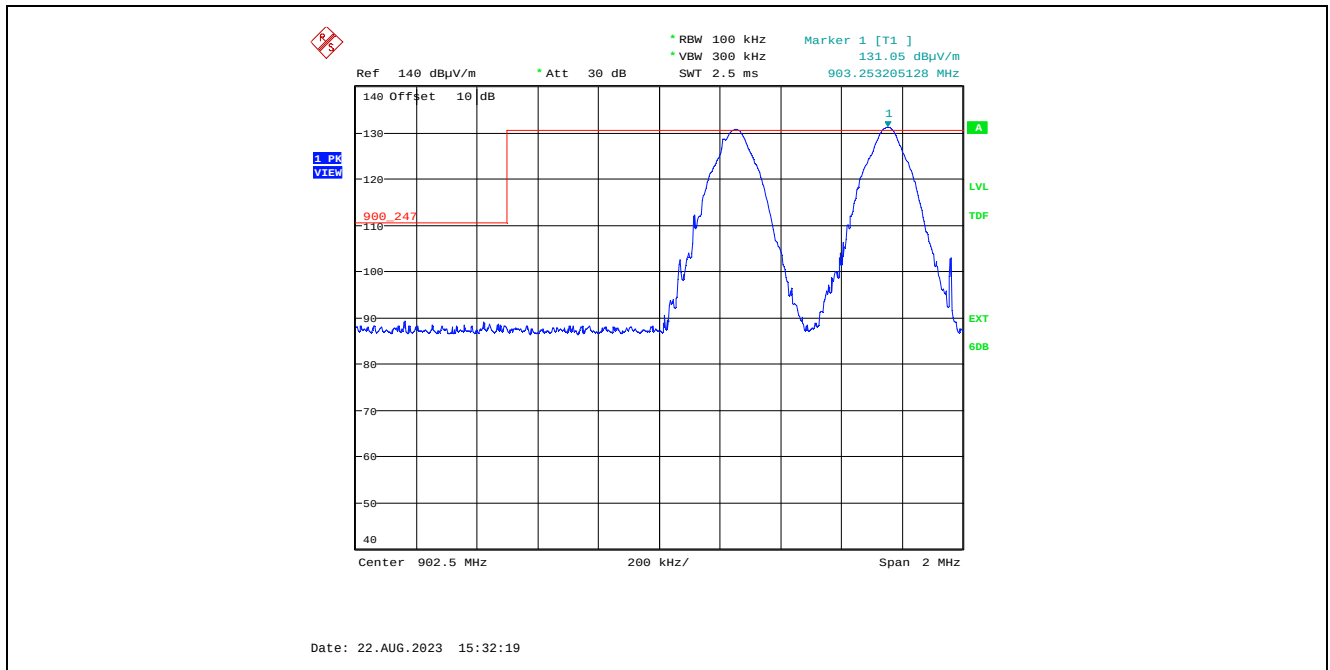
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.2.4.1.2. Band –Edge RF Radiated Emissions

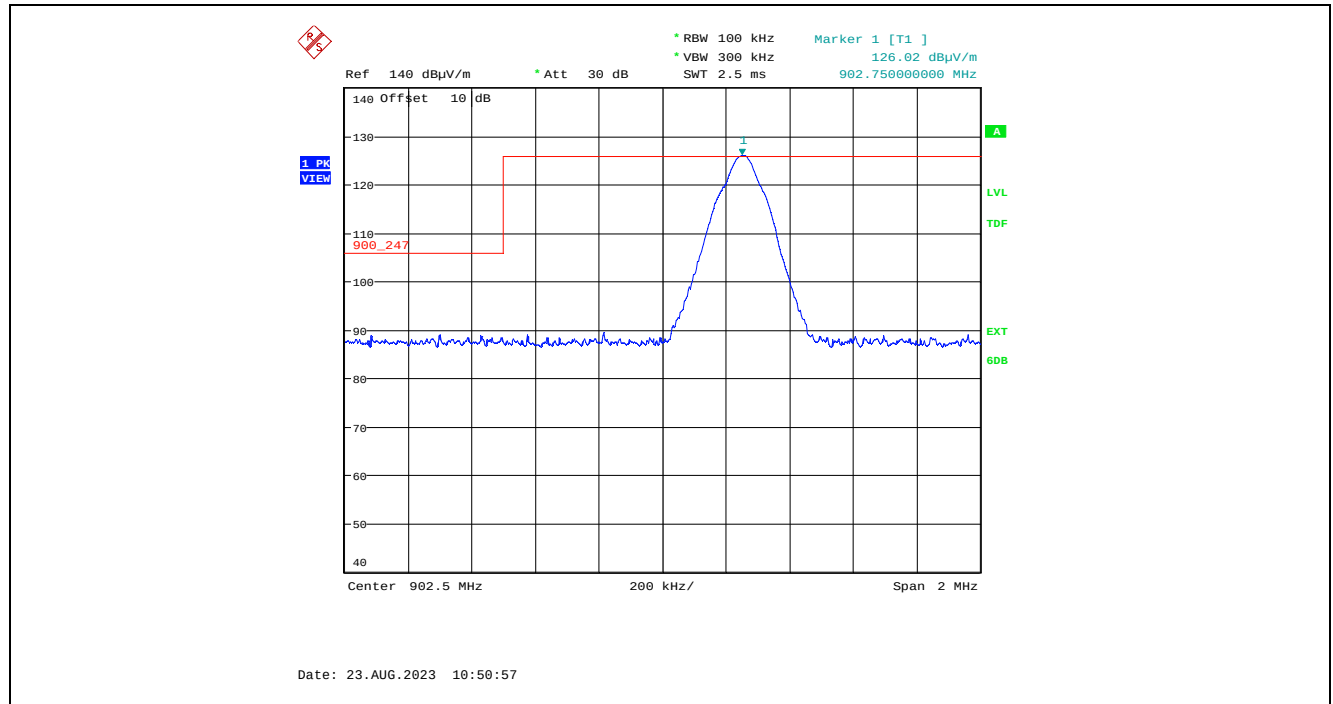
Plot 5.2.4.1.2.1. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Low End of Frequency Band, Single Frequency Mode, 902.75 MHz



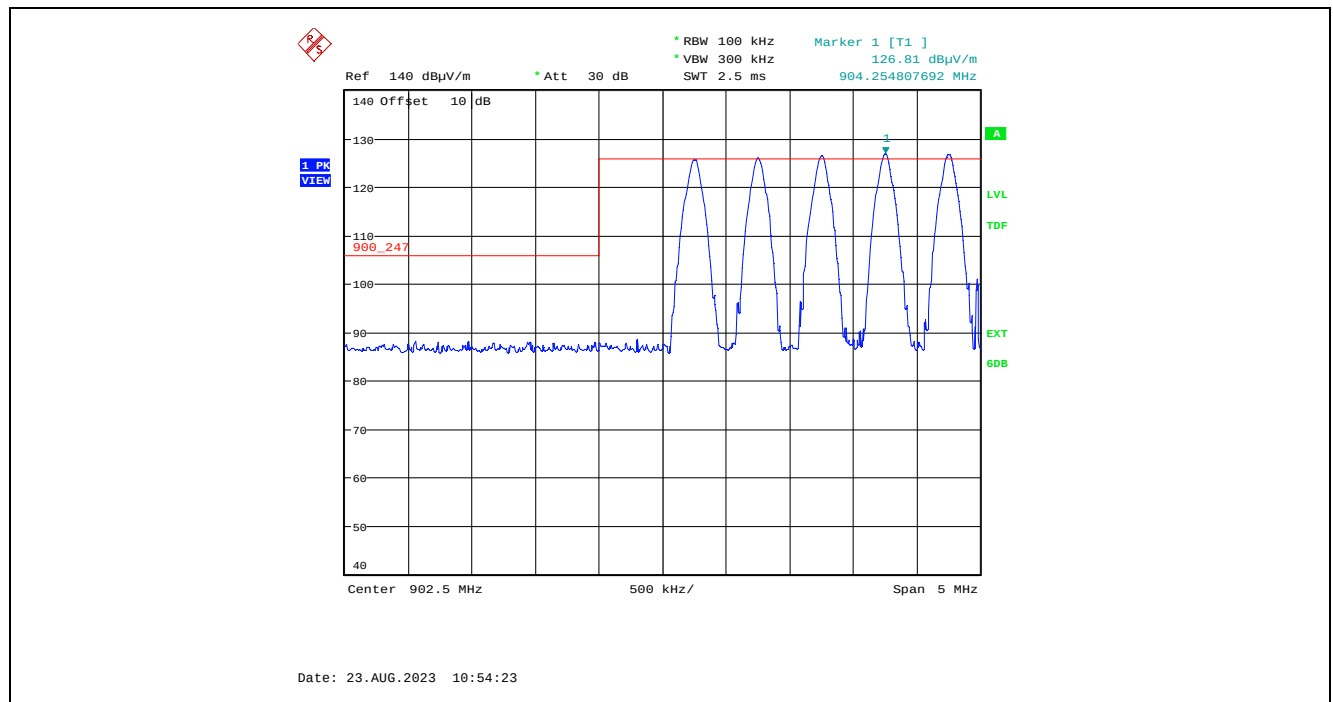
Plot 5.2.4.1.2.2. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Low End of Frequency Band, Pseudorandom Channel Hopping Mode



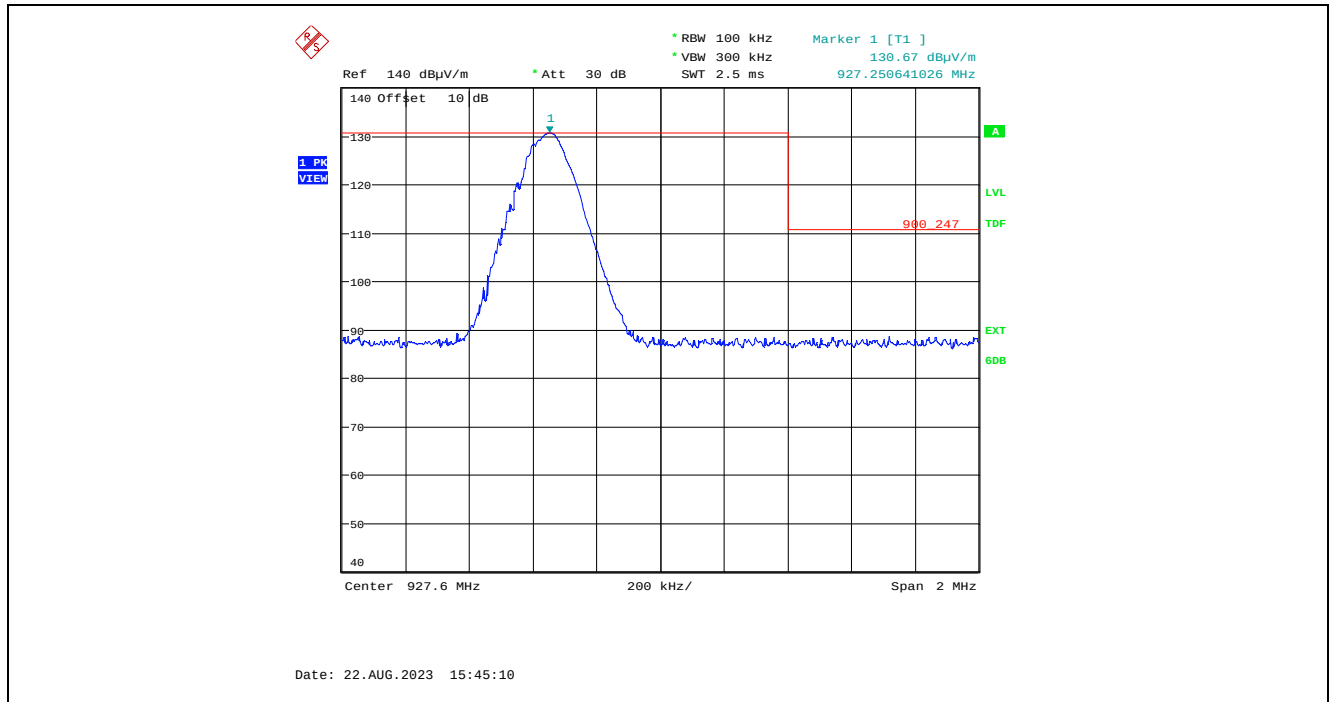
Plot 5.2.4.1.2.3. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Low End of Frequency Band, Single Frequency Mode, 902.75 MHz



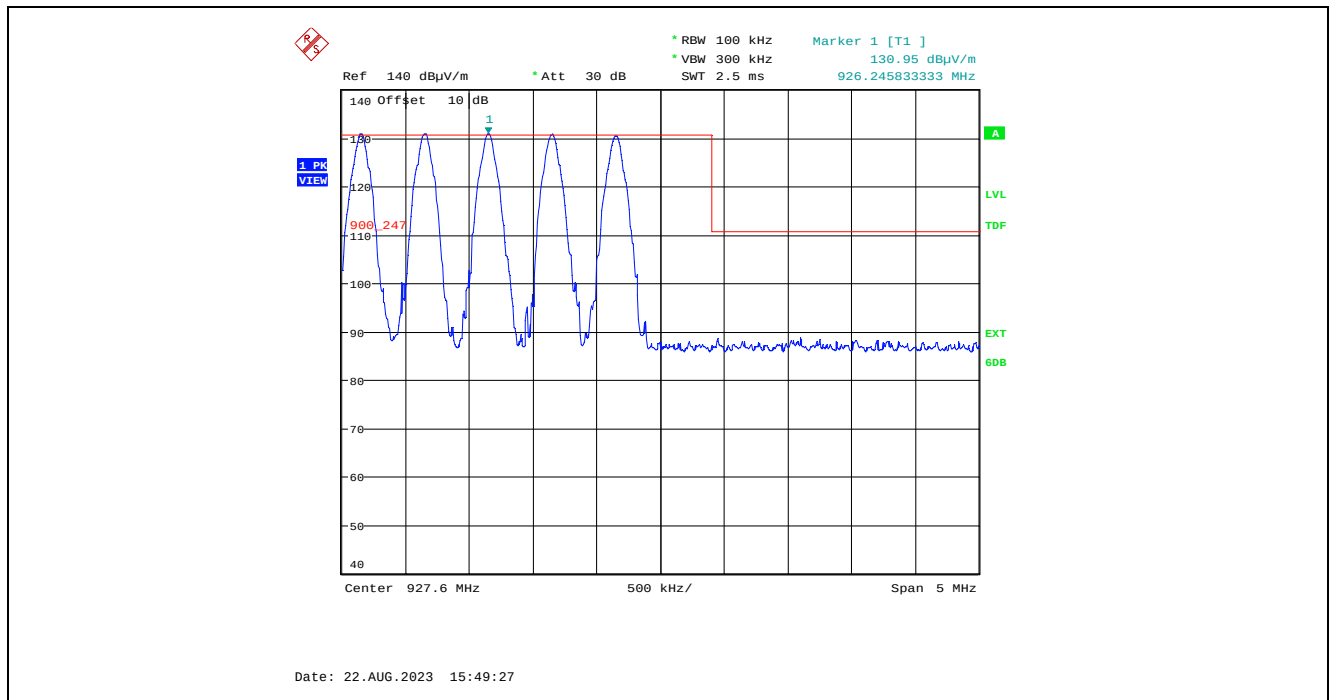
Plot 5.2.4.1.2.4. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Low End of Frequency Band, Pseudorandom Channel Hopping Mode



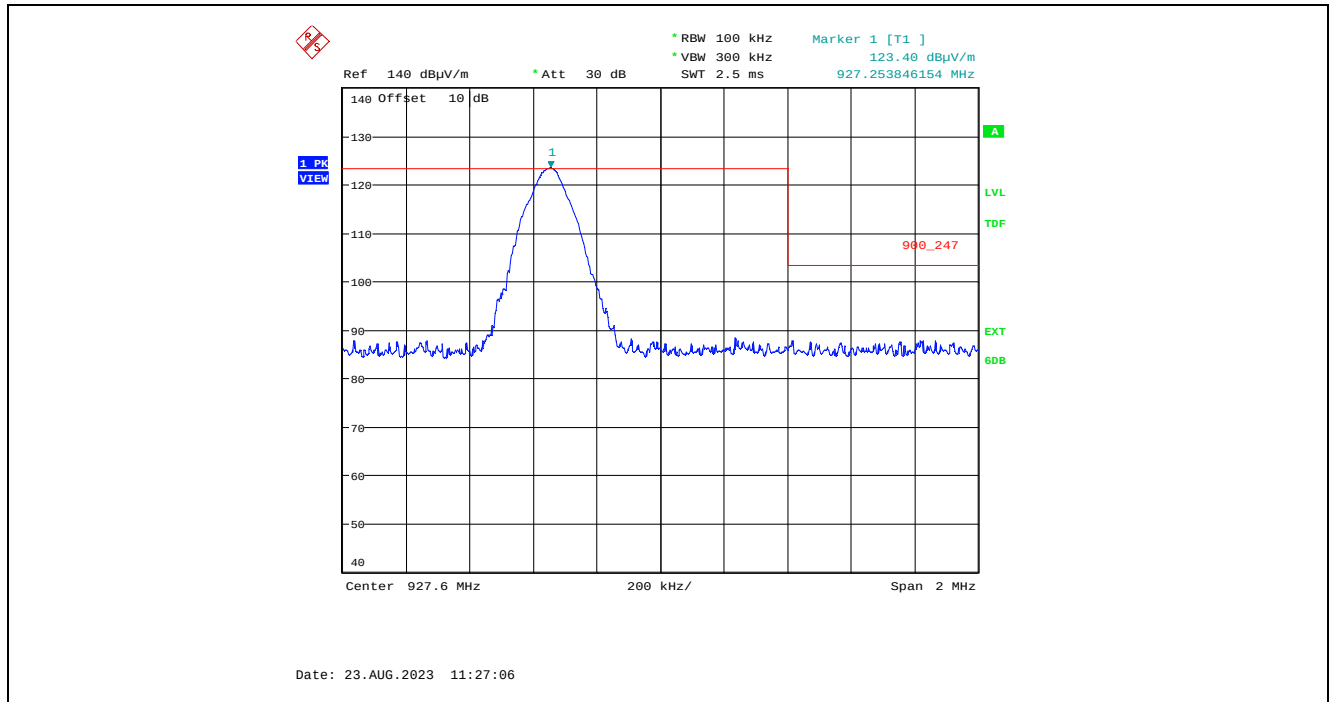
Plot 5.2.4.1.2.5. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
High End of Frequency Band, Single Frequency Mode, 927.25 MHz



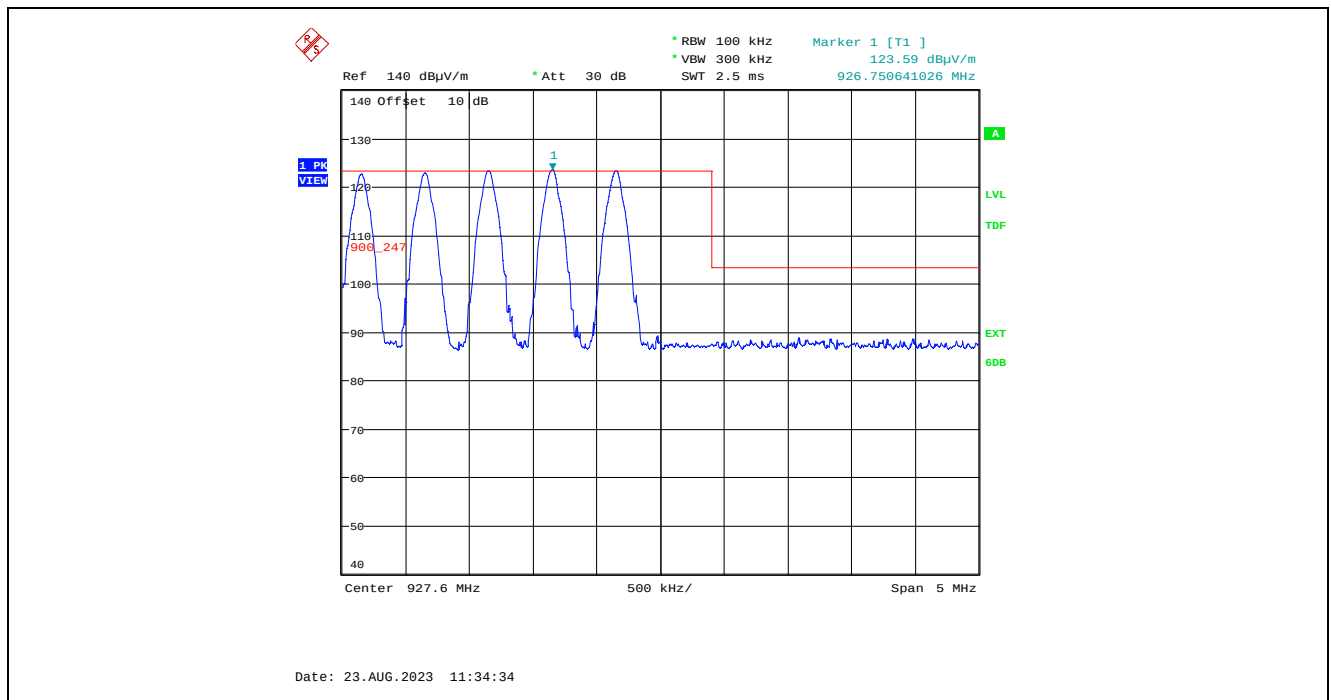
Plot 5.2.4.1.2.6. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
High End of Frequency Band, Pseudorandom Channel Hopping Mode



Plot 5.2.4.1.2.7. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
High End of Frequency Band, Single Frequency Mode, 927.25 MHz



Plot 5.2.4.1.2.8. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
High End of Frequency Band, Pseudorandom Channel Hopping Mode



5.2.4.2. Mode 2(NA2)

5.2.4.2.1. Spurious Radiated Emission

Fundamental Frequency:		917.4 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
917.4	130.61	--	V	--	--	--	--
917.4	125.49	--	H	--	--	--	--
2752.2	53.01	48.26	V	54.0	110.6	-5.7	Pass*
2752.2	52.24	46.44	H	54.0	110.6	-7.6	Pass*
4587.0	57.62	51.62	V	54.0	110.6	-2.4	Pass*
4587.0	53.81	47.81	H	54.0	110.6	-6.2	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:		922.4 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
922.4	130.60	--	V	--	--	--	--
922.4	124.71	--	H	--	--	--	--
2767.2	51.74	47.09	V	54.0	110.6	-6.9	Pass*
2767.2	50.86	45.31	H	54.0	110.6	-8.7	Pass*
4612.0	55.04	49.63	V	54.0	110.6	-4.4	Pass*
4612.0	52.37	44.76	H	54.0	110.6	-9.2	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

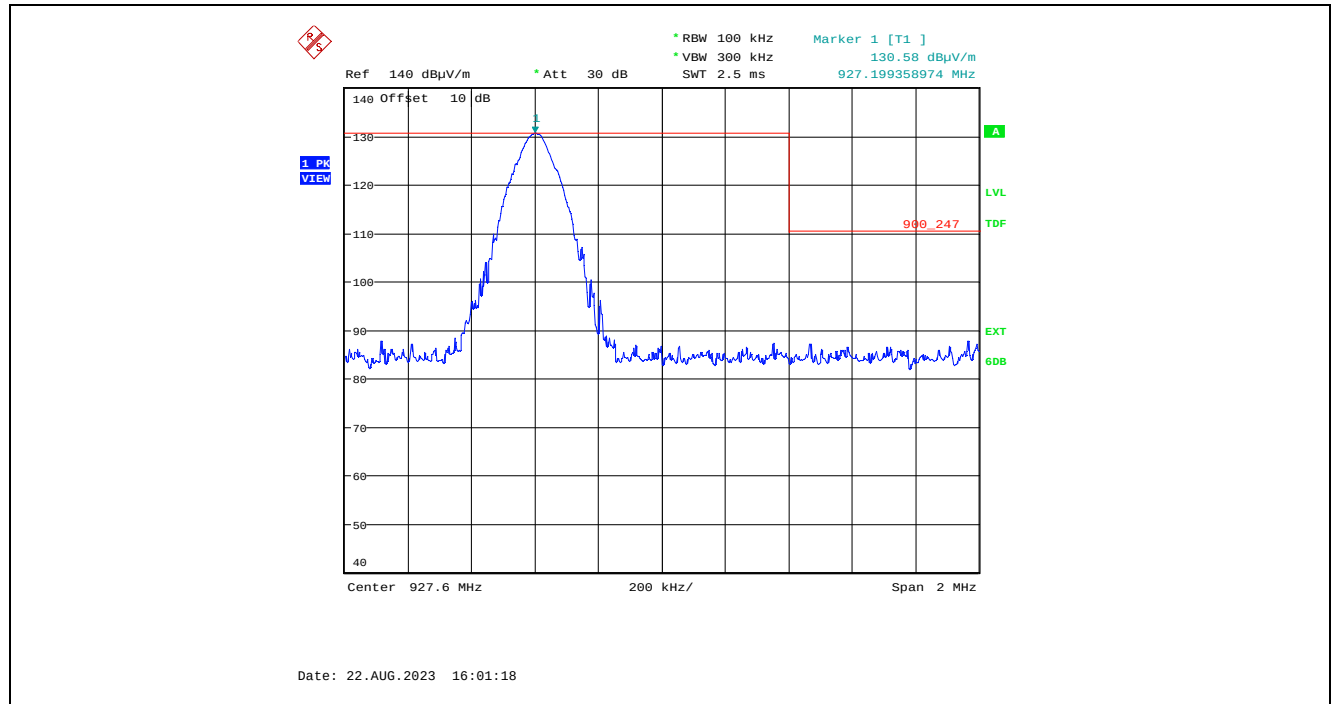
Fundamental Frequency:		927.2 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
927.2	130.58	--	V	--	--	--	--
927.2	123.14	--	H	--	--	--	--
2781.6	51.55	46.27	V	54.0	110.6	-7.7	Pass*
2781.6	49.90	43.46	H	54.0	110.6	-10.5	Pass*
4636.0	54.81	49.73	V	54.0	110.6	-4.3	Pass*
4636.0	51.65	45.15	H	54.0	110.6	-8.9	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

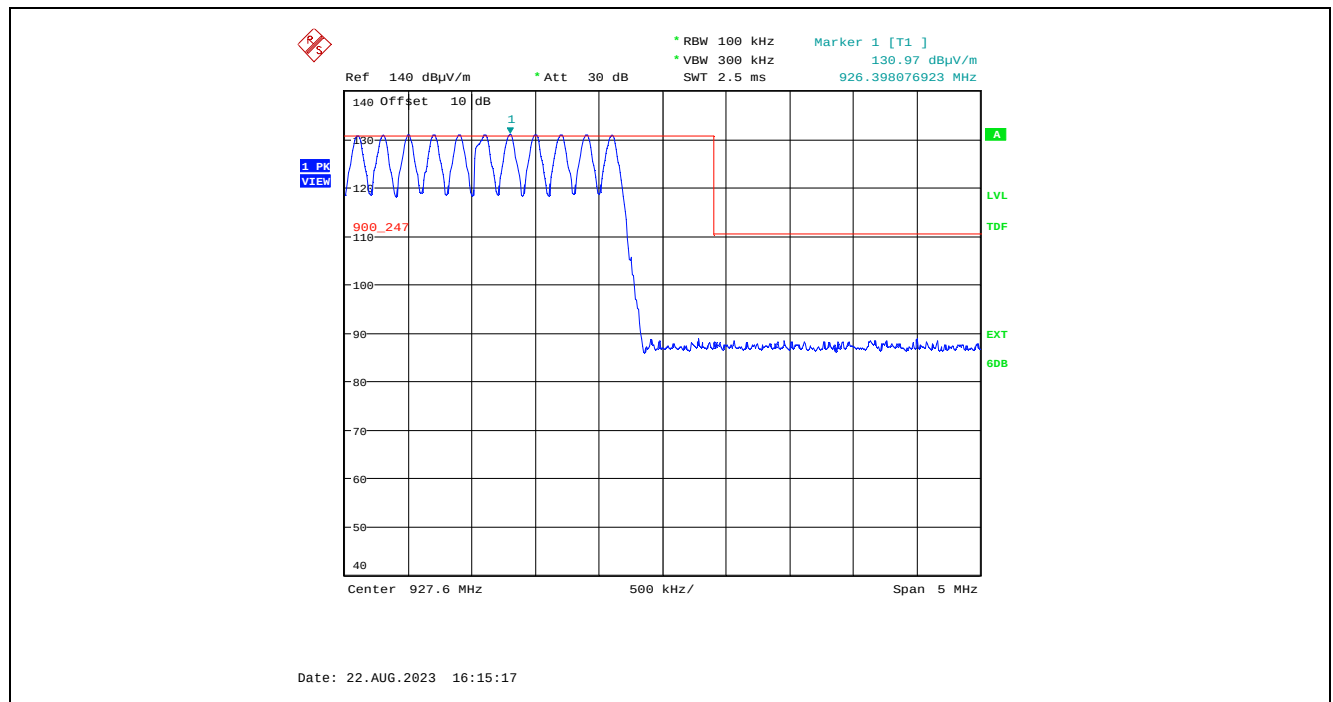
5.2.4.2.2. Band –Edge RF Radiated Emissions

Remark: The lowest frequency (917.4 MHz) is well within the permitted band, thus in compliance with band-edge requirement.

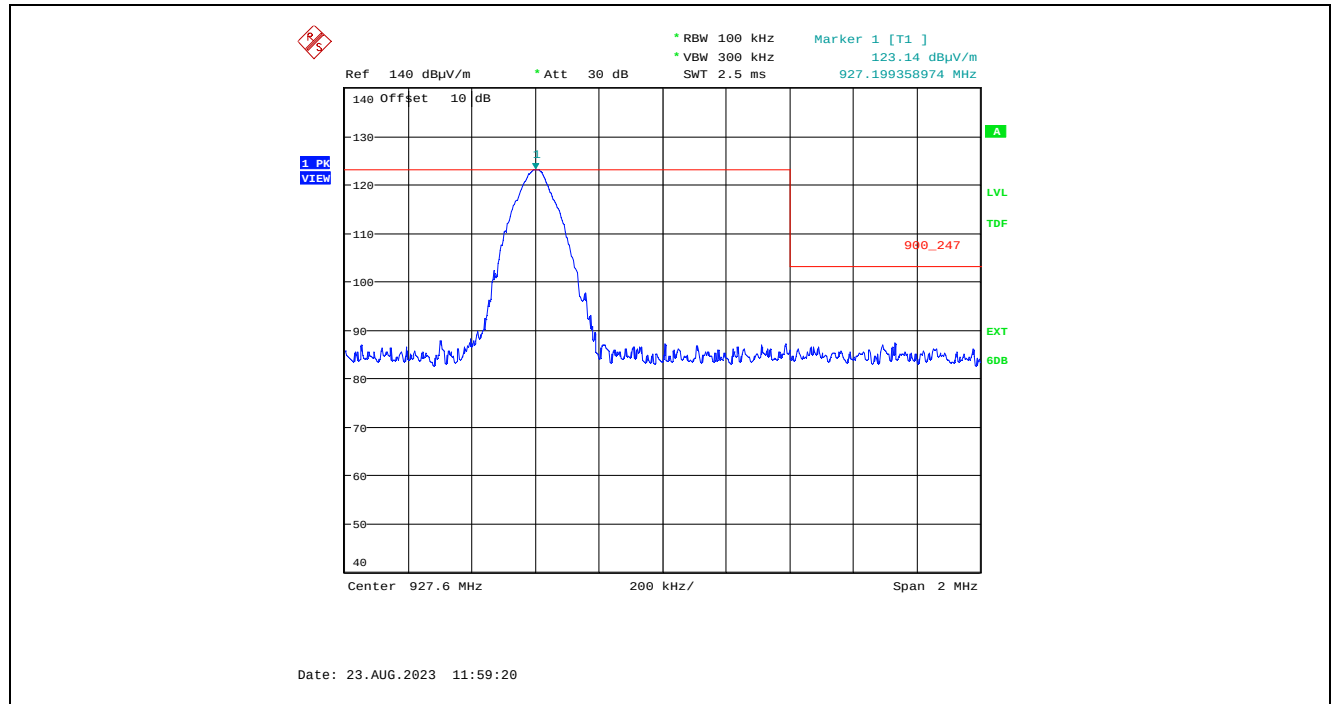
Plot 5.2.4.2.2.1. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
High End of Frequency Band, Single Frequency Mode, 927.2 MHz



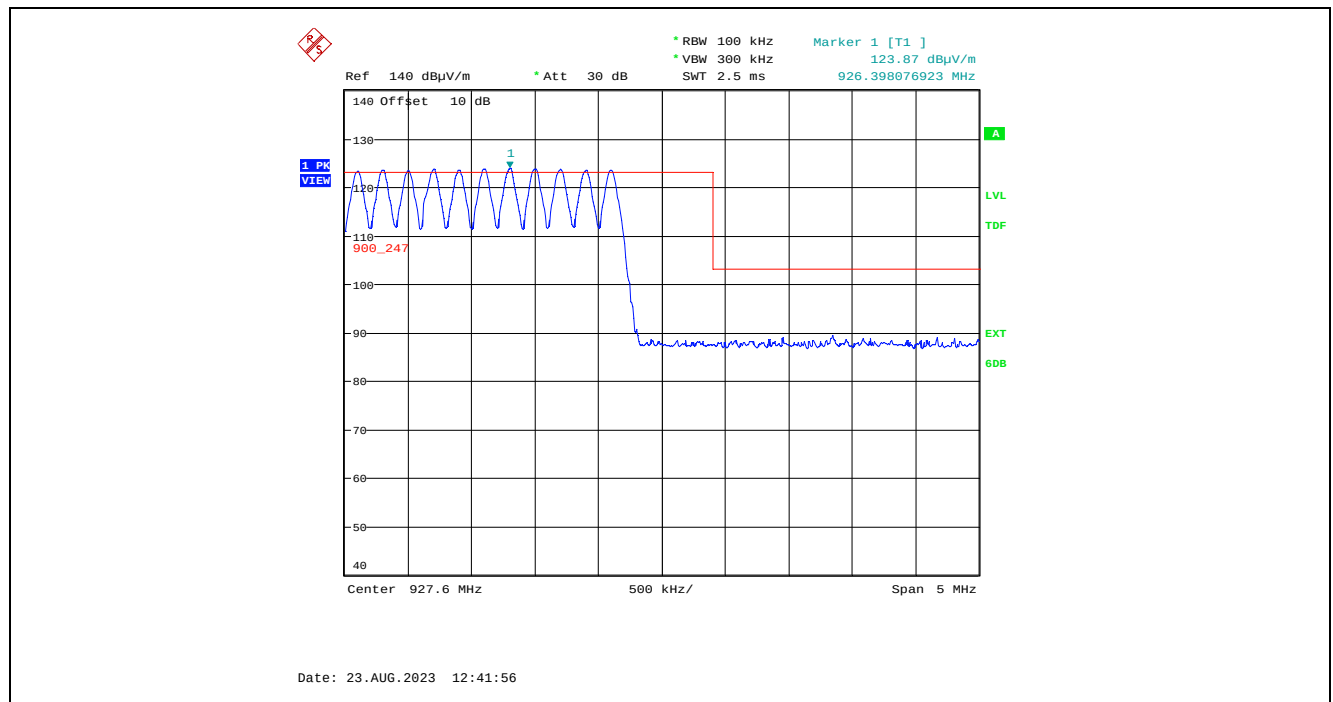
Plot 5.2.4.2.2.2. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
High End of Frequency Band, Pseudorandom Channel Hopping Mode



Plot 5.2.4.2.2.3. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
High End of Frequency Band, Single Frequency Mode, 927.2 MHz



Plot 5.2.4.2.2.4. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
High End of Frequency Band, Pseudorandom Channel Hopping Mode



5.2.4.3. Mode 3(NA3)

5.2.4.3.1. Spurious Radiated Emission

Fundamental Frequency:		917.5 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
917.5	130.57	--	V	--	--	--	--
917.5	124.63	--	H	--	--	--	--
2752.5	52.18	46.57	V	54.0	110.6	-7.4	Pass*
2752.5	48.95	42.99	H	54.0	110.6	-11.0	Pass*
4587.5	55.86	48.82	V	54.0	110.6	-5.2	Pass*
4587.5	52.54	45.38	H	54.0	110.6	-8.6	Pass*
7340.0	50.07	40.06	V	54.0	110.6	-13.9	Pass*
7340.0	49.30	38.97	H	54.0	110.6	-15.0	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:		920.1 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
920.1	130.54	--	V	--	--	--	--
920.1	124.39	--	H	--	--	--	--
2760.3	52.03	44.44	V	54.0	110.5	-9.6	Pass*
2760.3	49.73	42.60	H	54.0	110.5	-11.4	Pass*
4600.5	55.40	48.46	V	54.0	110.5	-5.5	Pass*
4600.5	52.15	45.30	H	54.0	110.5	-8.7	Pass*
7360.8	49.17	35.72	V	54.0	110.5	-18.3	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:		922.5 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
922.5	130.60	--	V	--	--	--	--
922.5	123.71	--	H	--	--	--	--
2767.5	50.94	42.75	V	54.0	110.6	-11.3	Pass*
2767.5	50.37	44.04	H	54.0	110.6	-10.0	Pass*
4612.5	55.91	49.13	V	54.0	110.6	-4.9	Pass*
4612.5	52.37	46.29	H	54.0	110.6	-7.7	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.2.4.3.2. Band –Edge RF Radiated Emissions

Remark: The lowest frequency (917.5 MHz) and highest frequency (922.5 MHz) are well within the permitted band, thus in compliance with band-edge requirement.

5.2.4.4. Mode 4(NA4)

5.2.4.4.1. Spurious Radiated Emission

Fundamental Frequency:		902.625 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
902.625	130.89	--	V	--	--	--	--
902.625	125.26	--	H	--	--	--	--
2707.875	53.77	47.12	V	54.0	110.9	-6.9	Pass*
2707.875	54.83	48.43	H	54.0	110.9	-5.6	Pass*
3610.500	43.70	35.85	V	54.0	110.9	-18.2	Pass*
3610.500	46.12	37.73	H	54.0	110.9	-16.3	Pass*
4513.125	56.45	48.99	V	54.0	110.9	-5.0	Pass*
4513.125	57.27	49.93	H	54.0	110.9	-4.1	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:		912.000 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
912.000	130.73	--	V	--	--	--	--
912.000	125.15	--	H	--	--	--	--
2736.000	52.06	46.74	V	54.0	110.7	-7.3	Pass*
2736.000	53.58	47.27	H	54.0	110.7	-6.7	Pass*
3648.000	45.75	35.60	H	54.0	110.7	-18.4	Pass*
4560.000	57.90	49.76	V	54.0	110.7	-4.2	Pass*
4560.000	56.16	48.93	H	54.0	110.7	-5.1	Pass*
7296.000	49.12	38.42	V	54.0	110.7	-15.6	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

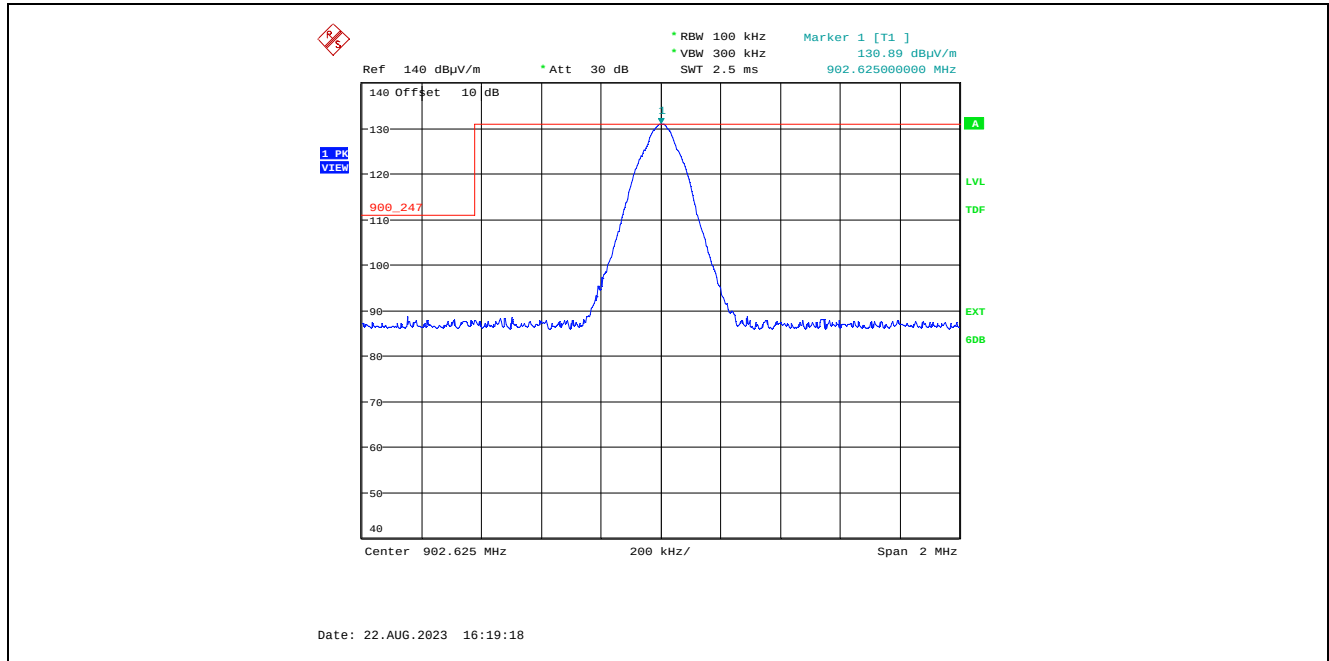
Fundamental Frequency:		921.000 MHz					
Frequency Test Range:		30 MHz – 10 GHz					
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
921.000	130.66	--	V	--	--	--	--
921.000	124.41	--	H	--	--	--	--
2763.000	51.59	44.63	V	54.0	110.7	-9.4	Pass*
2763.000	50.28	43.18	H	54.0	110.7	-10.8	Pass*
4605.000	56.17	47.13	V	54.0	110.7	-6.9	Pass*
4605.000	52.84	44.47	H	54.0	110.7	-9.5	Pass*
7368.000	48.74	37.41	V	54.0	110.7	-16.6	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

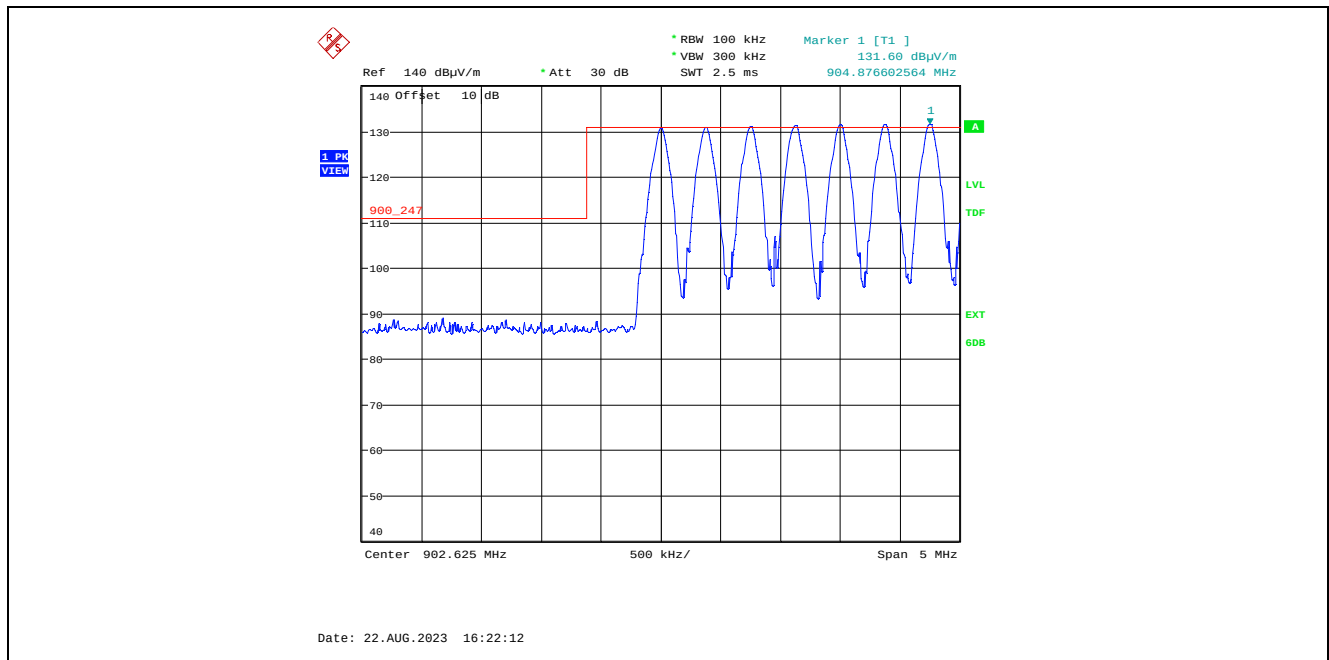
5.2.4.4.2. Band –Edge RF Radiated Emissions

Remark: Highest frequency (921.000 MHz) is well within permitted band, thus in compliance with band-edge requirement.

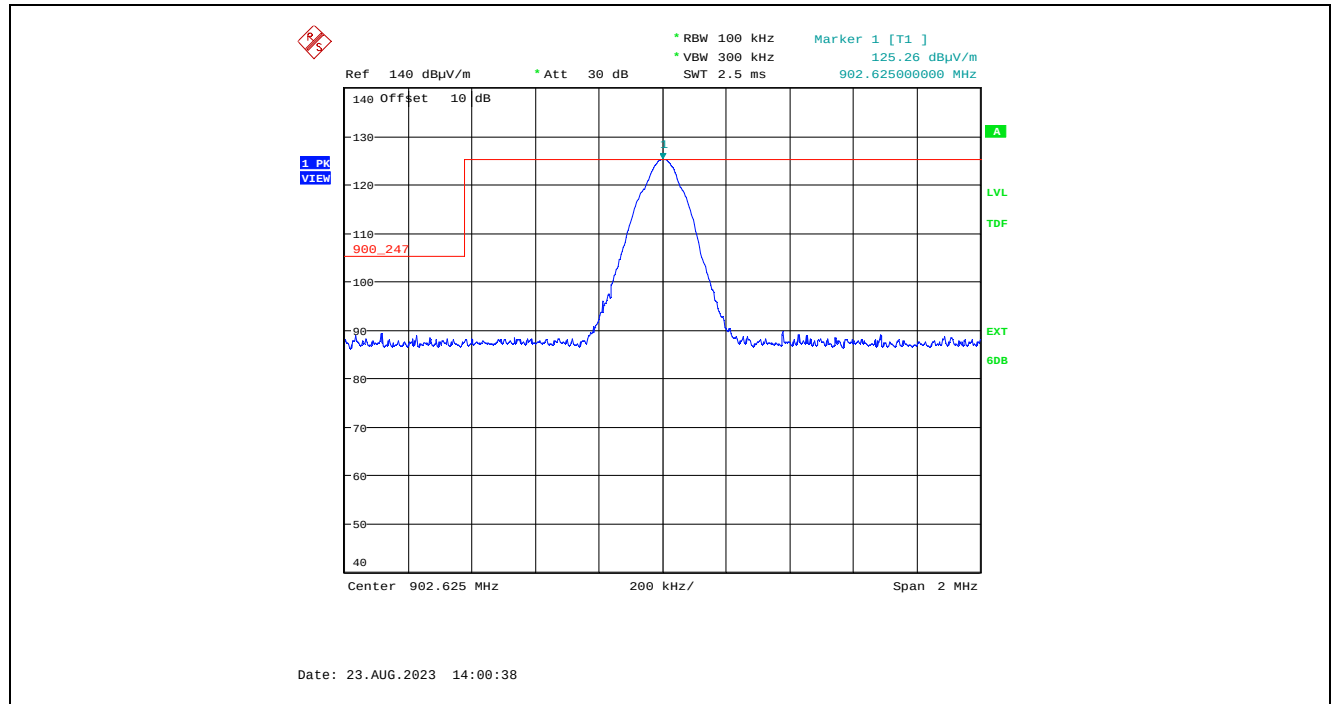
Plot 5.2.4.4.2.1. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Low End of Frequency Band, Single Frequency Mode, 902.625 MHz



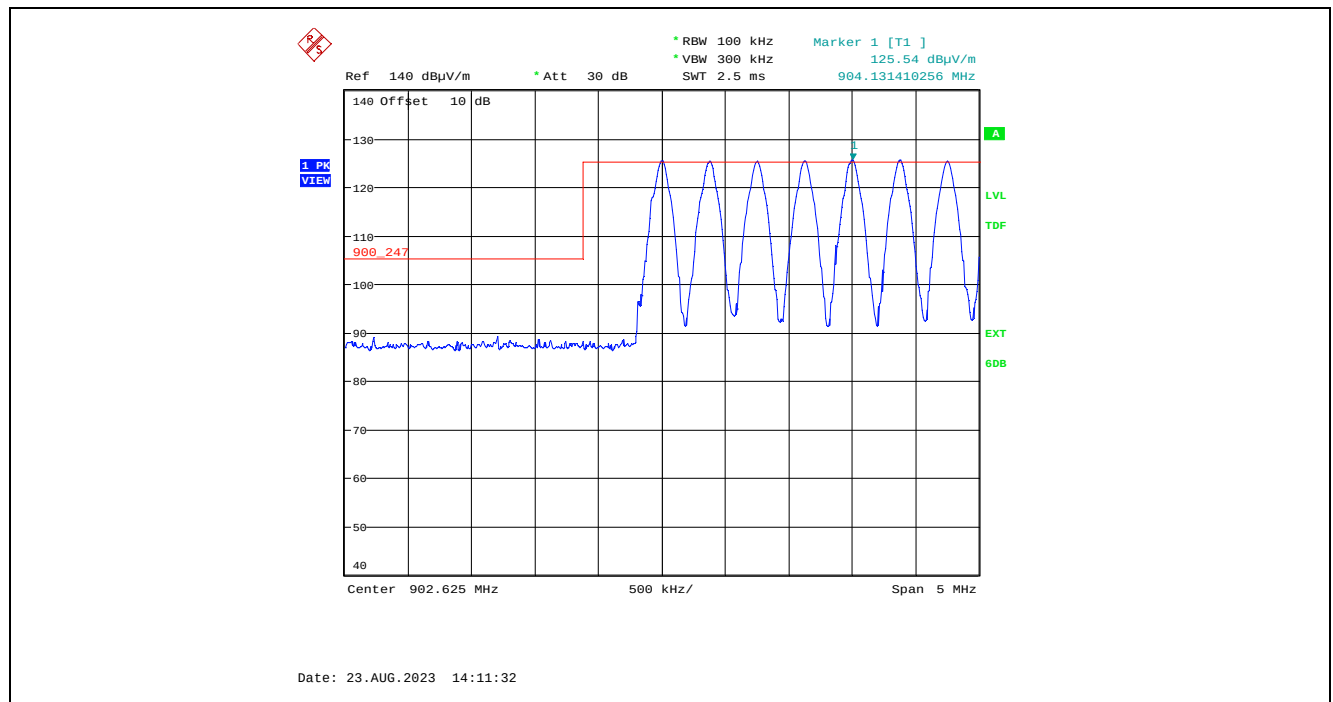
Plot 5.2.4.4.2.2. Band-Edge RF Radiated Emissions at 3 m, Vertical Polarization
Low End of Frequency Band, Pseudorandom Channel Hopping Mode



Plot 5.2.4.4.2.3. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Low End of Frequency Band, Single Frequency Mode, 902.625 MHz



Plot 5.2.4.4.2.4. Band-Edge RF Radiated Emissions at 3 m, Horizontal Polarization
Low End of Frequency Band, Pseudorandom Channel Hopping Mode



5.3. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

§ 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.3.1. Method of Measurements

Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where,

P: power input to the antenna in mW

EIRP: Equivalent (effective) isotropic radiated power.

S: power density mW/cm²

G: numeric gain of antenna relative to isotropic radiator

r: distance to centre of radiation in cm

5.3.2. RF Evaluation

Frequency (MHz)	*Maximum Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	Evaluation Distance, r (cm)	Power Density, S (mW/cm ²)	MPE Limit (mW/cm ²)	Margin (mW/cm ²)
902.625	29	6.9	35.90	3890.451	25	0.495	0.602	-0.107

* Maximum conducted power for use with antenna gain of 6.9 dBi shall not exceed 29 dBm.

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	11 Mar 2024
Attenuator	Hewlett Packard	8493C	0461	DC–26.5 GHz	See Note 1
DC Power Supply	HQ Power	PS 613U	--	0-30Vdc	See Note 1
Multi-meter	Fluke	8842A	4142058	20mV - 1kV	26 Oct 2024
Termination	db Products	---	---	50Ohm(15Watts)	See Note 1
Biconilog	EMCO	3142C	00026873	30MHz-1GHz	16 Dec 2023
Preamp	Hewlett Packard	PAM-118A	551016	500MHz-18GHz	13 Apr 2024
Horn Antenna	ETS	3115	9701-5061	1-18GHz	08 Aug 2024
High Pass Filter	K & L	11SH-10-1500/T8000	2	Cut off 900MHz to 1.5GHz	See Note 1
Note 1: Internal Verification/Calibration check					

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: 23LYI-213_FCC15C247
October 19, 2023

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

Test Description	Expanded Uncertainty, K=2 for 95% Confidence Level
Conducted Output Power	± 0.62 dB
Transmitter Band-edge Radiated Emissions	± 2.76 dB (1-18GHz)
Transmitter Spurious Radiated Emissions	± 4.20 dB (30 MHz – 1 GHz)
	± 2.70 dB (1 – 18 GHz)
	± 3.11 dB (18 – 26.5 GHz)

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: 23LYI-213_FCC15C247
October 19, 2023

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)