Test Report

HELEM2111000483-3

INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C AND ISED CANADA REQUIREMENTS

Equipment Under Test:	SRD repeater for temperature probes
Model:	Repeater
Manufacturer:	Quanturi Oy Lars Sonckin kaari 10 FI-02600 Espoo FINLAND
Customer:	Quanturi Oy Lars Sonckin kaari 10 FI-02600 Espoo FINLAND
FCC Rule Part:	15.247
IC Rule Part:	RSS-247, Issue 2, 2017 RSS-GEN Issue 5 Amendment 2, 2021
KDB:	558074 D01 15.247 Meas Guidance v05r02 Guidance for Compliance Measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under §15.247 of the FCC rules (April 2, 2019)

Date:	20 October 2022	Date:	20 October 2022
Issued by:	Rauno Repo Senior EMC Specialist	Checked by:	Henri Mäki Testing Engineer

These test results are valid for the tested unit only.
This report shall not be reproduced, except in full, without a written permission of SGS Fimko.

TABLE OF CONTENTS

TABLE OF CONTENTS 2

GENERAL REMARKS 3
Disclaimer 3

RELEASE HISTORY 4

PRODUCT DESCRIPTION 5
Equipment Under Test 5
General Description 5
Ratings and declarations 5
Power Supply 5
Mechanical Size of the EUT 5

SUMMARY OF TESTING 6
EUT Test Conditions during Testing 6
Test Facility 7

TEST RESULTS 8
Antenna Requirement 8
Conducted Emissions In The Frequency Range 150 kHz - 30 MHz 9
Maximum Peak Conducted Output Power 11
Transmitter Radiated Spurious Emissions 9 kHz - 10 GHz 13
Transmitter Band Edge Measurement and Conducted Spurious Emissions 16
6 dB Bandwidth of the Channel 21
Power Spectral Density 23
99% Occupied Bandwidth 25
Duty cycle correction factor, Transmit time in 100 ms 27

TEST EQUIPMENT 28

GENERAL REMARKS

Disclaimer

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at ***http://www.sgs.com/en/Terms-and-Conditions.aspx*** *and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at* ***http://www.sgs.com/en/Terms-and-Conditions/Terms-e-Document.aspx***

Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.

RELEASE HISTORY

Version	Changes	Issued
1.0	Initial release	14 February 2022
1.1	Type errors corrected	20 October 2022

PRODUCT DESCRIPTION

Equipment Under Test

Equipment Under Test:	SRD repeater for temperature probes
Model:	Repeater
Trademark:	Quanturi
Serial no:	-
FCC ID:	-
IC:	-
Radio module or chip:	ON Semiconductor AX8052F143-D

General Description

Repeater forwards all messages that are transmitted by the probes or base station.

Classification

Fixed device	☐
Mobile Device (Human body distance > 20cm)	☒
Portable Device (Human body distance < 20cm)	☐

Modifications Incorporated in the EUT

No modifications.

Ratings and declarations

Operating Frequency Range (OFR):	902 - 928 MHz
Modulation:	FSK
Antenna type:	Direct connect antenna by Siretta, model Delta 22B. Antenna is positioned inside the plastic cabinet of the EUT.
Antenna gain:	+3 dBi

Power Supply

Power supply:	TDC Power Products Co., Ltd. Model No: SA9A-120-2100W -Input: 100-120 V ~60 Hz 1 A -Output: 12.0 VDC 2.1 A

Conducted tests from the antenna port were performed using laboratory power supply.

Mechanical Size of the EUT

Height: 330 mm Width: 60 mm Length: 155 mm

SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.203	Antenna requirement	PASS
§15.207(a) / RSS-GEN 8.8	Conducted Emissions on Power Supply Lines	PASS
§15.247(b)(3) / RSS-247 5.4(d)	Maximum Peak Conducted Output Power	PASS
§15.247(a)(2) / RSS-247 5.2(a)	6 dB Bandwidth	PASS
§15.247(e) / RSS-247 5.2(b)	Power Spectral Density	PASS
RSS-GEN 6.7	99% Occupied Bandwidth	PASS
§15.247(d) / RSS-247 5.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	PASS
§15.209(a), §15.247(d) / RSS-247 5.5	Radiated Emissions Within the Restricted Bands	PASS

The decision rule applied for the tests results stated in this test report is according to the requirements of section 1.3 of ANSI C63.10-2013.

EUT Test Conditions during Testing

The EUT was in modulated transmit mode with maximum power during the tests. Radiated tests were made with low, mid and high frequencies and the worst-case results are presented (927 MHz). Measurements were performed in actual usage position.

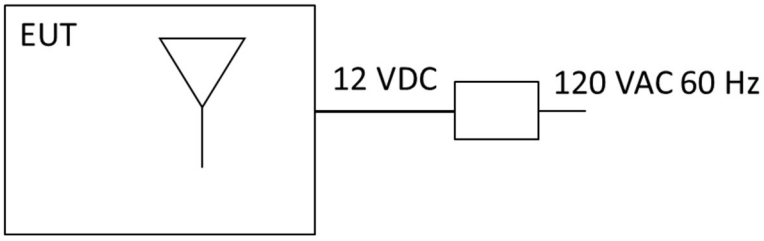


Figure 1: Test setup block diagram

Table 1: Test frequencies

Channel	Frequency (MHz)
Low	903
Mid	915
High	927

Test Facility

Testing Laboratory / address: FCC designation number: **FI0002** ISED CAB identifier: **T004**	SGS Fimko Ltd Takomotie 8 FI-00380, HELSINKI FINLAND
Test Site:	☐ K10LAB, ISED Canada registration number: **8708A-1** ☒ K5LAB, ISED Canada registration number: **8708A-2** ☐ T10LAB

TEST RESULTS

Antenna Requirement

Standard: FCC Rule §15.203
Tested by: RRE
Date: 11 February 2022

FCC Rule: 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Specification	Requirement (at least one of the following shall be applied)	Conclusion
§15.203	1. Permanently attached antenna 2. Unique coupling to the intentional radiator 3. Professionally installed radio. The installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.	**PASS**
Note	Option 1 is used	

Conducted Emissions In The Frequency Range 150 kHz - 30 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	RRE	
Date:	26 November 2021	
Temperature:	23 ± 3 °C	
Humidity:	20 - 75 % RH	
Measurement uncertainty:	± 2.9 dB	Level of confidence 95 % (k = 2)

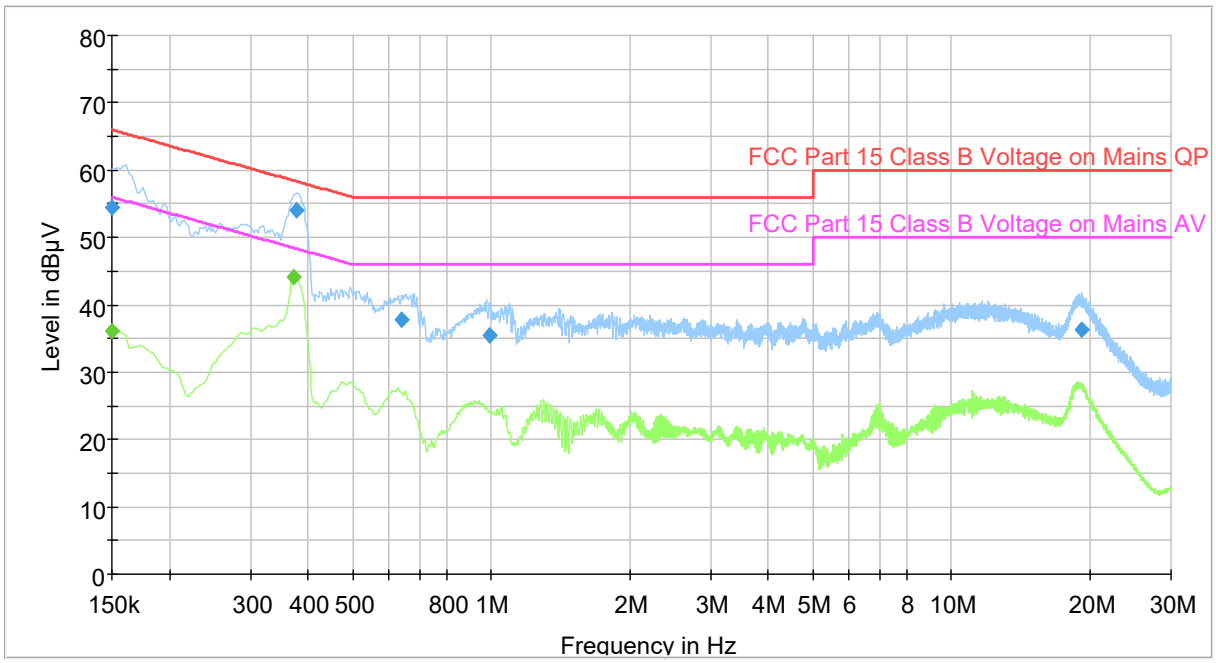
FCC Rule: 15.207 (a)
RSS-GEN 8.8

Conducted disturbance voltage was measured with an artificial main network from 150 kHz to 30 MHz with 4.5 kHz steps and a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors.

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

*Decreases with the logarithm of the frequency.

Full Spectrum



Preview Result 2-AVG
FCC Part 15 Class B Voltage on Mains QP
Final_Result QPK
Preview Result 1-PK+
FCC Part 15 Class B Voltage on Mains AV
Final_Result CAV

Figure 2: The measured curves with peak- and average detector (TX 903 MHz)

Final measurements from the worst frequencies

Table 2: Final measurement results

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	---	36.20	56.00	19.80	15x1000	9.000	N	9.7
0.150000	54.54	---	66.00	11.46	15x1000	9.000	L1	9.7
0.371750	---	44.11	48.46	4.35	15x1000	9.000	L1	9.7
0.378500	53.94	---	58.31	4.37	15x1000	9.000	L1	9.7
0.640000	37.86	---	56.00	18.14	15x1000	9.000	L1	9.7
0.990750	35.48	---	56.00	20.52	15x1000	9.000	N	9.8
19.153750	36.21	---	60.00	23.79	15x1000	9.000	N	10.5

The correction factor in the final result table contains the sum of the transducers (transient limiter + cables).
The result value is the measured value corrected with the correction factor.

Maximum Peak Conducted Output Power

Standard:	ANSI C63.10	(2013)
Tested by:	RRE	
Date:	24 February 2022	
Temperature:	23 ± 3 °C	
Humidity:	20 - 75 % RH	
Measurement uncertainty:	± 2.87dB	Level of confidence 95 % (k = 2)

FCC Rule: 15.247(b)(3)
RSS-247 5.4(d)

For systems using digital modulation in the 902-928 MHz bands the limit is 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

Measured values are peak values.

Results:

Table 3: Maximum conducted output power

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	11.53	30	18.47	PASS
Mid	11.77	30	18.23	PASS
High	11.88	30	18.12	PASS

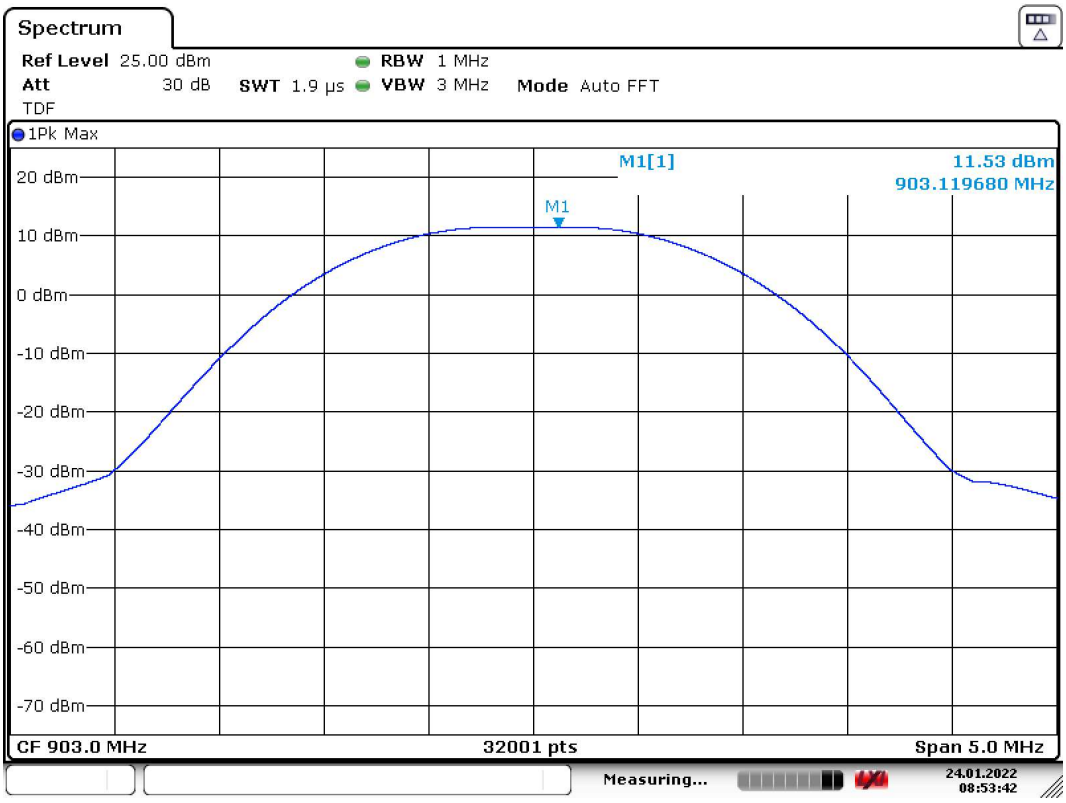


Figure 3: Conducted power, Channel LOW

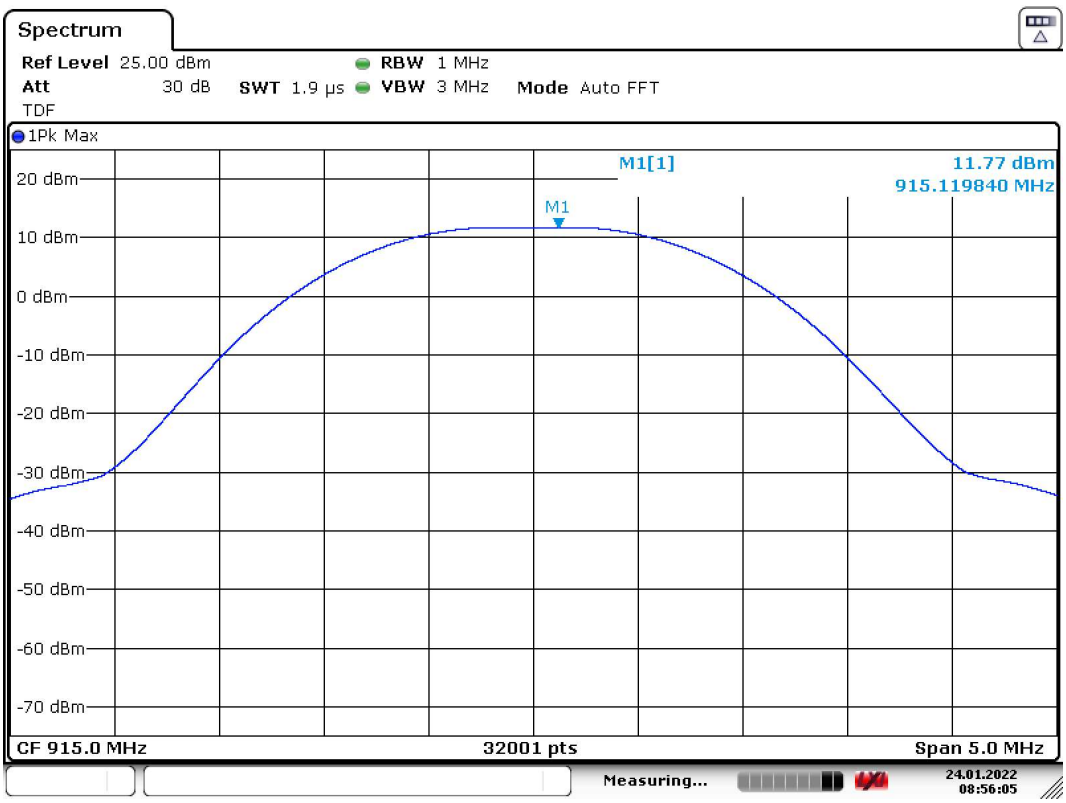


Figure 4: Conducted power, Channel MID

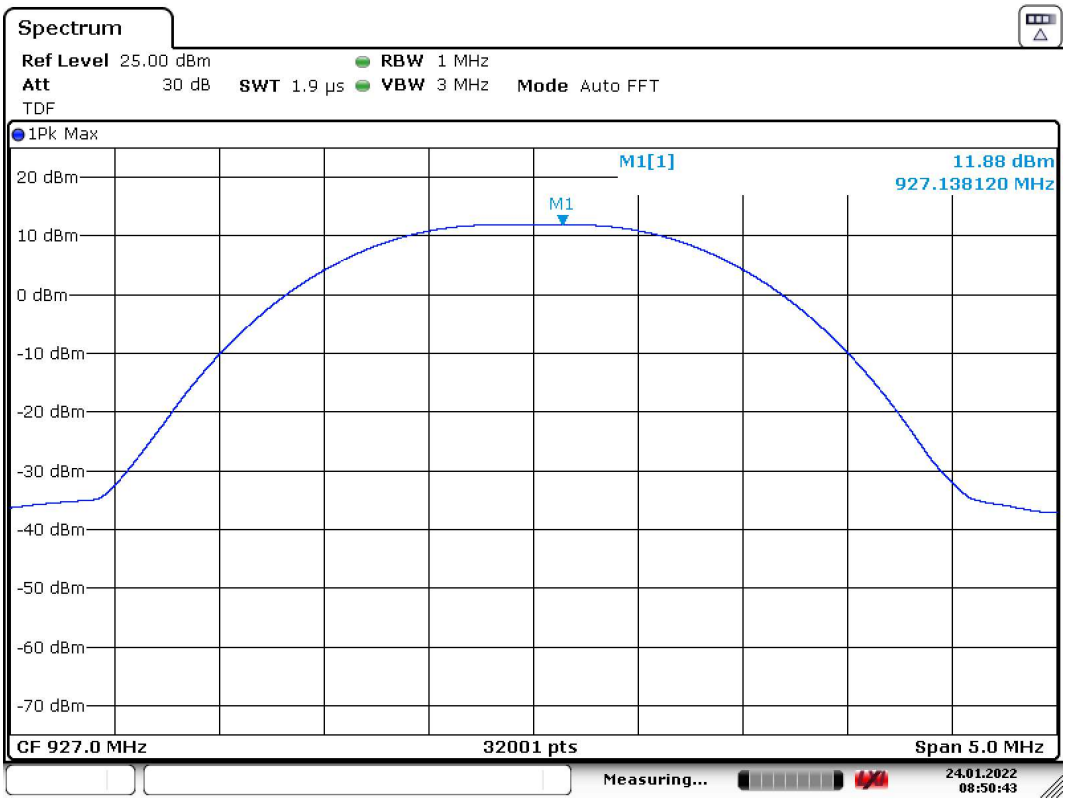


Figure 5: Conducted power, Channel HIGH

Transmitter Radiated Spurious Emissions 9 kHz - 10 GHz

Standard:	ANSI C63.10	(2013)
Tested by:	RRE	
Date:	8 December 2021, 9 February 2022	
Temperature:	23 ± 3 °C	
Humidity:	20 - 75 % RH	
Measurement uncertainty:	± 4.51 dB	Level of confidence 95 % (k = 2)

FCC Rule: 15.247(d), 15.209(a)

RSS-247 5.5

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. 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).

The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables).

Peak values of emissions below 1000 MHz measured for reference as well as transmitter fundamental.

Frequency range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector
0.009-0.490	2400/F(kHz)	48.5-13.8	Quasi-peak
0.490-1.705	24000/F(kHz)	33.8-22.97	Quasi-peak
1.705-30.0	30	29.54	Quasi-peak
30 - 80	100	40.0	Quasi-peak
88 - 216	150	43.5	Quasi-peak
216 - 960	200	46.0	Quasi-peak
960 - 1000	500	53.9	Quasi-peak
Above 1000	500	53.9	Average
Above 1000	5000	73.9	Peak

Results MID channel

Figure 6: MID channel (9 kHz – 30 MHz)

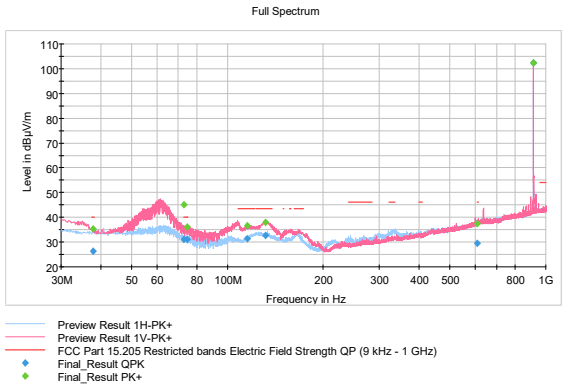


Figure 7: MID channel (30 MHz – 1000 MHz)

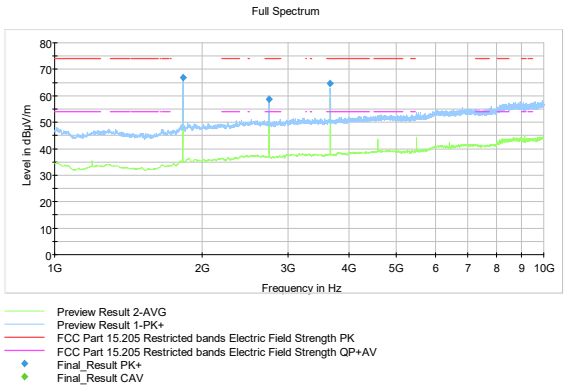


Figure 8: MID channel (1 GHz – 10 GHz)

Table 4: Peak results MID channel

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
37.755000	35.22	40.00	4.78	15x1000	120.000	100.0	V	126.0	26.7
72.825000	44.96	82.44**	37.48	15x1000	120.000	121.0	V	314.0	25.5
74.795000	35.98	82.44**	46.48	15x1000	120.000	142.0	V	343.0	24.8
115.235000	36.75	43.52	6.77	15x1000	120.000	105.0	V	86.0	25.4
131.425000	38.07	43.52	5.45	15x1000	120.000	117.0	V	121.0	27.1
608.595000	37.46	46.02	8.56	15x1000	120.000	307.0	V	139.0	37.0
915.125000*	102.44	---	---	15x1000	120.000	108.0	V	56.0	41.7
1830.225000	66.81	82.44**	15.63	15x1000	1000.000	121.0	V	144.0	12.1
2744.775000	58.66	74.00	15.34	15x1000	1000.000	162.0	V	131.0	14.2
3660.425000	64.70	74.00	9.30	15x1000	1000.000	245.0	H	114.0	15.4

*Fundamental frequency

**Limit is 20 dB less than the fundamental peak value

Table 5: Average results MID channel

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
0.491000	1.05	33.78	32.73	15x1000	9.000	190.0	V	0.0	-20.2
2744.775000*	38.61	74.00	15.34	15x1000	1000.000	162.0	V	131.0	14.2
3660.425000*	44.65	74.00	9.30	15x1000	1000.000	245.0	H	114.0	15.4

* Average values for the harmonics are calculated from the peak results using duty cycle correction factor (look at section “Duty cycle correction factor, Transmit time in 100 ms”).

Table 6: Quasi-peak results MID channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
0.491000	2.29	33.78	31.49	15x1000	9.000	190.0	V	0.0	-20.2
37.755000	26.24	40.00	13.76	15x1000	120.000	100.0	V	126.0	26.7
72.825000	31.19	---	---	15x1000	120.000	121.0	V	314.0	25.5
74.795000	31.15	---	---	15x1000	120.000	142.0	V	343.0	24.8
115.235000	31.30	43.52	12.22	15x1000	120.000	105.0	V	86.0	25.4
131.425000	32.74	43.52	10.78	15x1000	120.000	117.0	V	121.0	27.1
608.595000	29.46	46.02	16.56	15x1000	120.000	307.0	V	139.0	37.0

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard:	ANSI C63.10	(2013)
Tested by:	RRE	
Date:	24 January 2022	
Temperature:	23 ± 3 °C	
Humidity:	20 - 75 % RH	
Measurement uncertainty:	± 2.87 dB	Level of confidence 95 % (k = 2)

FCC Rule: 15.247(d), 15.209(a)

RSS-247 5.5

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)).

Table 7: Band edge attenuation

Band Edge Attenuation	
Lower Band Edge	**Upper Band Edge**
-43.68 dBc	-50.36 dBc
Limit: -20 dBc	

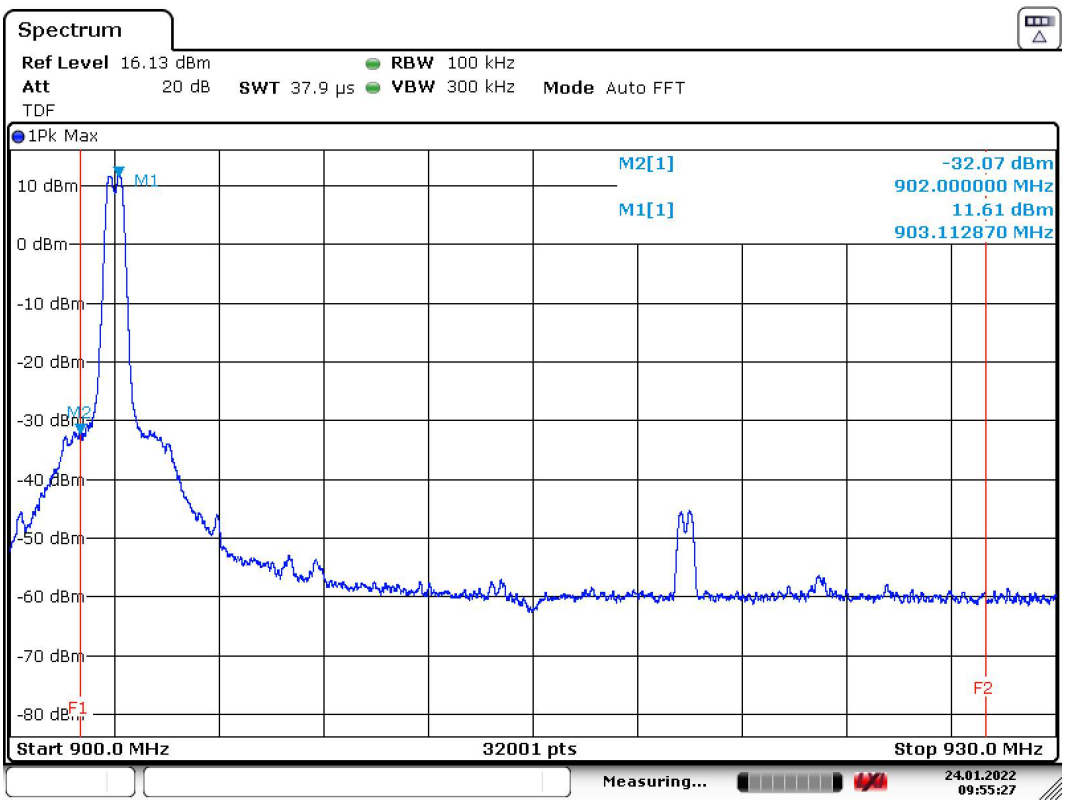


Figure 9: Lower Band Edge

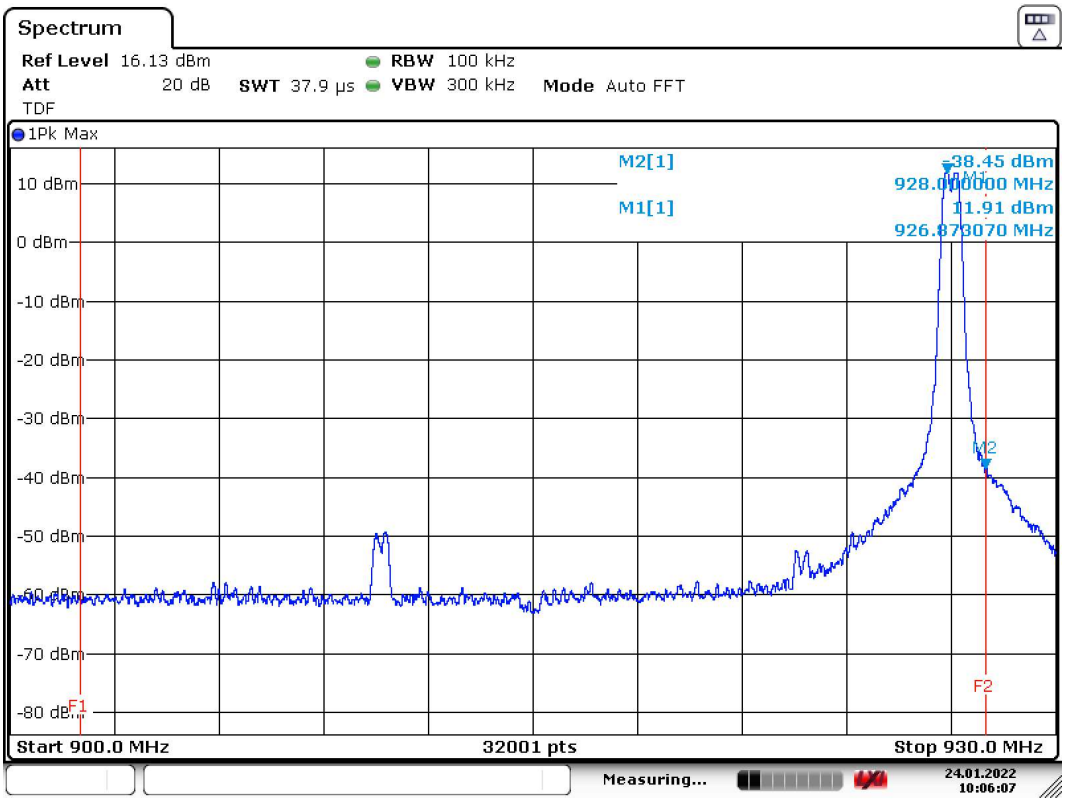


Figure 10: Upper Band Edge

Conducted spurious emissions results LOW channel

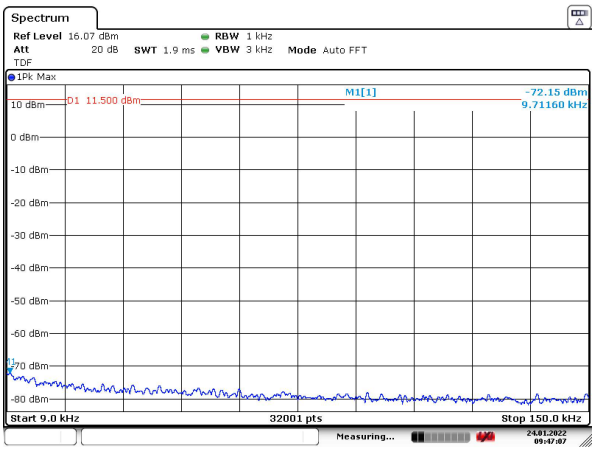


Figure 11: Conducted spurious emissions 9-150 kHz LOW channel

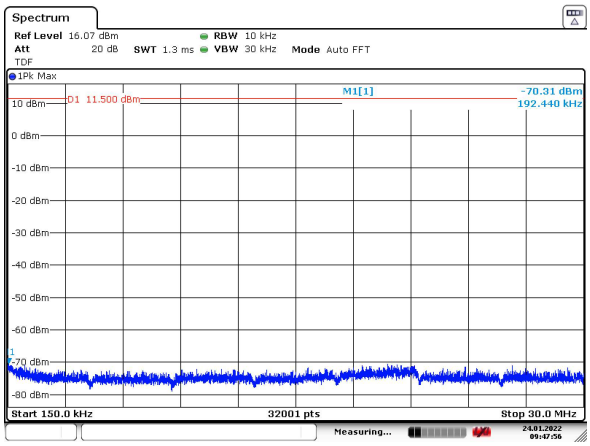


Figure 12: Conducted spurious emissions 150 kHz – 30 MHz LOW channel

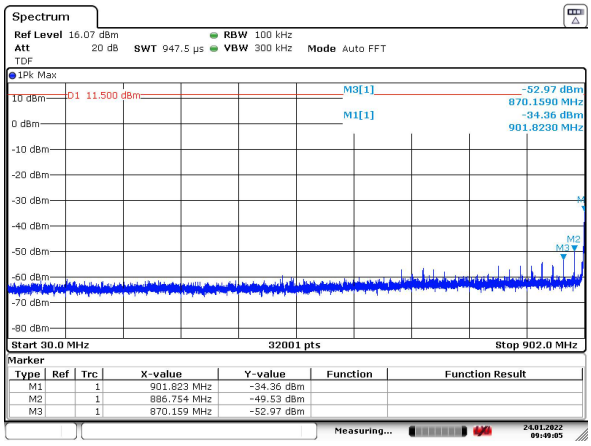


Figure 13: Conducted spurious emissions 30 MHz – 902 MHz LOW channel

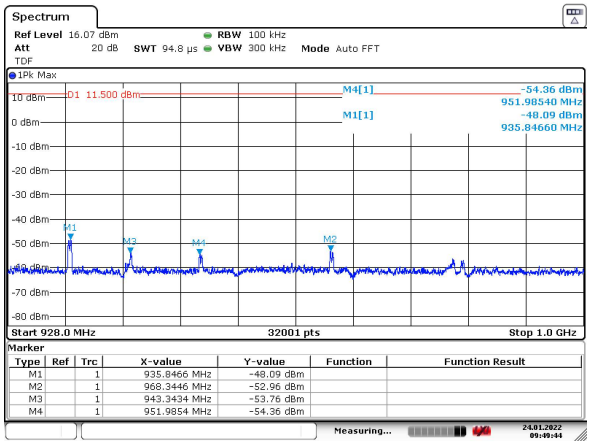


Figure 14: Conducted spurious emissions 928 MHz – 1 GHz LOW channel

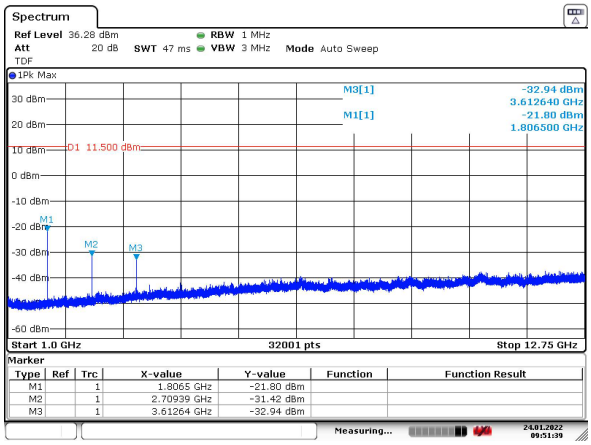


Figure 15: Conducted spurious emissions 1 GHz – 12.75 GHz LOW channel

Conducted spurious emissions results MID channel

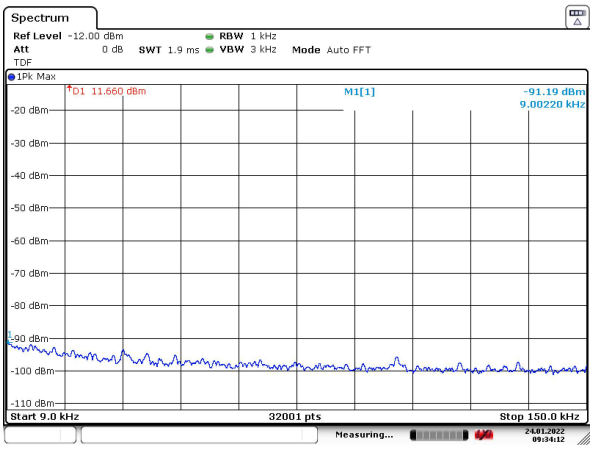


Figure 16: Conducted spurious emissions 9-150 kHz MID channel

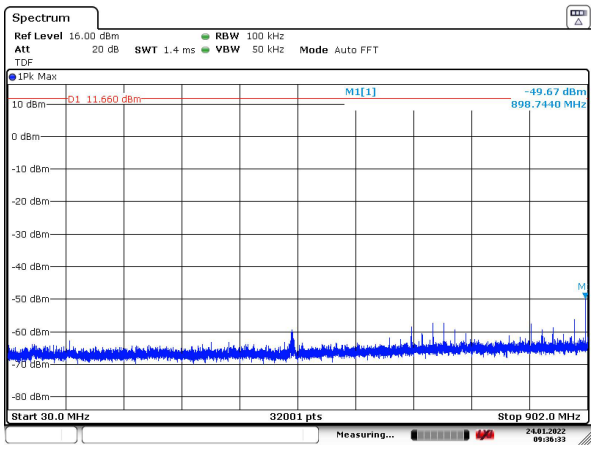


Figure 17: Conducted spurious emissions 150 kHz – 30 MHz MID channel

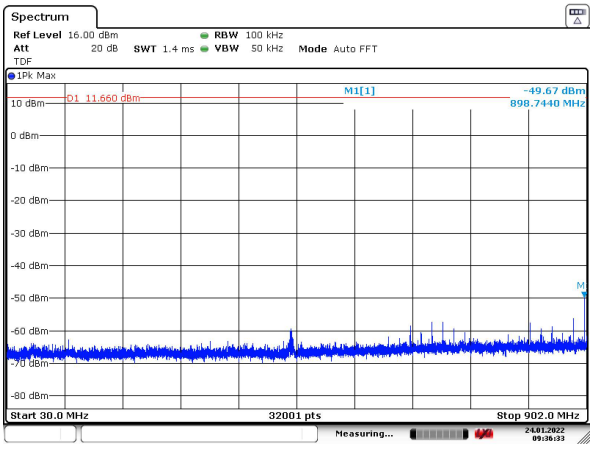


Figure 18: Conducted spurious emissions 30 MHz – 902 MHz MID channel

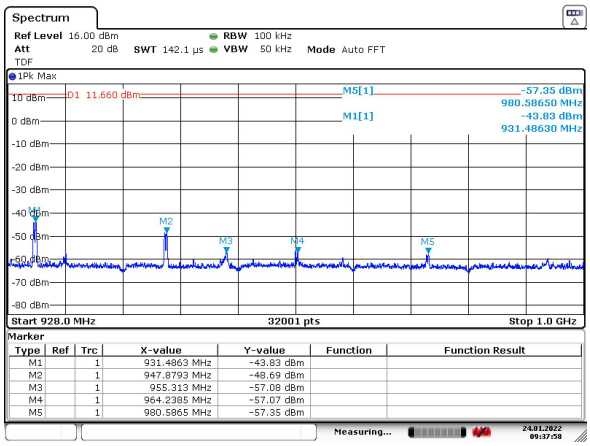


Figure 19: Conducted spurious emissions 928 MHz – 1 GHz MID channel

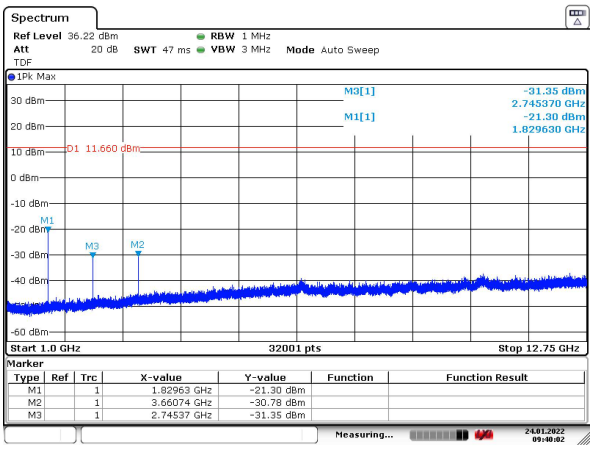


Figure 20: Conducted spurious emissions 1 GHz – 12.75 GHz MID channel

Conducted spurious emissions results HIGH channel

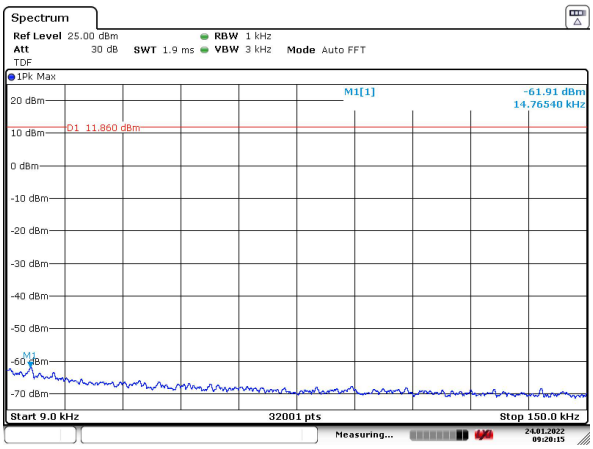


Figure 21: Conducted spurious emissions 9-150 kHz HIGH channel

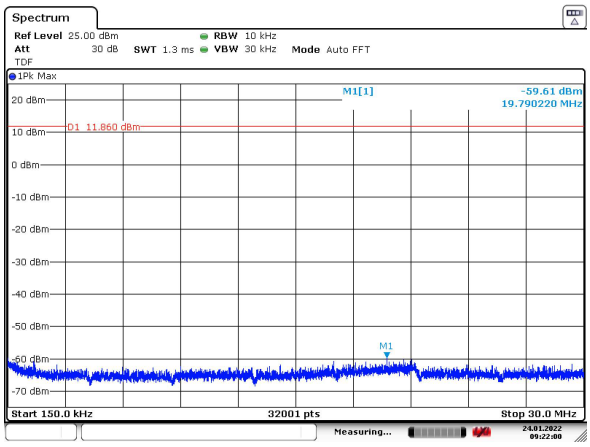


Figure 22: Conducted spurious emissions 150 kHz – 30 MHz HIGH channel

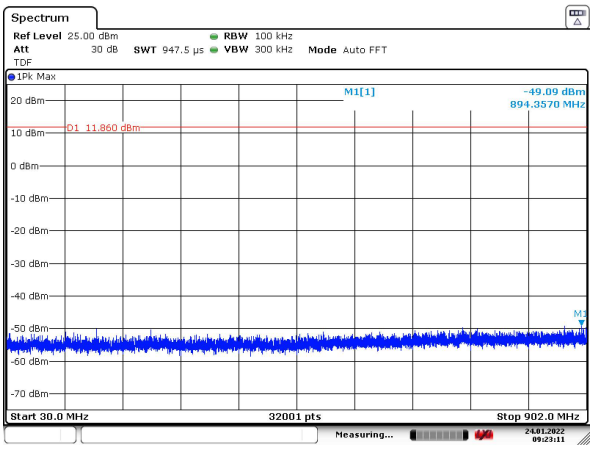


Figure 23: Conducted spurious emissions 30 MHz – 902 MHz HIGH channel

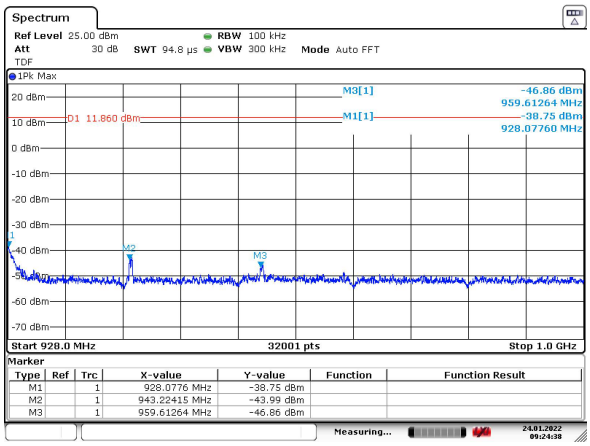


Figure 24: Conducted spurious emissions 928 MHz – 1 GHz HIGH channel

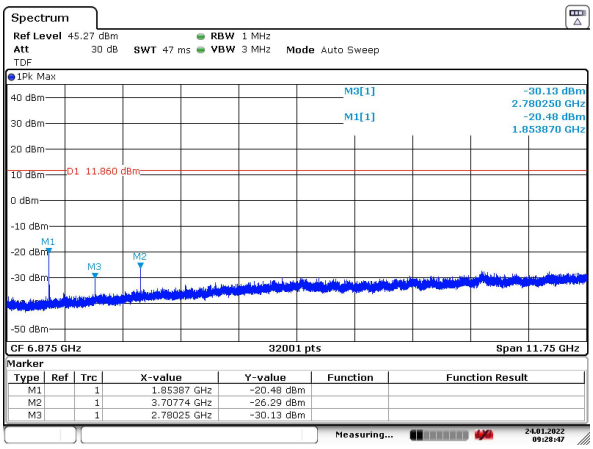


Figure 25: Conducted spurious emissions 1 GHz – 12.75 GHz HIGH channel

6 dB Bandwidth of the Channel

Standard:	ANSI C63.10	(2013)
Tested by:	RRE	
Date:	24 January 2022	
Temperature:	23 ± 3 °C	
Humidity:	20 - 75 % RH	

FCC Rule: 15.247(a)(2)
RSS-247 5.2(a)

Results

Table 8: 6 dB bandwidth test results

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	517.8	500
Mid	518.6	
High	518.1	

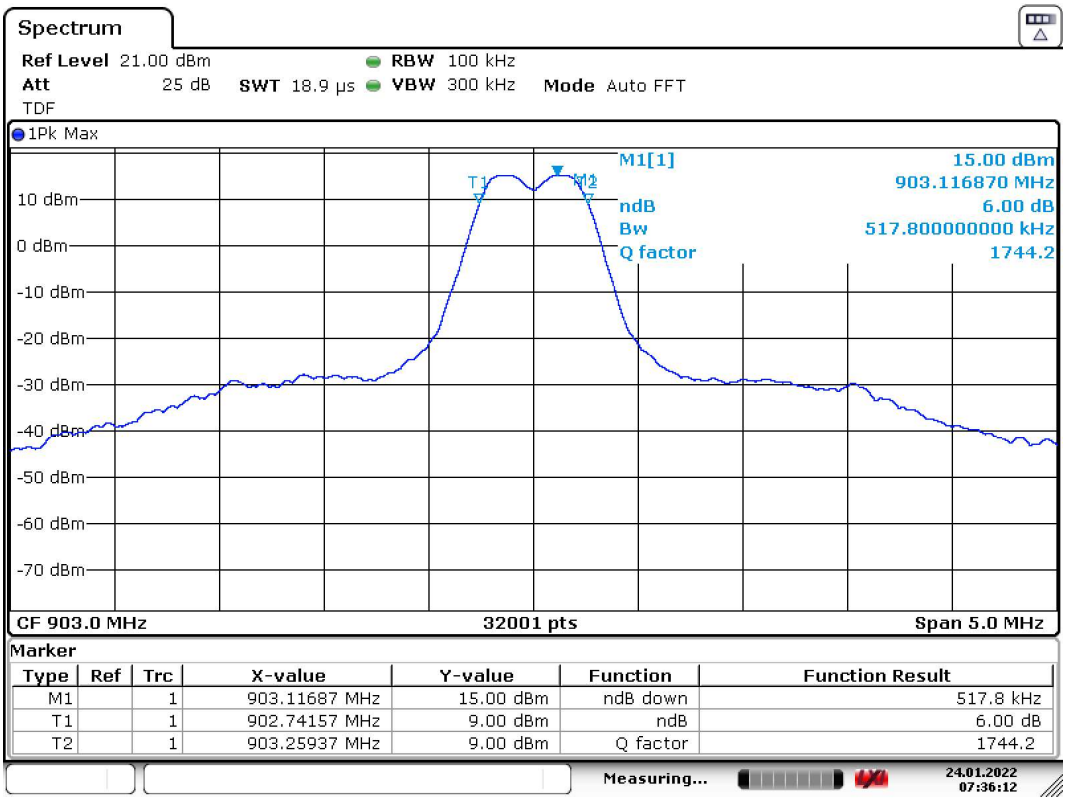


Figure 26: 6 dB bandwidth, channel LOW

6 dB Bandwidth of the Channel

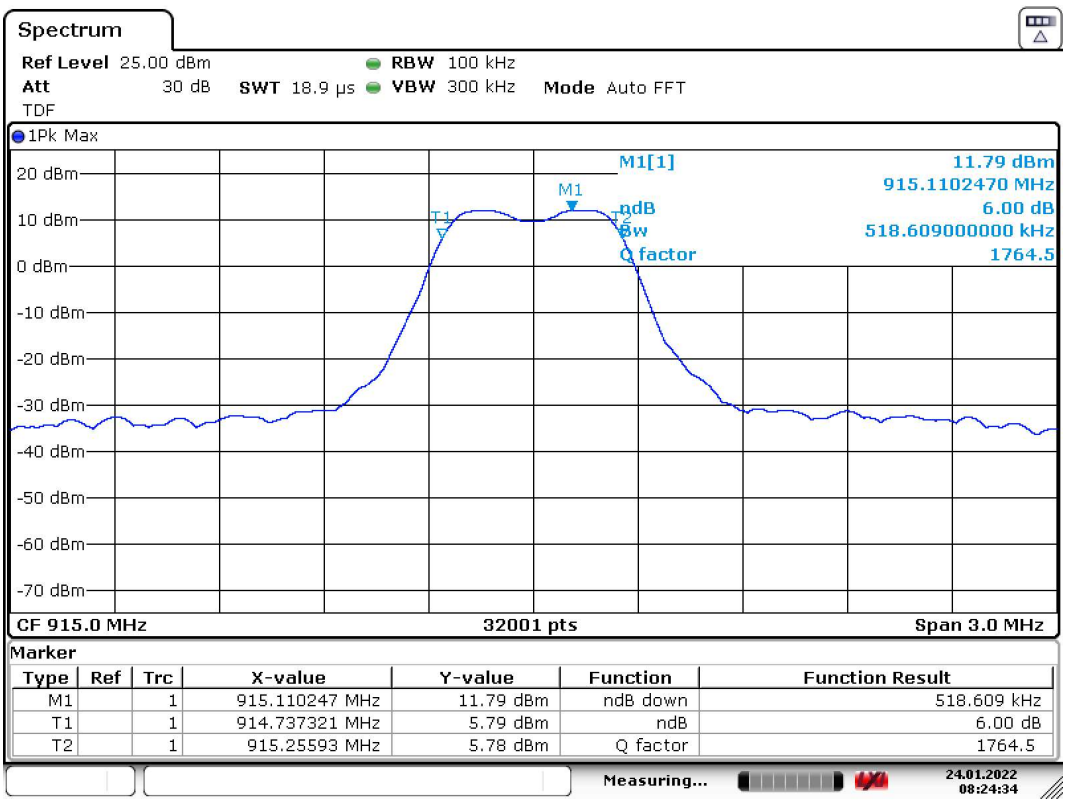


Figure 27: 6 dB bandwidth, channel MID

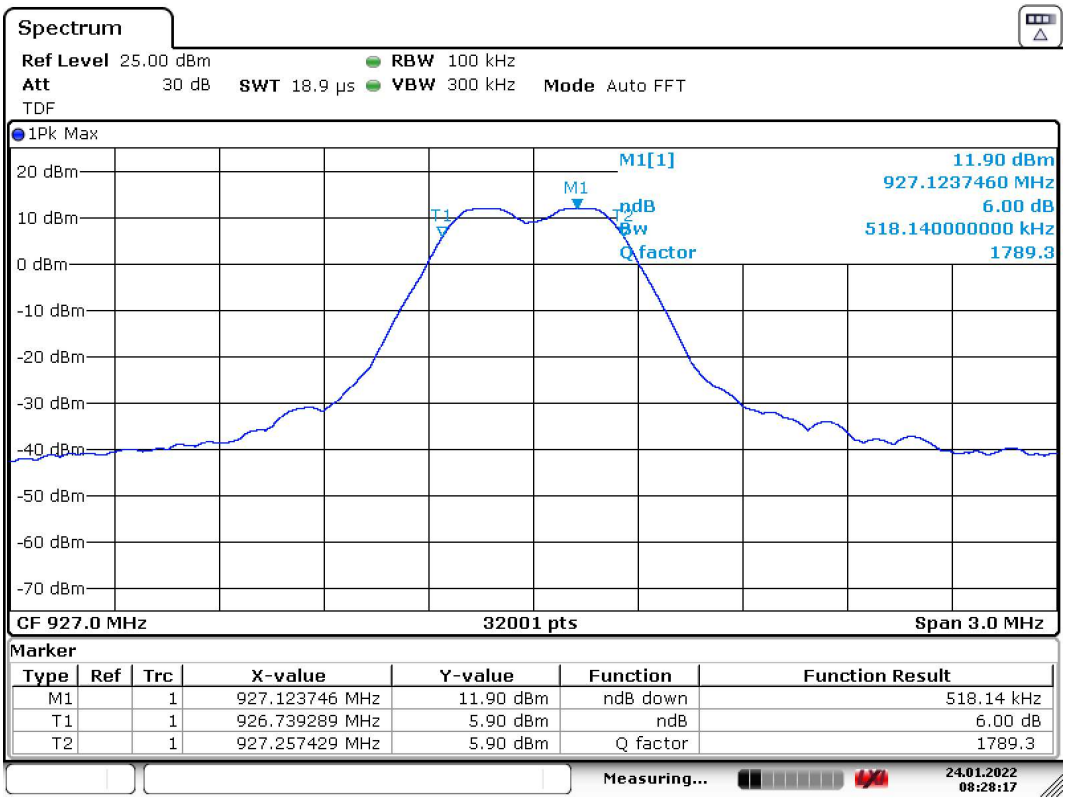


Figure 28: 6 dB bandwidth, channel HIGH

Power Spectral Density

Standard:	ANSI C63.10	(2013)
Tested by:	RRE	
Date:	24 January 2022	
Temperature:	23 ± 3 °C	
Humidity:	20 - 75 % RH	

FCC Rule: 15.247(e)
RSS-247 5.2(b)

Results

Table 9: Power spectral density test results

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
Low	7.18	+8.00
Mid	6.36	
High	7.61	

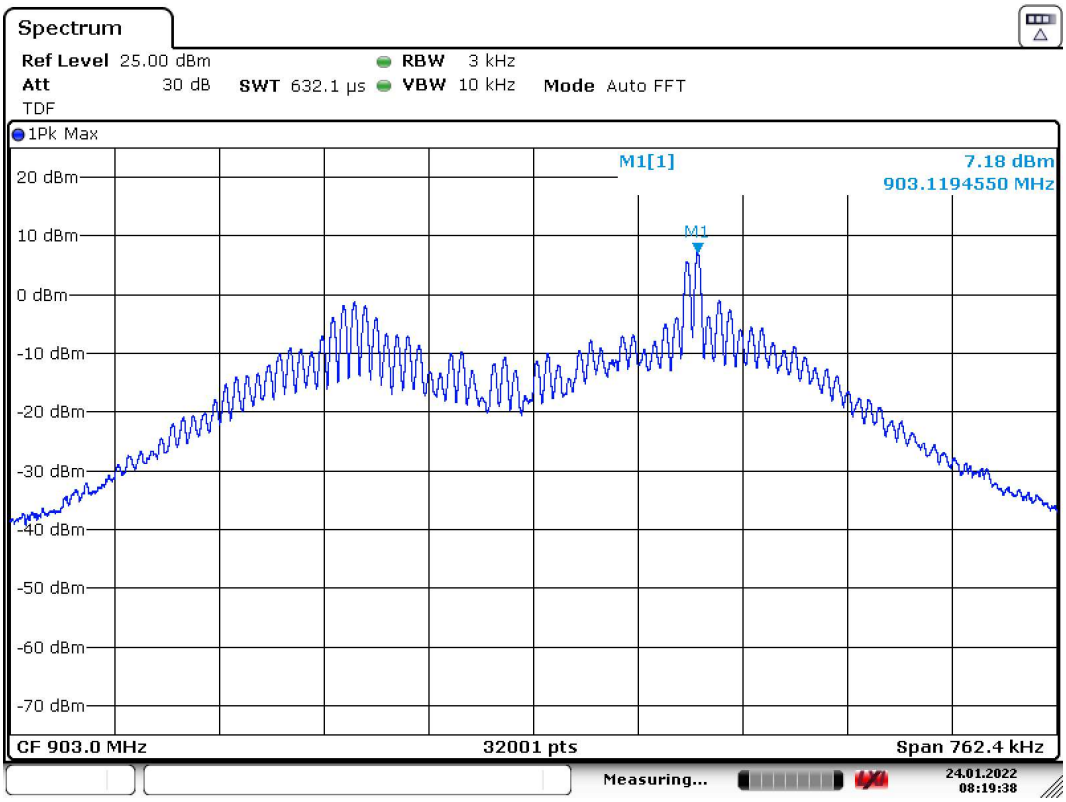


Figure 29: Power spectral density, channel LOW

Power Spectral Density

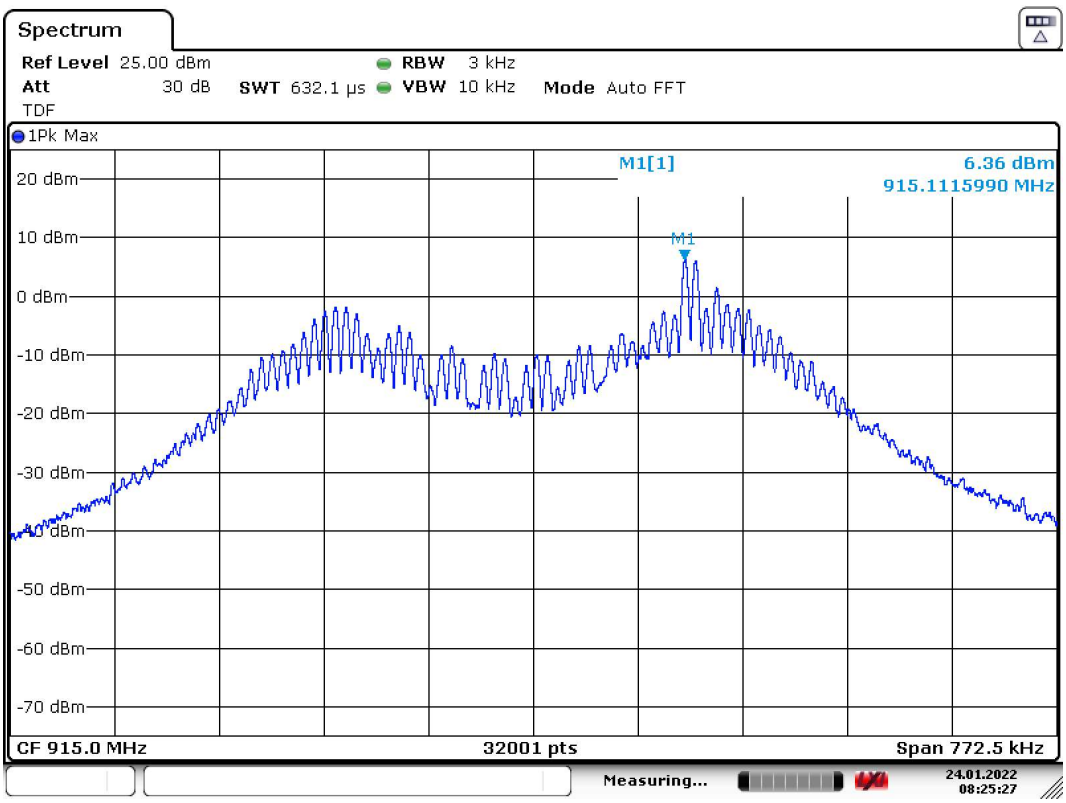


Figure 30: Power spectral density, channel MID

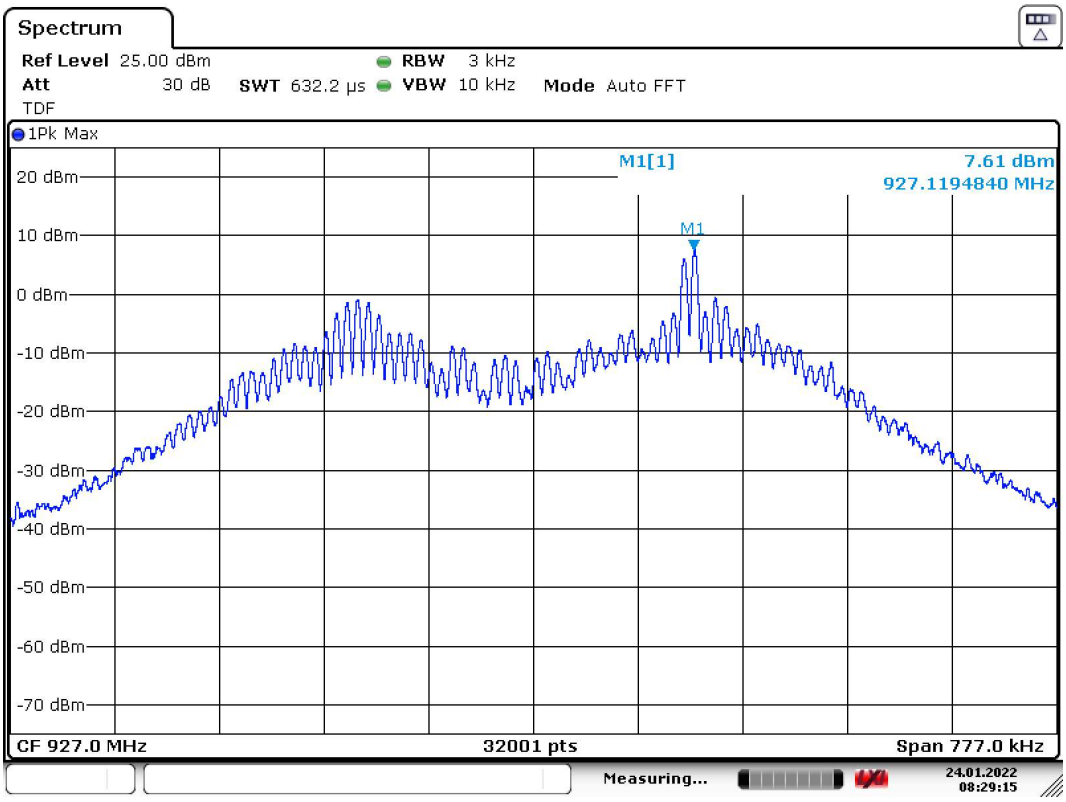


Figure 31: Power spectral density, channel HIGH

99% Occupied Bandwidth

Standard:	RSS-GEN	(2019)
Tested by:	RRE	
Date:	24 January 2022	
Temperature:	23 ± 3 °C	
Humidity:	20 - 75 % RH	

RSS-GEN 6.6

Results

Table 10: 99% occupied bandwidth test results

Channel	Limit	99 % BW [kHz]	Result
Low	-	468.110371551	PASS
Mid	-	452.485859827	PASS
High	-	472.953970188	PASS

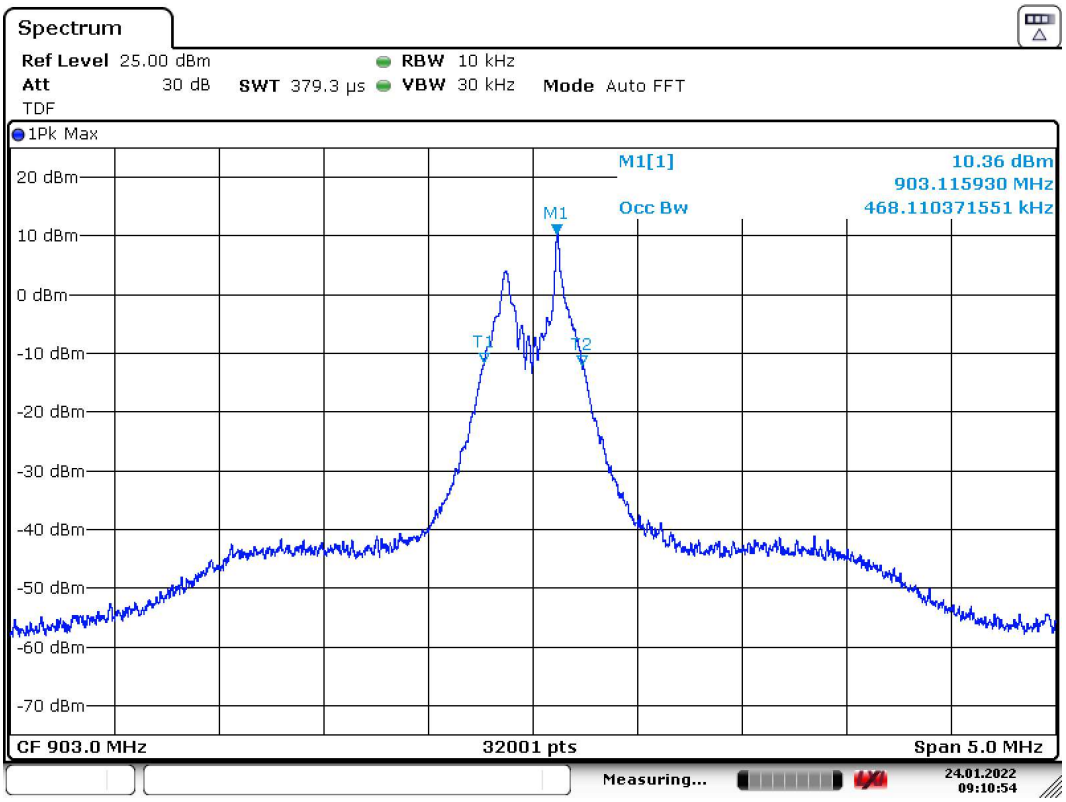


Figure 32: 99% OBW, channel LOW

99% Occupied Bandwidth

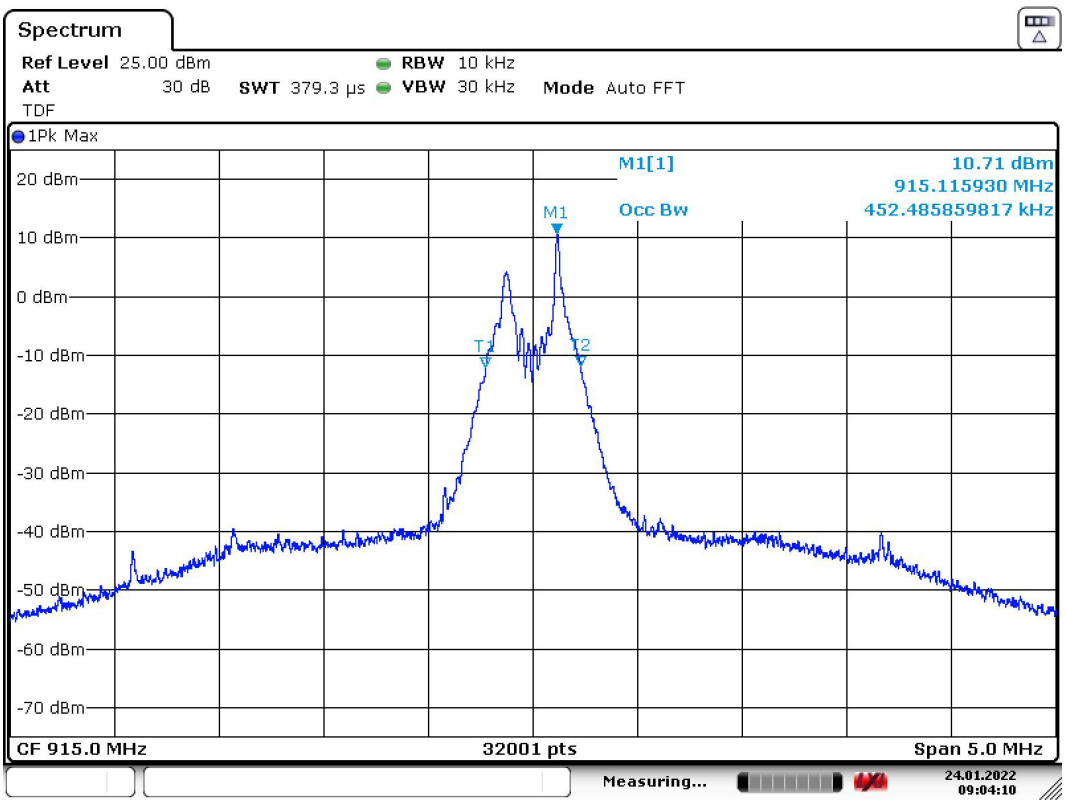


Figure 33: 99% OBW, channel MID

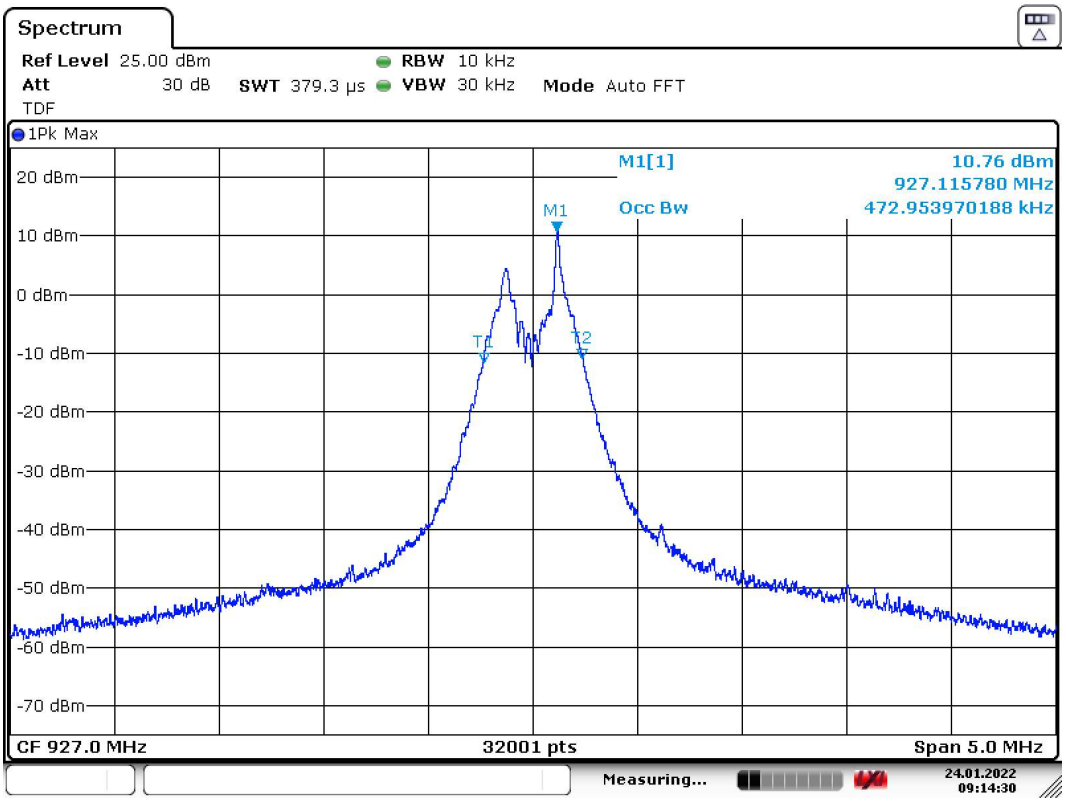


Figure 34: 99% OBW, channel HIGH

Duty cycle correction factor, Transmit time in 100 ms

Standard:	ANSI C63.10	(2013)
Tested by:	RRE	
Date:	17 December 2021	
Temperature:	23 ± 3 °C	
Humidity:	20 - 75 % RH	

Spectrum analyzer with zero span was used to investigate spectrum.

15.35(c) Unless otherwise specified, e.g.§ 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Pulses / 100 ms = 1
Length of one pulse = 9.936735 ms
Duty Cycle Correction Factor=20*log(Tocc/100)=20*log(1*9.936735 /100) = -20.05 dB

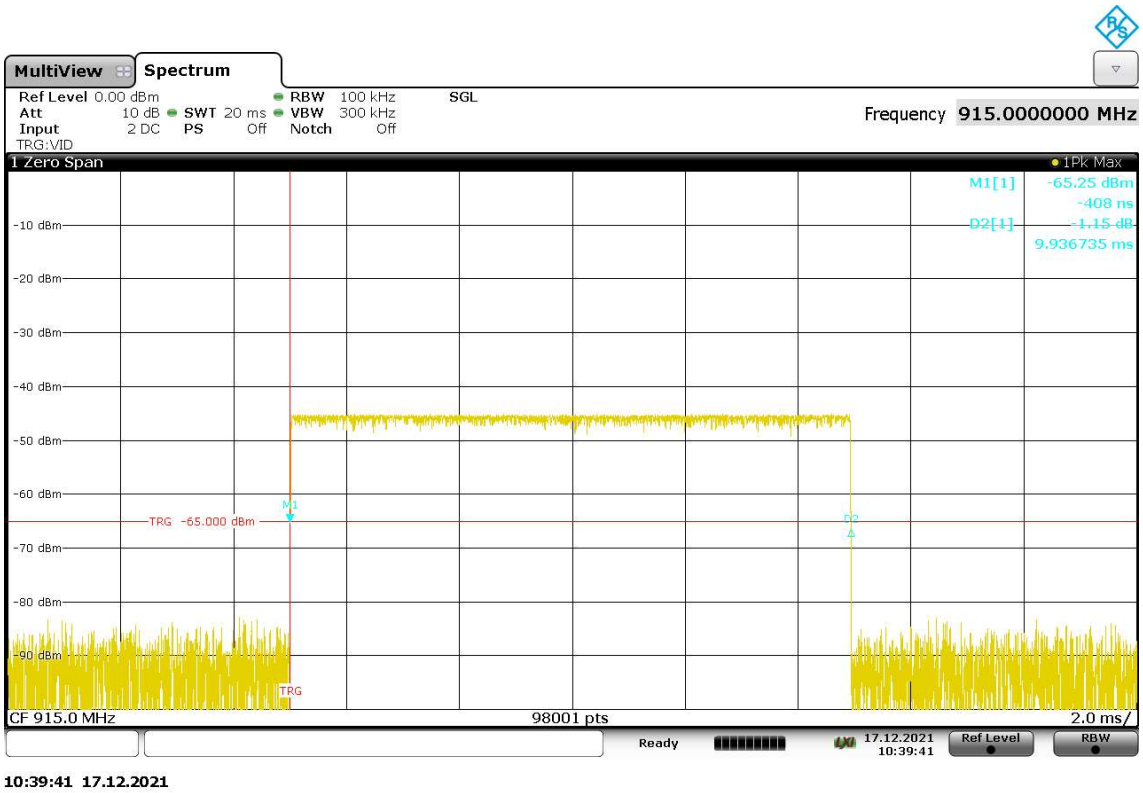


Figure 35. Pulse length

TEST EQUIPMENT

Conducted Emissions

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	NCR	NCR
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv:10679	2021-06-21	2022-06-21
LISN	ROHDE & SCHWARZ	ENV216	inv:9611	2022-02-02	2023-02-02
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 SAC	inv:10517	2021-10-22	2022-10-22

RF-Test Equipment

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
ATTENUATOR	HUBER&SUHNER	6810.17.B (10dB)	inv:10390	2021-01-25	2023-01-25
ATTENUATOR	INMET	10 dB, DC-40 GHz	inv:10347	2021-04-20	2023-04-20
ANTENNA	A.H. SYSTEMS	SAS-200/518	inv:7873	NCR	NCR
SPECTRUM ANALYZER	AGILENT	E7405A, monitoring	inv:9746	2020-02-17	2022-02-17
RF PREAMPLIFIER	CIAO	CA118-3123	inv:10278	2021-10-05	2022-10-05
TEMPERATURE/ HUMIDITY SENSOR	EDS	OW-ENV-TH, K5 SAC	inv:10517	2021-10-22	2022-10-22
ANTENNA	EMCO	3117, emi 1-18GHz	inv:7293	2020-03-11	2022-03-11
TURNTABLE	MATURO	DS430 UPGRADED	inv:10182	NCR	NCR
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv:10183	NCR	NCR
ANTENNA MAST	MATURO	TAM 4.0E	inv:10181	NCR	NCR
ATTENUATOR	PASTERNACK	PE 7004-4 (4dB)	inv:10126	2021-03-26	2022-03-26
GPS REFERENCE	PENDELUM	GPS-88	inv:8032	NCR	NCR
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	NCR	NCR
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv:10679	2021-06-21	2022-06-21
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSV40	inv:9093	2021-12-06	2022-12-06
ANTENNA	SCHWARZBECK	VULB 9168	inv:8911	2020-11-04	2022-11-04
FILTER	WAINWRIGHT	HP, WHKX1.0/15G-10SS	inv:8267	2021-01-29	2023-01-29

NCR = No calibration required

END OF REPORT