ENGINEERING TEST REPORT

MMB Gen2 Wi-SUN Module (DTX01PA10)
Model(s): DTX01PA10-RFC and DTX01PA10-CHP
FCC ID: XFF-DTX01

Applicant:

MMB Research Inc.
25 Adelaide Street East, Suite 400
Toronto, ON M5C 3A1
Canada

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247 Frequency Hopping Spread Spectrum (FHSS)

UltraTech's File No.: 24MMBN076-FCC15C247

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: February 9, 2024	
Report Prepared by: Dan Huynh Issued Date: February 9, 2024	Tested by: Angus Au Test Dates: September 26 – December 4, 2023 January 23, 2024 February 7-8, 2024

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
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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:	Equipment Certification for Part 15C Spread Spectrum Transmitter
Test Procedures:	▪ ANSI C63.4 ▪ ANSI C63.10
Environmental Classification:	[x] Commercial, industrial or business environment [x] 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

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

Applicant	
Name:	MMB Research Inc.
Address:	25 Adelaide Street East, Suite 400 Toronto, ON M5C 3A1 Canada

Manufacturer	
Name:	MMB Research Inc.
Address:	25 Adelaide Street East, Suite 400 Toronto, ON M5C 3A1 Canada

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:	MMB Research Inc.
Product Name:	MMB Gen2 Wi-SUN Module (DTX01PA10)
Model(s):	DTX01PA10-RFC and DTX01PA10-CHP
Serial Number:	Test Sample
Type of Equipment:	Spread Spectrum Transmitter
Input Power Supply Type:	External Regulated DC Sources
Primary User Functions of EUT:	Wi-SUN 802.15.4g Sub-GHz solution designed to connect end devices such as smart meters to a Wi-Sun Mesh Network.

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	▪ Mobile ▪ Base Station (fixed use)
Intended Operating Environment:	Residential Commercial, industrial or business environment
Power Supply Requirement:	4 VDC derived from carrier board (test jig board)
RF Output Power Rating:	29.21 dBm (0.83368 W)
Operating Frequency Range:	902.2 - 927.8 MHz (Mode 1b: 50 kbps, 200 kHz channel spacing and Mode 2a: 100 kbps, 200 kHz channel spacing) 902.4 - 927.6 MHz (Mode 3: 150 kbps, 400 kHz channel spacing)
Number of Channels:	129 (for 50 kbps and 100 kbps) 64 (for 150 kbps)
RF Output Impedance:	50 Ω
Duty Cycle:	Continuous
Modulation Type:	Binary GFSK
Antenna Connector Type:	U.FL / Integral (Chip Antenna)

2.4. ASSOCIATED ANTENNA DESCRIPTION

Antenna Type	Maximum Gain (dBi)
Chip	1
Phantom (Dome)	3
Rubber Rod (Monopole)	3

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	U.FL Antenna Input	1	U.FL	Shielded

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:	Carrier Board (Test Jig Board)
Brand name:	MMB Research Inc.
Model Name or Number:	N/A
Connected to EUT's Port:	I/O Port

Ancillary Equipment # 2	
Description:	Wall Mount Power Supply
Brand name:	Tri-Mag
Model Name or Number:	L6R06H-050
Connected to EUT's Port:	Carrier Board Barrel Jack Connector

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 ^{o}C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	5 VDC input to carrier board (test jig board)

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	▪ Each of lowest, middle and highest channel frequencies transmits continuously for tests which required the unit to operate in single channel mode. ▪ The EUT operates in normal Frequency Hopping mode for tests which required the unit to operate in hopping mode.
Special Test Software:	Test software (Tera Term Ver. 4.106) provided by the Applicant is installed to allow the EUT to operate in hopping mode or single channel mode.
Special Hardware Used:	MMB Research carrier board (Test Jig Board)
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral/non-integral antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	902.2 - 927.8MHz (Mode 1b and Mode 2a) 902.4 - 927.6MHz (Mode 3)
Frequency(ies) Tested: (Near lowest, near middle & near highest frequencies in the frequency range of operation.)	902.2 MHz, 915 MHz and 927.8 MHz 902.4 MHz, 915.2 MHz and 927.6 MHz
RF Power Output: (measured maximum output power at antenna terminals)	29.21 dBm, 0.83368 W (conducted)
Normal Test Modulation:	2GFSK
Modulating Signal Source:	Internal

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	Compliance (Yes/No)
15.203	Antenna requirements	Yes
15.207(a)	AC Power Line Conducted Emissions	Yes
15.247(a)	Provisions for Frequency Hopping Systems	Yes
15.247(b)(2)	Maximum Peak Conducted Output Power	Yes
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(i), 1.1307, 1.1310, 2.1091	RF Exposure	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. TEST DATA

5.1. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

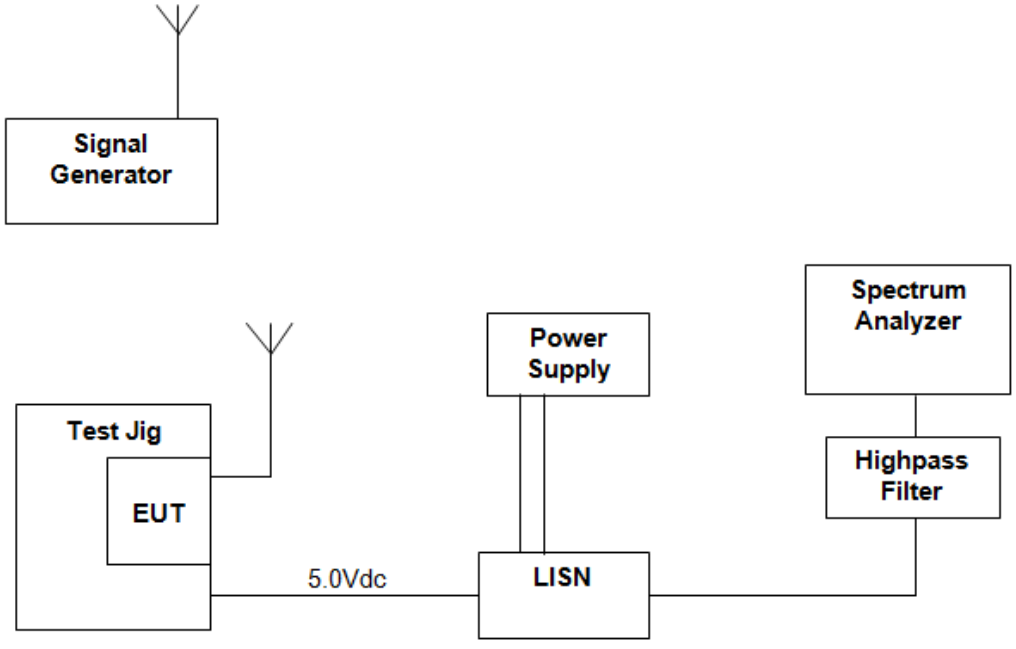
Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5 .....……...	66 to 56*	56 to 46*
0.5–5 .....……...	56	46
5-30 ……...	60 ..……..	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

ANSI C63.4

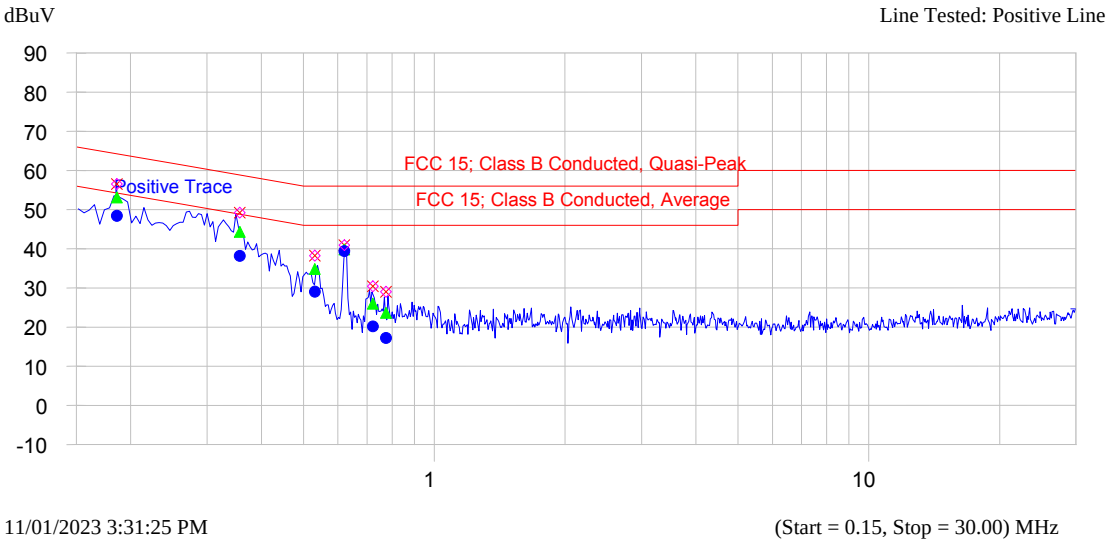
5.1.3. Test Arrangement



5.1.4. Test Data

Plot 5.1.4.1. Power Line Conducted Emissions
Line Voltage: 5 VDC; Line Tested: Positive

Current Graph

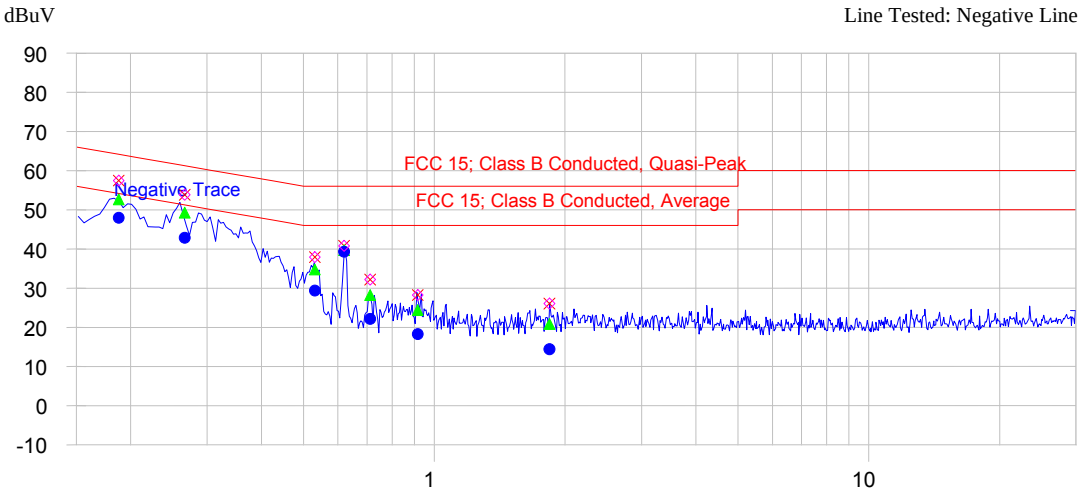


Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.186	56.5	53.1	-11.1	48.4	-5.8	Positive Trace
0.357	49.2	44.3	-14.5	38.2	-10.6	Positive Trace
0.531	38.2	34.8	-21.2	29.0	-17.0	Positive Trace
0.621	40.9	39.8	-16.2	39.4	-6.6	Positive Trace
0.723	30.4	26.0	-30.0	20.1	-25.9	Positive Trace
0.774	29.0	23.6	-32.4	17.2	-28.8	Positive Trace

Plot 5.1.4.2. Power Line Conducted Emissions
Line Voltage: 5 VDC, Line Tested: Negative

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.188	57.4	52.6	-11.5	48.0	-6.2	Negative Trace
0.267	53.8	49.3	-12.0	42.9	-8.4	Negative Trace
0.531	37.9	34.7	-21.3	29.4	-16.6	Negative Trace
0.621	40.8	39.7	-16.3	39.3	-6.7	Negative Trace
0.712	32.2	28.2	-27.8	22.1	-23.9	Negative Trace
0.917	28.2	24.4	-31.6	18.2	-27.8	Negative Trace
1.842	26.1	20.8	-35.2	14.4	-31.6	Negative Trace

5.2. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	Manufacturer's Clarification
15.203	Described how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where EUT must be professionally installed. In order to demonstrate that professional installation is required, the following 3 points must be addressed: ➢ The application (or intended use) of the EUT ➢ The installation requirements of the EUT ➢ The method by which the EUT will be marketed	The antenna employs a unique antenna connector.
15.204	Provided the information for every antenna proposed for use with the EUT: ➢ type (e.g. Yagi, patch, grid, dish, etc…), ➢ manufacturer and model number ➢ gain with reference to an isotropic radiator	See proposed antenna listed in user manual.
15.247(a)	Description of how the EUT meets the definition of a frequency hopping spread spectrum, found in Section 2.1. Based on the technical description.	See Operational Description
15.247(a)	Pseudo Frequency Hopping Sequence: Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirements specified in the definition of a frequency hopping spread spectrum system, found in Section 2.1	See Operational Description
15.247(a)	Equal Hopping Frequency Use: Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g. that each new transmission event begins on the next channel in the hopping sequence after final channel used in the previous transmission events).	See Operational Description
15.247(a)	System Receiver Input Bandwidth: Describe how the associated receiver(s) complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.	See Operational Description

FCC Section	FCC Rules	Manufacturer's Clarification
15.247(a)	System Receiver Hopping Capability: Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals	See Operational Description
15.247(g)	Describe how the EUT complies with the requirement that it be designed to be capable of operating as a true frequency hopping system	See Operational Description
15.247(h)	Describe how the EUT complies with the requirement that it not have the ability to coordinated with other FHSS is an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters	See Operational Description

5.3. PROVISIONS FOR FREQUENCY HOPPING SYSTEMS [§ 15.247(a)(1)]

5.3.1. Limits

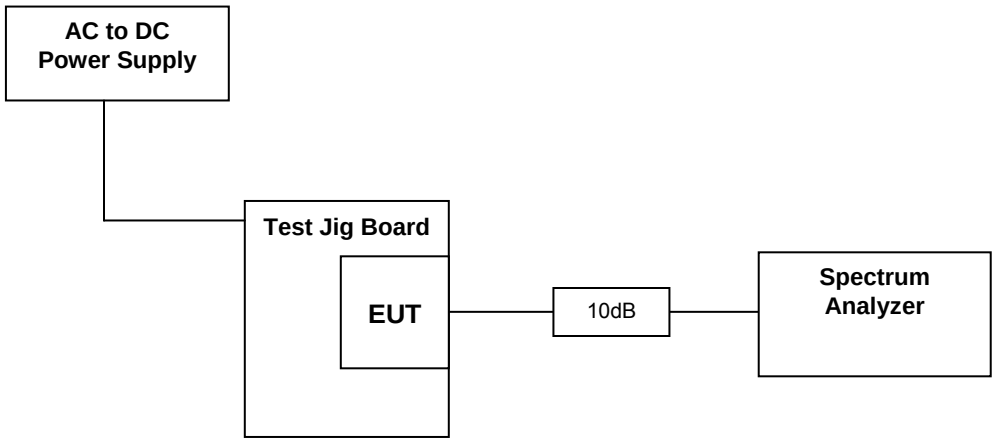
§ 15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

§ 15.247(a)(1)(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

5.3.2. Method of Measurements

ANSI C63.10-2013, Sections 6.9.2, 7.8.2, 7.8.3 and 7.8.4

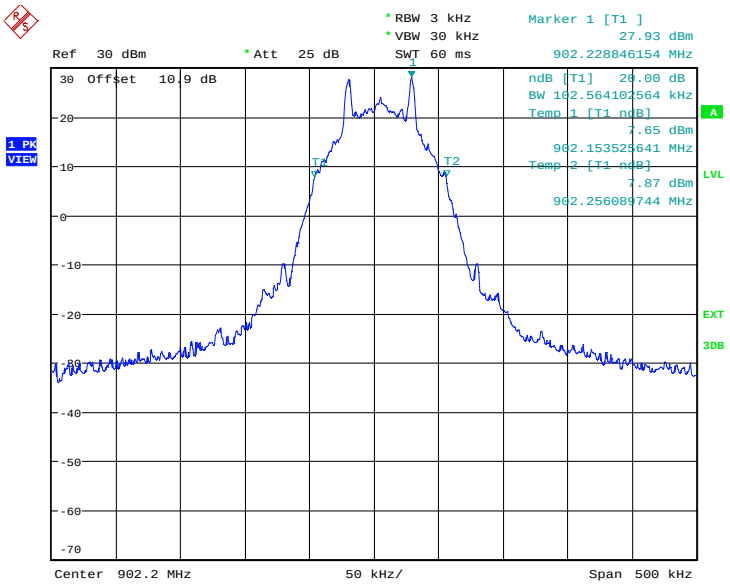
5.3.3. Test Arrangement



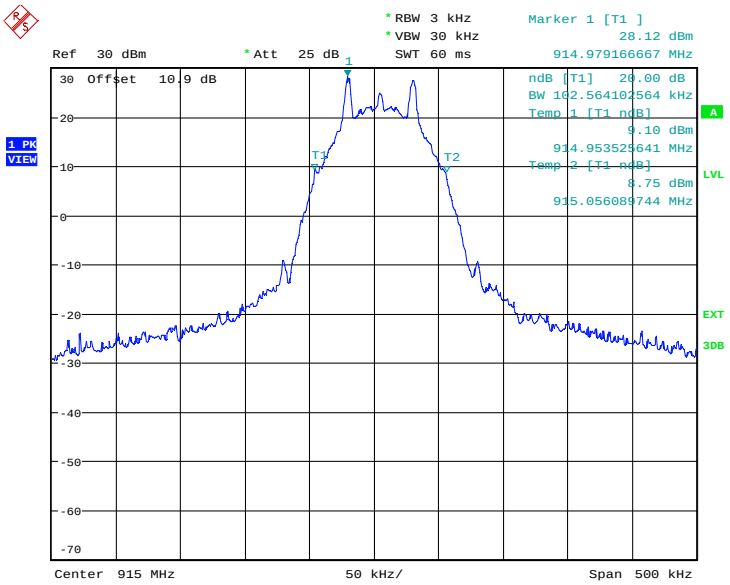
5.3.4. Test Data

Test Description	FCC Specification	Measured Values	Comments
Frequency Hopping Systems Requirements	The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.	--	See Note 1
20 dB BW of the hopping channel	The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.	104.17 kHz (for 50 kbps, 200 kHz CS) 122.60 kHz (for 100 kbps, 200 kHz CS) 180.29 kHz (for 150 kbps, 400 kHz CS)	See Note 2
Channel Hopping Frequency Separation	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.	205 kHz (for 50 kbps, 200 kHz CS) 200 kHz (for 100 kbps, 200 kHz CS) 405 kHz (for 150 kbps, 400 kHz CS)	See Note 2
Number of hopping frequencies	If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies	129 hopping frequencies [for Mode 1b (50 kbps, 200 kHz CS) and Mode 2a (100 kbps, 200 kHz CS)] 64 hopping frequencies [for Mode 3 (150 kbps, 400 kHz CS)]	See Note 1 and 2
Average Time of Occupancy	If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period	39.58 ms in 20s period [for Mode 1b (50 kbps, 200 kHz CS)] 19.86 ms in 20s period [for Mode 2a (100 kbps, 200 kHz CS)] 13.14 ms in 20s period [for Mode 3 (150 kbps, 400 kHz CS)]	See Note 2
Note 1: See operational description exhibit for details. **Note 2**: See the following plots for detail.			

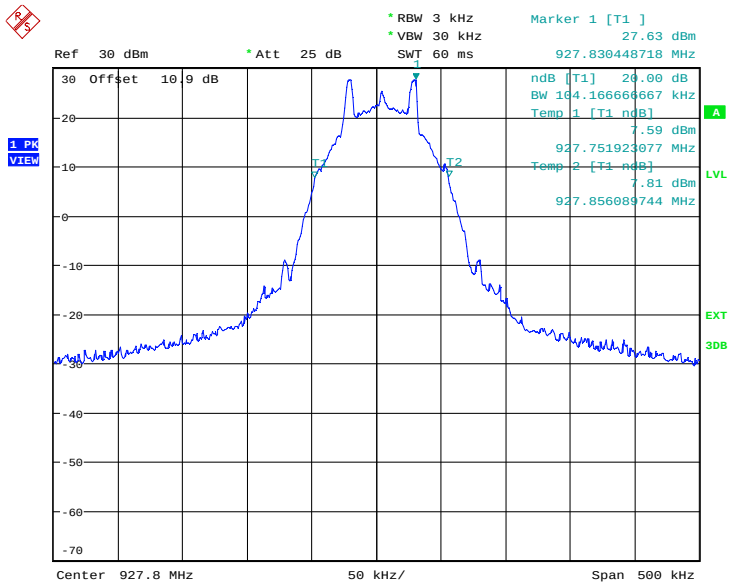
Plot 5.3.4.1. 20 dB Bandwidth, Mode 1b (50 kbps, 200 kHz CS), Raw Power Setting at 14, 902.2 MHz



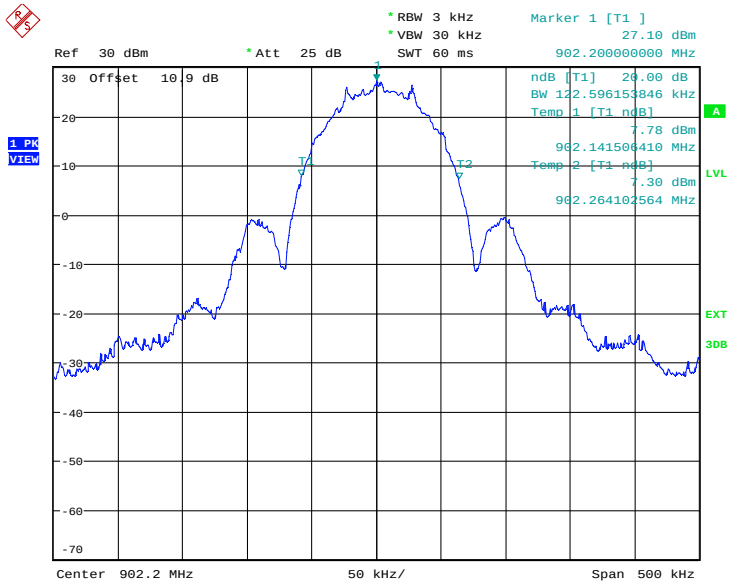
Plot 5.3.4.2. 20 dB Bandwidth, Mode 1b (50 kbps, 200 kHz CS), Raw Power Setting at 14, 915 MHz



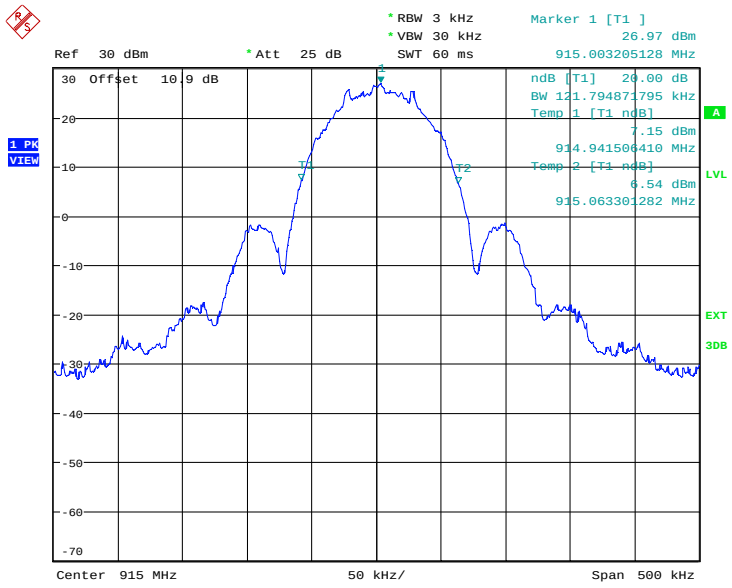
Plot 5.3.4.3. 20 dB Bandwidth, Mode 1b (50 kbps, 200 kHz CS), Raw Power Setting at 14, 927.8 MHz



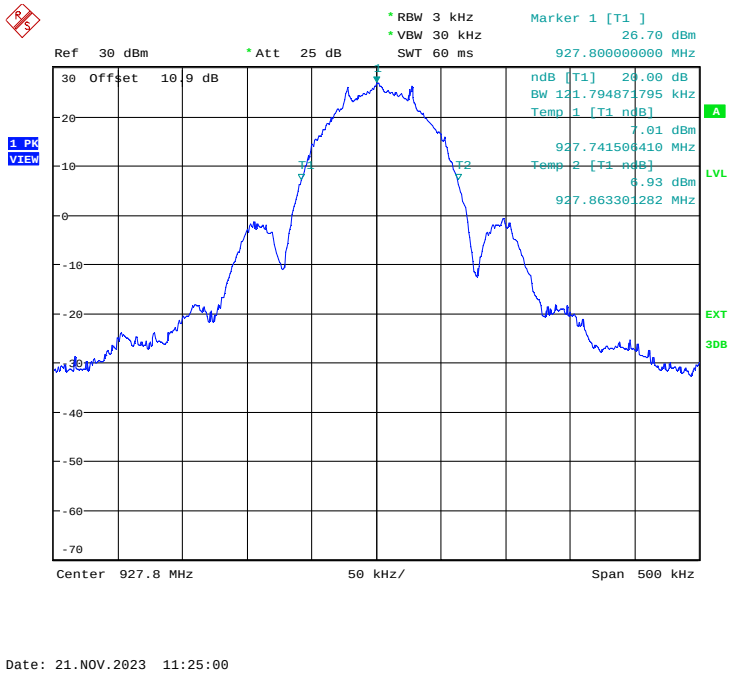
Plot 5.3.4.4. 20 dB Bandwidth, Mode 2a (100 kbps, 200 kHz CS), Raw Power Setting at 14, 902.2 MHz



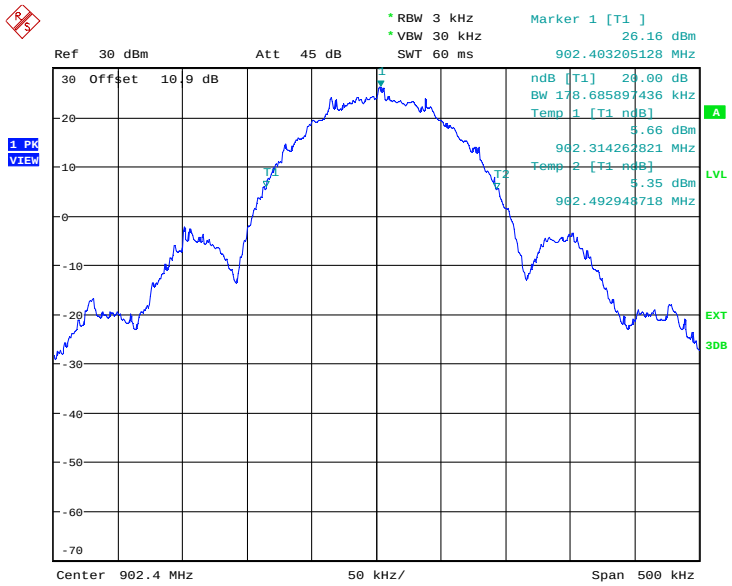
Plot 5.3.4.5. 20 dB Bandwidth, Mode 2a (100 kbps, 200 kHz CS), Raw Power Setting at 14, 915 MHz



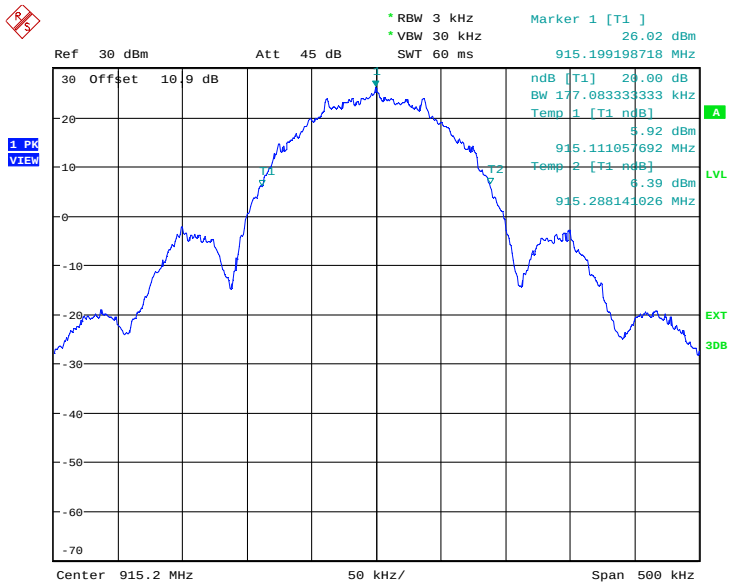
Plot 5.3.4.6. 20 dB Bandwidth, Mode 2a (100 kbps, 200 kHz CS), Raw Power Setting at 14, 927.8 MHz



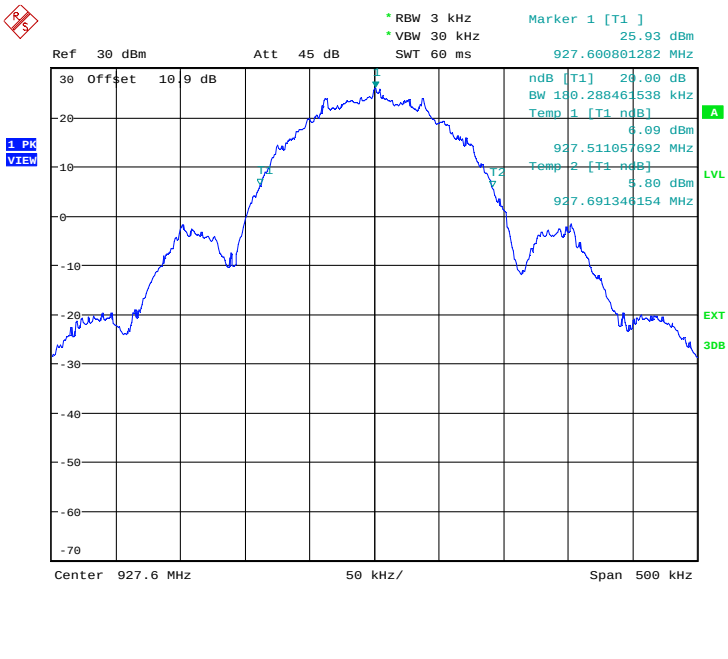
Plot 5.3.4.7. 20 dB Bandwidth, Mode 3 (150 kbps, 400 kHz CS),, Raw Power Setting at 14, 902.4 MHz



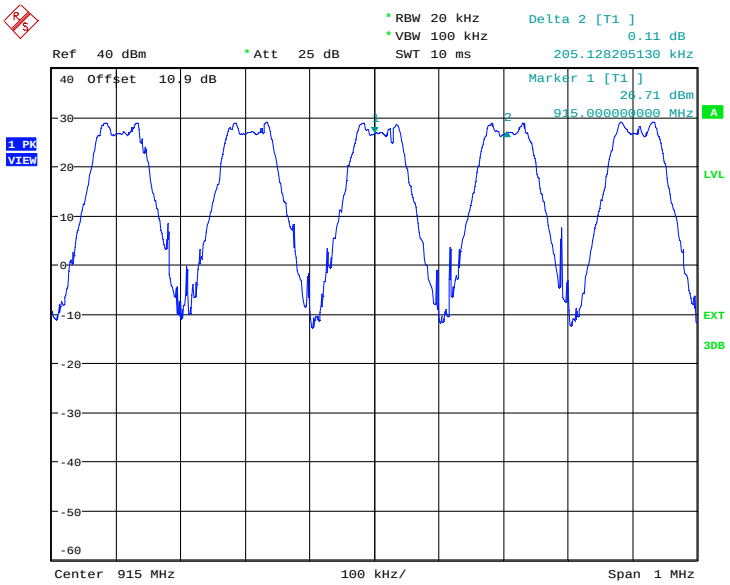
Plot 5.3.4.8. 20 dB Bandwidth, Mode 3 (150 kbps, 400 kHz CS),, Raw Power Setting at 14, 915.2 MHz



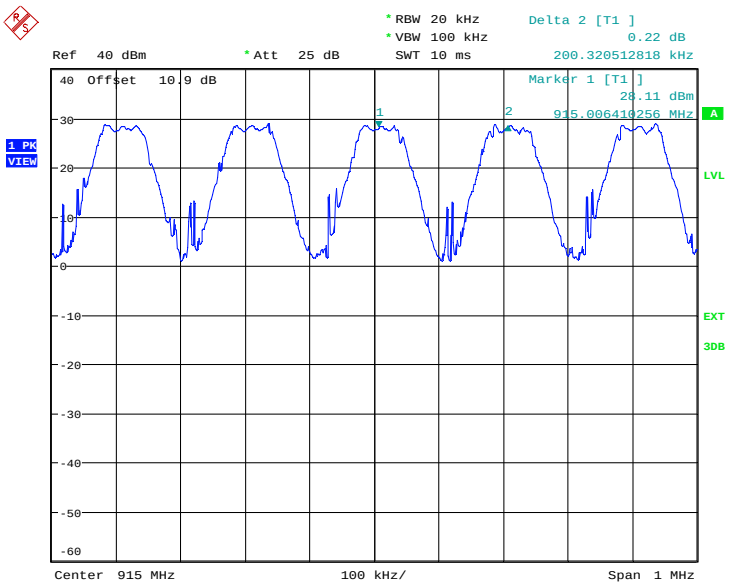
Plot 5.3.4.9. 20 dB Bandwidth, Mode 3 (150 kbps, 400 kHz CS), Raw Power Setting at 14, 927.6 MHz



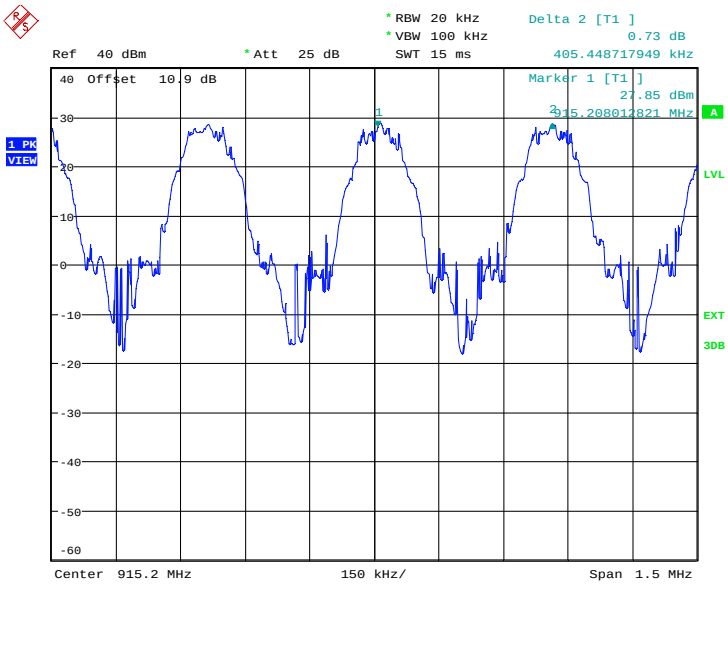
Plot 5.3.4.10. Carrier Frequency Separation, Mode 1b (50 kbps, 200 kHz CS)



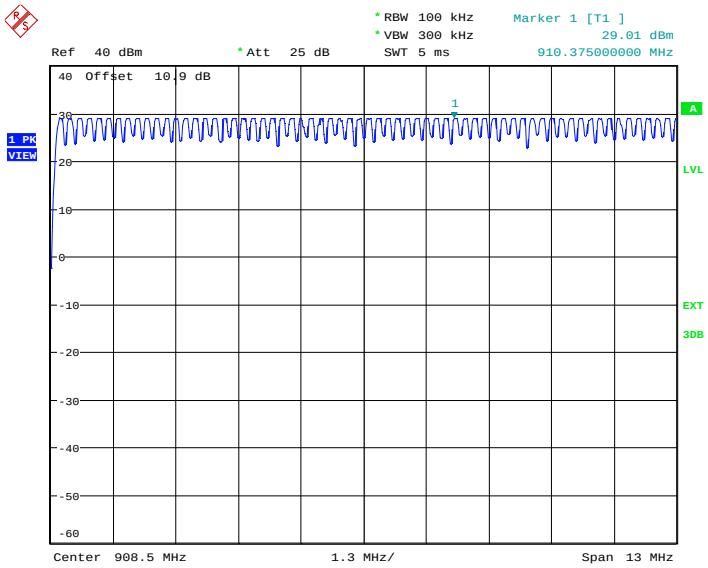
Plot 5.3.4.11. Carrier Frequency Separation, Mode 2a (100 kbps, 200 kHz CS)



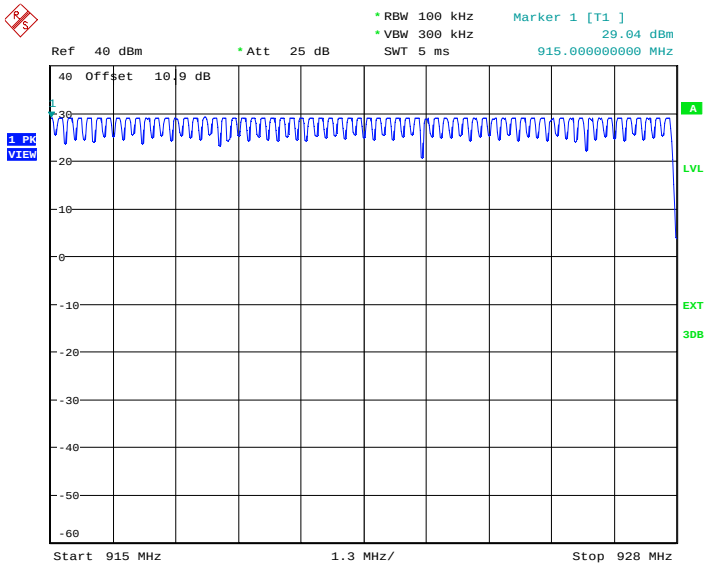
Plot 5.3.4.12. Carrier Frequency Separation, Mode 3 (150 kbps, 400 kHz CS)



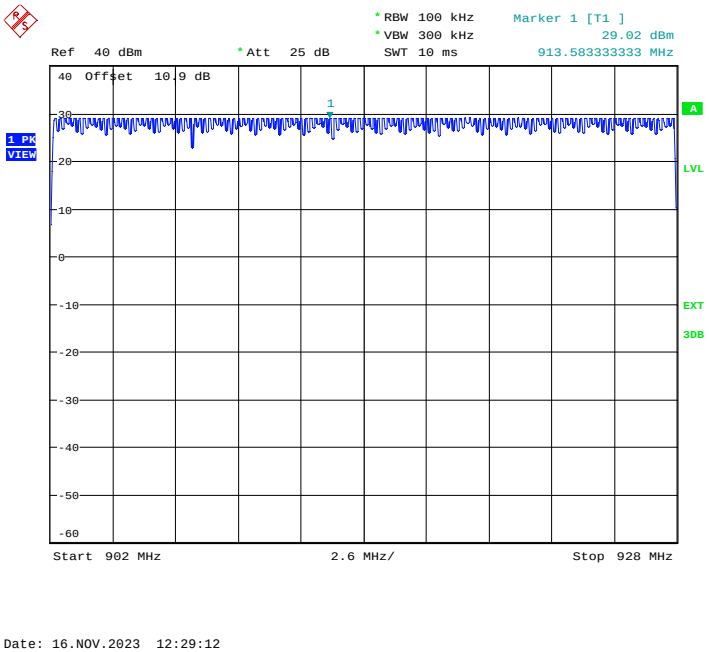
Plot 5.3.4.13. Number of Hopping Frequencies, Mode 1b (50 kbps, 200 kHz CS)
64 1/2 Hopping Channels from 902 - 915 MHz



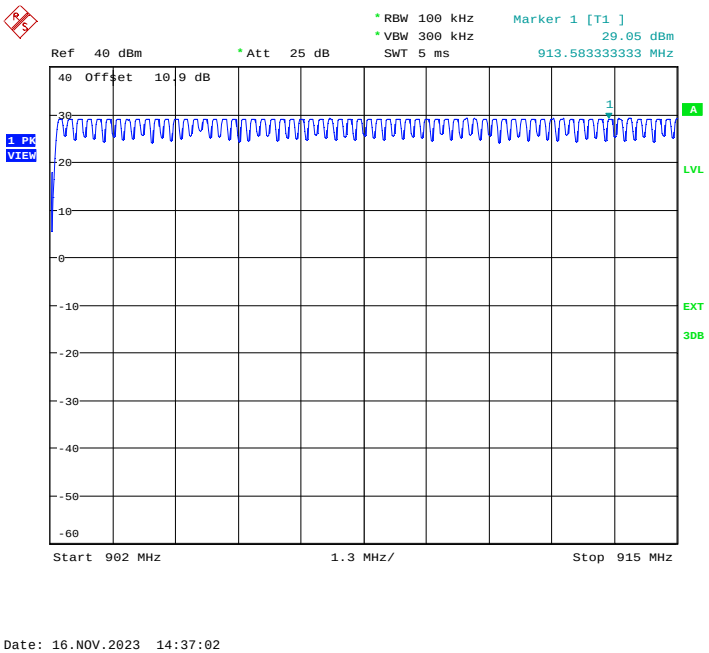
Plot 5.3.4.14. Number of Hopping Frequencies, Mode 1b (50 kbps, 200 kHz CS)
64 1/2 Hopping Channel from 915 - 928 MHz



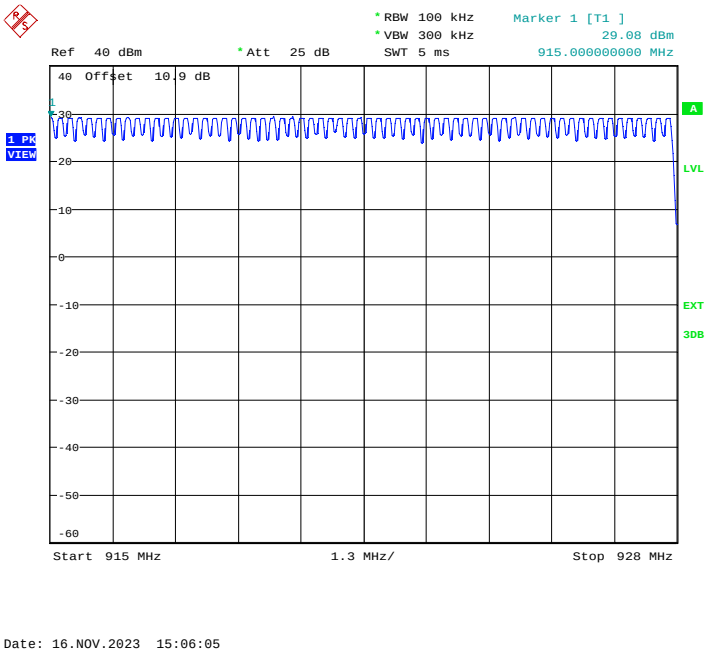
Plot 5.3.4.15. Number of Hopping Frequencies, Mode 1b (50 kbps, 200 kHz CS)
The Total Number of Hopping Channel in 902 – 928 MHz Band is 129



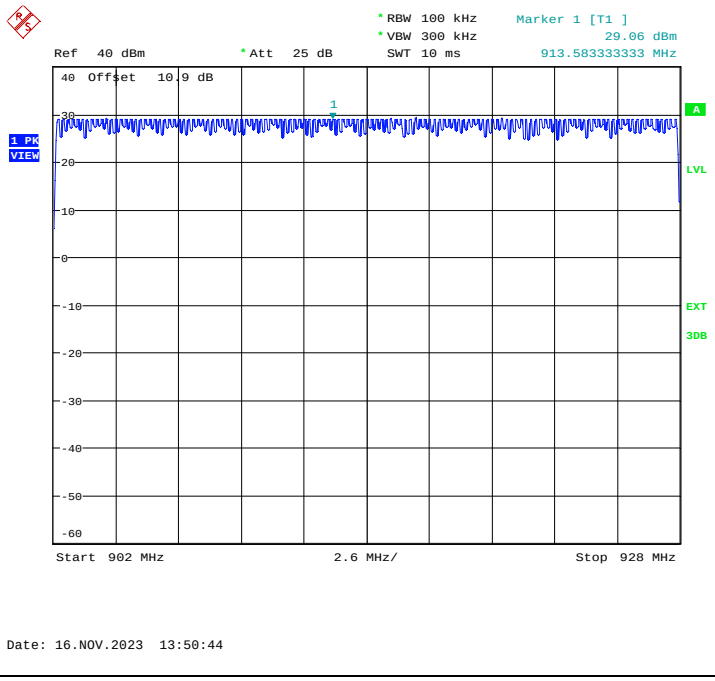
Plot 5.3.4.16. Number of Hopping Frequencies, Mode 2a (100 kbps, 200 kHz CS)
64 1/2 Hopping Channels from 902 – 915 MHz



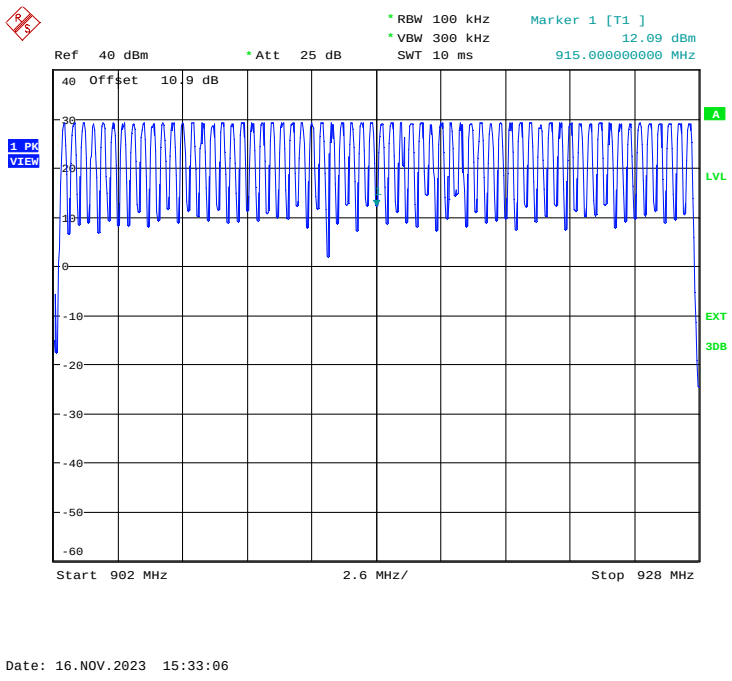
Plot 5.3.4.17. Number of Hopping Frequencies, Mode 2a (100 kbps, 200 kHz CS)
64 1/2 Hopping Channels from 915 – 928 MHz



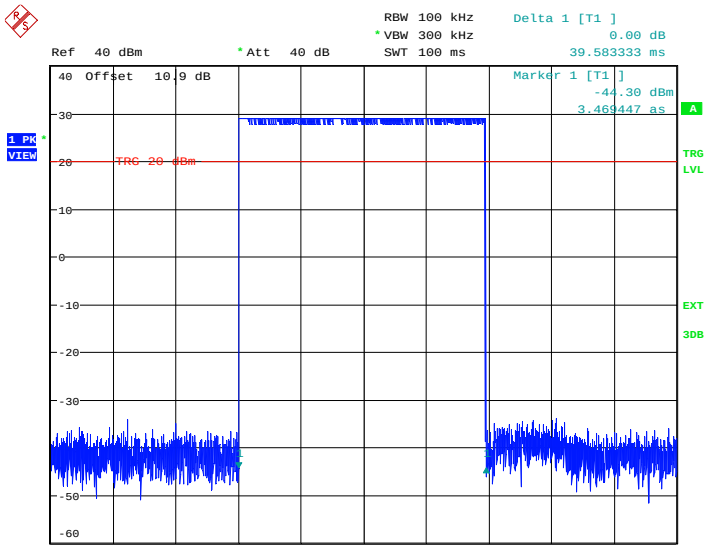
Plot 5.3.4.18. Number of Hopping Frequencies, Mode 2a (100 kbps, 200 kHz CS)
The Total Number of Hopping Channel in 902 – 928 MHz Band is 129



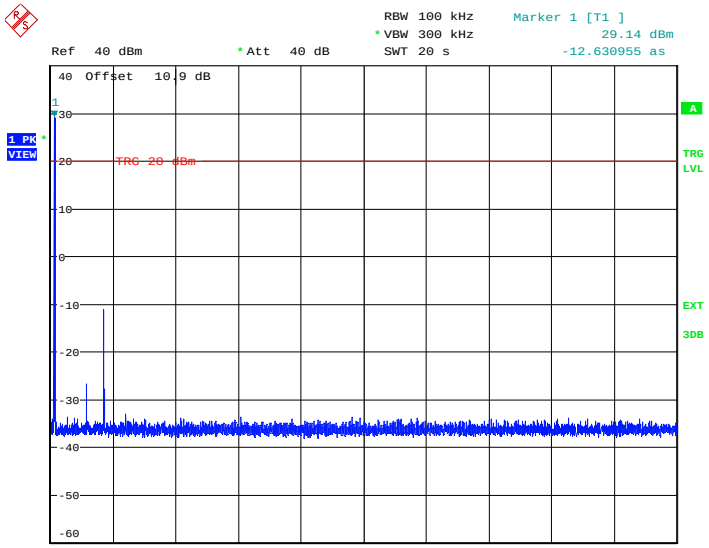
Plot 5.3.4.19. Number of Hopping Frequencies, Mode 3 (150 bps, 400 kHz CS)
The Total Number of Hopping Channel in 902 – 928 MHz Band is 64



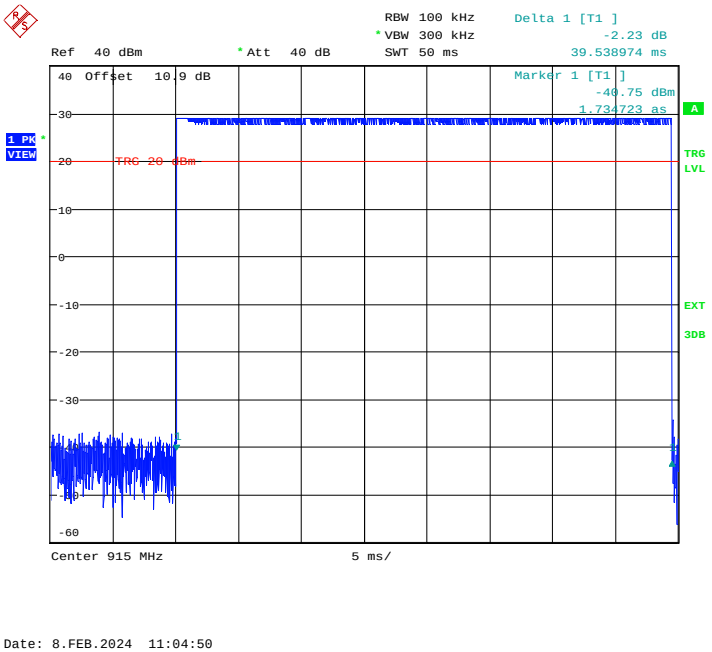
Plot 5.3.4.20. Time of Occupancy, Mode 1b (50 kbps, 200 kHz CS) 902.2 MHz
Dwell Time at 902.2 MHz = 39.58 ms



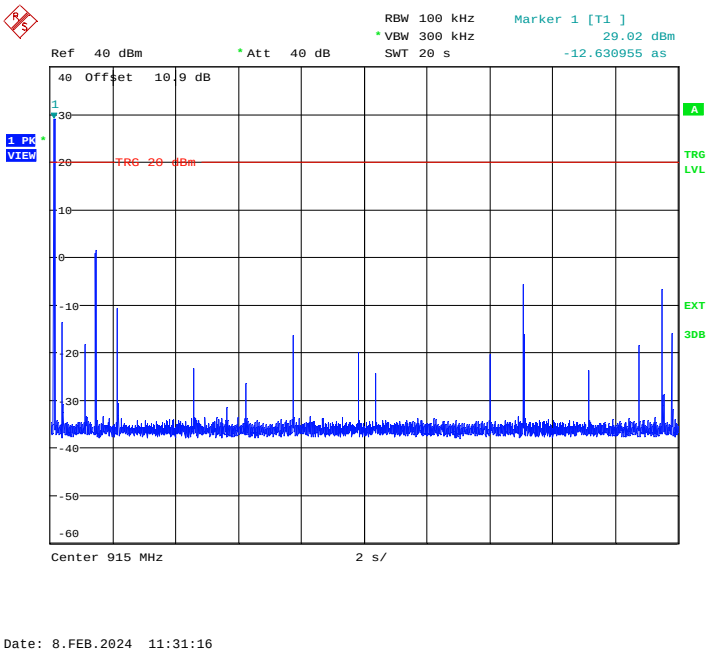
Plot 5.3.4.21. Time of Occupancy, Mode 1b (50 kbps, 200 kHz CS) 902.2 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a 20s period) = 39.58 ms x 1 = 39.58 ms



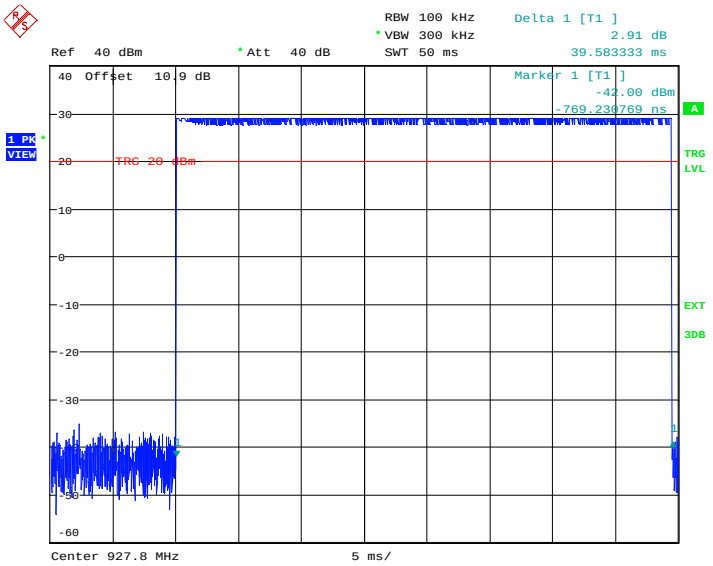
Plot 5.3.4.22. Time of Occupancy, Mode 1b (50 kbps, 200 kHz CS) 915 MHz
Dwell Time at 915 MHz = 39.54 ms



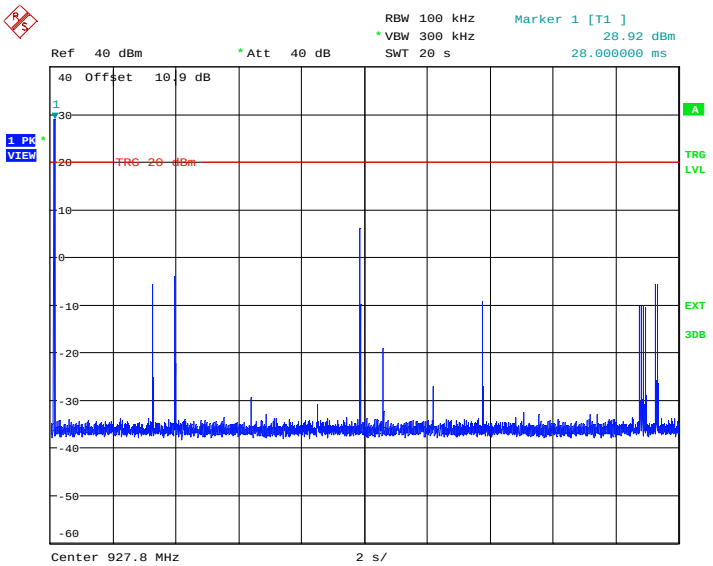
Plot 5.3.4.23. Time of Occupancy, Mode 1b (50 kbps, 200 kHz CS) 915 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a 20s period) = 39.54 ms x 1 = 39.54 ms



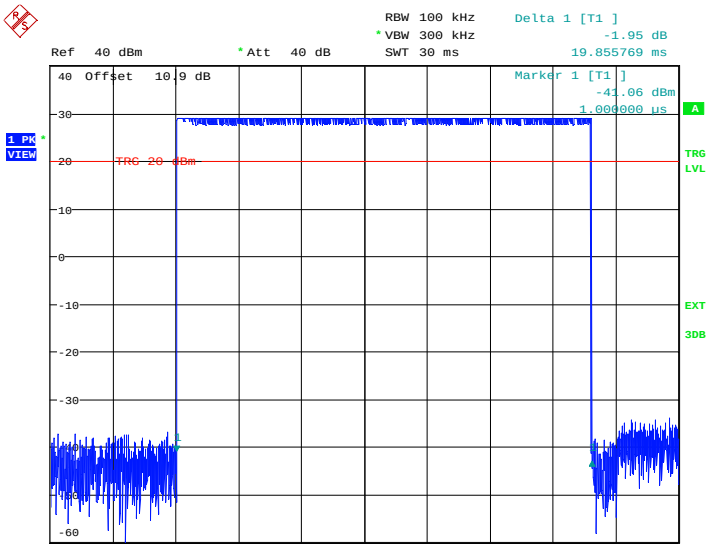
Plot 5.3.4.24. Time of Occupancy, Mode 1b (50 kbps, 200 kHz CS) 927.8 MHz
Dwell Time at 927.8 MHz = 39.58 ms



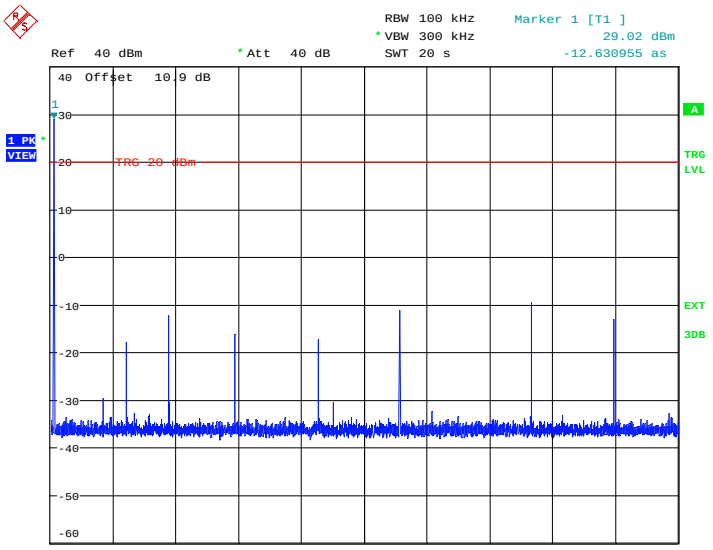
Plot 5.3.4.25. Time of Occupancy, Mode 1b (50 kbps, 200 kHz CS) 927.8 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a 20s period) = 39.58 ms x 1 = 39.58 ms



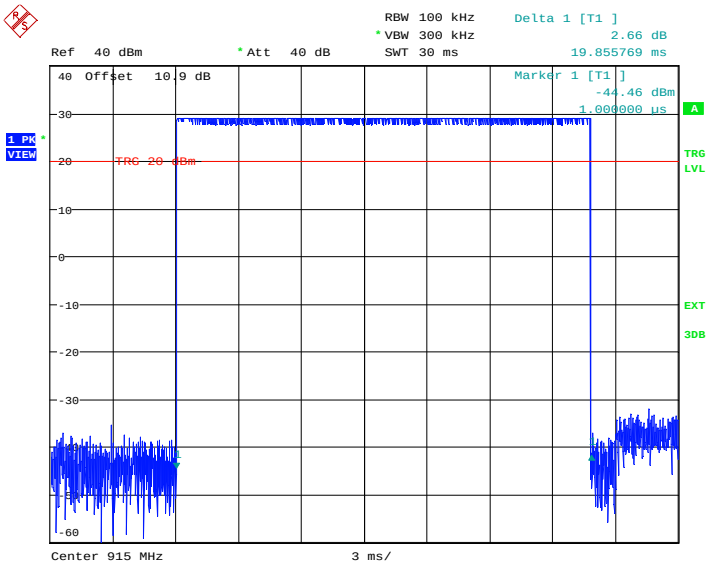
Plot 5.3.4.26. Time of Occupancy, Mode 2a (100 kbps, 200 kHz CS) 902.2 MHz
Dwell Time at 902.2 MHz = 19.86 ms



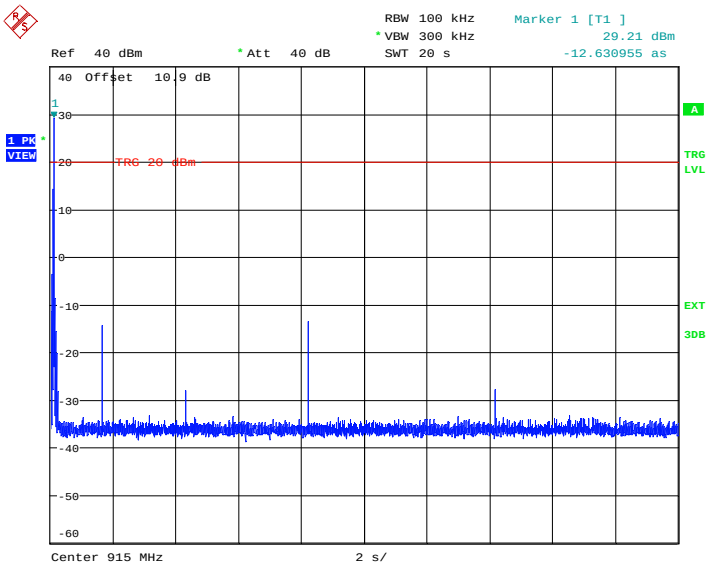
Plot 5.3.4.27. Time of Occupancy, Mode 2a (100 kbps, 200 kHz CS) 902.2 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a 20s period) = 19.86 ms x 1 = 19.86 ms



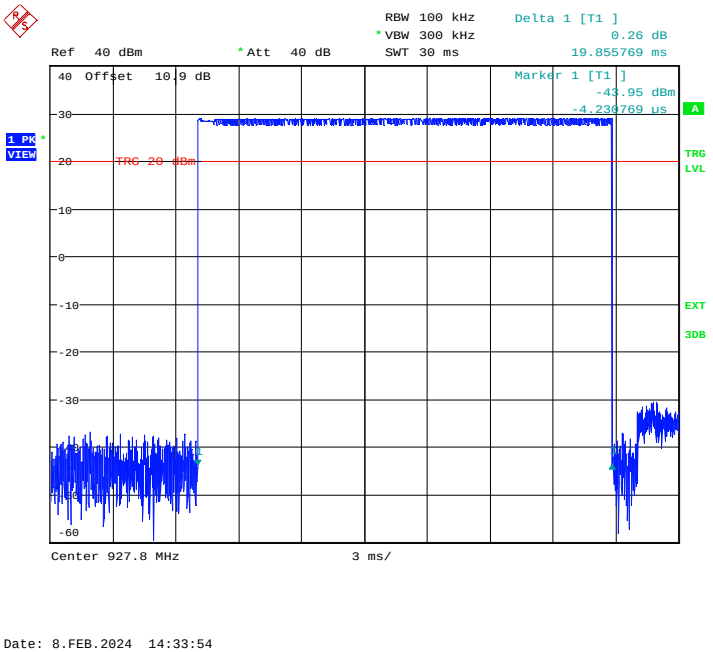
Plot 5.3.4.28. Time of Occupancy, Mode 2a (100 kbps, 200 kHz CS) 915 MHz
Dwell Time at 915 MHz = 19.86 ms



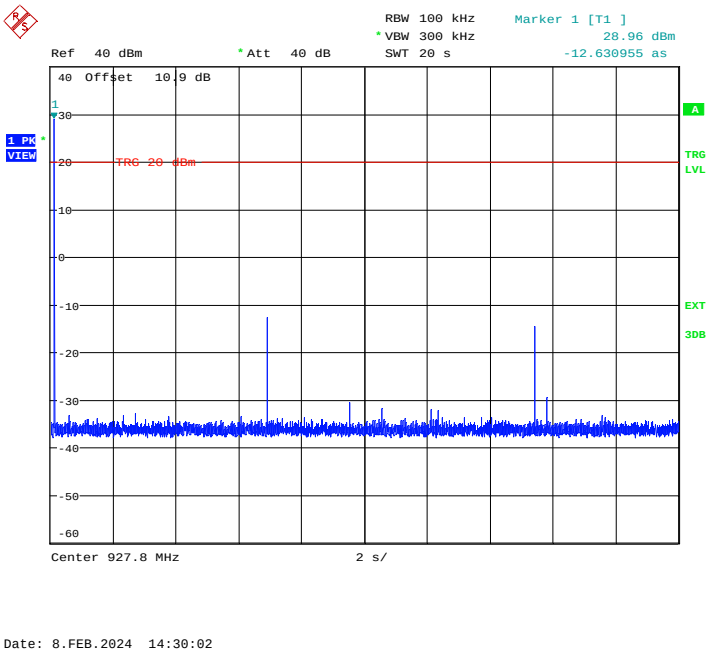
Plot 5.3.4.29. Time of Occupancy, Mode 2a (100 kbps, 200 kHz CS) 915 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a 20s period) = 19.86 ms x 1 = 19.86 ms



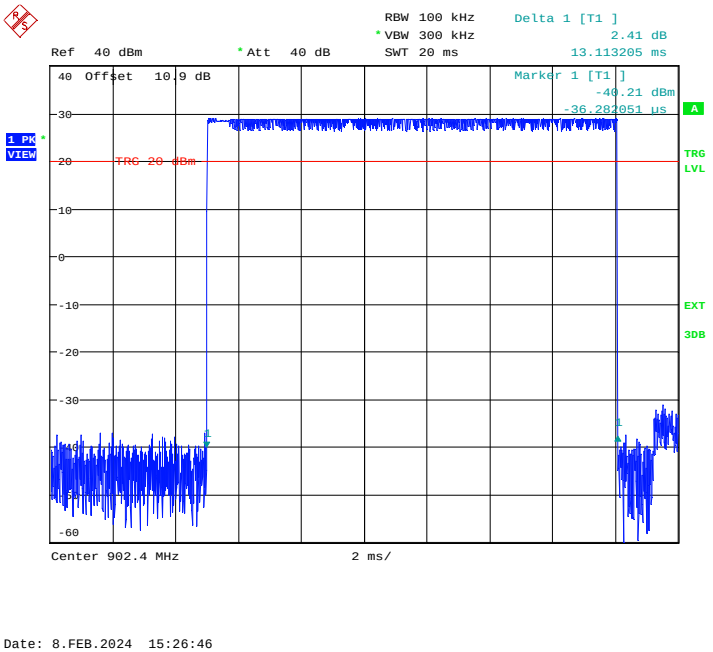
Plot 5.3.4.30. Time of Occupancy, Mode 2a (100 kbps, 200 kHz CS) 927.8 MHz
Dwell Time at 927.8 MHz = 19.86 ms



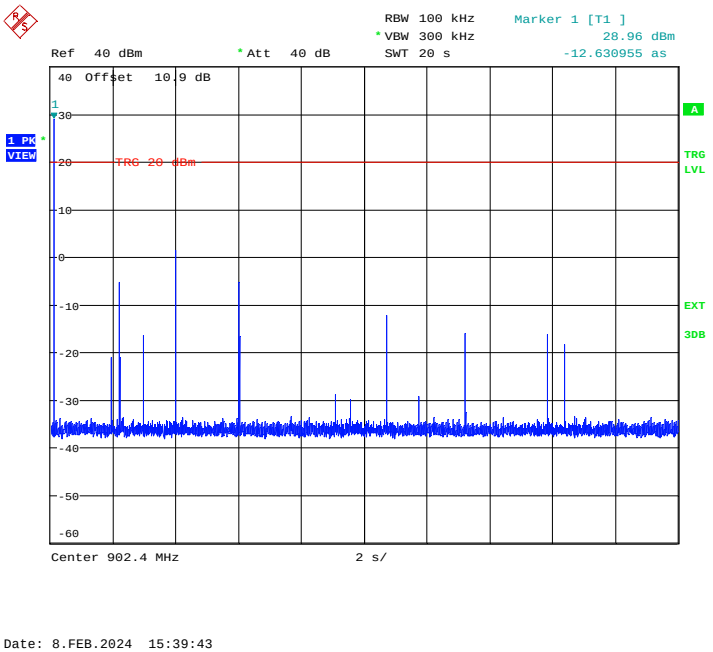
Plot 5.3.4.31. Time of Occupancy, Mode 2a (100 kbps, 200 kHz CS) 927.8 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a 20s period) = 19.86 ms x 1 = 19.86 ms



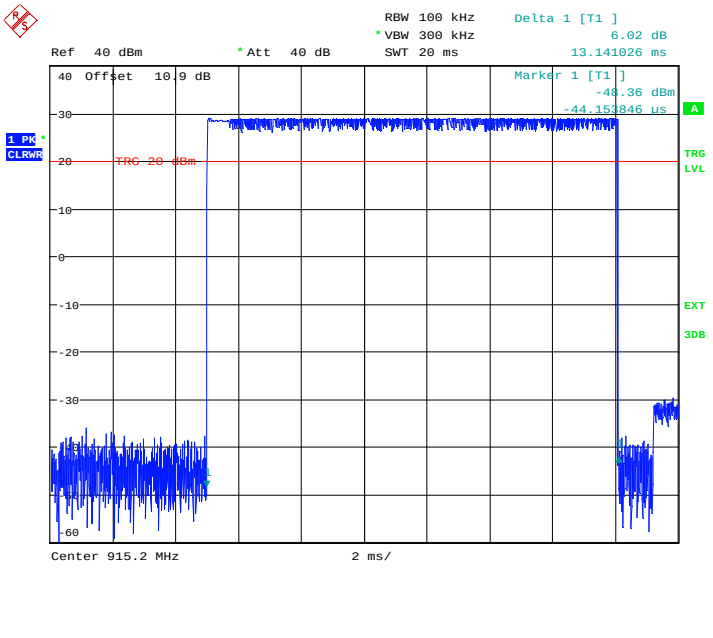
Plot 5.3.4.32. Time of Occupancy, Mode 3 (150 kbps, 400 kHz CS) 902.4 MHz
Dwell Time at 902.4 MHz = 13.11 ms



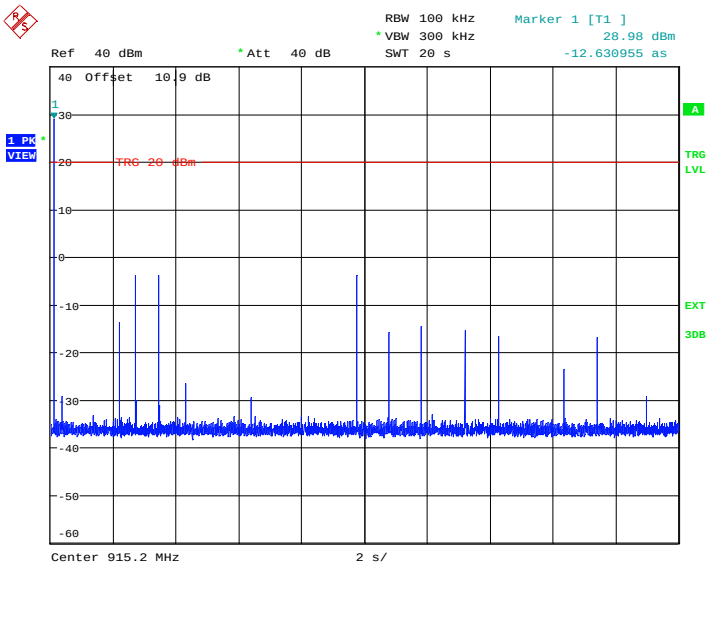
Plot 5.3.4.33. Time of Occupancy, Mode 3 (150 kbps, 400 kHz CS) 902.4 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a 20s period) = 13.11 ms x 1 = 13.11 ms



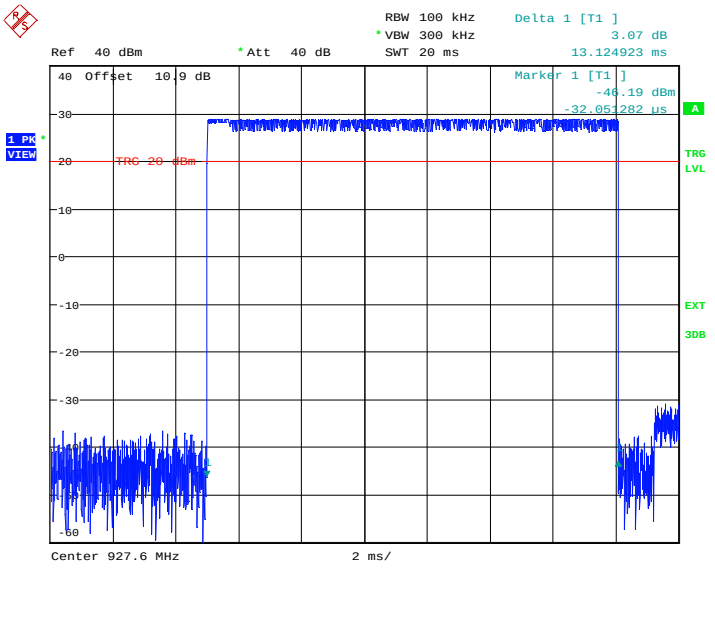
Plot 5.3.4.34. Time of Occupancy, Mode 3 (150 kbps, 400 kHz CS) 915.2 MHz
Dwell Time at 915.2 MHz = 13.14 ms



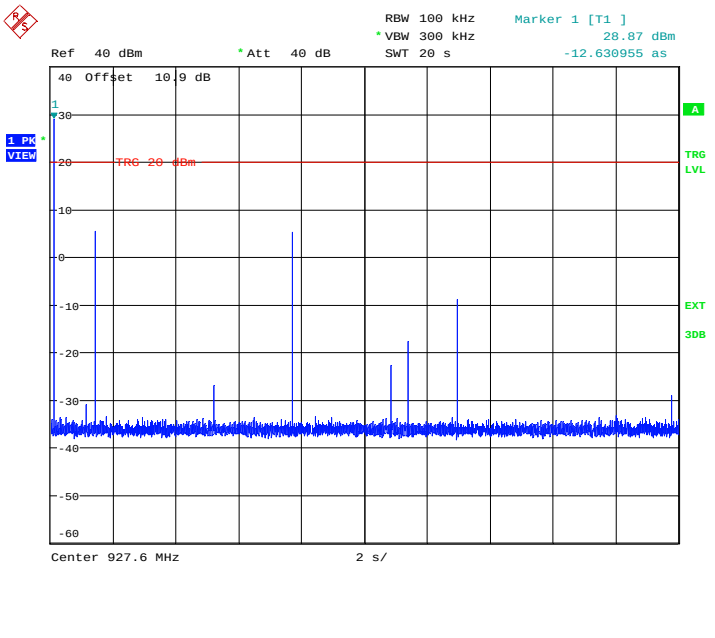
Plot 5.3.4.35. Time of Occupancy, Mode 3 (150 kbps, 400 kHz CS) 915.2 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a 20s period) = 13.14 ms x 1 = 13.14 ms



Plot 5.3.4.36. Time of Occupancy, Mode 3 (150 kbps, 400 kHz CS) 927.6 MHz
Dwell Time at 927.6 MHz = 13.12 ms



Plot 5.3.4.37. Time of Occupancy, Mode 3 (150 kbps, 400 kHz CS) 927.6 MHz
Average time of occupancy = (Dwell Time) x (number of hops within a 20s period) = 13.12 ms x 1 = 13.12 ms



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

5.4.1. Limits

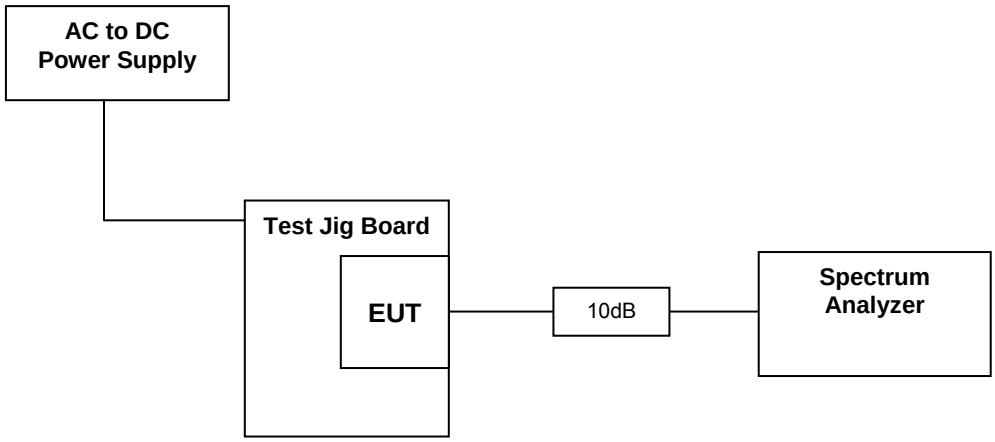
§15.247(b)(2): For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section..

§15.247(b)(4): he 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.

5.4.2. Method of Measurements

ANSI C63.10-2013, section 7.8.5

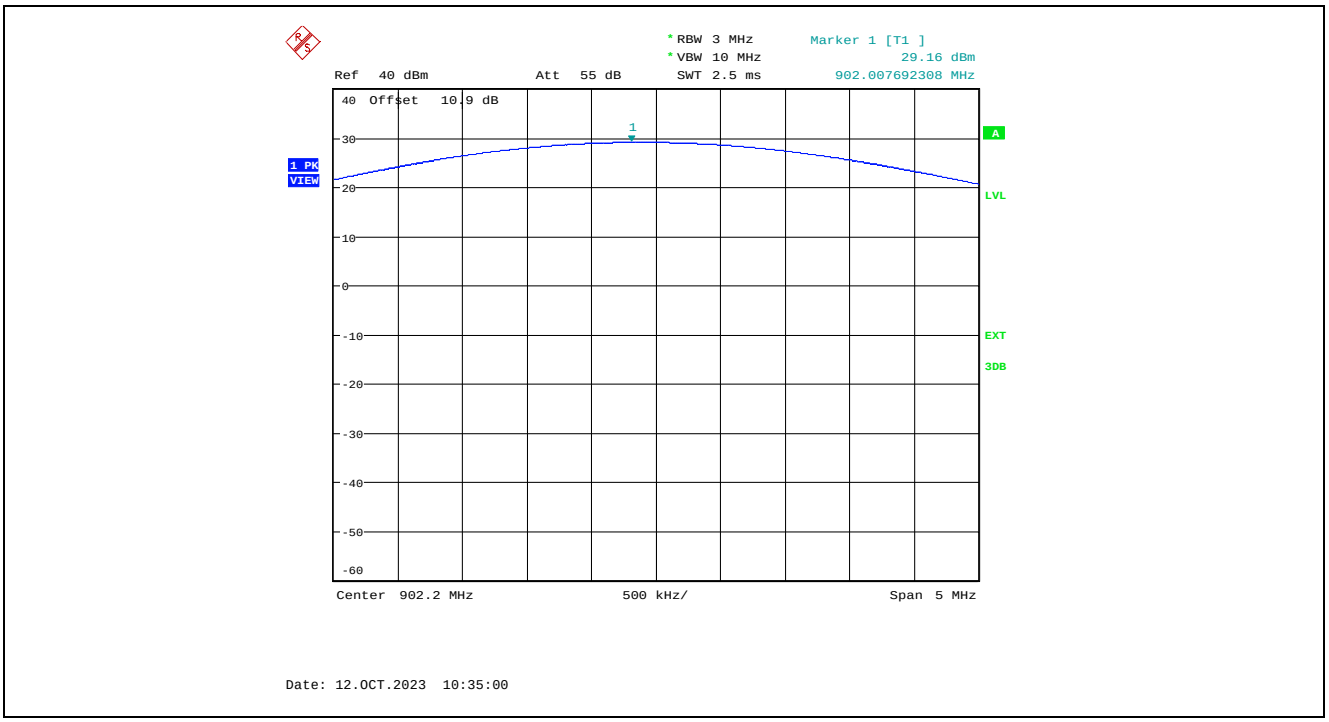
5.4.3. Test Arrangement



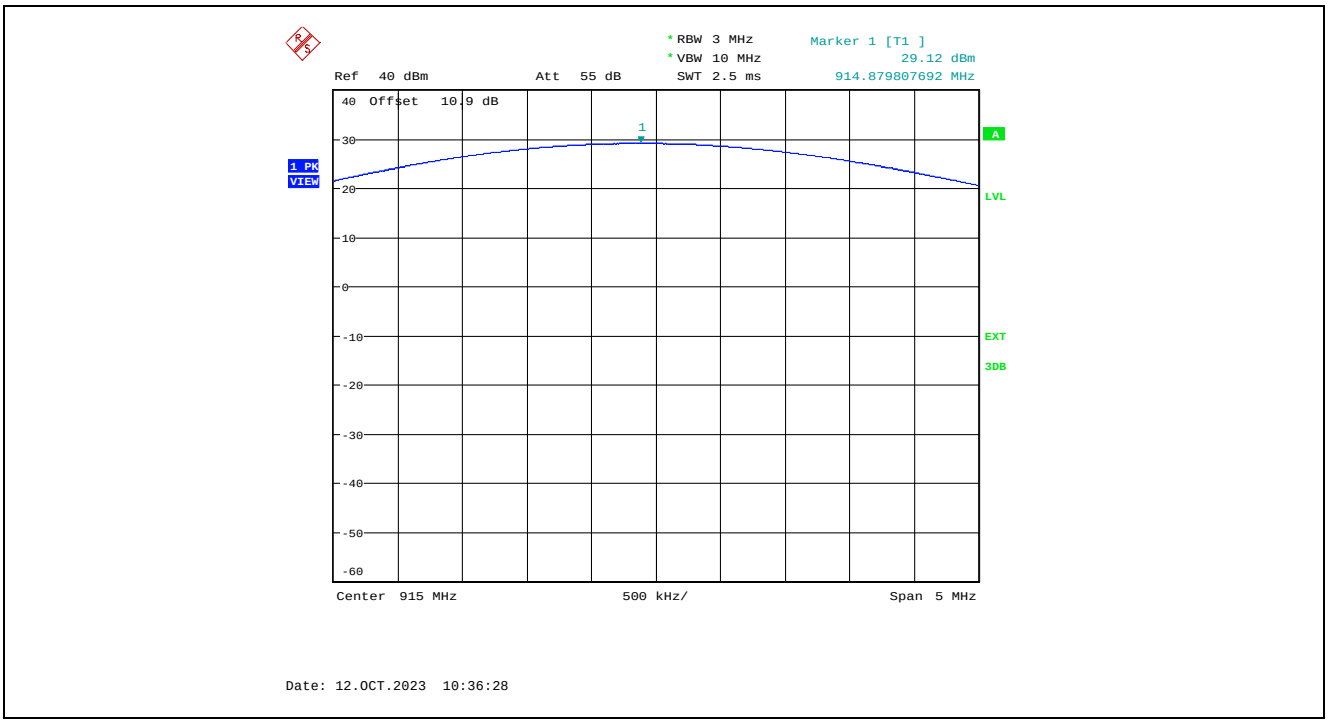
5.4.4. Test Data

Operating Mode	Raw Power Setting	Frequency (MHz)	Max. Peak Output Power at Antenna Terminal		Max. Antenna Assembly Gain (dBi)	EIRP (dBm)	Max. Peak Conducted Output Power Limit (dBm)	EIRP Limit (dBm)
			(dBm)	(W)				
Mode 1b (50 kbps)	14	902.2	29.16	0.82414	3	32.16	30	36
		915	29.12	0.81658	3	32.12	30	36
		927.8	28.98	0.79068	3	31.98	30	36
	-10	902.2	9.83	0.00962	3	12.83	30	36
		915	8.31	0.00678	3	11.31	30	36
		927.8	5.19	0.00330	3	8.19	30	36
Mode 2a (100 kbps)	14	902.2	29.04	0.80168	3	32.04	30	36
		915	29.09	0.81096	3	32.09	30	36
		927.8	28.93	0.78163	3	31.93	30	36
	-10	902.2	9.64	0.00920	3	12.64	30	36
		915	8.46	0.00701	3	11.46	30	36
		927.8	7.46	0.00557	3	10.46	30	36
Mode 3 (150 kbps)	14	902.4	29.21	0.83368	3	32.21	30	36
		915.2	29.14	0.82035	3	32.14	30	36
		927.6	29.02	0.79799	3	32.02	30	36
	-10	902.4	14.53	0.02838	3	17.53	30	36
		915.2	12.96	0.01977	3	15.96	30	36
		927.6	9.53	0.00897	3	12.53	30	36

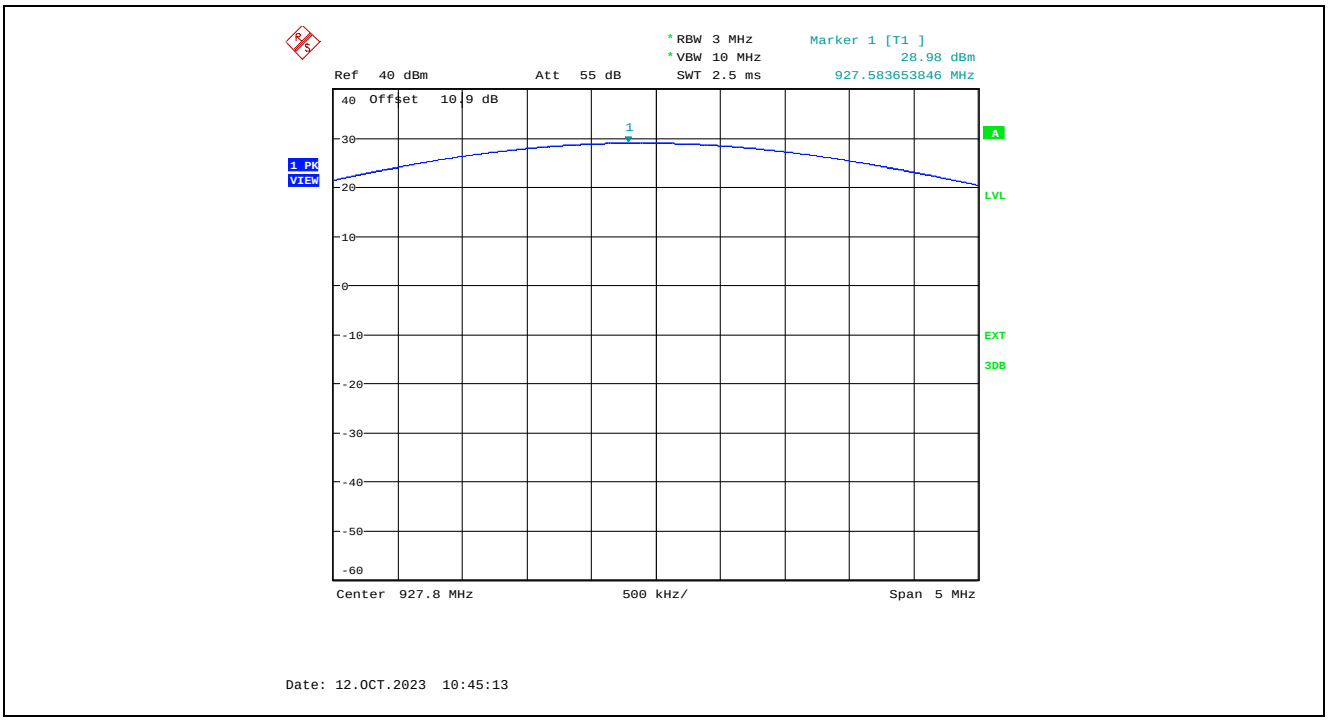
Plot 5.4.4.1. Maximum Peak Conducted Output Power, Mode 1b, Raw Power Setting at 14, 902.2 MHz



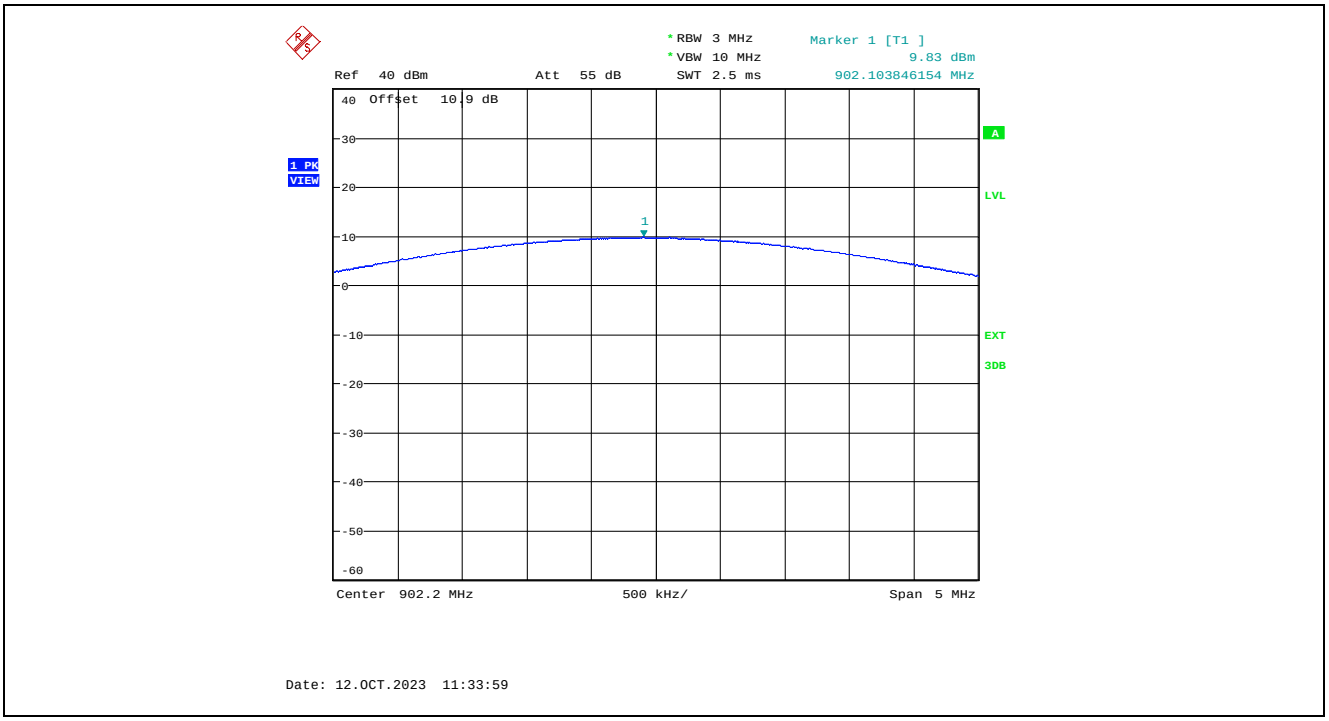
Plot 5.4.4.2. Maximum Peak Conducted Output Power, Mode 1b, Raw Power Setting at 14, 915 MHz



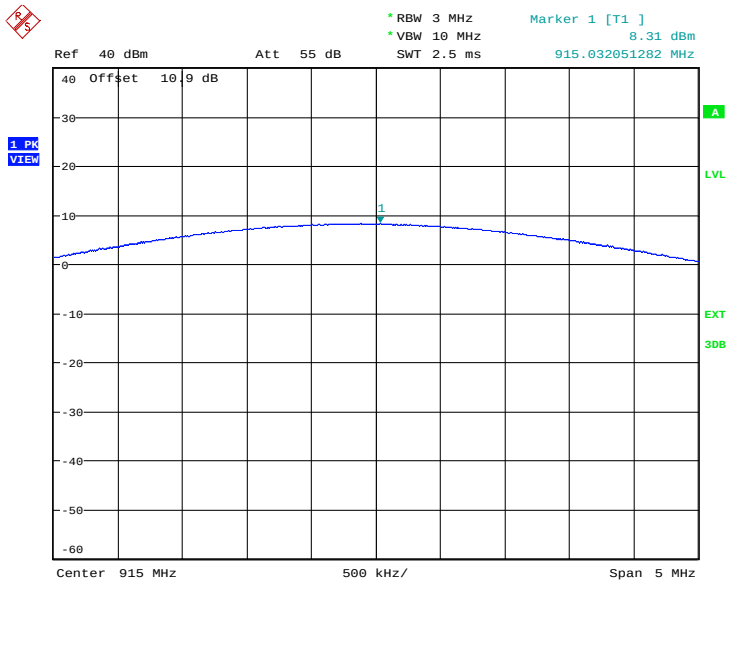
Plot 5.4.4.3. Maximum Peak Conducted Output Power, Mode 1b, Raw Power Setting at 14, 927.8 MHz



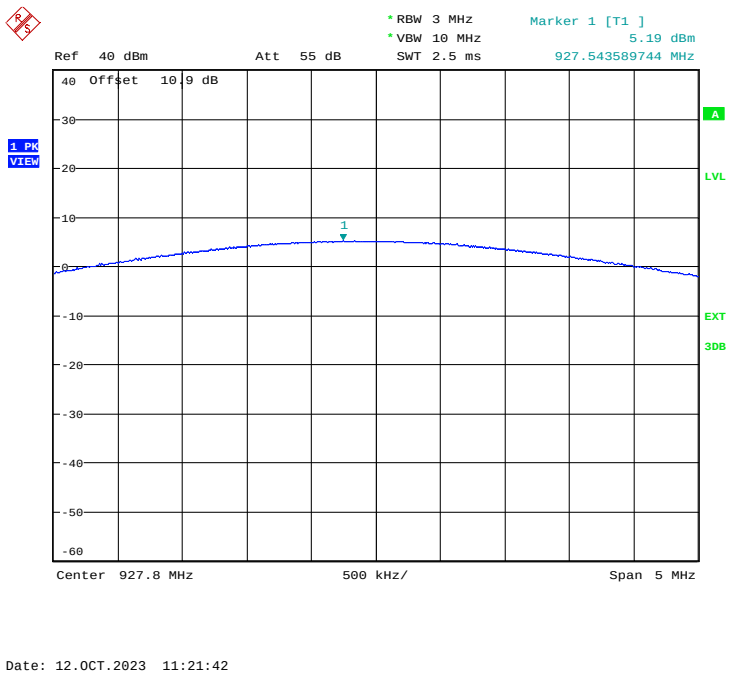
Plot 5.4.4.4. Maximum Peak Conducted Output Power, Mode 1b, Raw Power Setting at -10, 902.2 MHz



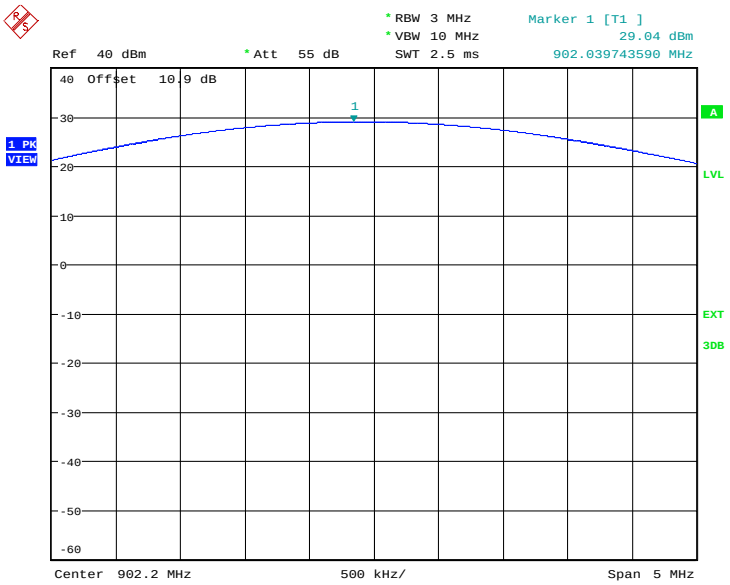
Plot 5.4.4.5. Maximum Peak Conducted Output Power, Mode 1b, Raw Power Setting at -10, 915 MHz



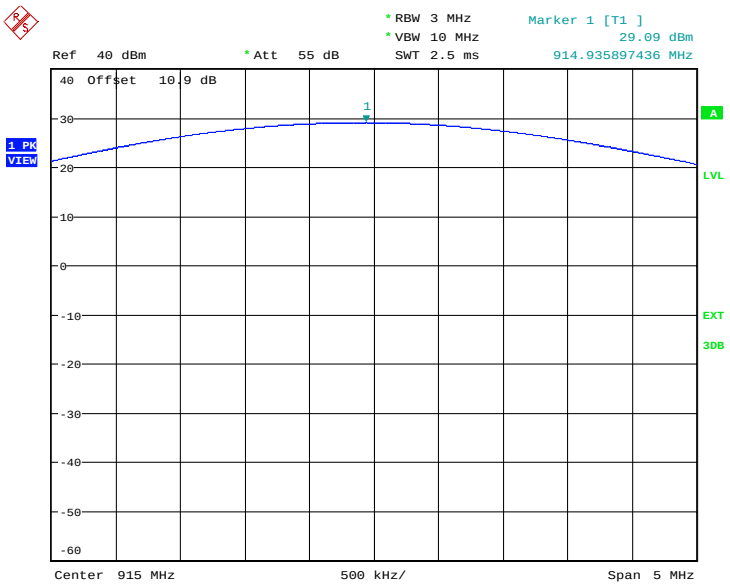
Plot 5.4.4.6. Maximum Peak Conducted Output Power, Mode 1b, Raw Power Setting at -10, 927.8 MHz



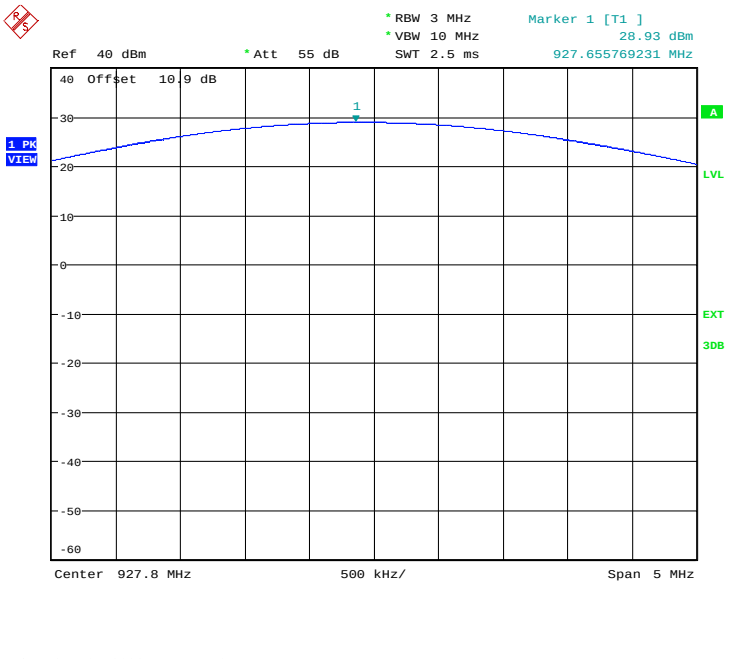
Plot 5.4.4.7. Maximum Peak Conducted Output Power, Mode 2a, Raw Power Setting at 14, 902.2 MHz



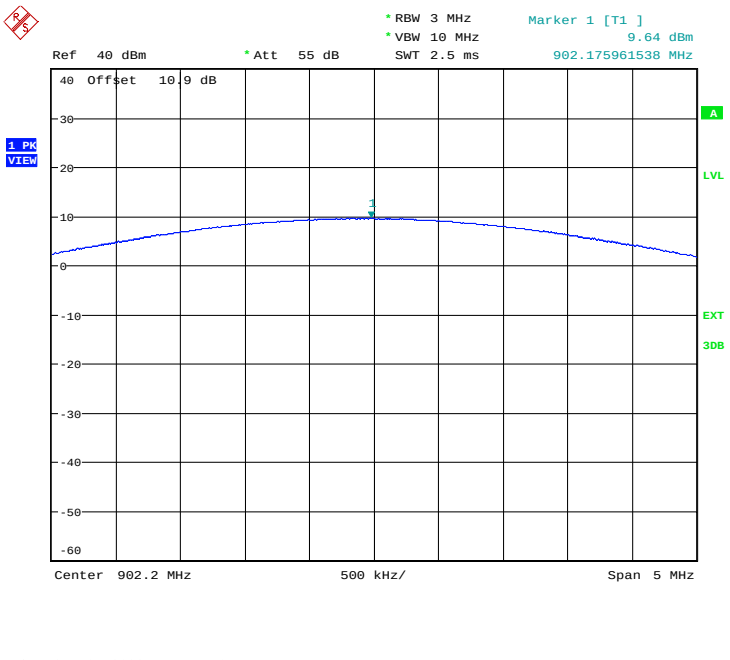
Plot 5.4.4.8. Maximum Peak Conducted Output Power, Mode 2a, Raw Power Setting at 14, 915 MHz



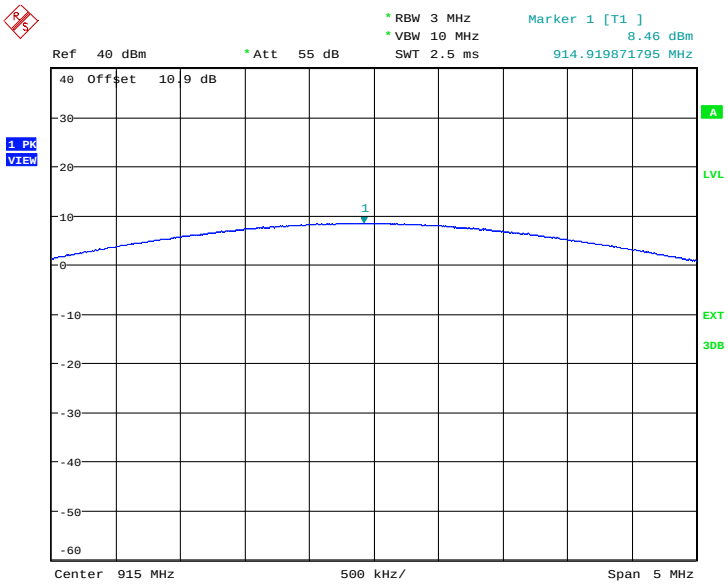
Plot 5.4.4.9. Maximum Peak Conducted Output Power, Mode 2a, Raw Power Setting at 14, 927.8 MHz



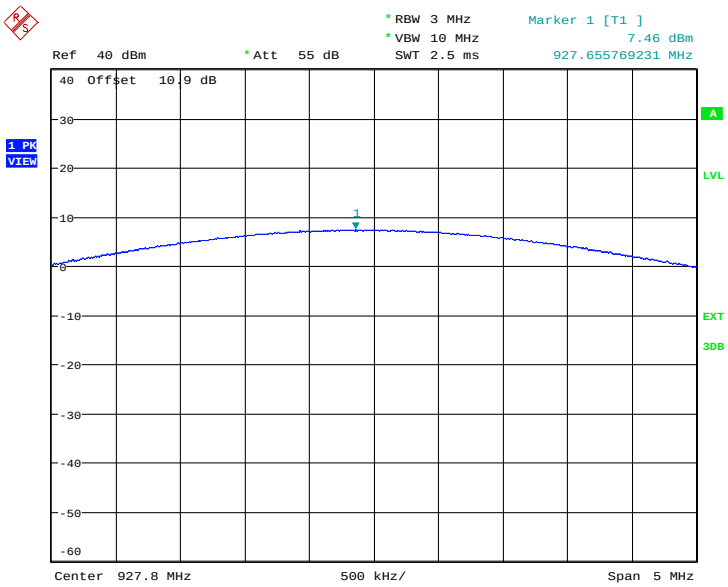
Plot 5.4.4.10. Maximum Peak Conducted Output Power, Mode 2a, Raw Power Setting at -10, 902.2 MHz



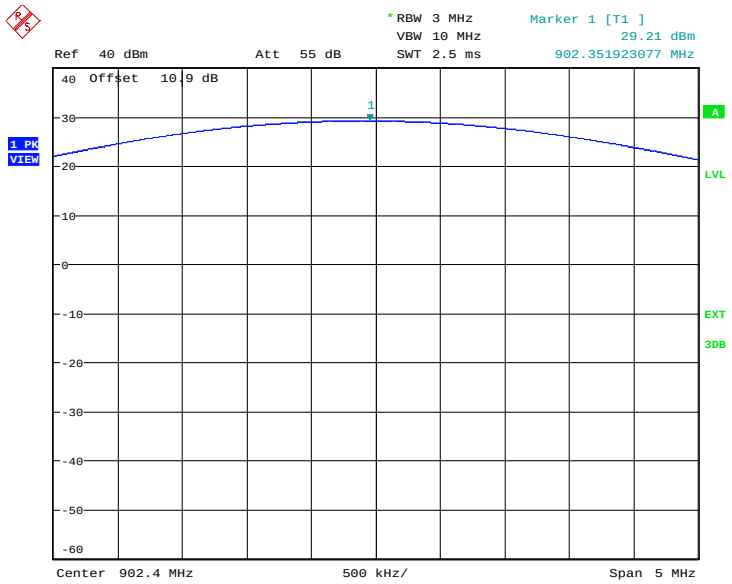
Plot 5.4.4.11. Maximum Peak Conducted Output Power, Mode 2a, Raw Power Setting at -10, 915 MHz



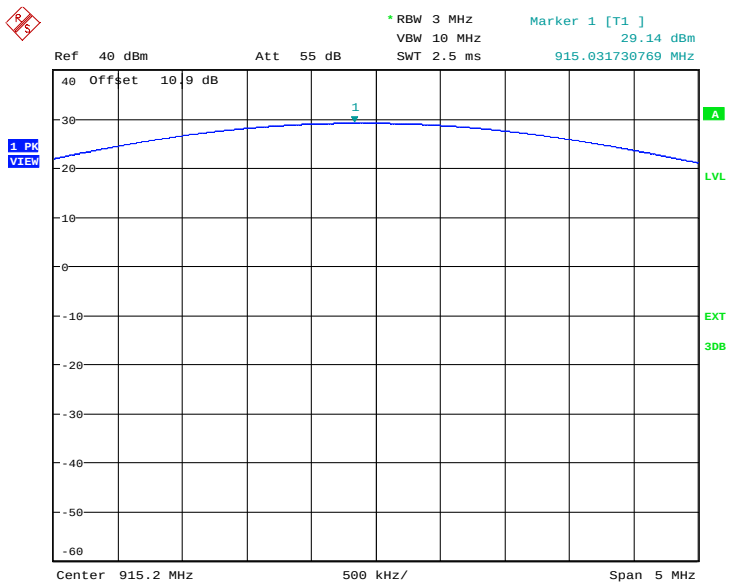
Plot 5.4.4.12. Maximum Peak Conducted Output Power, Mode 2a, Raw Power Setting at -10, 927.8 MHz



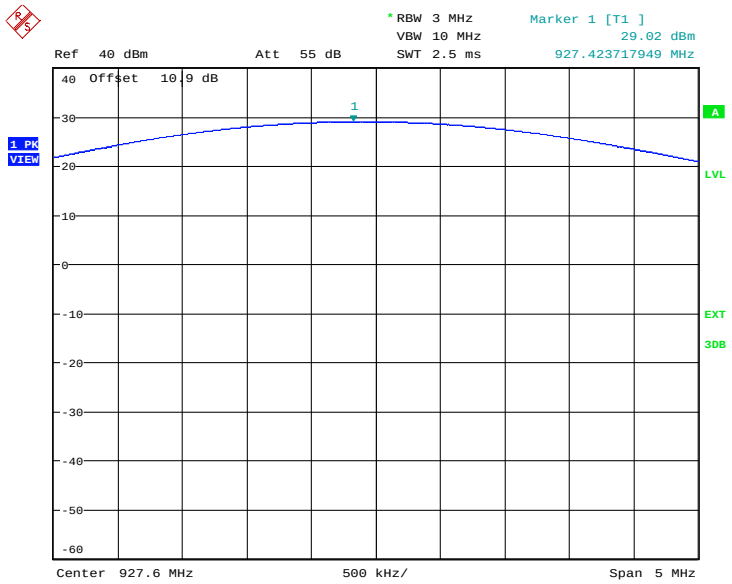
Plot 5.4.4.13. Maximum Peak Conducted Output Power, Mode 3, Raw Power Setting at 14, 902.4 MHz



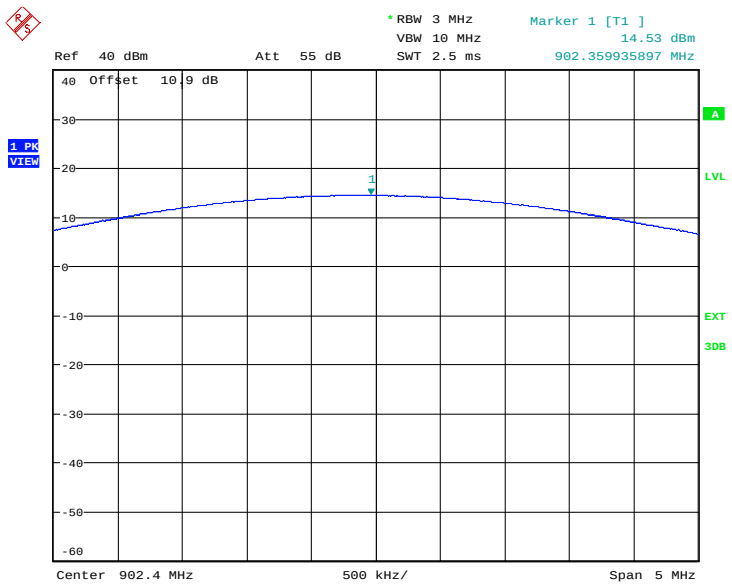
Plot 5.4.4.14. Maximum Peak Conducted Output Power, Mode 3, Raw Power Setting at 14, 915.2 MHz



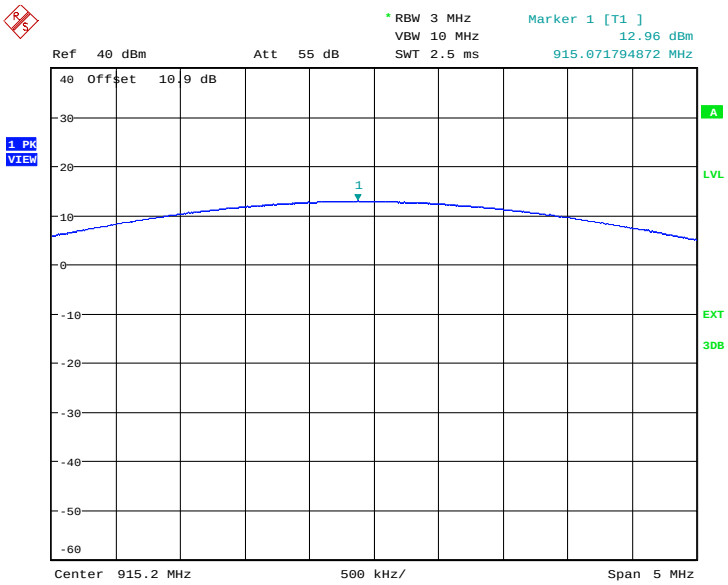
Plot 5.4.4.15. Maximum Peak Conducted Output Power, Mode 3, Raw Power Setting at 14, 927.6 MHz



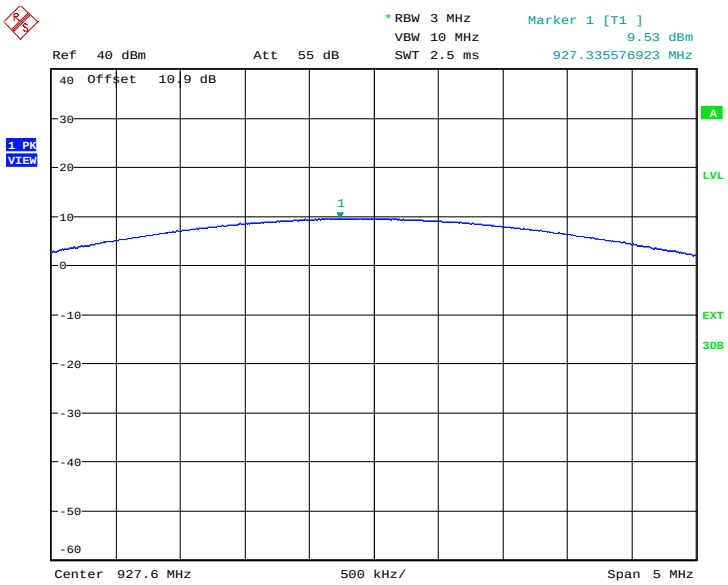
Plot 5.4.4.16. Maximum Peak Conducted Output Power, Mode 3, Raw Power Setting at -10, 902.4 MHz



Plot 5.4.4.17. Maximum Peak Conducted Output Power, Mode 3, Raw Power Setting at -10, 915.2 MHz



Plot 5.4.4.18. Maximum Peak Conducted Output Power, Mode 3, Raw Power Setting at -10, 927.6 MHz



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

5.5.1. 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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §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

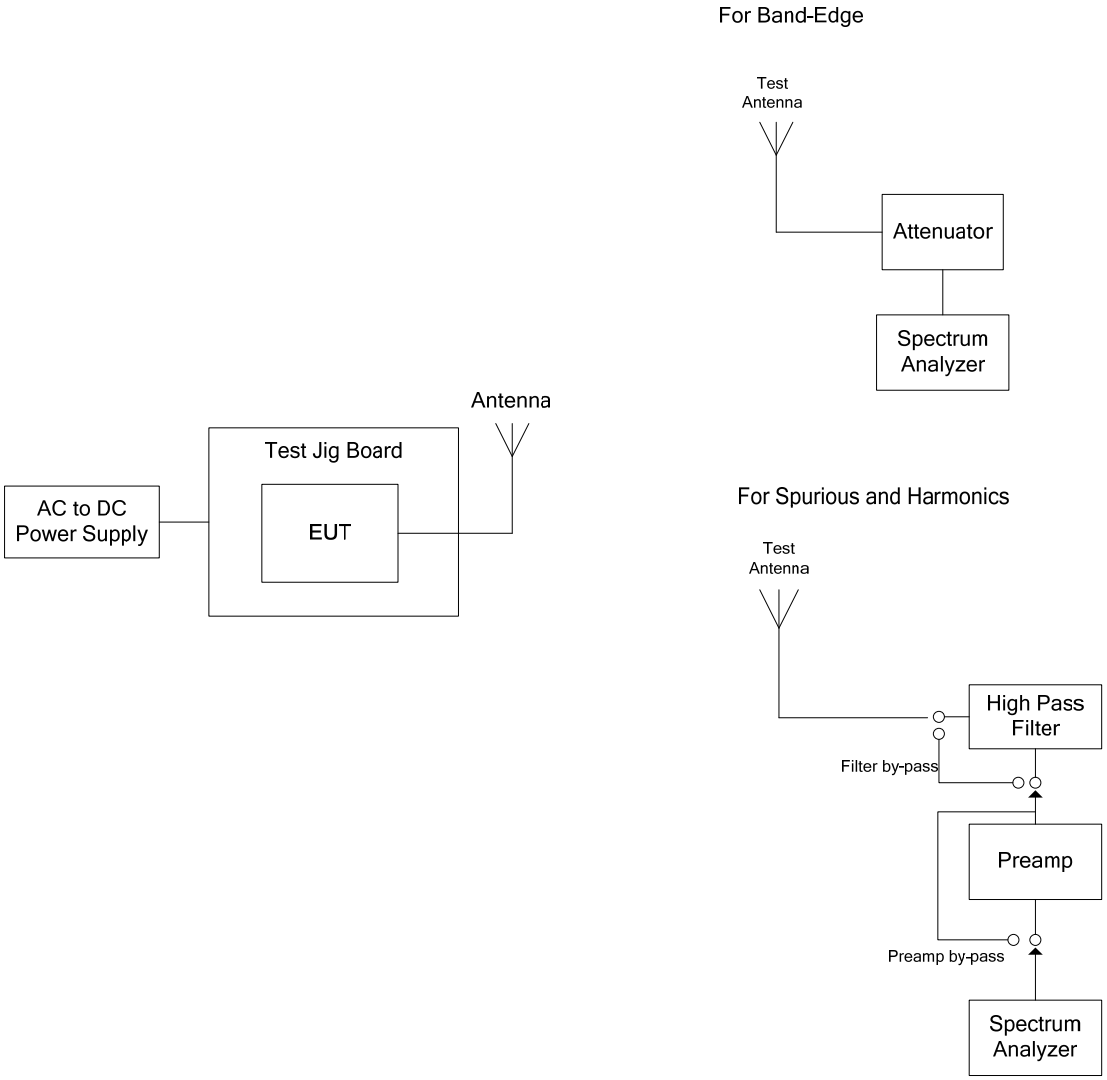
Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

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

5.5.2. Method of Measurements

ANSI C63.10 and ANSI 63.4 procedures.

5.5.3. Test Arrangement



5.5.4. Test Data

Remark(s):

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.
- The following test data represent the worst-case derived from exploratory tests.

5.5.4.1. EUT with 1 dBi Chip Antenna, Mode 3

5.5.4.1.1. Spurious Radiated Emission

Fundamental Frequency:	902.4 MHz
Raw Power Setting:	14
Measured Conducted Power:	29.21 dBm
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
902.4	118.27	--	V	--	--	--	--
902.4	119.52	--	H	--	--	--	--
2707.2	50.60	48.35	V	54.0	99.5	-5.7	Pass*
2707.2	49.55	46.19	H	54.0	99.5	-7.8	Pass*
3609.6	43.88	35.19	V	54.0	99.5	-18.8	Pass*
3609.6	44.48	36.17	H	54.0	99.5	-17.8	Pass*
4512.0	44.74	32.04	H	54.0	99.5	-22.0	Pass*
5414.4	46.22	35.18	V	54.0	99.5	-18.8	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:	915.2 MHz
Raw Power Setting:	14
Measured Conducted Power:	29.14 dBm
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
915.2	118.14	--	V	--	--	--	--
915.2	118.36	--	H	--	--	--	--
2745.6	46.16	42.11	V	54.0	98.4	-11.9	Pass*
2745.6	48.53	45.07	H	54.0	98.4	-8.9	Pass*
3660.8	44.19	34.93	H	54.0	98.4	-19.1	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:	927.6 MHz
Raw Power Setting:	14
Measured Conducted Power:	29.02 dBm
Frequency Test Range:	30 MHz – 10 GHz

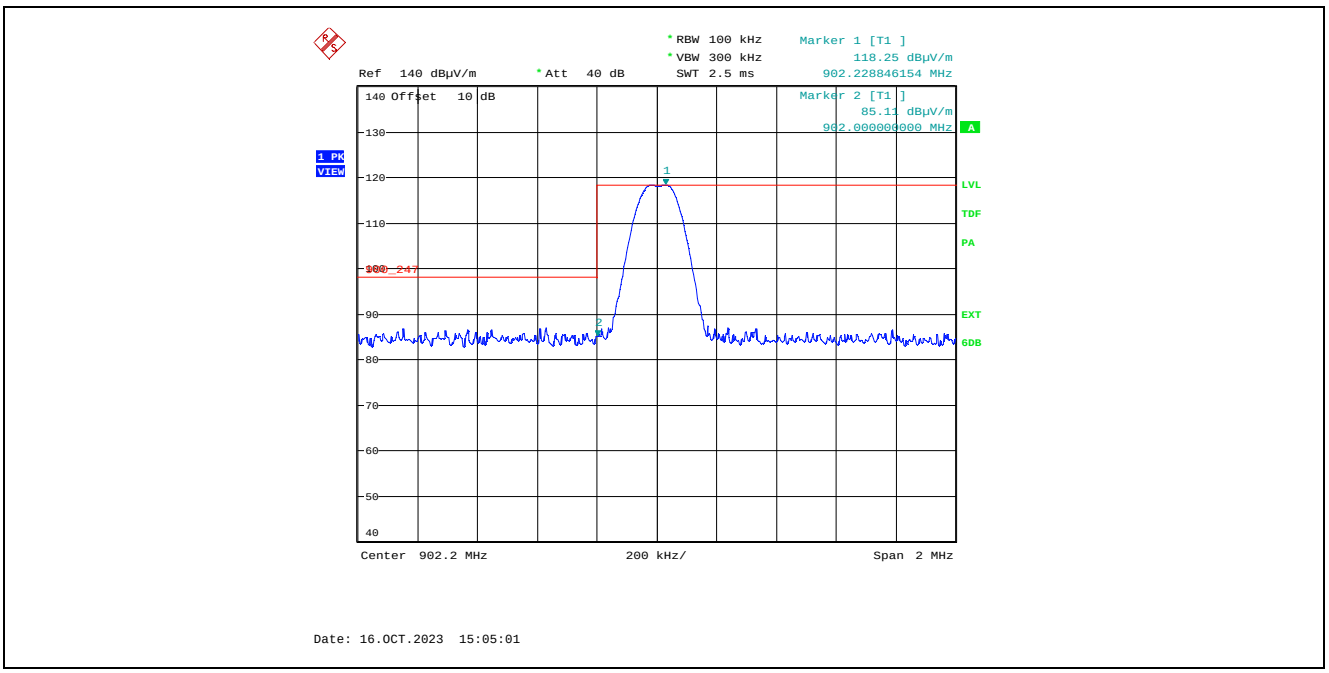
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
927.6	117.55	--	V	--	--	--	--
927.6	118.07	--	H	--	--	--	--
2782.8	50.30	47.76	V	54.0	98.1	-6.2	Pass*
2782.8	47.30	49.71	H	54.0	98.1	-4.3	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

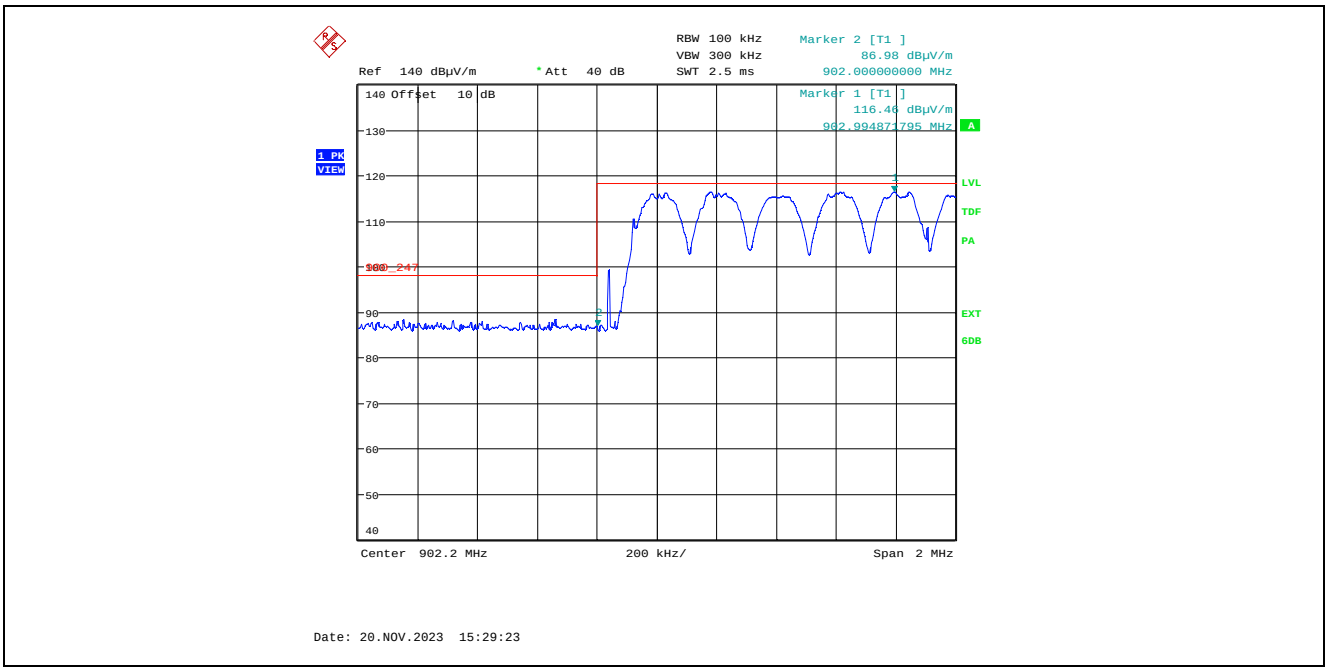
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.5.4.1.2. Band –Edge RF Radiated Emissions

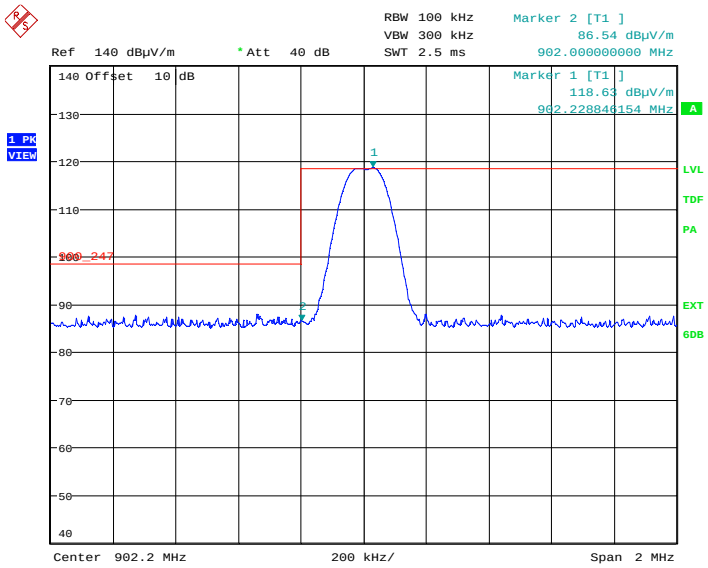
Plot 5.5.4.1.2.1. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



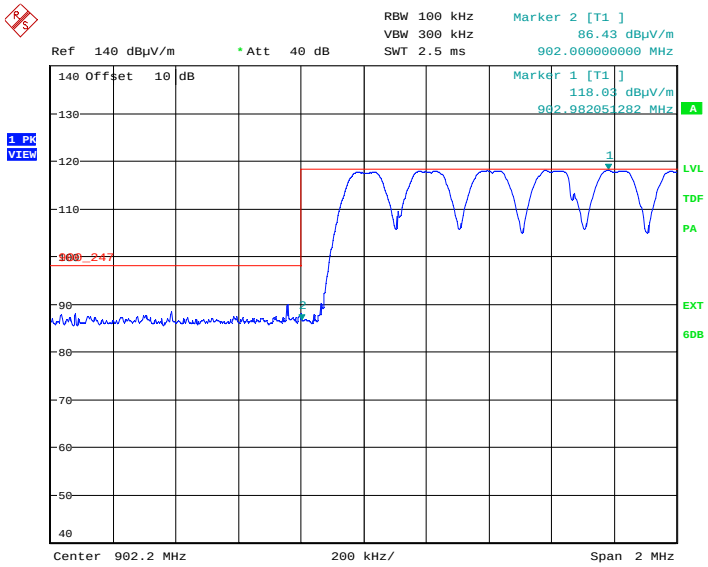
Plot 5.5.4.1.2.2. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



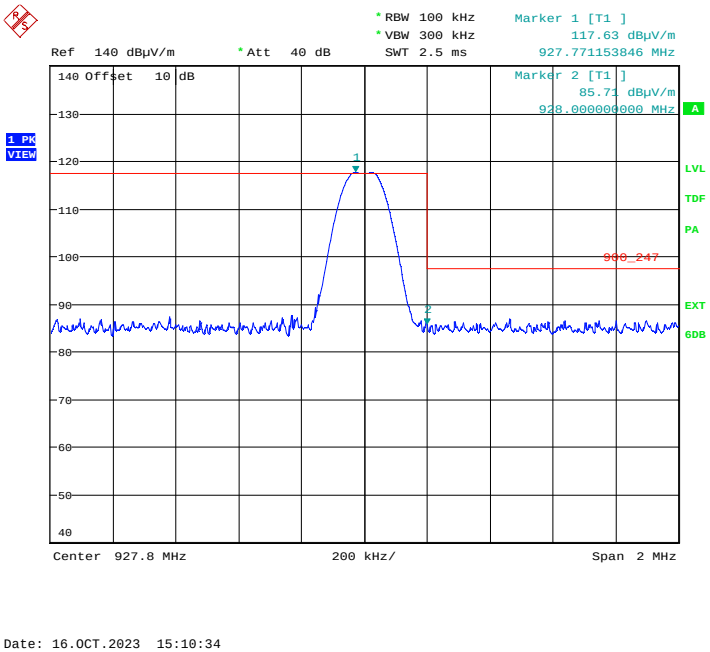
Plot 5.5.4.1.2.3. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



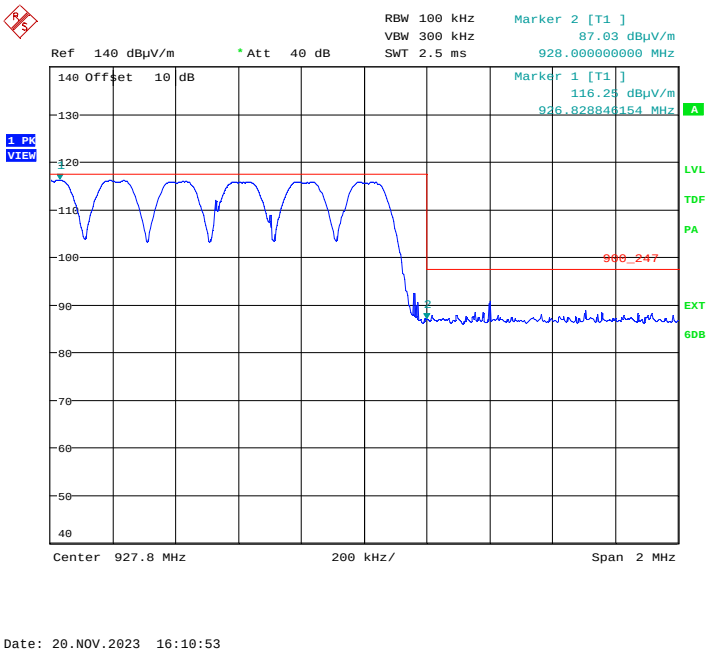
Plot 5.5.4.1.2.4. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



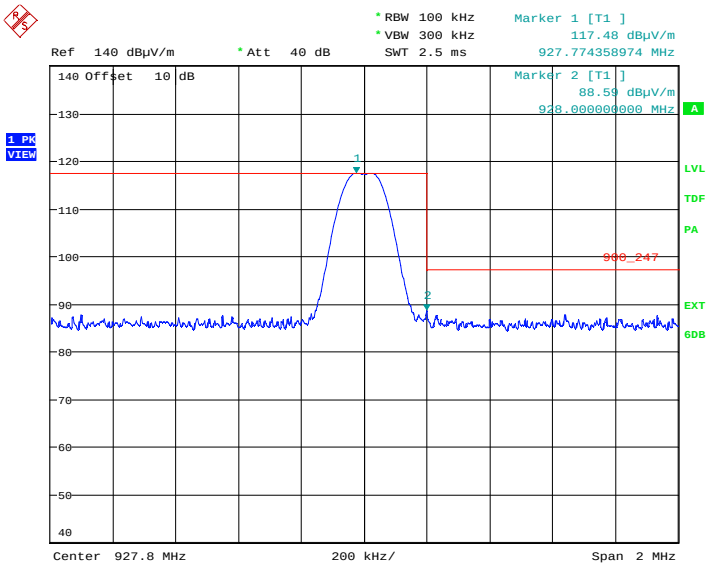
Plot 5.5.4.1.2.5. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Single Frequency Mode, High End of Frequency Band



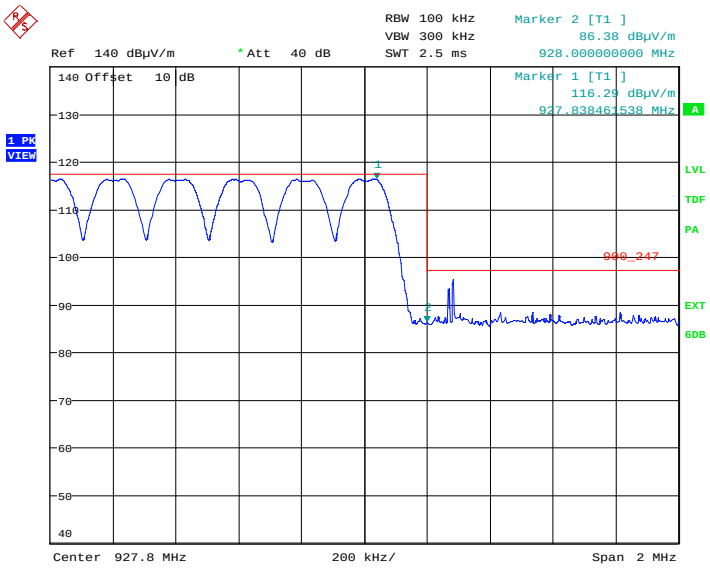
Plot 5.5.4.1.2.6. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



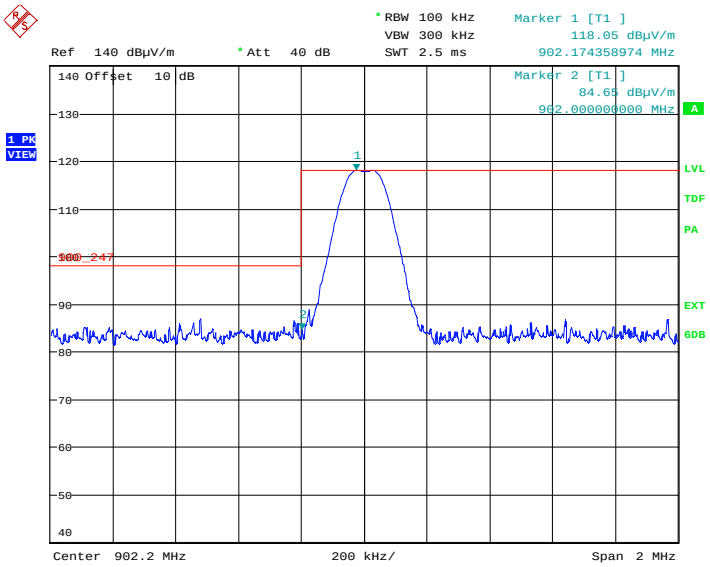
Plot 5.5.4.1.2.7. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Single Frequency Mode, High End of Frequency Band



Plot 5.5.4.1.2.8. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band

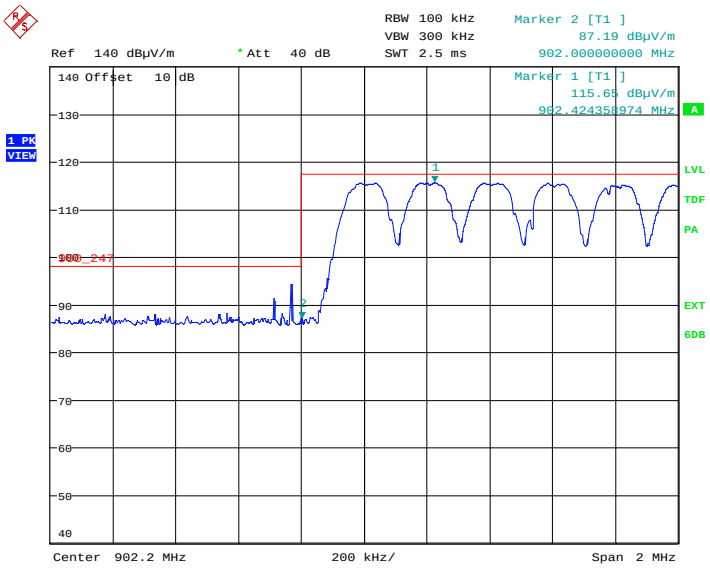


Plot 5.5.4.1.2.9. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



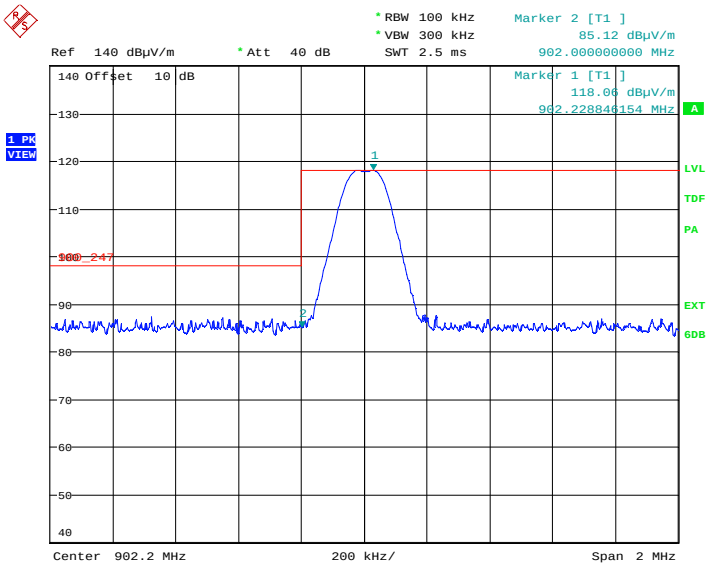
Date: 21.NOV.2023 12:35:32

Plot 5.5.4.1.2.10. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band

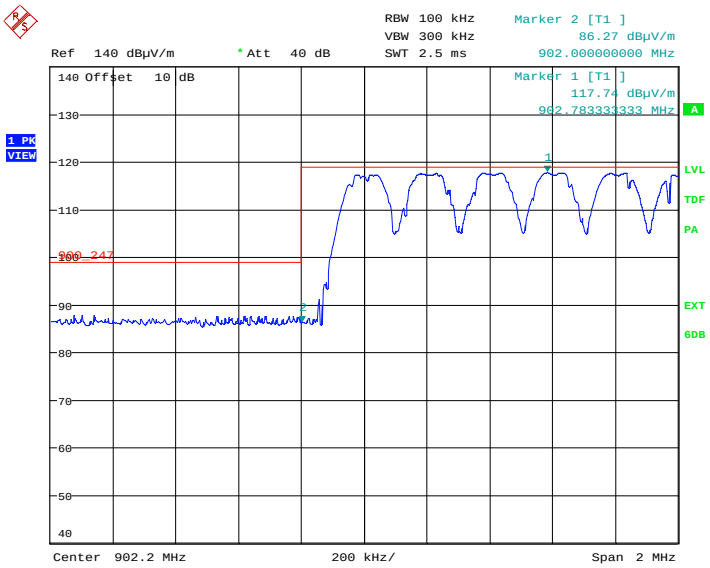


Date: 20.NOV.2023 16:30:31

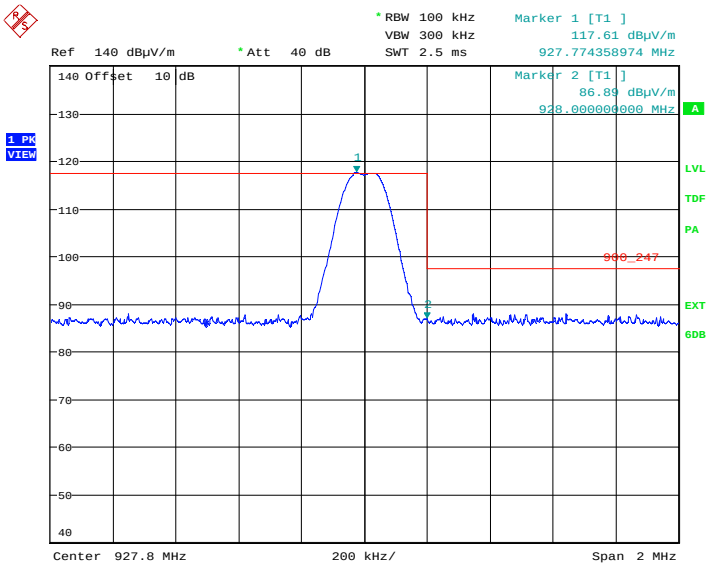
Plot 5.5.4.1.2.11. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



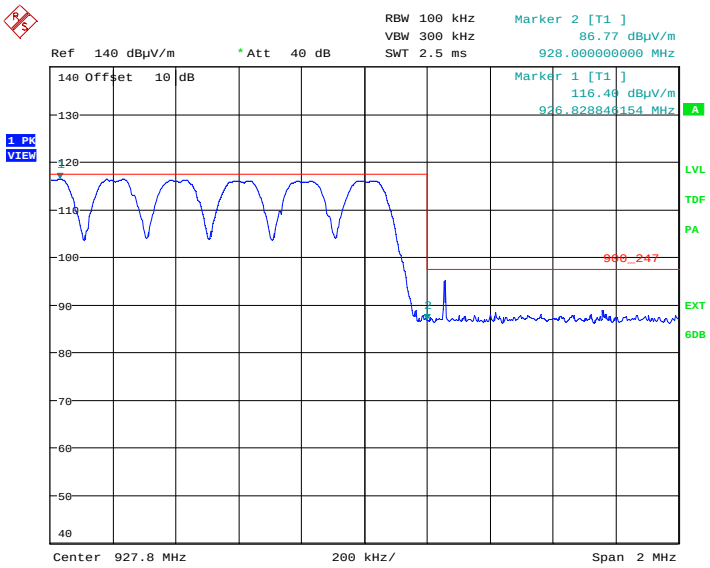
Plot 5.5.4.1.2.12. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



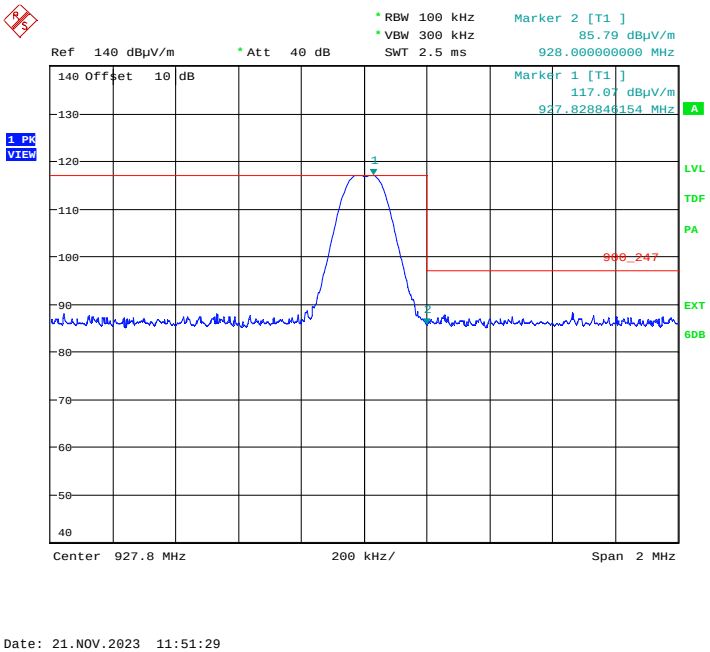
Plot 5.5.4.1.2.13. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Single Frequency Mode, High End of Frequency Band



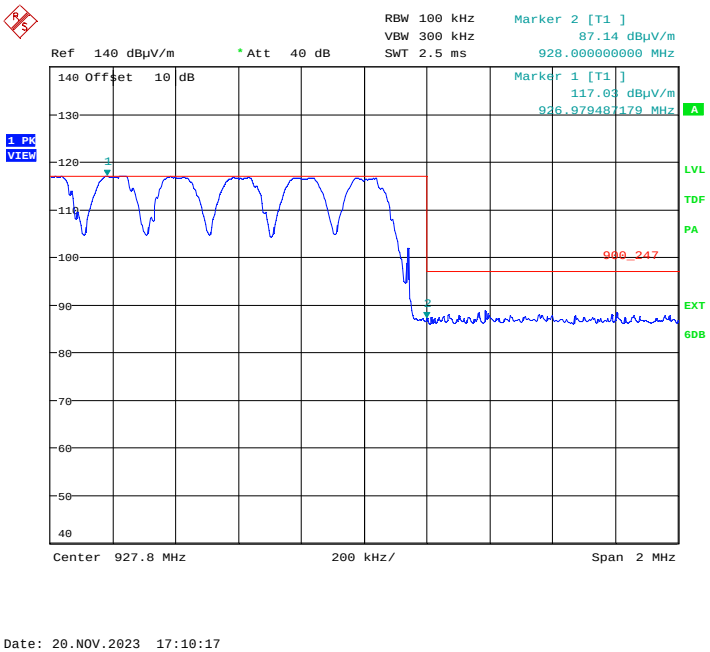
Plot 5.5.4.1.2.14. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



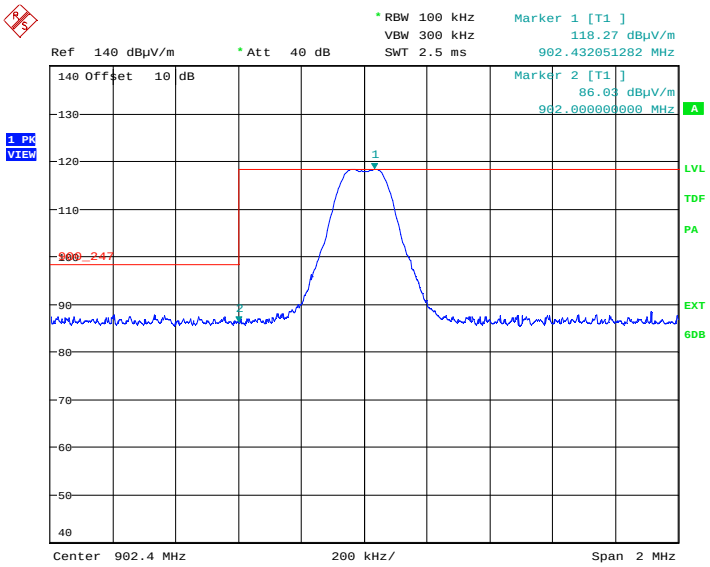
Plot 5.5.4.1.2.15. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Single Frequency Mode, High End of Frequency Band



Plot 5.5.4.1.2.16. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band

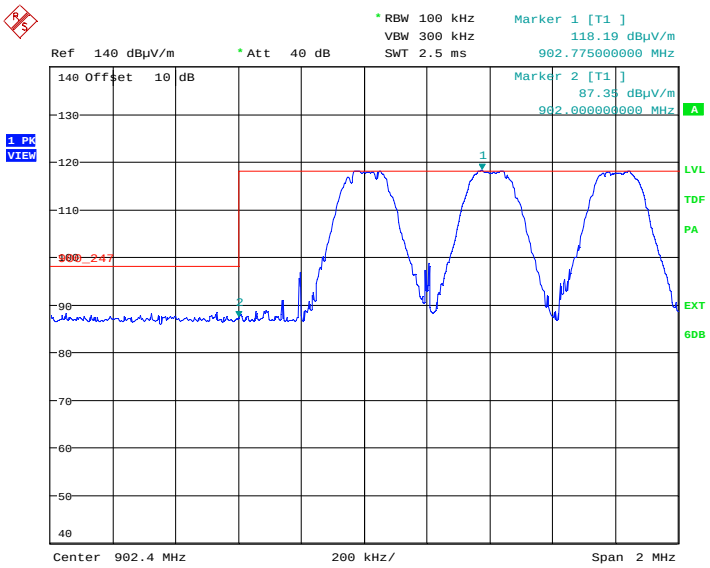


Plot 5.5.4.1.2.17. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



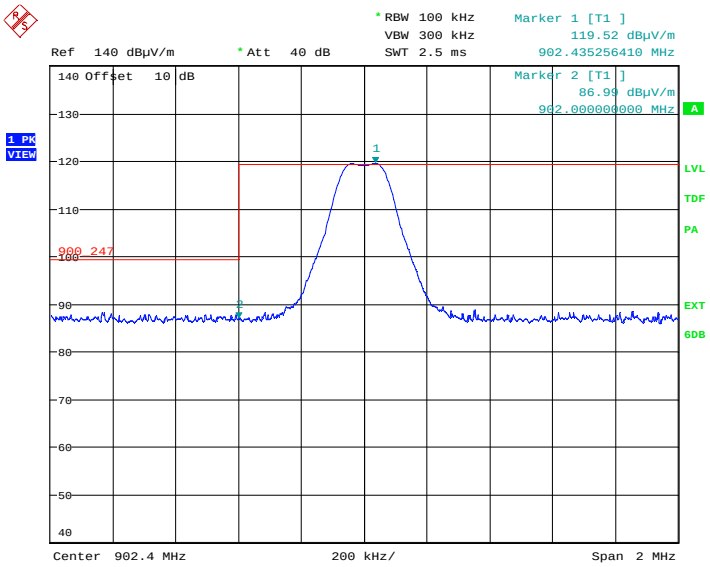
Date: 28.SEP.2023 15:11:05

Plot 5.5.4.1.2.18. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band

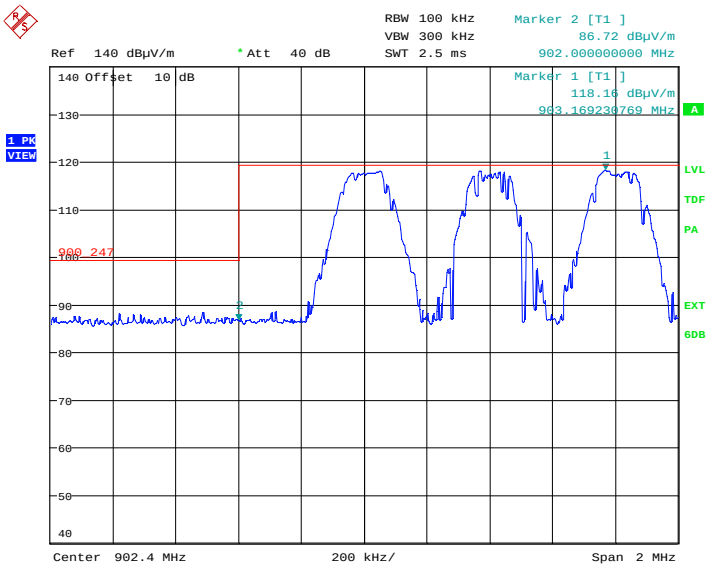


Date: 21.NOV.2023 13:43:36

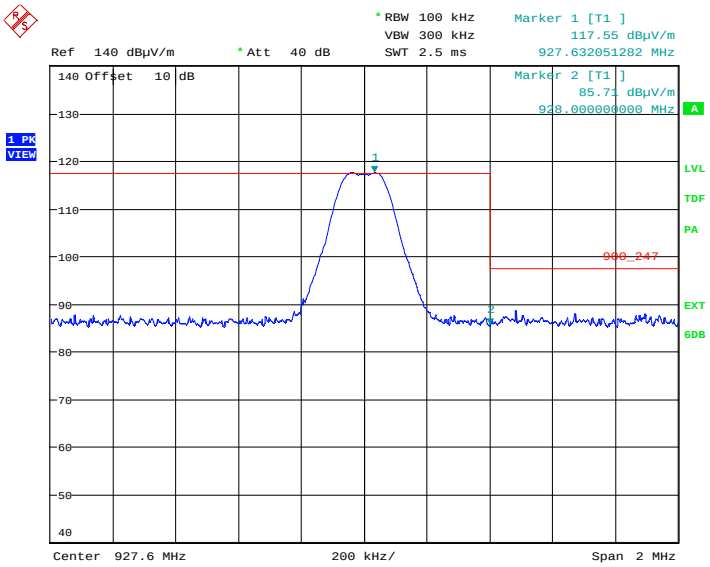
Plot 5.5.4.1.2.19. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



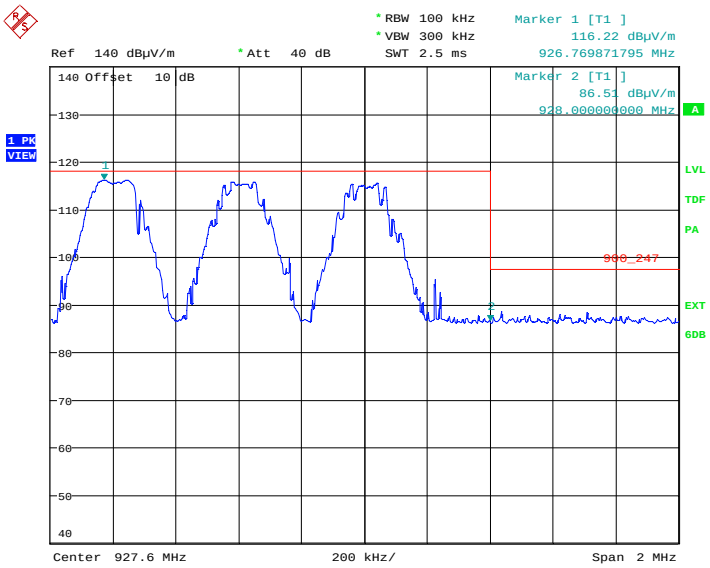
Plot 5.5.4.1.2.20. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



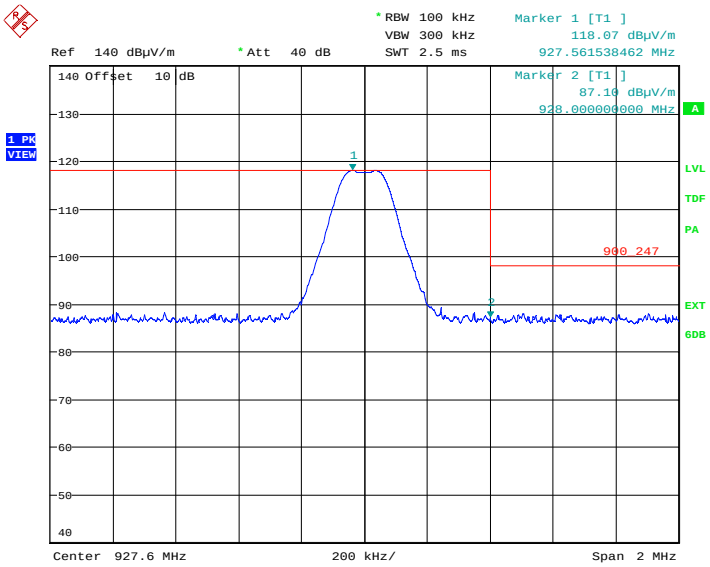
Plot 5.5.4.1.2.21. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Single Frequency Mode, High End of Frequency Band



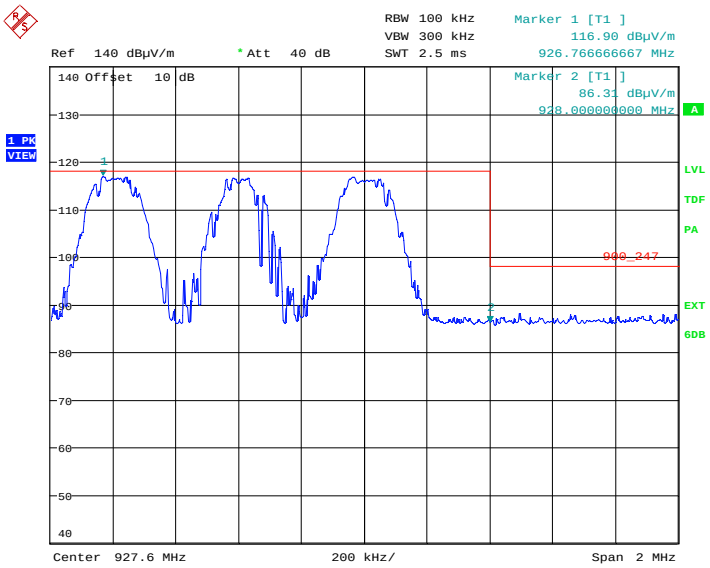
Plot 5.5.4.1.2.22. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



Plot 5.5.4.1.2.23. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Single Frequency Mode, High End of Frequency Band



Plot 5.5.4.1.2.24. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



5.5.4.2. EUT with 3 dBi Phantom (Dome) Antenna, Mode 3

5.5.4.2.1. Spurious Radiated Emissions

Fundamental Frequency:	902.4 MHz
Raw Power Setting:	14
Measured Conducted Power:	29.21 dBm
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
902.4	127.82	--	V	--	--	--	--
902.4	121.38	--	H	--	--	--	--
2707.2	52.20	50.02	V	54.0	107.8	-4.0	Pass*
2707.2	51.97	50.42	H	54.0	107.8	-3.6	Pass*
3609.6	44.61	34.76	V	54.0	107.8	-19.2	Pass*
3609.6	44.63	35.39	H	54.0	107.8	-18.6	Pass*
4512.0	47.51	35.53	V	54.0	107.8	-18.5	Pass*
4512.0	45.08	34.37	H	54.0	107.8	-19.6	Pass*
5414.4	46.88	34.69	V	54.0	107.8	-19.3	Pass*
8121.6	50.68	38.10	V	54.0	107.8	-15.9	Pass*
8121.6	50.12	37.82	H	54.0	107.8	-16.2	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:	915.2 MHz
Raw Power Setting:	14
Measured Conducted Power:	29.14 dBm
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
915.2	127.59	--	V	--	--	--	--
915.2	121.04	--	H	--	--	--	--
2745.6	50.85	48.64	V	54.0	107.6	-5.4	Pass*
2745.6	53.42	52.23	H	54.0	107.6	-1.8	Pass*
3660.8	44.67	34.39	H	54.0	107.6	-19.6	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:	927.6 MHz
Raw Power Setting:	14
Measured Conducted Power:	29.02 dBm
Frequency Test Range:	30 MHz – 10 GHz

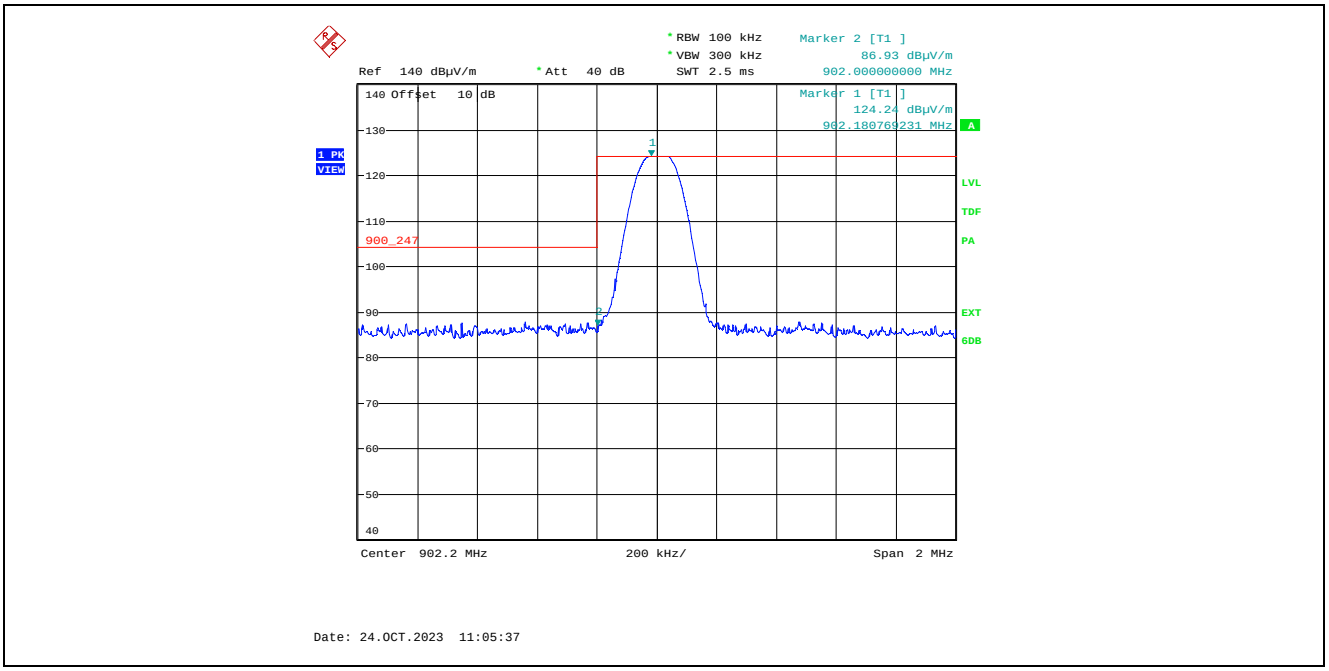
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
927.6	127.47	--	V	--	--	--	--
927.6	120.16	--	H	--	--	--	--
2782.8	52.76	51.66	V	54.0	107.5	-2.3	Pass*
2782.8	52.89	50.14	H	54.0	107.5	-3.9	Pass*
3710.4	44.96	36.68	V	54.0	107.5	-17.3	Pass*
3710.4	44.44	36.36	H	54.0	107.5	-17.6	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

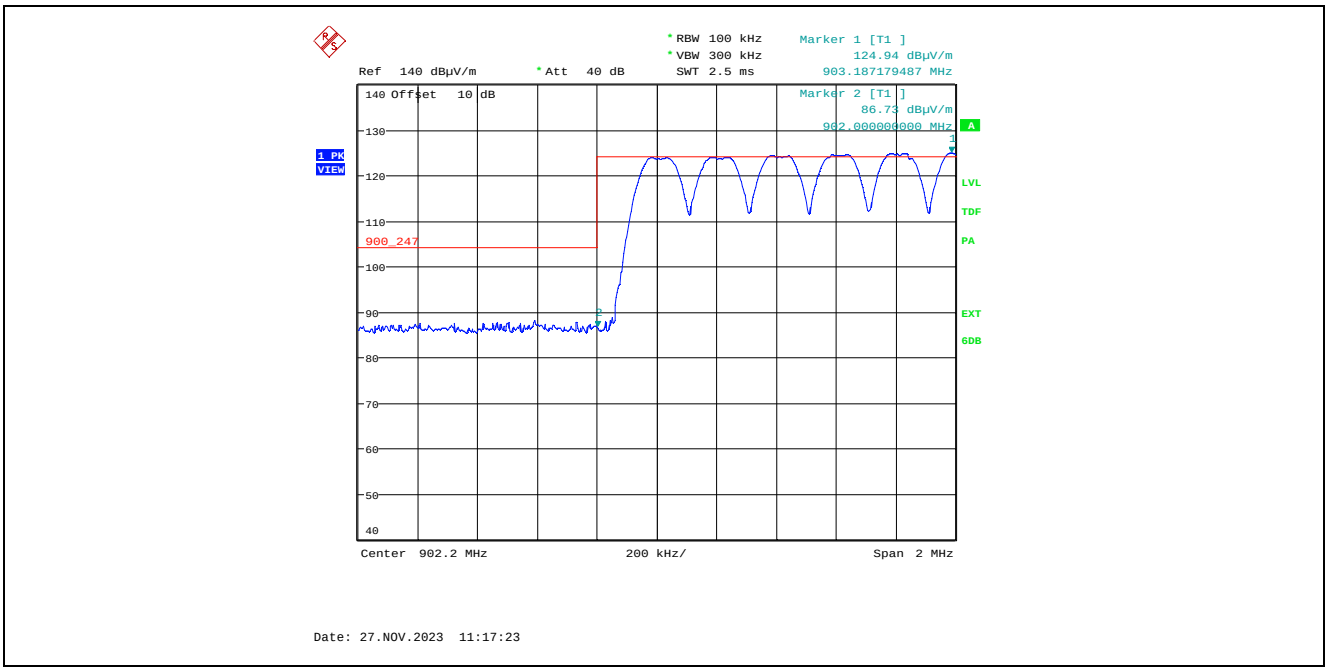
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.5.4.2.2. Band –Edge RF Radiated Emissions

Plot 5.5.4.2.2.1. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Single Frequency Mode, Low End of Frequency Band

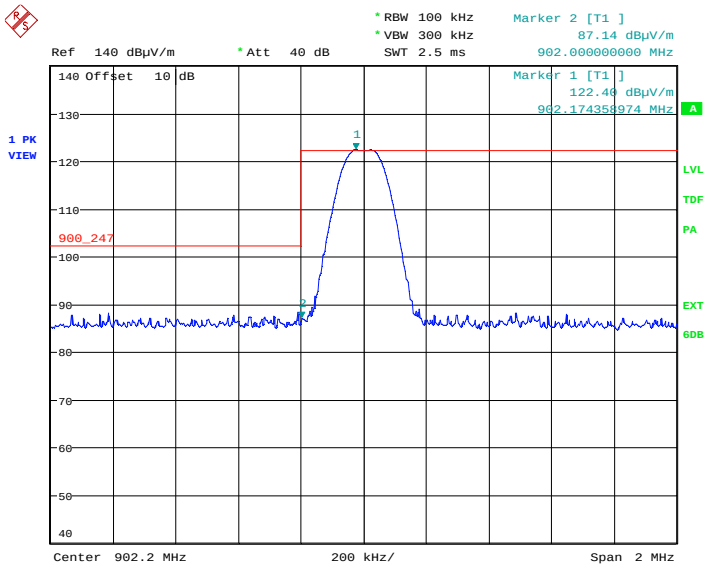


Plot 5.5.4.2.2.2. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band

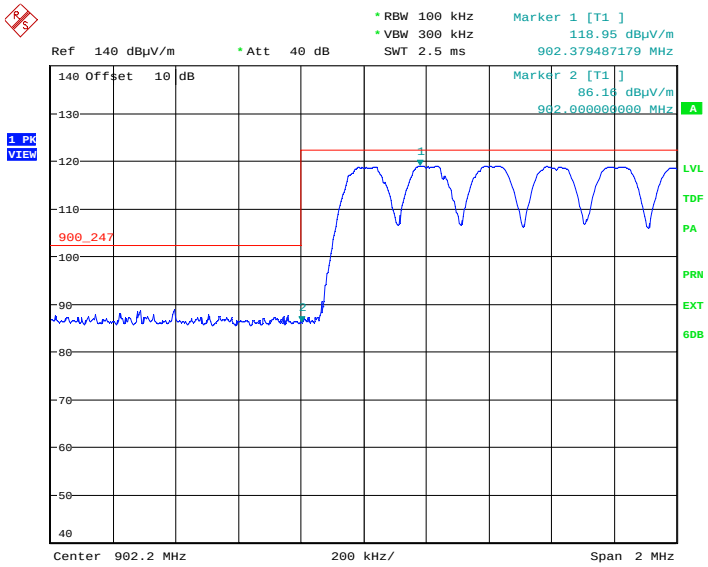


All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

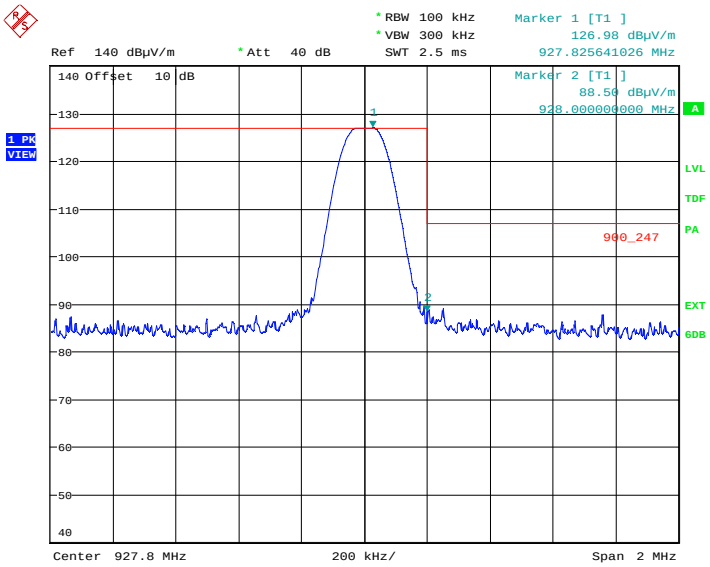
Plot 5.5.4.2.2.3. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



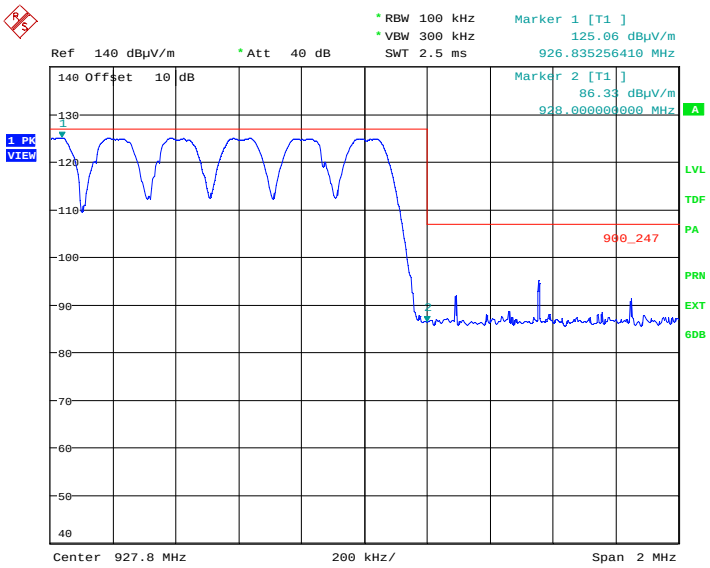
Plot 5.5.4.2.2.4. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



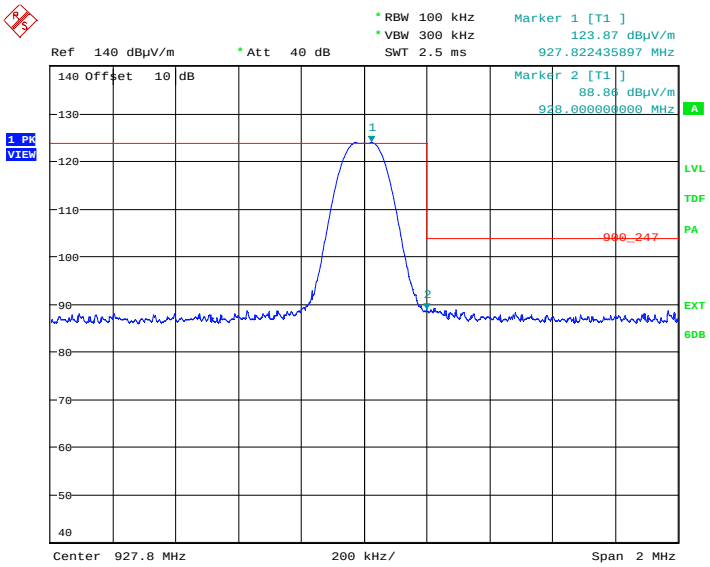
Plot 5.5.4.2.2.5. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Single Frequency Mode, High End of Frequency Band



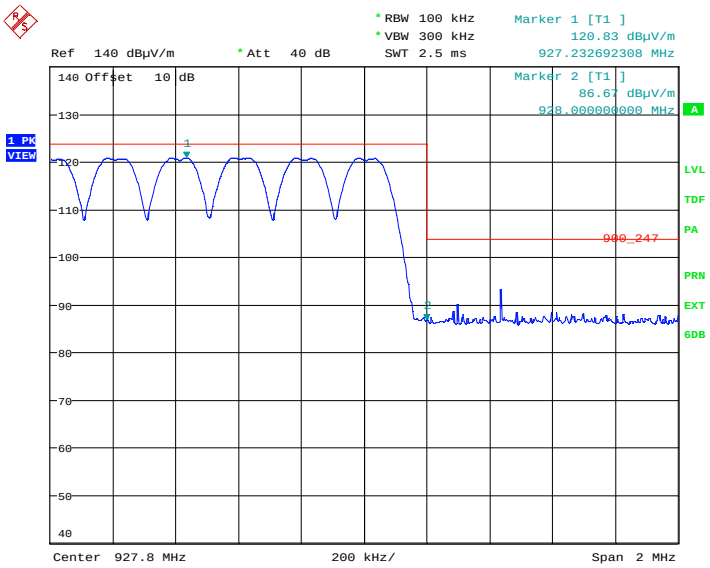
Plot 5.5.4.2.2.6. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



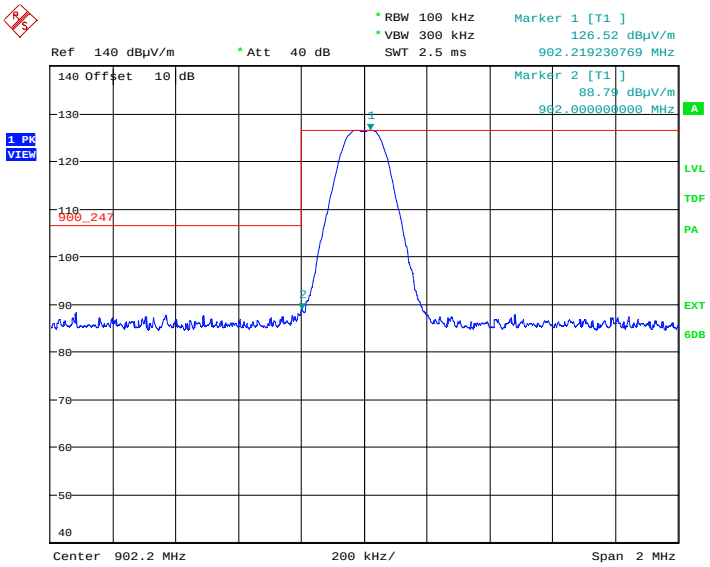
Plot 5.5.4.2.2.7. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Single Frequency Mode, High End of Frequency Band



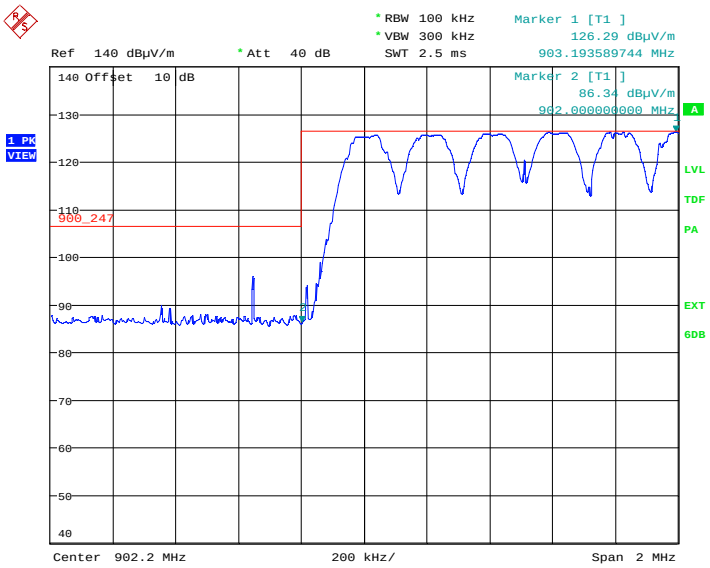
Plot 5.5.4.2.2.8. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



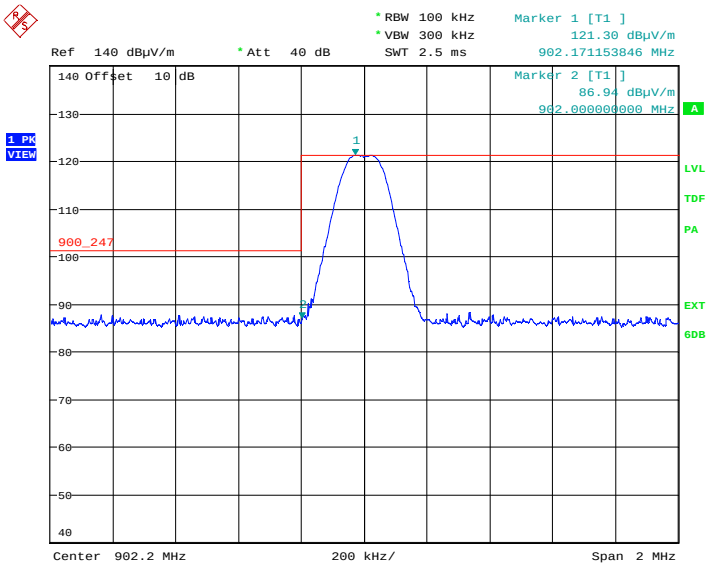
Plot 5.5.4.2.2.9. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



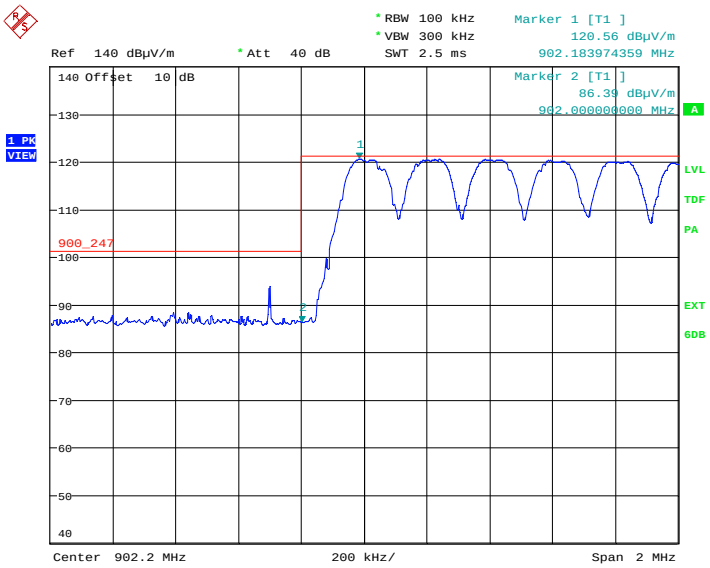
Plot 5.5.4.2.2.10. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



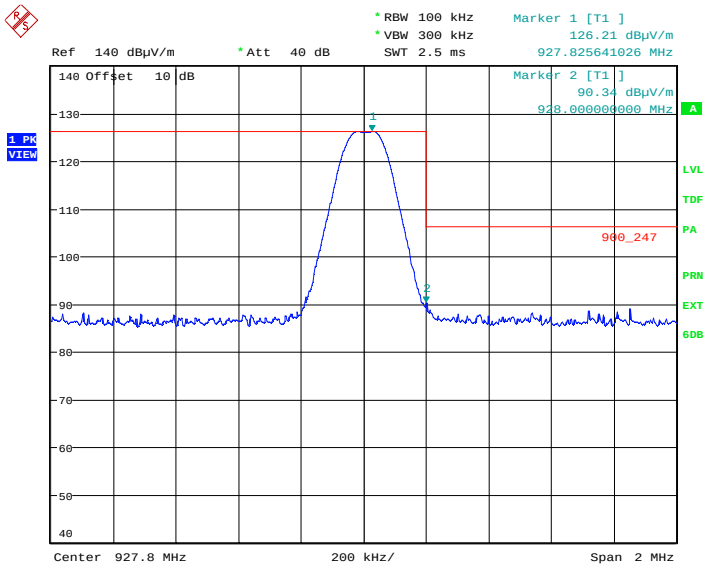
Plot 5.5.4.2.2.11. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



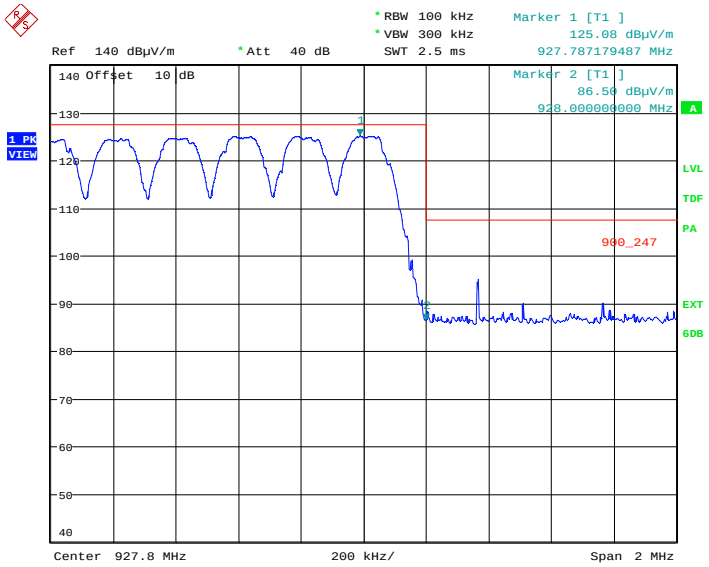
Plot 5.5.4.2.2.12. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



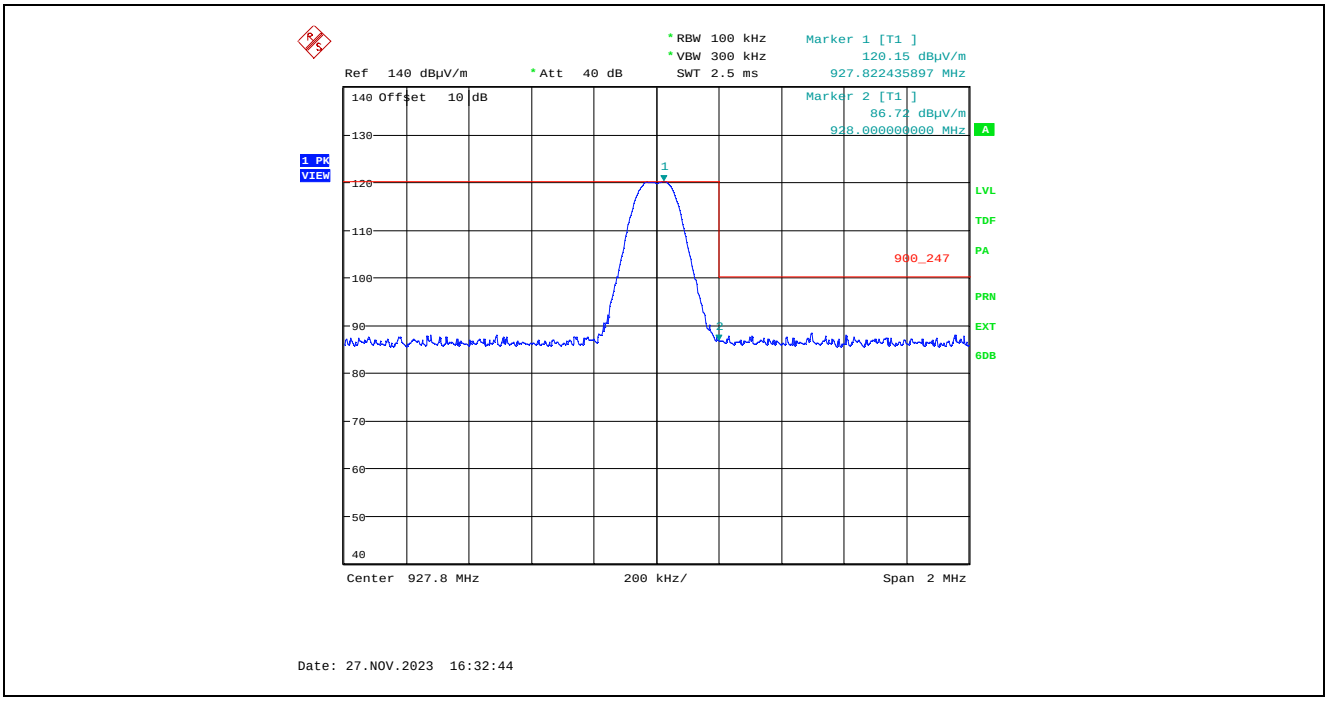
Plot 5.5.4.2.2.13. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Single Frequency Mode, High End of Frequency Band



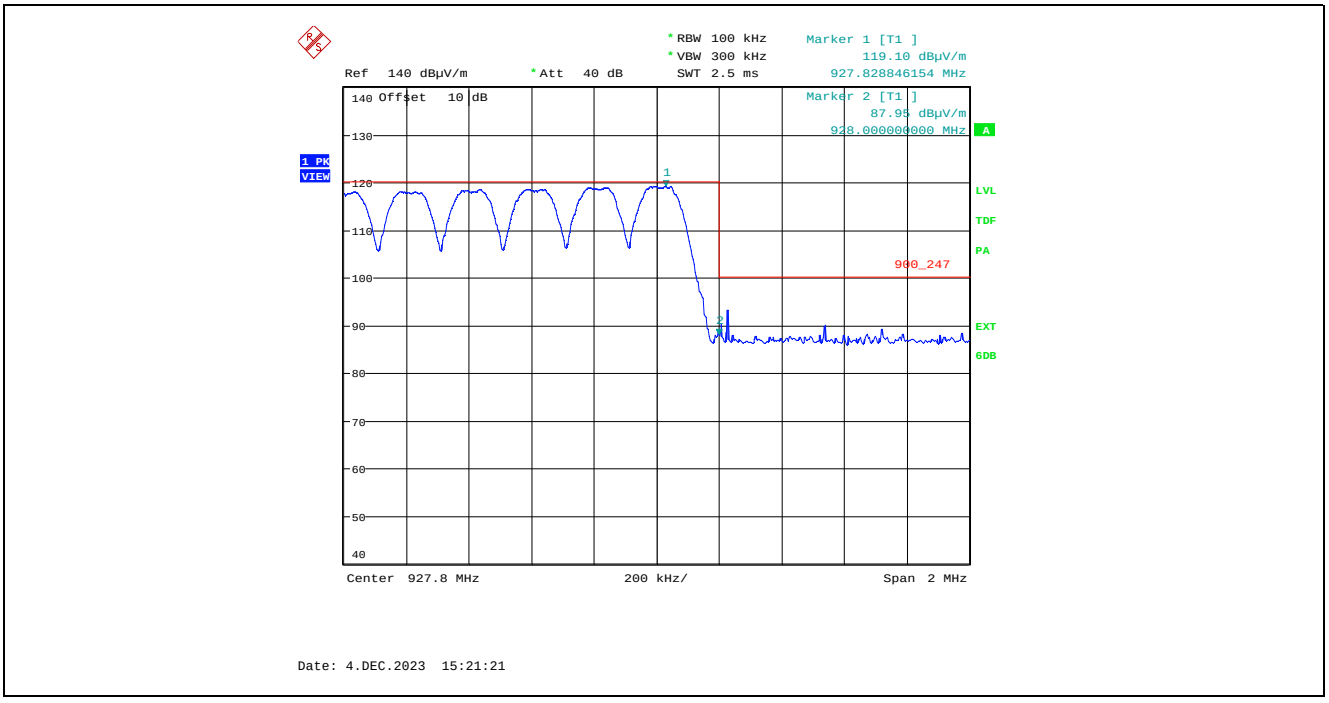
Plot 5.5.4.2.2.14. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



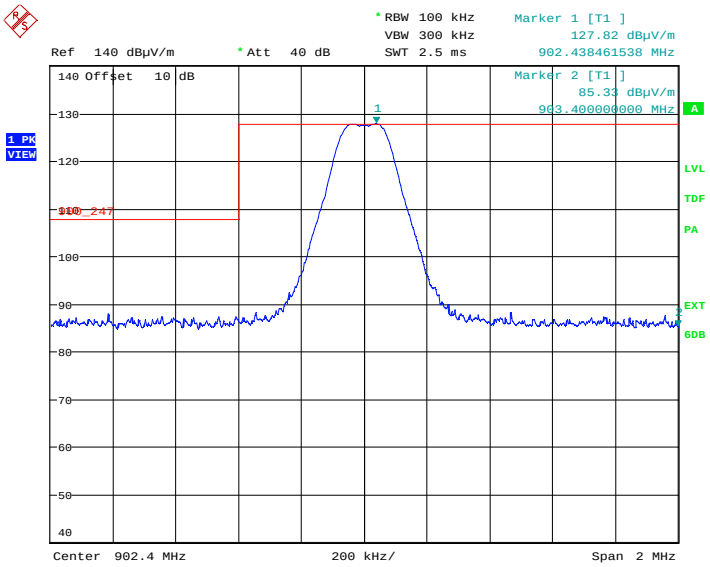
Plot 5.5.4.2.2.15. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Single Frequency Mode, High End of Frequency Band



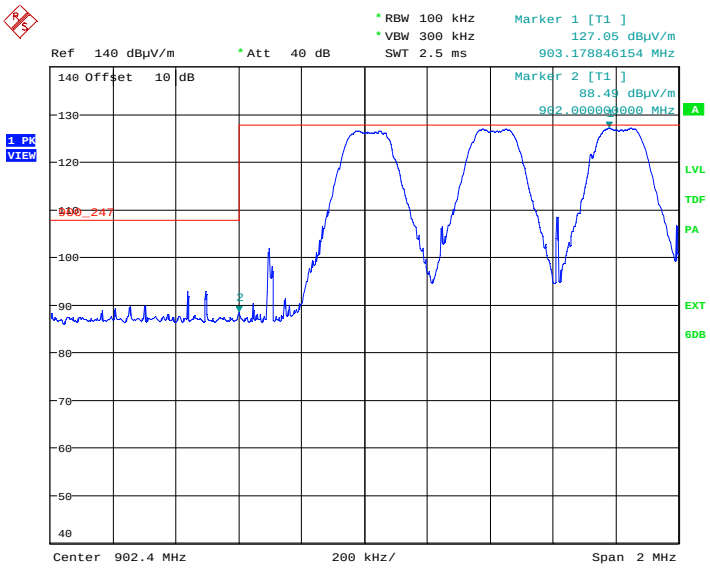
Plot 5.5.4.2.2.16. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



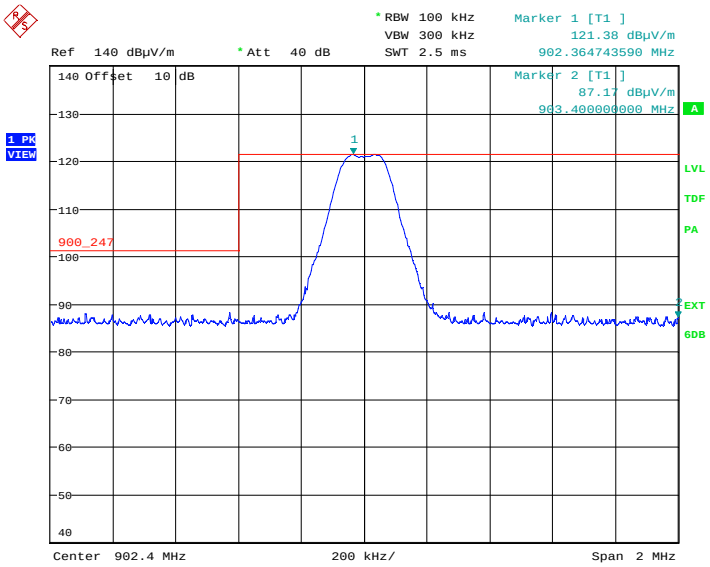
Plot 5.5.4.2.2.17. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



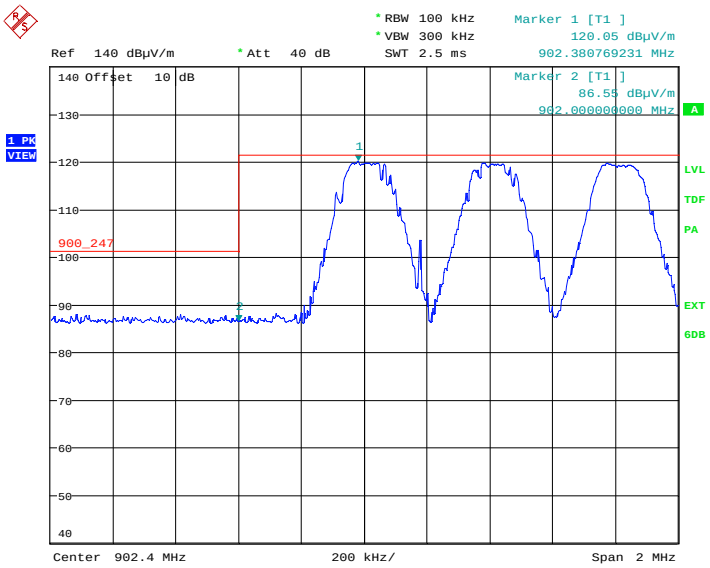
Plot 5.5.4.2.2.18. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



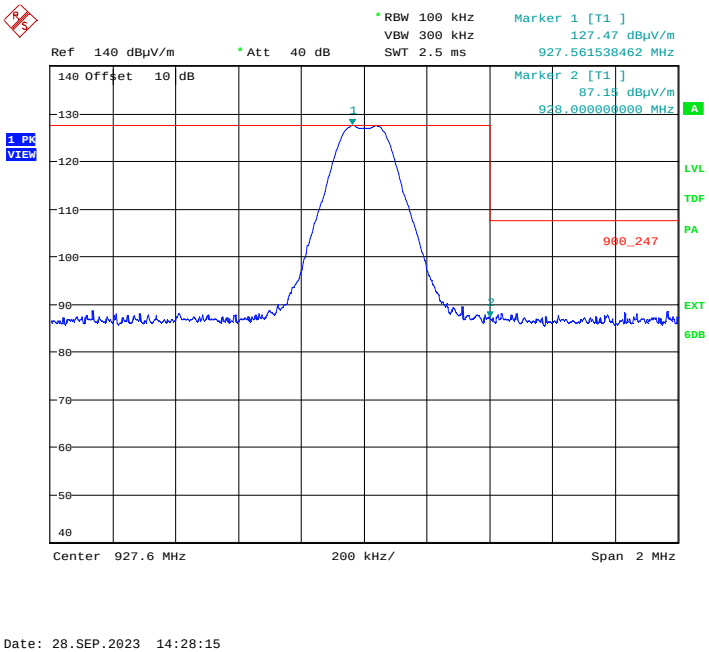
Plot 5.5.4.2.2.19. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



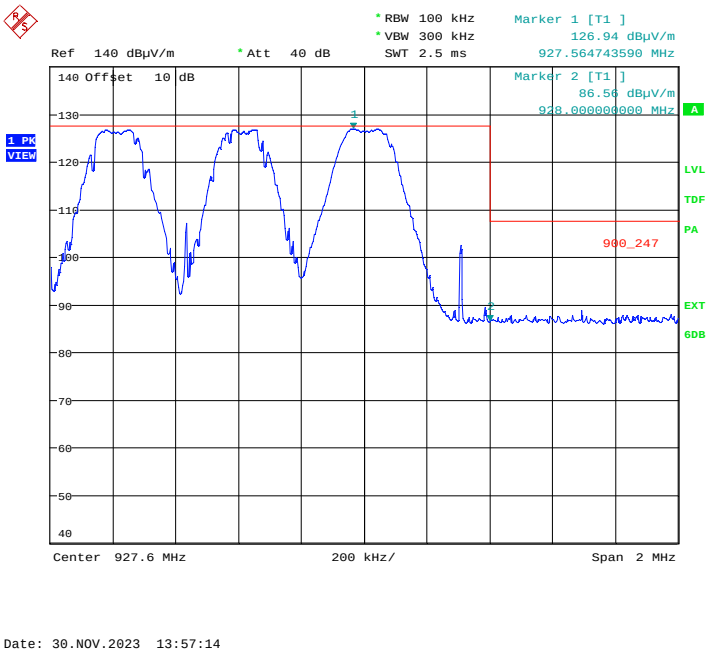
Plot 5.5.4.2.2.20. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



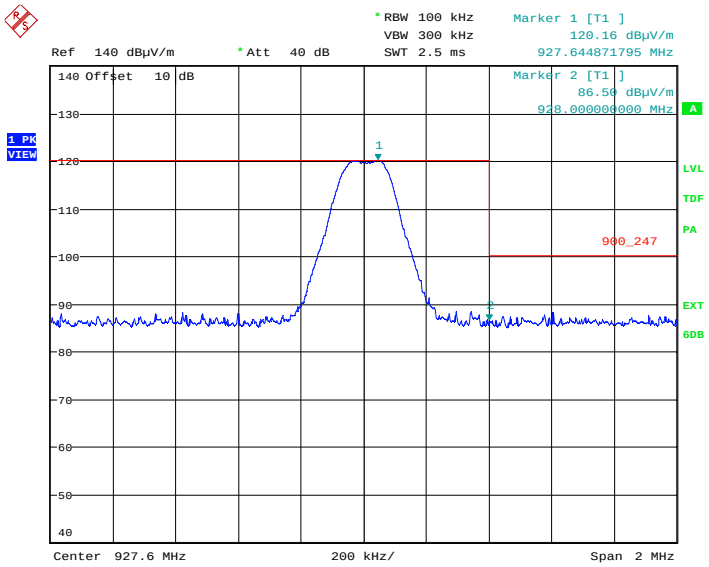
Plot 5.5.4.2.2.21. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Single Frequency Mode, High End of Frequency Band



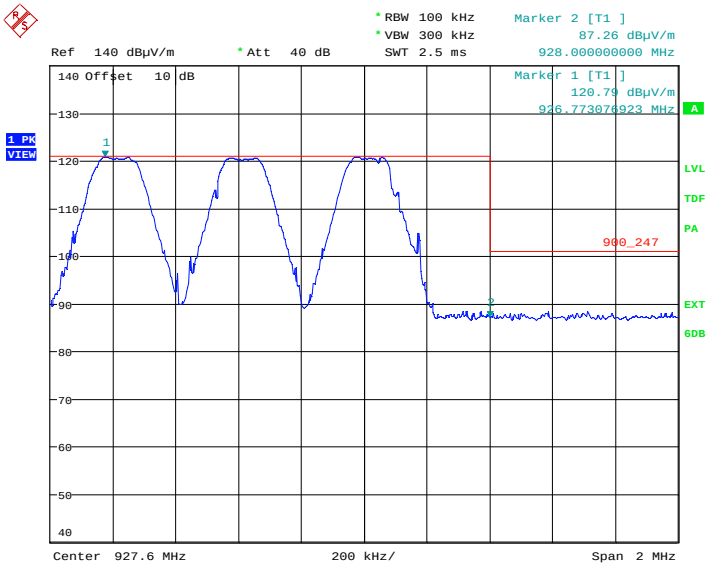
Plot 5.5.4.2.2.22. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



Plot 5.5.4.2.2.23. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Single Frequency Mode, High End of Frequency Band



Plot 5.5.4.2.2.24. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



5.5.4.3. EUT with 3 dBi Rubber Rod (Monopole) Antenna, Mode 3

5.5.4.3.1. Spurious Radiated Emissions

Fundamental Frequency:	902.4 MHz
Raw Power Setting:	14
Measured Conducted Power:	29.21 dBm
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
902.4	121.66	--	V	--	--	--	--
902.4	123.36	--	H	--	--	--	--
2707.2	45.41	40.60	V	54.0	103.4	-13.4	Pass*
2707.2	47.43	43.81	H	54.0	103.4	-10.2	Pass*
3609.6	48.16	42.07	V	54.0	103.4	-11.9	Pass*
3609.6	45.55	38.52	H	54.0	103.4	-15.5	Pass*
4512.0	49.54	44.46	V	54.0	103.4	-9.5	Pass*
4512.0	47.06	40.66	H	54.0	103.4	-13.3	Pass*
5414.4	48.64	40.60	V	54.0	103.4	-13.4	Pass*
5414.4	47.50	38.27	H	54.0	103.4	-15.7	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.

Fundamental Frequency:	915.2 MHz
Raw Power Setting:	14
Measured Conducted Power:	29.14 dBm
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
915.2	123.38	--	V	--	--	--	--
915.2	125.45	--	H	--	--	--	--
2745.6	48.32	44.90	V	54.0	105.5	-9.1	Pass*
2745.6	51.99	50.25	H	54.0	105.5	-3.8	Pass*
3660.8	45.12	35.27	V	54.0	105.5	-18.7	Pass*
3660.8	44.52	36.09	H	54.0	105.5	-17.9	Pass*
4576.0	51.10	45.35	V	54.0	105.5	-8.7	Pass*
4576.0	44.95	35.17	H	54.0	105.5	-18.8	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:	927.6 MHz
Raw Power Setting:	14
Measured Conducted Power:	29.02 dBm
Frequency Test Range:	30 MHz – 10 GHz

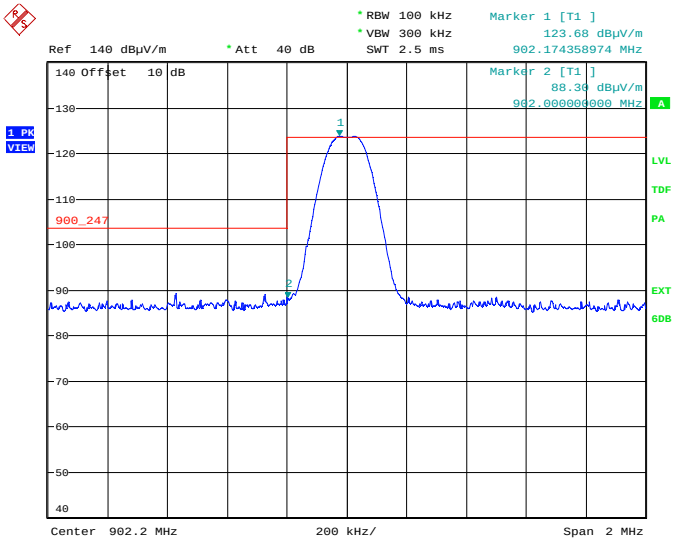
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/ Fail
927.6	125.97	--	V	--	--	--	--
927.6	126.93	--	H	--	--	--	--
2782.8	48.24	45.41	V	54.0	106.9	-8.6	Pass*
2782.8	50.29	48.03	H	54.0	106.9	-6.0	Pass*
3710.4	44.14	36.52	V	54.0	106.9	-17.5	Pass*
3710.4	46.33	38.23	H	54.0	106.9	-15.8	Pass*
4638.0	45.09	35.22	V	54.0	106.9	-18.8	Pass*
4638.0	46.01	34.31	H	54.0	106.9	-19.7	Pass*

All other spurious emissions and harmonics are more than 20 dB below the applicable limit.

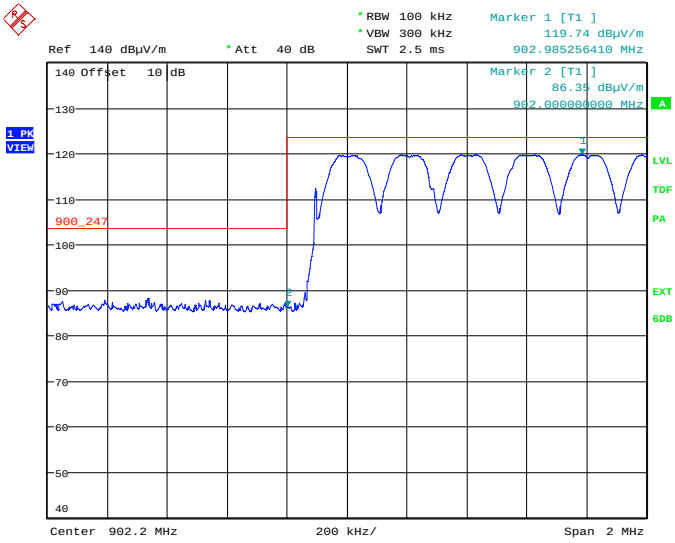
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.5.4.3.2. Band –Edge RF Radiated Emissions

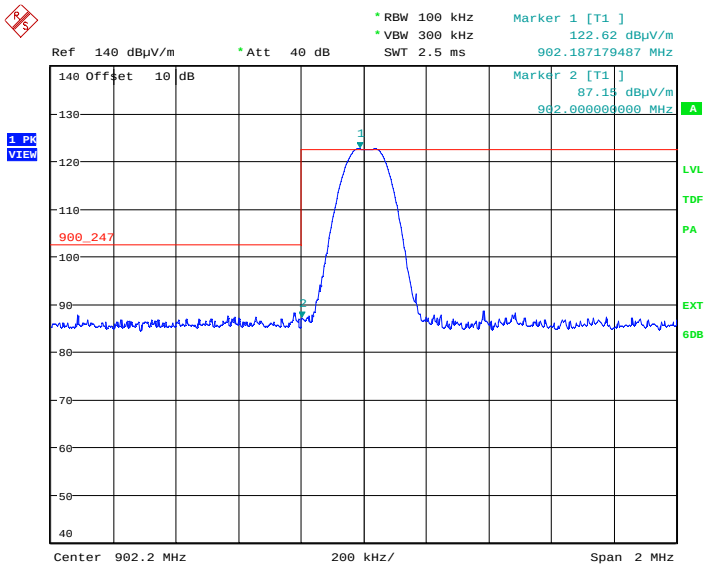
Plot 5.5.4.3.2.1. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



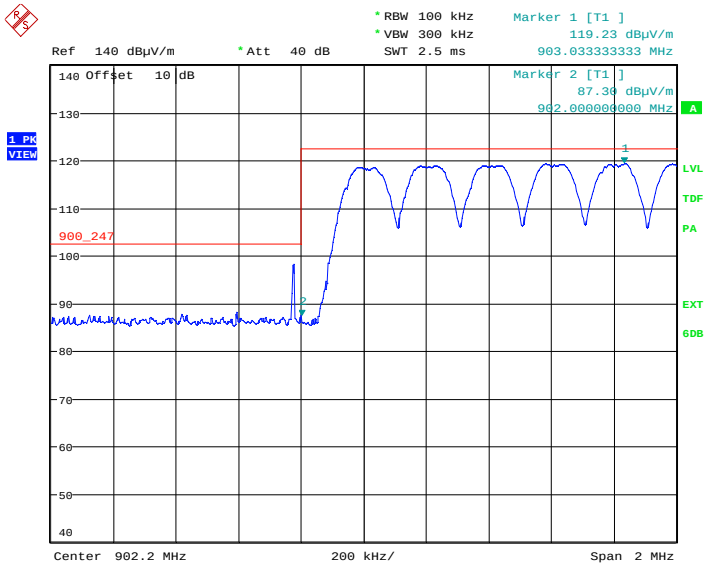
Plot 5.5.4.3.2.2. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



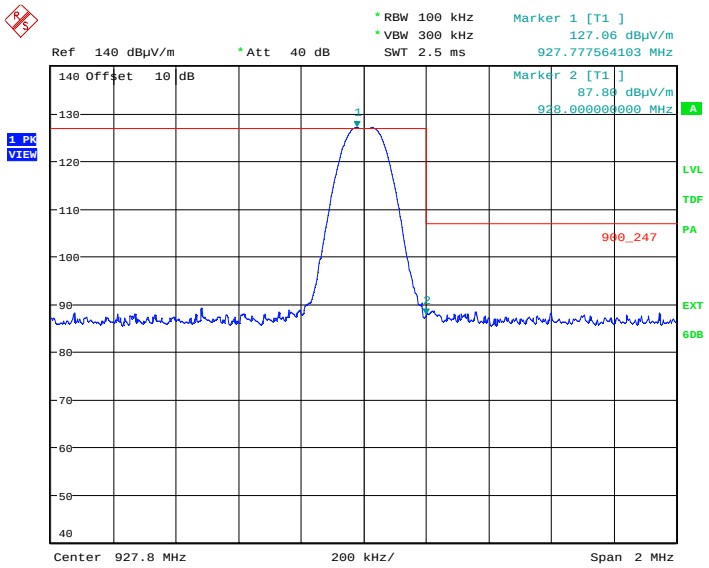
Plot 5.5.4.3.2.3. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



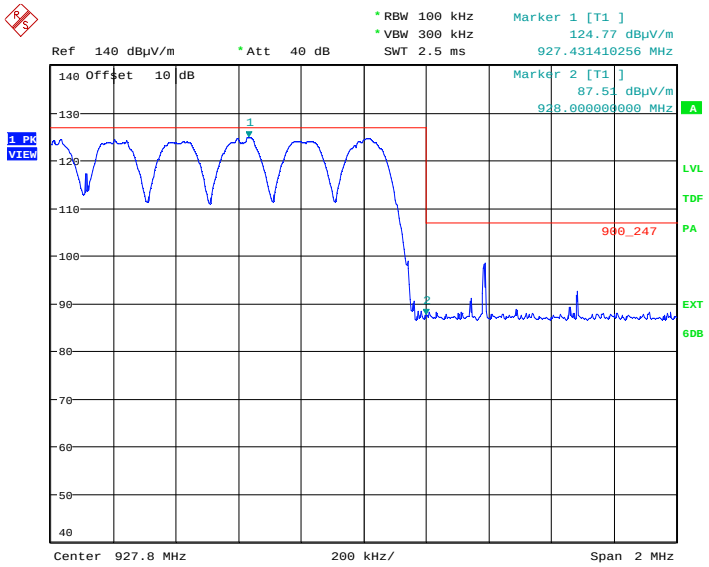
Plot 5.5.4.3.2.4. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



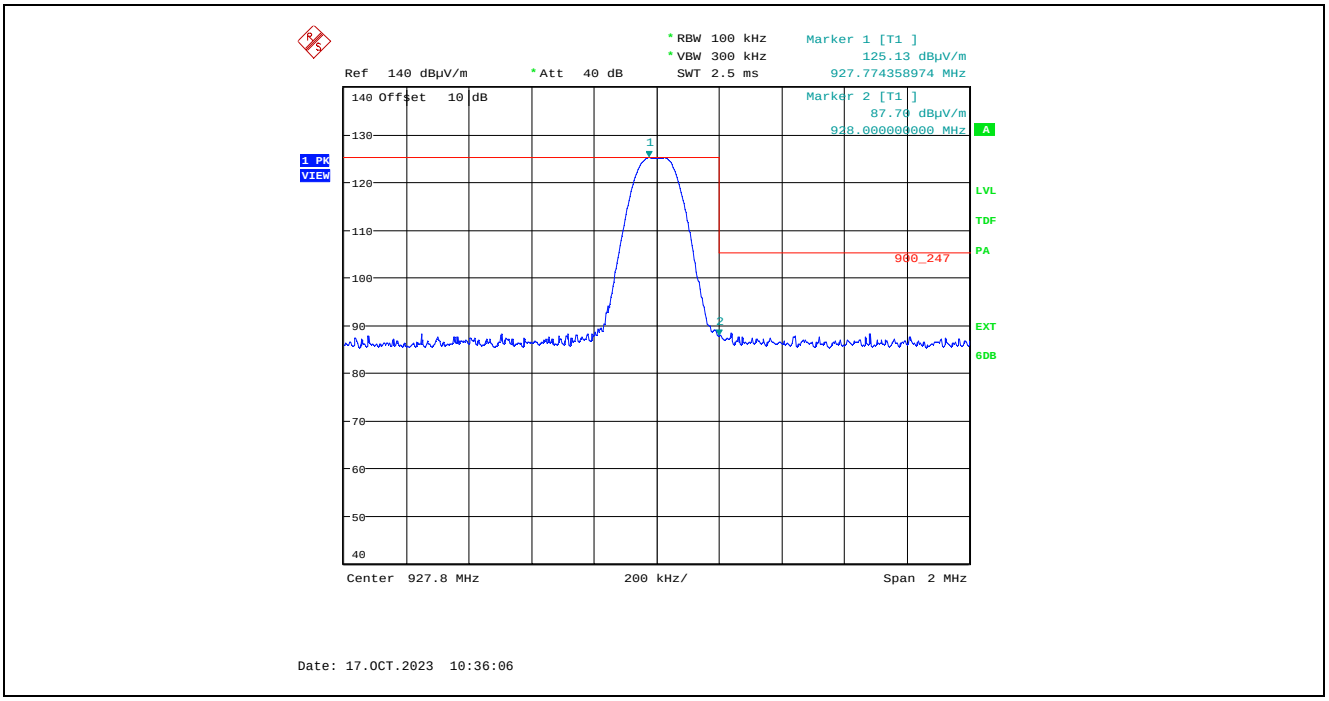
Plot 5.5.4.3.2.5. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Single Frequency Mode, High End of Frequency Band



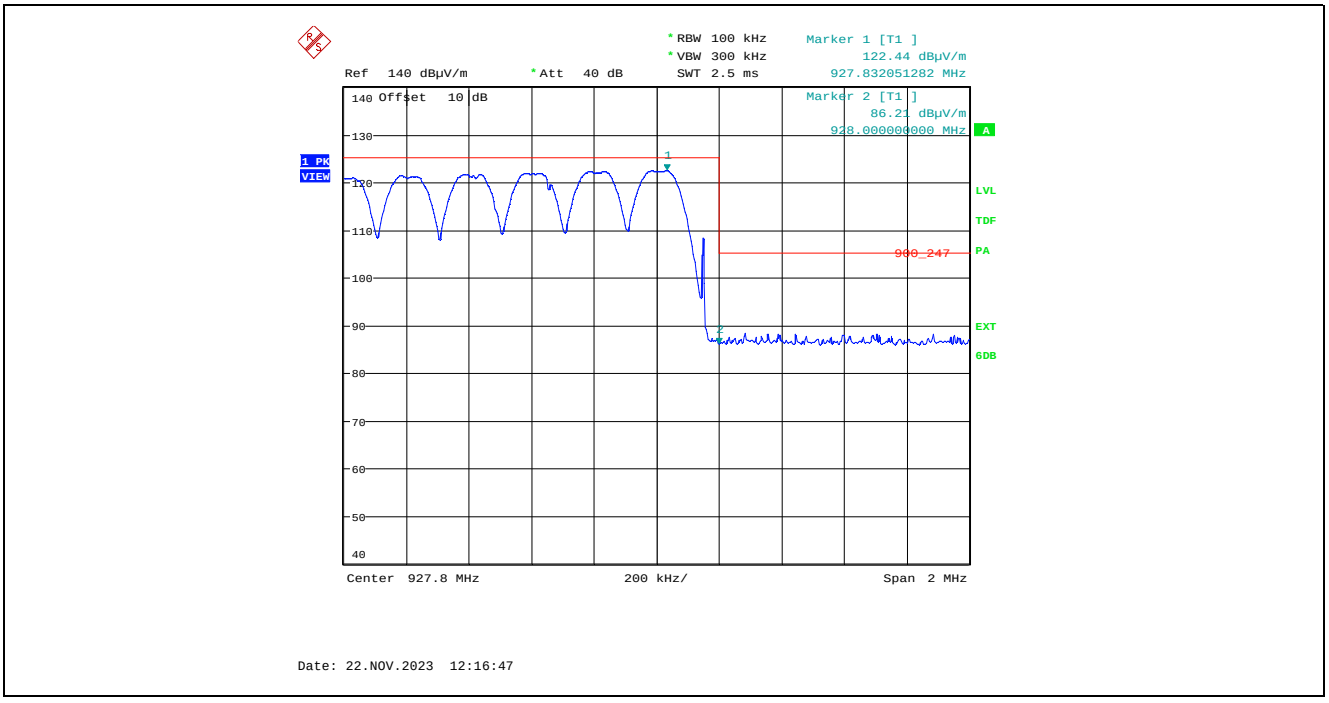
Plot 5.5.4.3.2.6. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



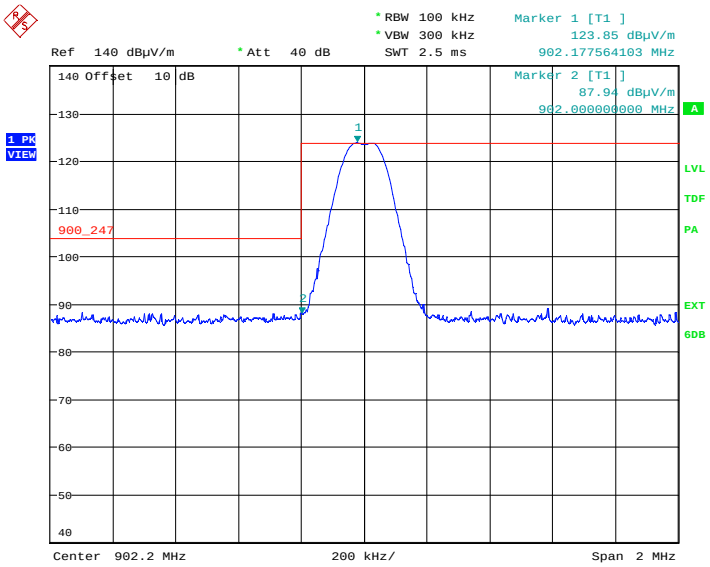
Plot 5.5.4.3.2.7. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Single Frequency Mode, High End of Frequency Band



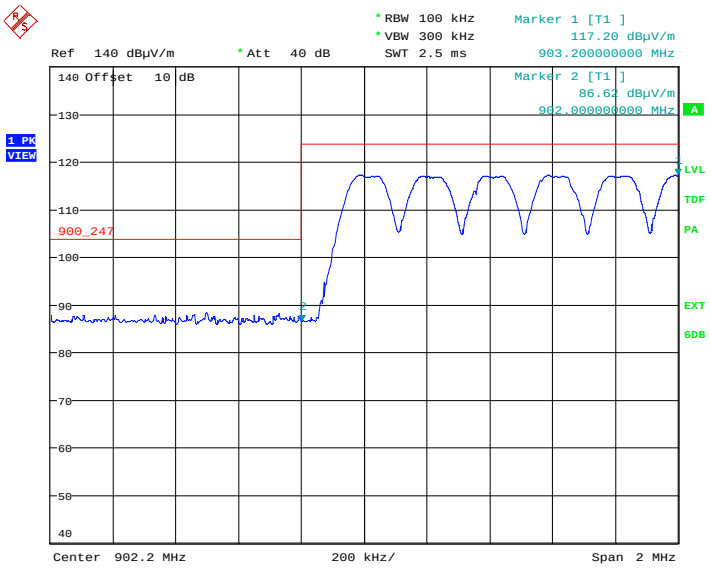
Plot 5.5.4.3.2.8. Band-Edge RF Radiated Emissions at 3 m, Mode 1b (50 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



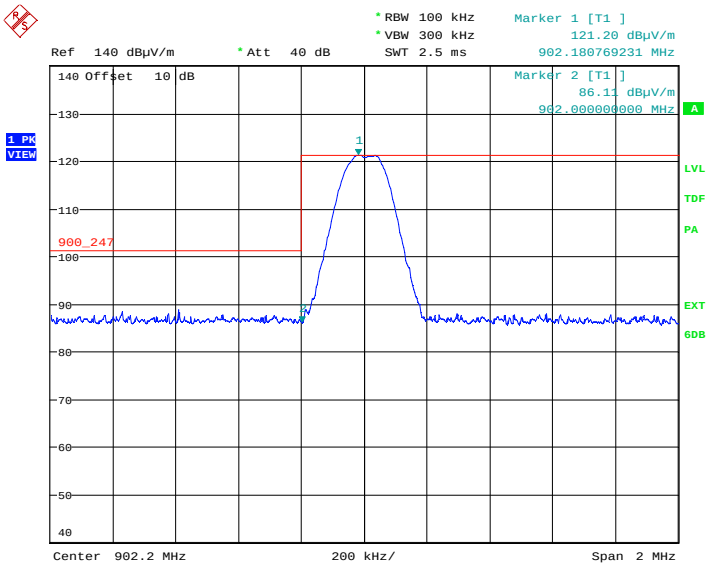
Plot 5.5.4.3.2.9. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



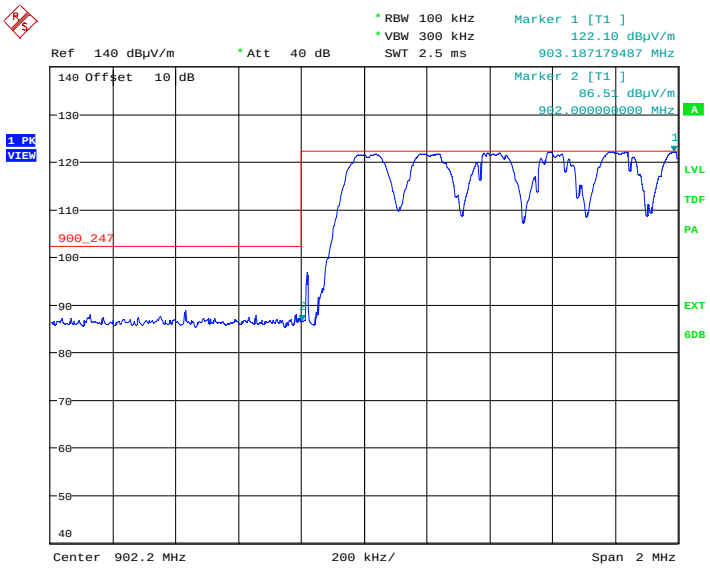
Plot 5.5.4.3.2.10. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



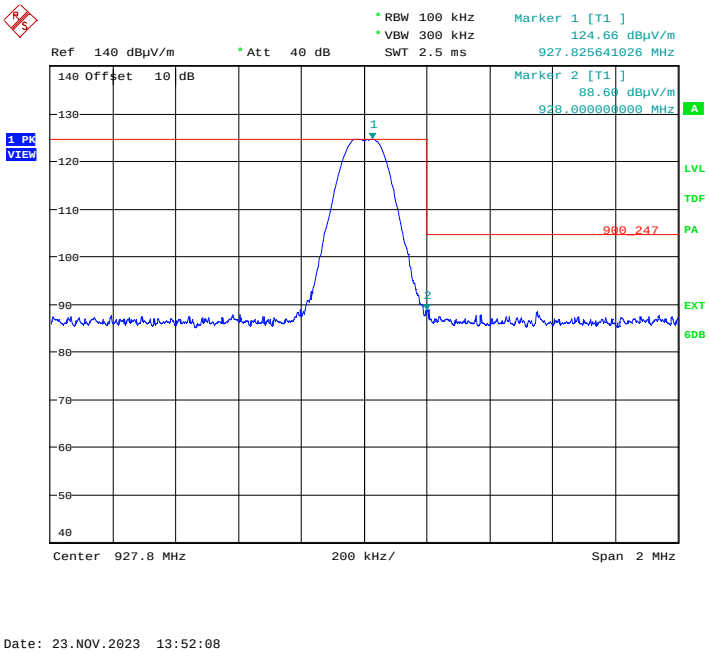
Plot 5.5.4.3.2.11. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



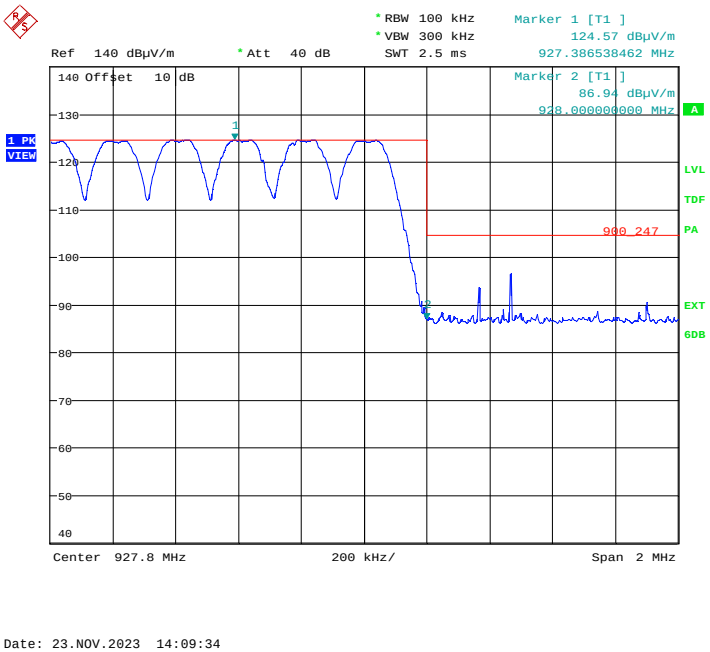
Plot 5.5.4.3.2.12. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



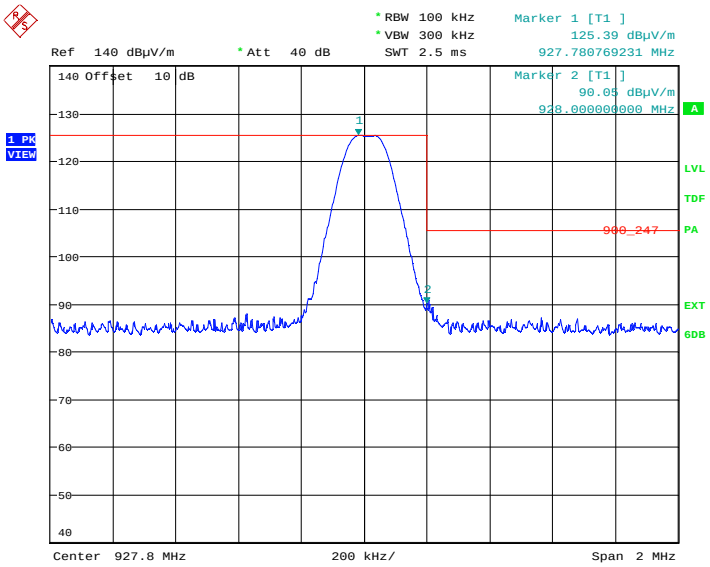
Plot 5.5.4.3.2.13. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Single Frequency Mode, High End of Frequency Band



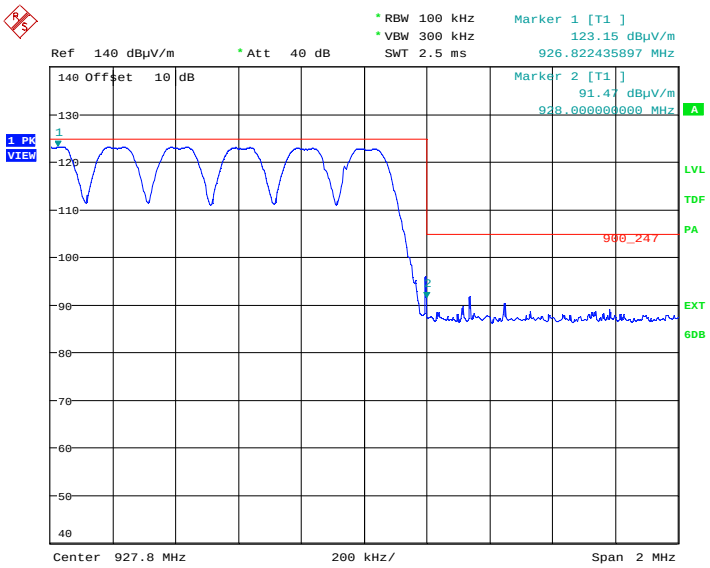
Plot 5.5.4.3.2.14. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



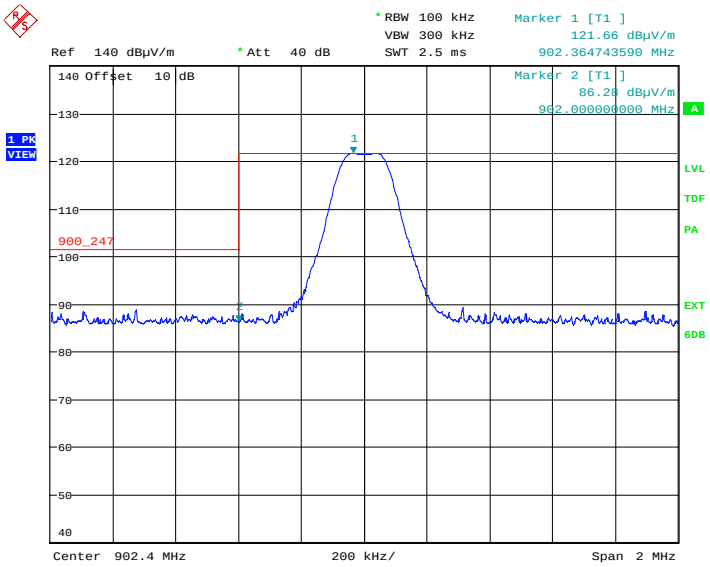
Plot 5.5.4.3.2.15. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Single Frequency Mode, High End of Frequency Band



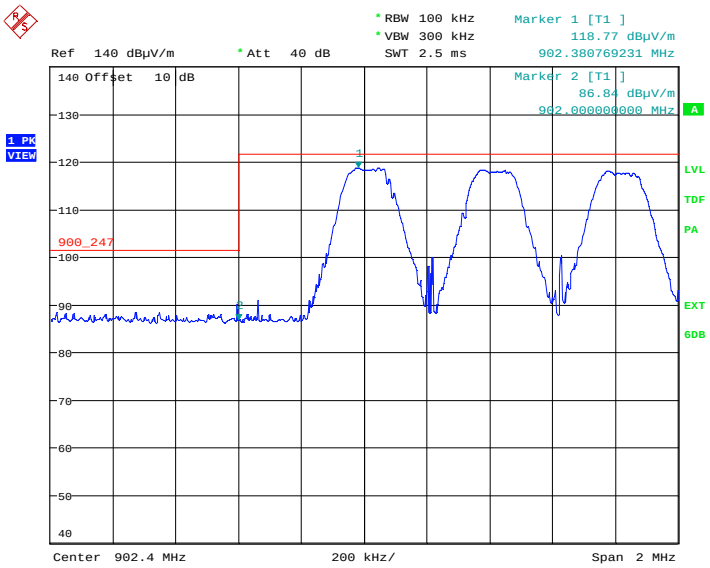
Plot 5.5.4.3.2.16. Band-Edge RF Radiated Emissions at 3 m, Mode 2a (100 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



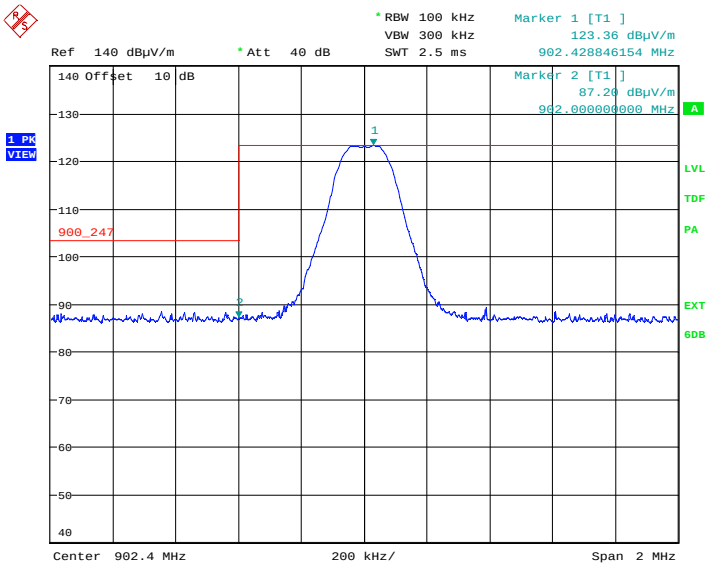
Plot 5.5.4.3.2.17. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Single Frequency Mode, Low End of Frequency Band



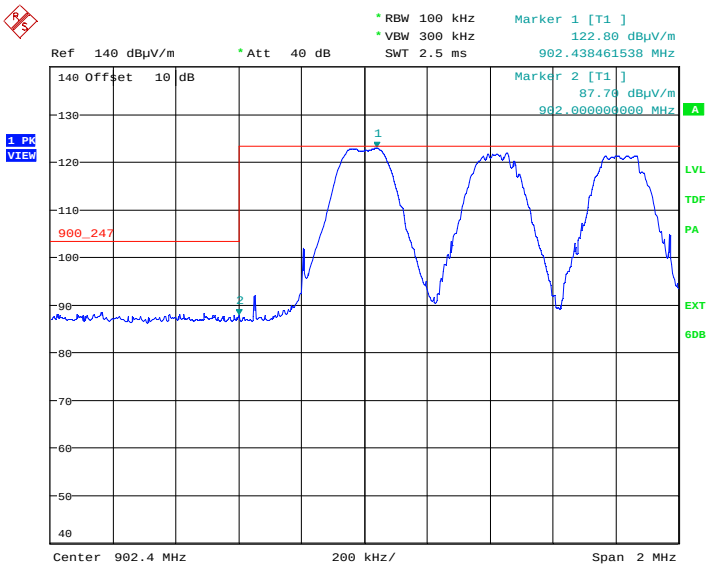
Plot 5.5.4.3.2.18. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



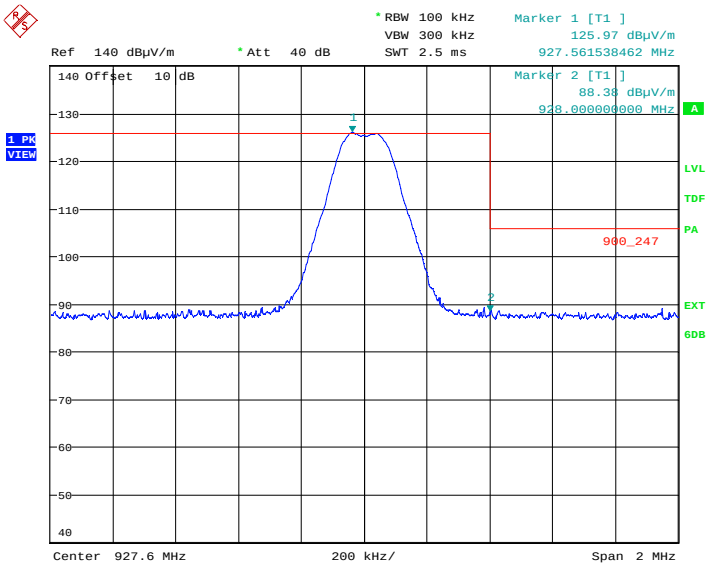
Plot 5.5.4.3.2.19. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Single Frequency Mode, Low End of Frequency Band



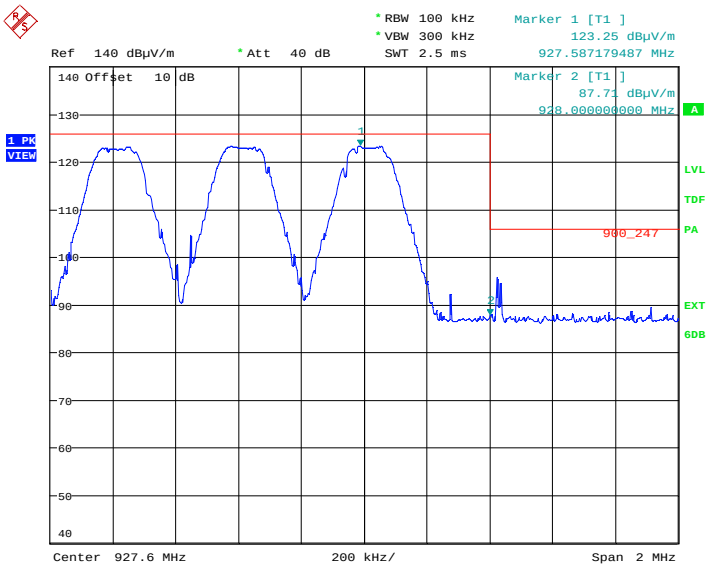
Plot 5.5.4.3.2.20. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, Low End of Frequency Band



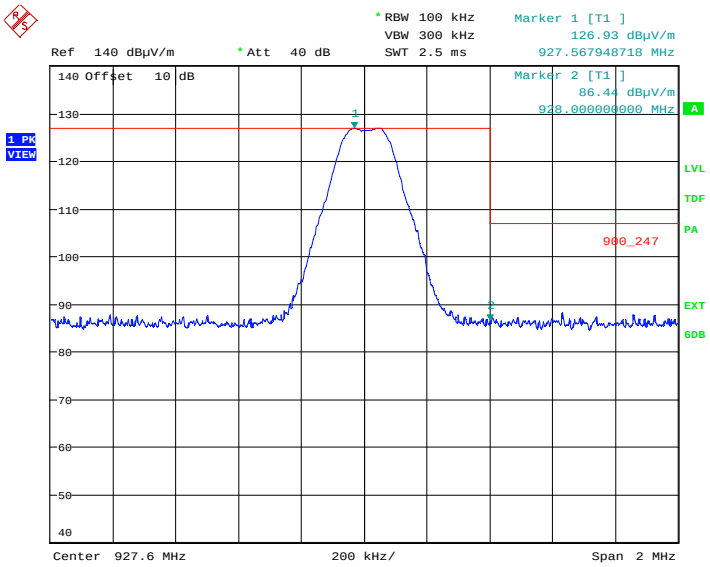
Plot 5.5.4.3.2.21. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Single Frequency Mode, High End of Frequency Band



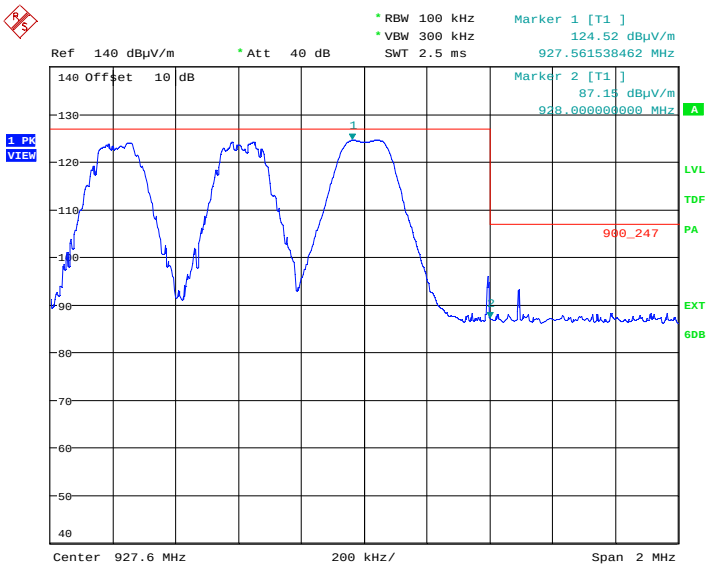
Plot 5.5.4.3.2.22. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Vertical Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



Plot 5.5.4.3.2.23. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Single Frequency Mode, High End of Frequency Band



Plot 5.5.4.3.2.24. Band-Edge RF Radiated Emissions at 3 m, Mode 3 (150 kbps), Horizontal Polarization
Pseudorandom Channel Hopping Mode, High End of Frequency Band



5.6. 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.

5.6.1. 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 (in same unit as P)
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.6.2. RF Evaluation

Frequency (MHz)	Tune up Power (dBm)	Max. 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)
902.2	30	3	33	1995.262	25	0.254	0.601	-0.347

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
Highpass Filter	Rohde & Schwarz	EZ-25	830164/007	Cut off 150kHz	12 Oct 2024
LISN	Schwarzbeck Mess Elektronik	NSLK 8127	8127276	---	11 Nov 2023*
Power Supply	HQ Power	PS 613U	---	0-30Vdc	See Note 1
Spectrum Analyzer	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	11 Mar 2024
Attenuator	Pasternack	PE7024-10	3	DC–26.5 GHz	See Note 1
Horn Antenna	ETS	3115	9701-5061	1-18GHz	09 Aug 2024
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	21 Sep 2024
Biconilog Antenna	EMCO	3142C	00026873	26-2000MHz	16 Dec 2023*
Horn Antenna	ETS	3115	9701-5061	1-18GHz	09 Aug 2024
Preamp	Com-Power	PAM-118A	551052	500MHz-18GHz	06 Oct 2024
Preamp	Hewlett Packard	8449B	3003A00769	1000MHz-26.5GHz	08 Nov 2024
High Pass Filter	K & L	11SH10-1500/T8000	2	1.0 – 1.5GHz	See Note 1
Note 1: Internal Verification/Calibration Check					

* Equipment used before calibration due date.

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
Power Line Conducted Emissions	± 2.62 dB
Occupied Bandwidth	±0.20 Hz / ±0.63 dB
Conducted Output Power	±0.62 dB
Transmitter Spurious Radiated Emissions	±4.20 dB (30 MHz – 1 GHz)
	±2.70 dB (1 – 18 GHz)
Transmitter Radiated Band-edge Emissions	±2.76dB