Certification Test Report

FCC Rule Part: CFR 47 Part 24 Subpart D, Part 101 Subpart C
ISED Canada's Radio Standards Specification: RSS-119, RSS-134

FCC ID: SDBVGBM4700
IC: 2220A-VGBM4700

TÜV SÜD Report Number: RD72154722.100

Applicant: Sensus USA, Inc.
Model: VGBM4700

Test Begin Date: November 8, 2019
Test End Date: November 26, 2019

Report Issue Date: December 19, 2019

A2LA Cert. No. 2955.18

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 2955.18

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, ANSI, or any agency of the Federal Government.

Prepared by:

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REVISION HISTORY Report Number: RD72154722.100 Manufacturer: Sensus USA, Inc. Model: VGBM4700					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
December 19, 2019	---	.100	Initial Release	All	Kirby Munroe

Table of Content

1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 2 Subpart J, Part 24 Subpart D and Part 101 Subpart C of the FCC's Code of Federal Regulations, and ISED Canada Radio Standards Specifications RSS-119 and RSS-134.

1.2 Product Description

The Sensus FlexNet Vehicle Gateway Basestation (VGB) is a portable radio-based device used for the acquisition of data from utility meters and other field-based diagnostic instruments. The VGB is compact and portable, allowing it to be used in any vehicle providing 12-volt DC power.

Antenna: External, 5.15dBi gain
Overall antenna assembly: 3.2dBi gain

Manufacturer Information:
Sensus USA, Inc.
639 Davis Drive
Morrisville, NC 27560

Test Sample Serial Numbers: 19080014

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology

1.3.1 Configurations and Justification

The FLEXNET 900MHz transmitter was evaluated for radiated and RF conducted measurements for the three modulations listed in the emission designators table in section 1.4. The worst-case results for each of the modulations and power levels are reported where applicable.

A Minicircuits VLF-2250+ low pass filter was installed in the unit by the manufacturer to minimize the harmonic spurious output of the unit for conducted spurious at the antenna terminals.

The EUT was tested standalone, and a power supply was used to power the EUT. The client provided software to exercise the EUT.

The limits of FCC Part 24 and Part 101 were applied to both transmit bands. For radiated emissions the more stringent limits were applied.

1.3.2 In-Band Testing Methodology

The EUT is designed to operate in multiple bands under the requirements of CFR 47 Parts 24 and 101. The following is a list of the frequency bands of operation sorted based on the FCC rule parts in which the band is associated.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)
24D	930 - 931
24D	940 - 941
101	941 – 941.5
101	952.0 – 953.0
101	959.85 - 960.0

Based on the requirements set forth in accordance 47 CFR 2.1046-2.1057 as stated above, the methodology in selecting the places to test in the available bands of operation is outlined in the following table.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)	Location in the Range of Operation	Approx. Test Freq.
24	930 – 931	Near Middle	930.5
24	940 – 941	Near Middle	940.5
101	941 – 941.5	Near Middle	941.25
101	952 – 953	Near Middle	952.5
101	959.85 – 960	Near Middle	959.925

1.4 Emission Designators

The transmitter produces three distinct modulation types. The emission designators for the modulation types used by the VGBM4700 transmitter were calculated using the baud rate defined in the Theory of Operation are as follows:

EMISSIONS DESIGNATORS

Mode	Emission Designator	Modulation
MPass (5 kbps)	5K90F1D	2-GFSK
MPass (10 kbps)	11K8F1D	2-GFSK
MPass (12.5 kbps)	11K8F1D	2-GFSK

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

TÜV SÜD America Inc.
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

FCC Designation Number: US1245
FCC Test Firm Registration Number: 238628
ISED Canada Company Number: 20446

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. (Durham) is accredited to ISO/IEC 17025 by A2LA accreditation program, and has been issued certificate number 2955.18 in recognition of this accreditation. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of an 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is an aluminum, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

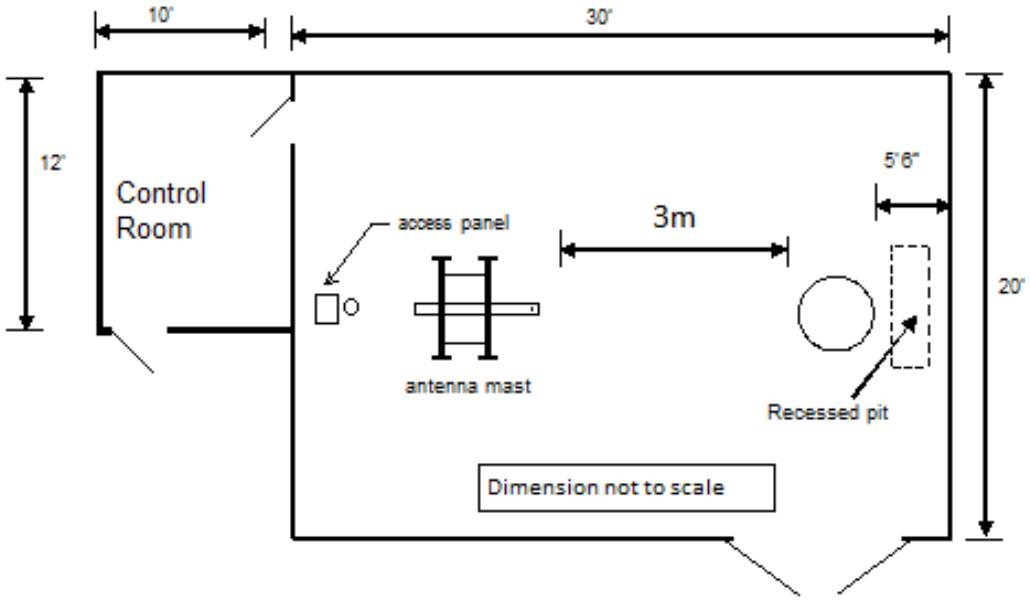


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.26-2015: Compliance Testing of Transmitters Used in Licensed Radio Services
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures - 2019
- US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communications Services – 2019
- US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services -2019
- ISED Canada Radio Standards Specification: RSS-119 - Radio Transmitters and Receivers Operating in the Land Mobile and Fixed Services in the Frequency Range 27.41-960 MHz, Issue 12, May 2015
- ISED Canada Radio Standards Specification: RSS-134 - 900 MHz Narrow Band Personal Communication Service, Issue 2, February 2016
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5 Amendment 1, March 2019.

4.0 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment Radiated Emissions

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
DEMC0426	Thermotron	S-8 Mini Max	Environmental Chamber	25-2888-10	1/23/2019	1/23/2020
DEMC3002	Rohde & Schwarz	ESU40	Receiver	100346	10/31/2018	1/31/2020
DEMC3006	Rohde & Schwarz	TS-PR18	Amplifier	122006	1/22/2019	1/22/2020
DEMC3008	Rohde & Schwarz	NRP2	Meter	103131	2/7/2019	2/7/2020
DEMC3009	Rohde & Schwarz	NRP-Z81	Meter	102397	2/7/2019	2/7/2020
DEMC3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
DEMC3013	Agilent	53132A	Meter	MY40007729	1/22/2019	1/22/2020
DEMC3014	EMCO	3115	Antenna	9901-5653	4/12/2019	4/12/2021
DEMC3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antenna	2013120203	2/7/2018	2/7/2020
DEMC3020	Rohde & Schwarz	SMB100A	Signal Generator	175943	1/22/2019	1/22/2020
DEMC3029	Micro-Tronics	HPM50108	900MHz HP Filter	134	1/15/2019	1/15/2020
DEMC3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/16/2019	1/16/2020
DEMC3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/16/2019	1/16/2020
DEMC3041	Aeroflex Inmet	18N10W-30	Attenuator	1447	1/15/2019	1/15/2020
DEMC3055	Rohde & Schwarz	3005	Cable	3055	1/22/2019	1/22/2020
DEMC3064	Times	LMR195	Cable	3064	8/15/2019	8/15/2020
DEMC3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	3/28/2019	3/28/2020
DEMC3161	TESEQ	CBL-6112D	Antenna	51323	1/31/2019	1/31/2020

NCR = No Calibration Required
Asset DEMC3002: Firmware Version: ESU40 is 4.73 SP4
Asset DEMC3012: Software Version: EMC32-B is 10.50.00
Asset DEMC3020: Firmware Rev: 2.20.382.113
Asset DEMC3085: Instrument Firmware 2.90 SP1

5.0 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Sensus	VGBM4700	See Section 1.2
2	Power Supply	Hewlett Packard	6674A	N/A
3	PC	Dell	Latitude E6420	FSNVNW1

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	DC Power	1.0m	No	1 to 2
C	AC Power	1.2m	No	2 to AC
D	USB	1.8m	Yes	PC to EUT

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

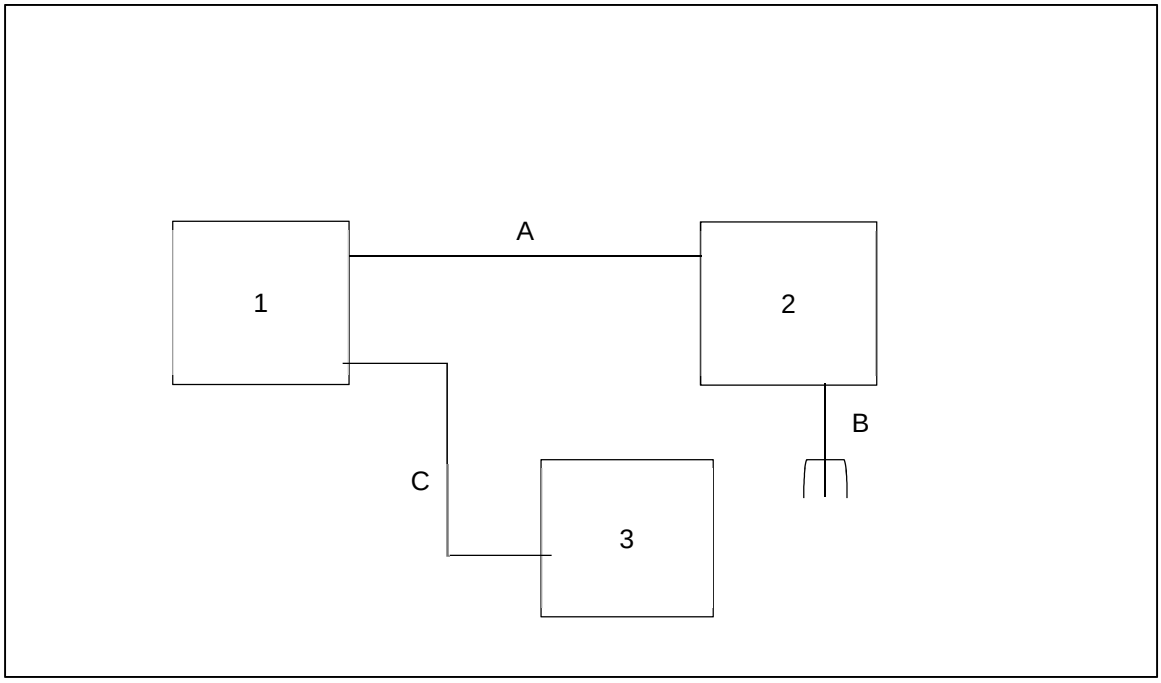


Figure 6-1: Test Setup Block Diagram

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 RF Power Output

7.1.1 Measurement Procedure (ANSI 63.26: 2015 Section 5.2.3.2)

The RF output of the equipment under test was directly connected to the input of a wide band RF power meter through 30.5dB of passive attenuation. The results are shown below.

Part 24.132, 101.113 (a), and ISED Canada RSS-134 4.3(a), (b) and RSS-119 5.4 – Power Output

7.1.2 Measurement Results

Performed by: Chris Gormley

Table 7.1.2-1: Output Power – High Power

FCC Rule Part	Frequency (MHz)	Output Power High (dBm)	Output Power High (Watts)
24	930.5	37.4	5.5
24	940.5	37.3	5.4
101	941.25	37.3	5.4
101	952.5	36.9	4.9
101	959.925	36.7	4.7

Table 7.1.2-2: Output Power – Low Power

FCC Rule Part	Frequency (MHz)	Output Power Low (dBm)	Output Power Low (Watts)
24	930.5	31.0	1.3
24	940.5	30.9	1.2
101	941.25	30.9	1.2
101	952.5	30.4	1.1
101	959.925	30.1	1.0

7.2 Out of Band Unwanted Emissions

7.2.1 Measurement Procedure (ANSI 63.26: 2015 Section 5.7.3)

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 30.5dB of passive attenuation. The spectrum analyzer resolution and video bandwidths were set to 300 Hz and 1000 Hz respectively. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. Results of the test are shown below for all modes of operation.

7.2.2 Measurement Results – Emission Masks

Performed by: Chris Gormley

Part 24.133 a(1), a(2), ISED Canada RSS-134 4.4.1 (a), (b), 4.4.2 (a),(b) – Emission Limits

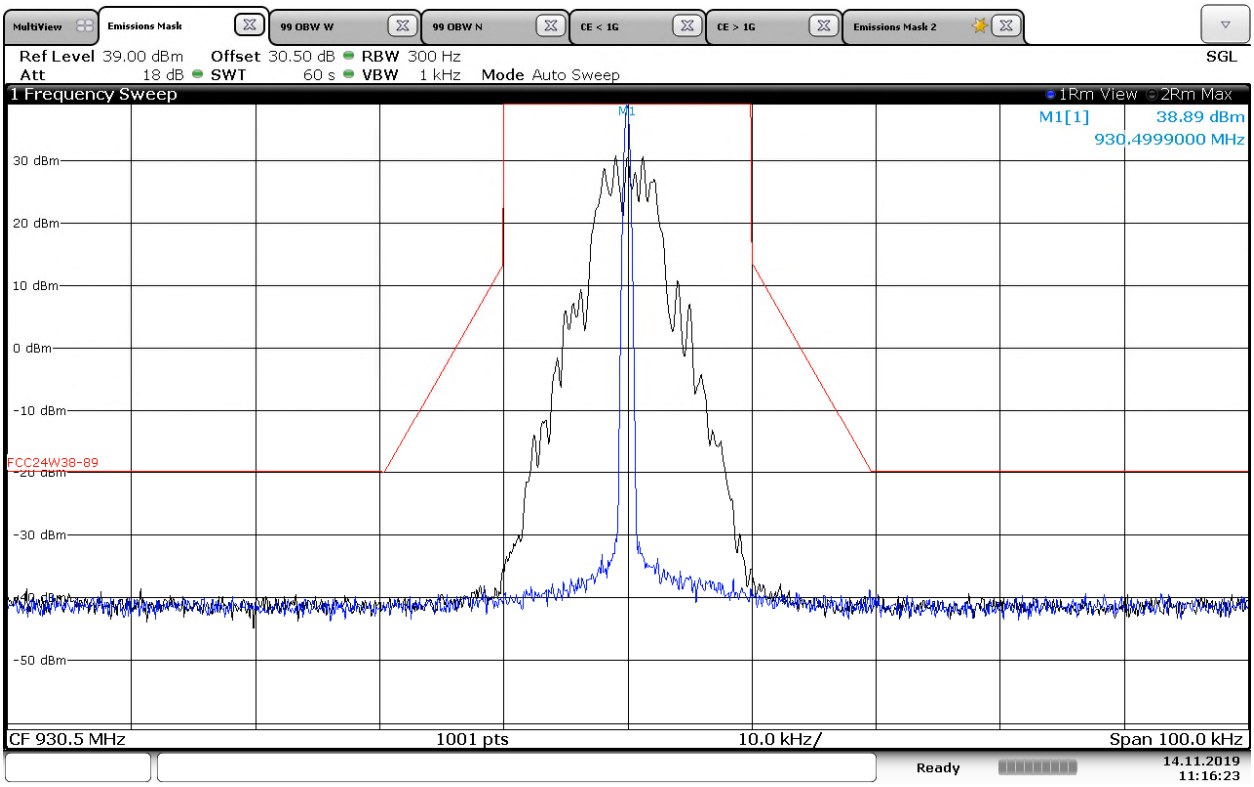
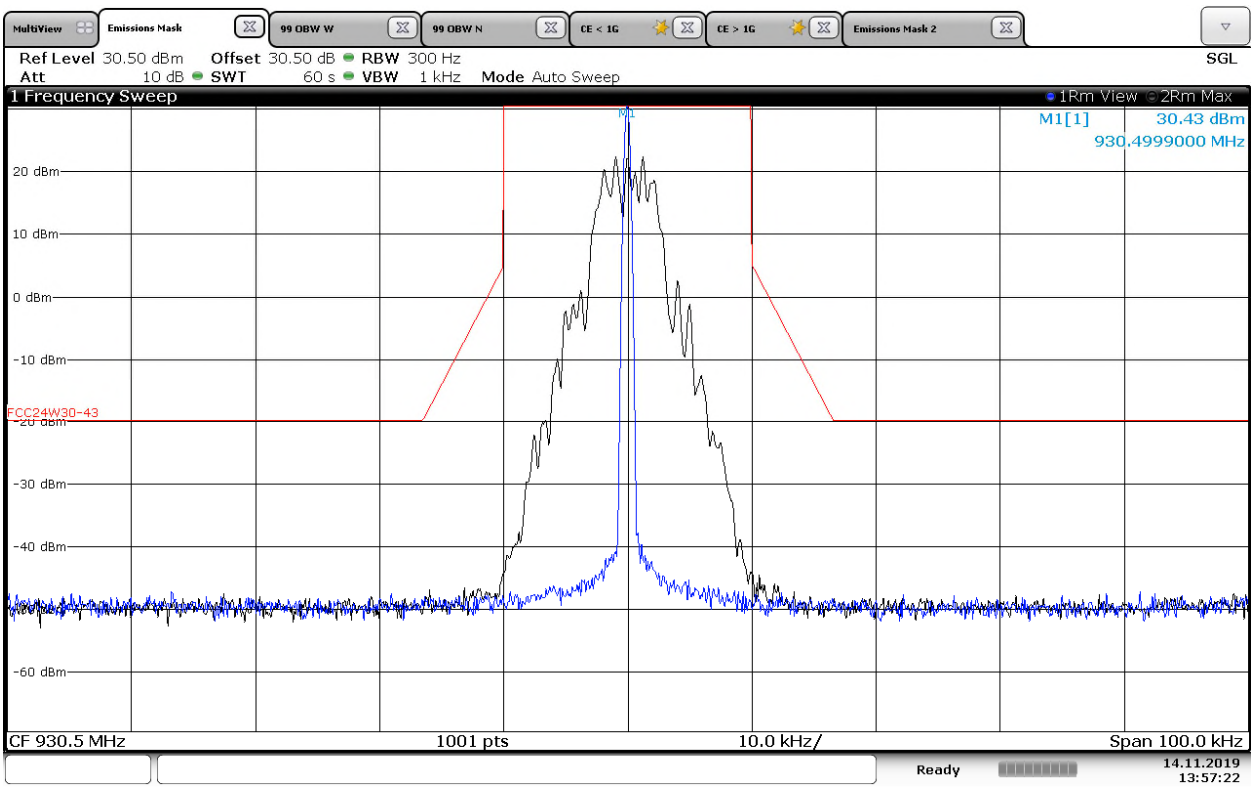
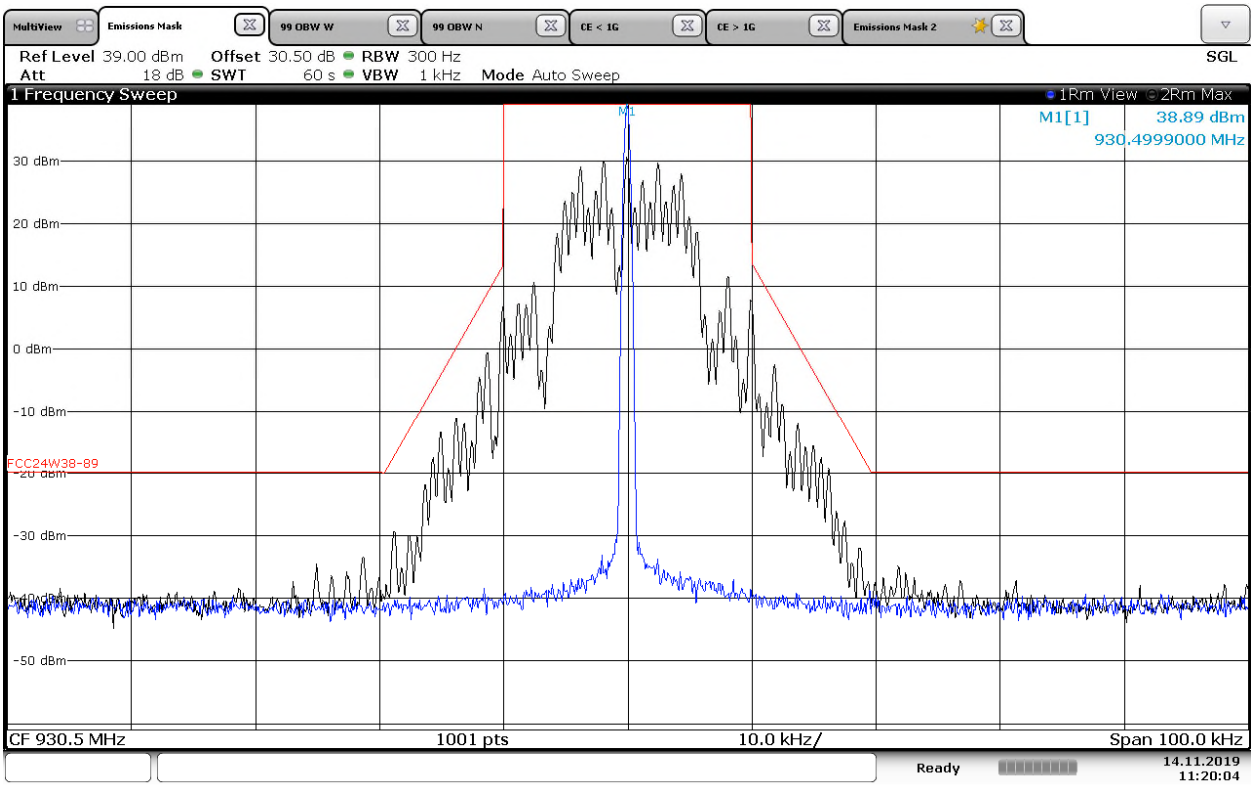


Figure 7.2.2-1: 930.5 MHz – 25 kHz Channel Spacing – MPass 5kbps – High Power



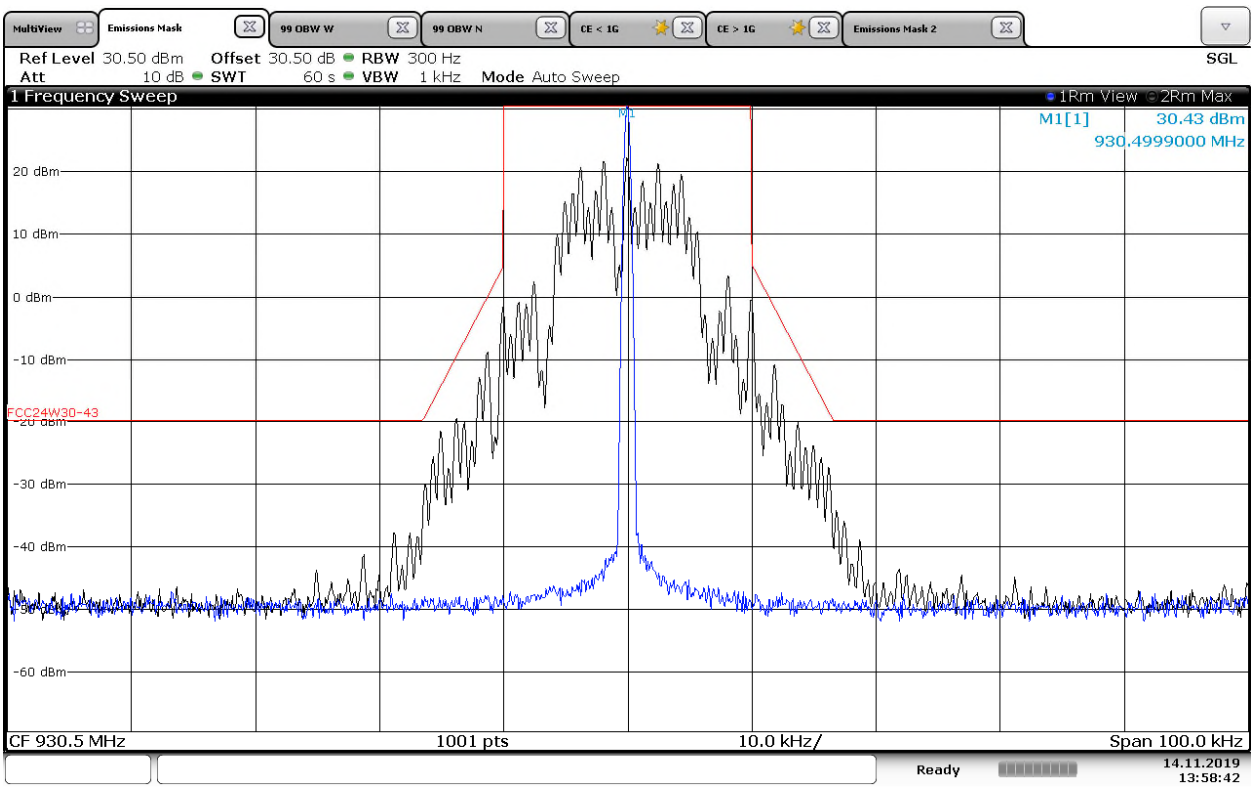
13:57:22 14.11.2019

Figure 7.2.2-2: 930.5 MHz – 25 kHz Channel Spacing – MPass 5kbps – Low Power



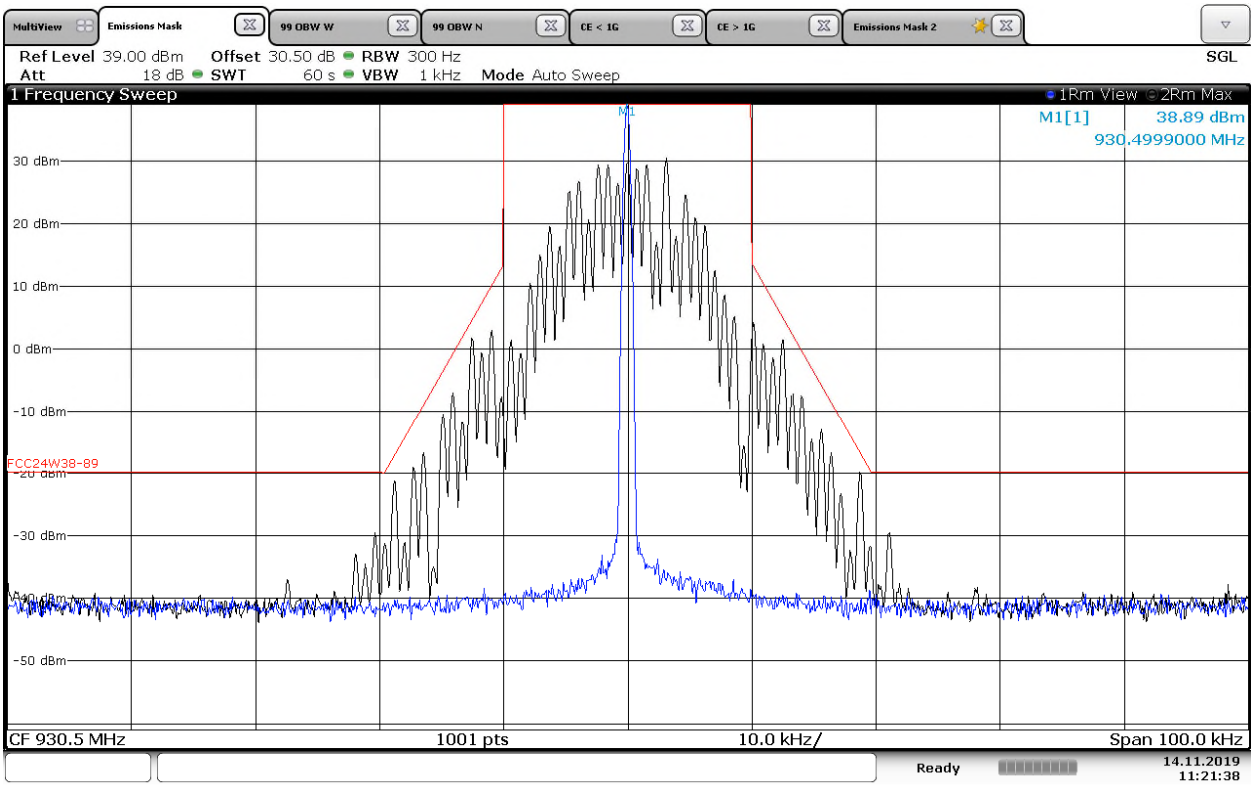
11:20:05 14.11.2019

Figure 7.2.2-3: 930.5 MHz – 25 kHz Channel Spacing – MPass 10kbps – High Power



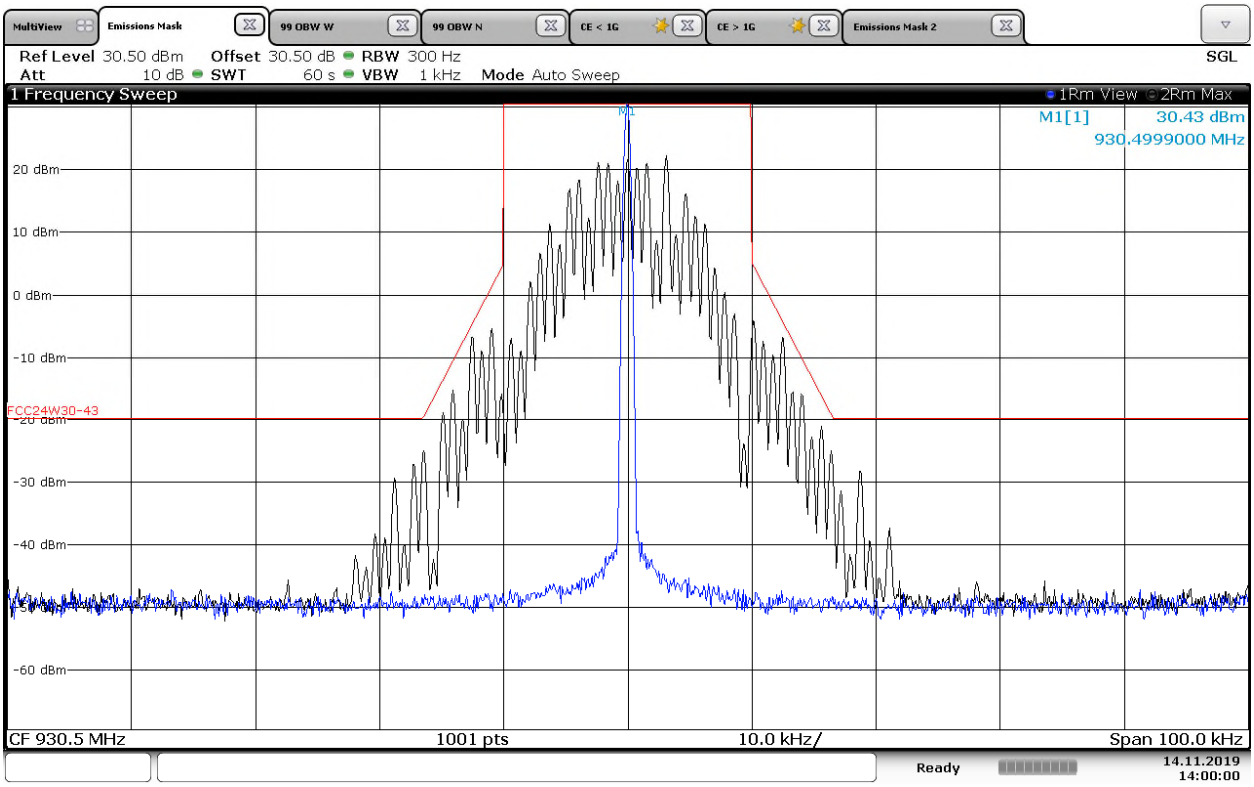
13:58:43 14.11.2019

Figure 7.2.2-4: 930.5 MHz – 25 kHz Channel Spacing – MPass 10kbps – Low Power



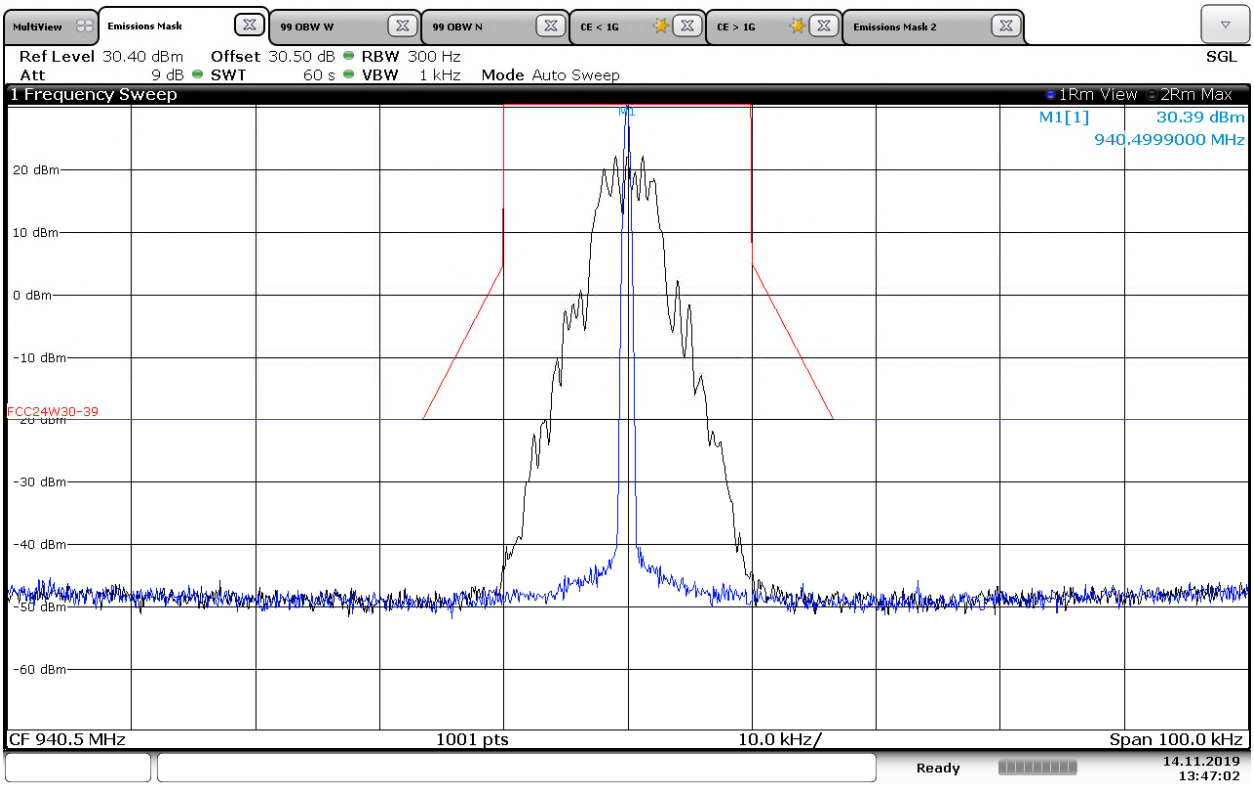
11:21:38 14.11.2019

Figure 7.2.2-5: 930.5 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – High Power



14:00:01 14.11.2019

Figure 7.2.2-6: 930.5 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – Low Power



13:47:02 14.11.2019

Figure 7.2.2-7: 940.5 MHz – 25 kHz Channel Spacing – MPass 5kbps – High Power

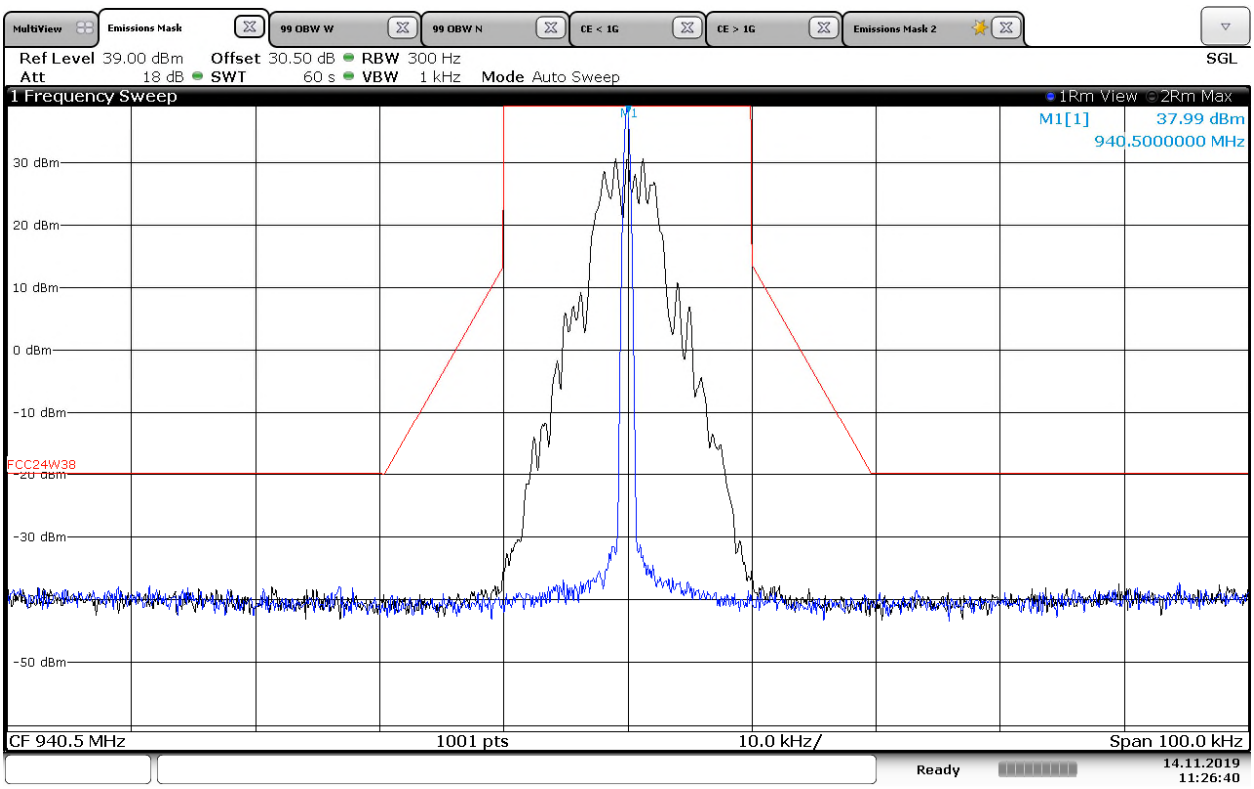


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Figure 7.2.2-8: 940.5 MHz – 25 kHz Channel Spacing – MPass 5kbps – Low Power

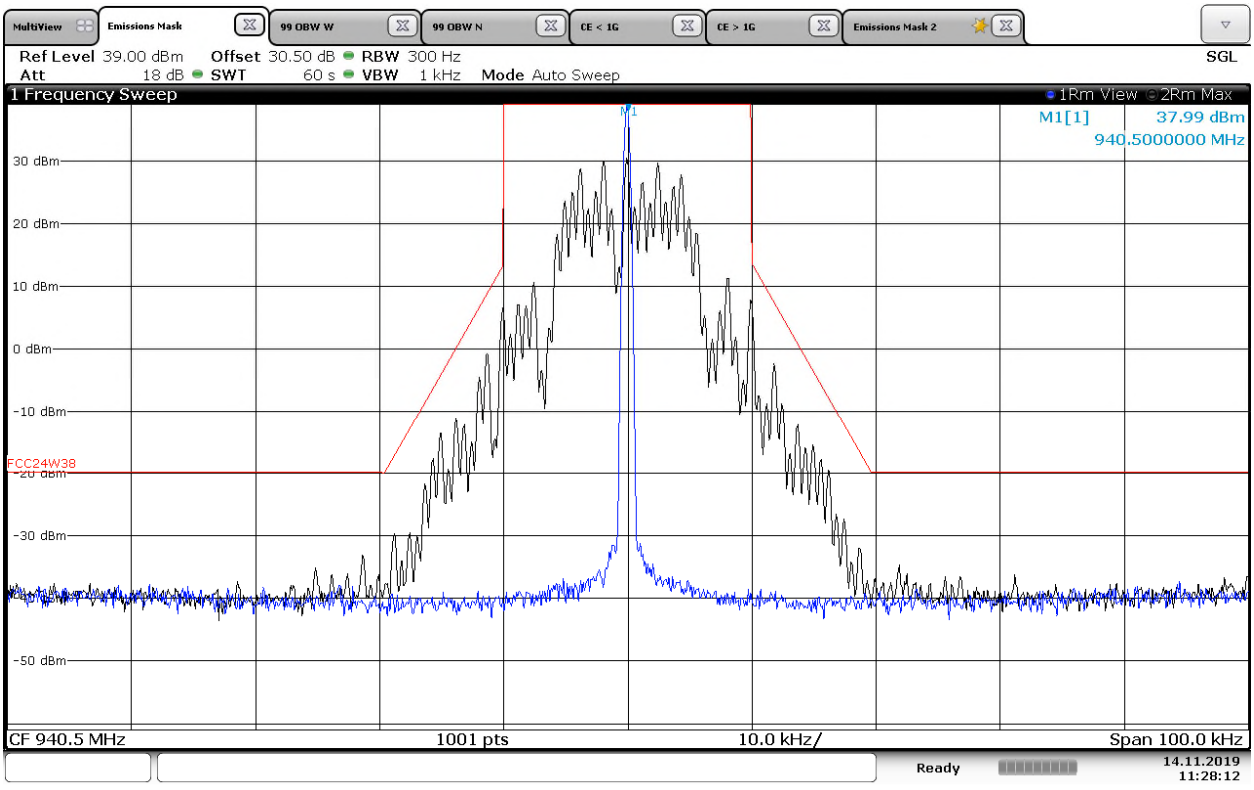

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Figure 7.2.2-9: 940.5 MHz – 25 kHz Channel Spacing – MPass 10kbps – High Power

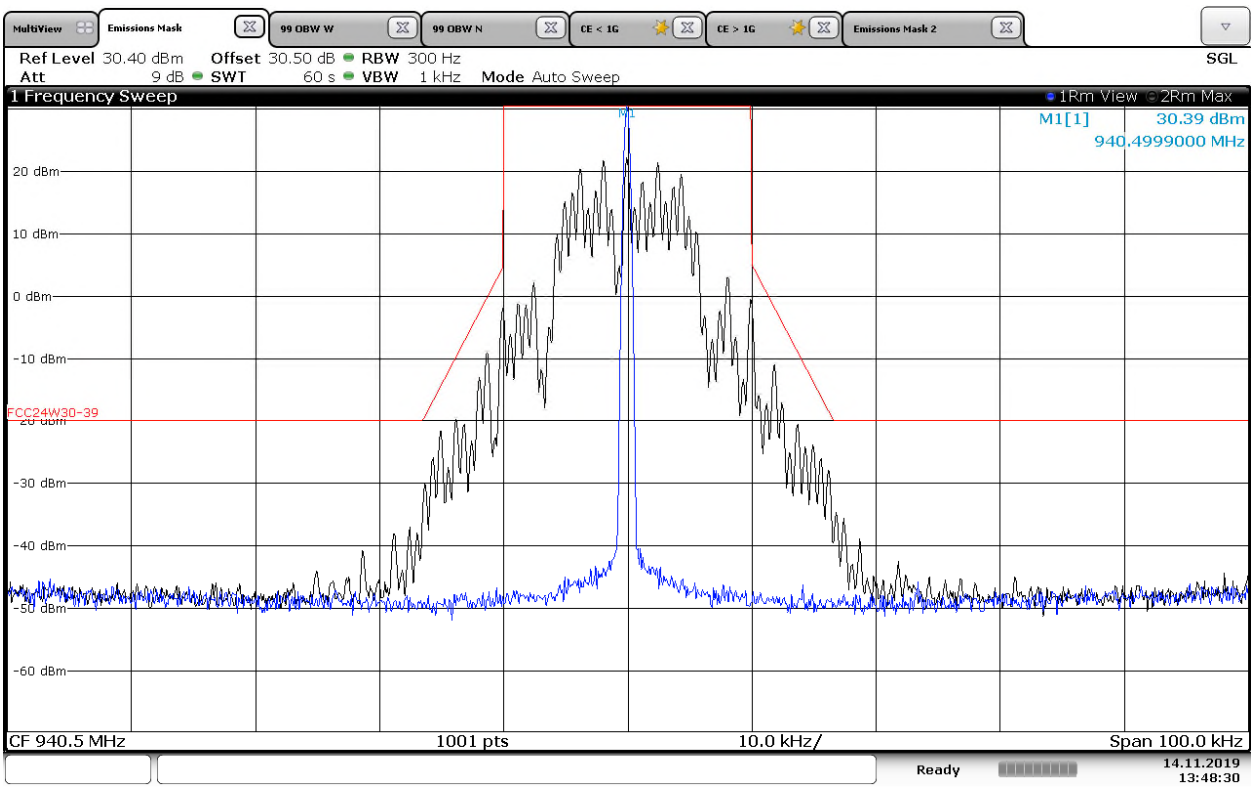

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Figure 7.2.2-10: 940.5 MHz – 25 kHz Channel Spacing – MPass 10kbps – Low Power

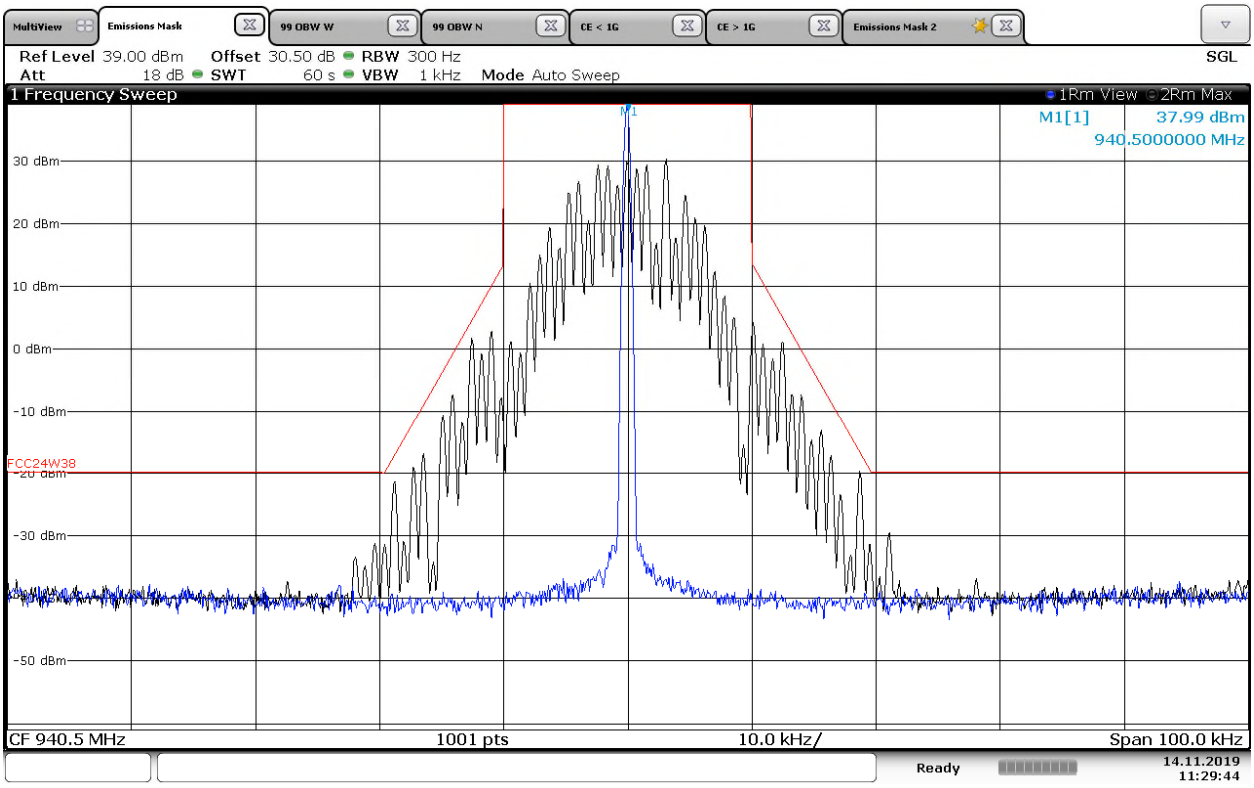

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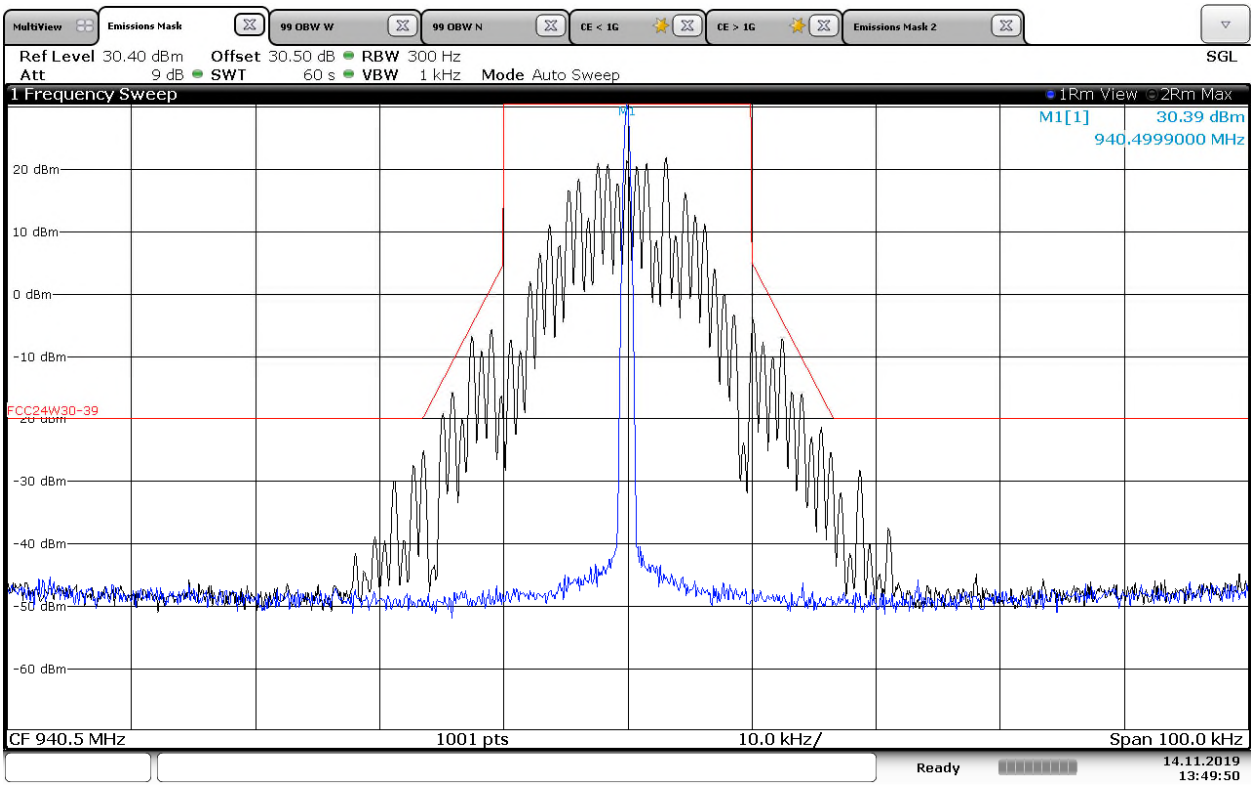
Figure 7.2.2-11: 940.5 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – High Power



13:49:50 14.11.2019

Figure 7.2.2-12: 940.5 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – Low Power

Part 101.111 a(5), a(6), RSS-119 5.8.6 (FCC Part 101.111 a(5) a(6) provides worst case)

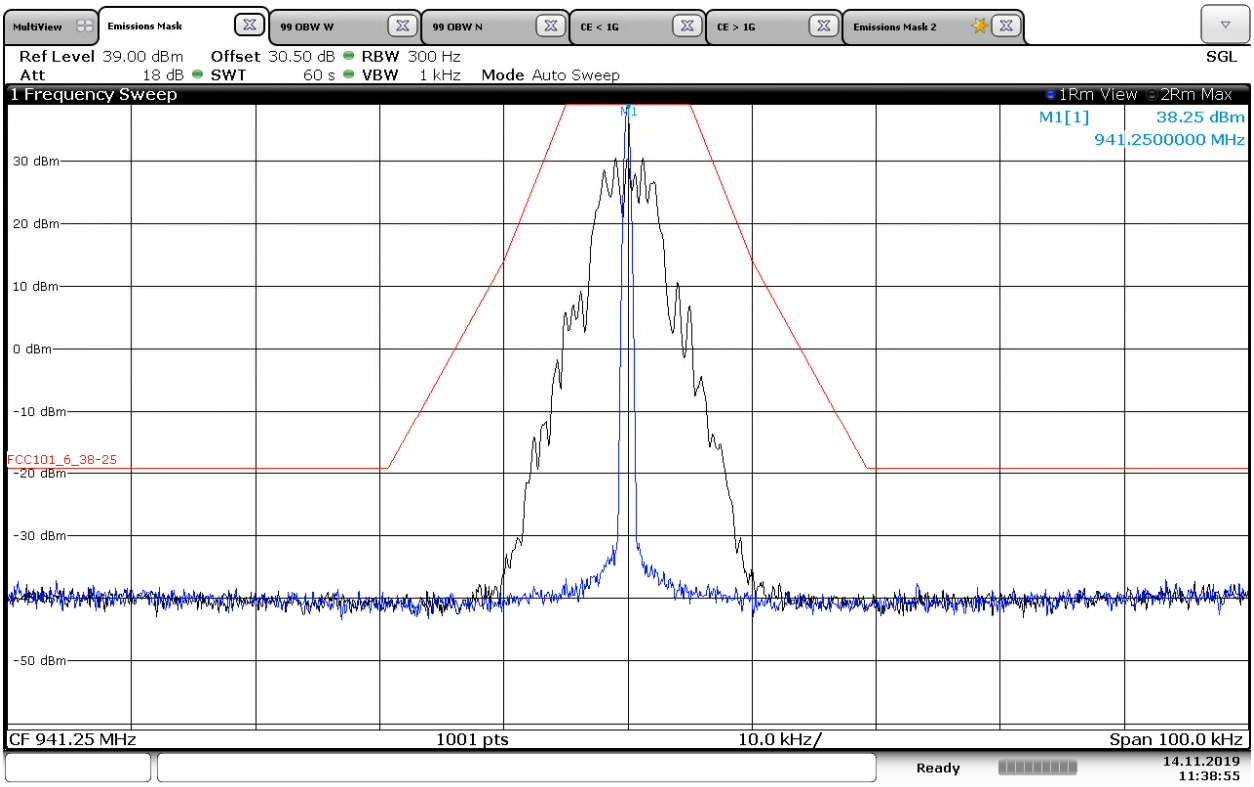


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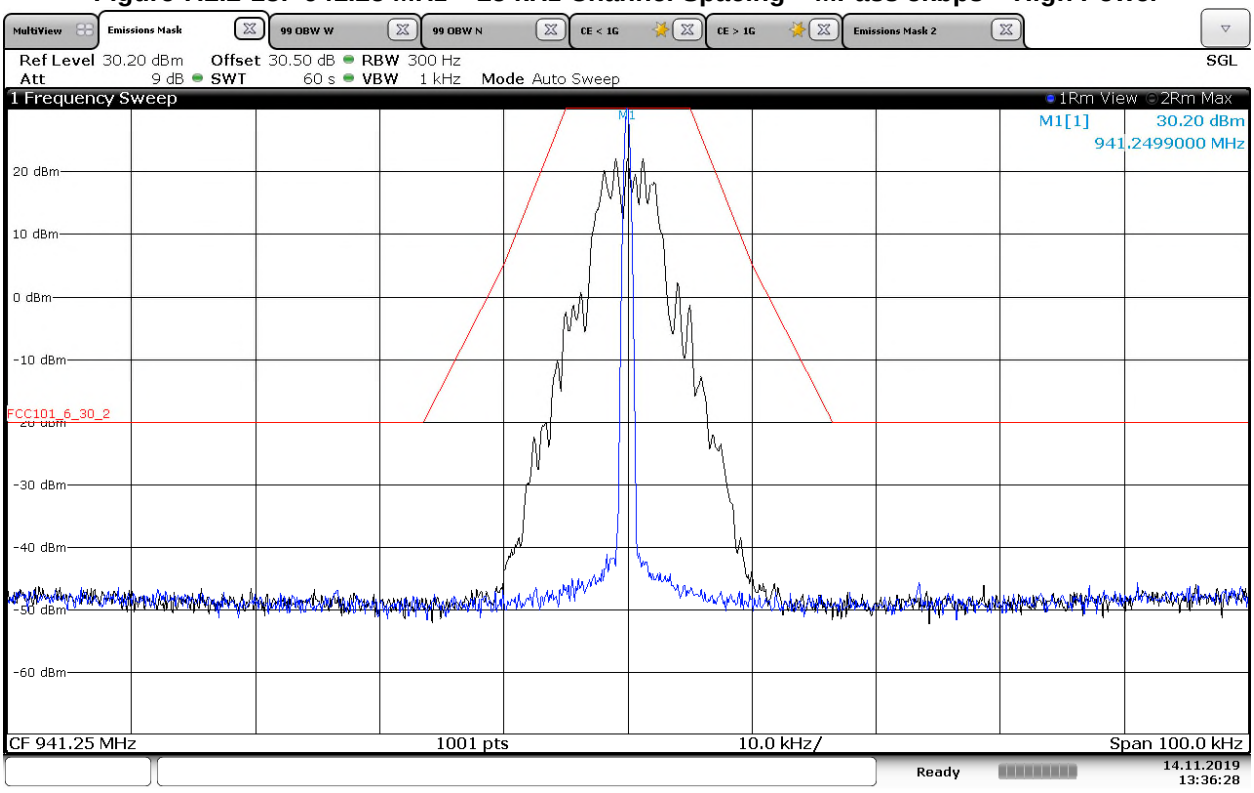
Figure 7.2.2-13: 941.25 MHz – 25 kHz Channel Spacing – MPass 5kbps – High Power



13:36:28 14.11.2019

Figure 7.2.2-14: 941.25 MHz – 25 kHz Channel Spacing – MPass 5kbps – Low Power

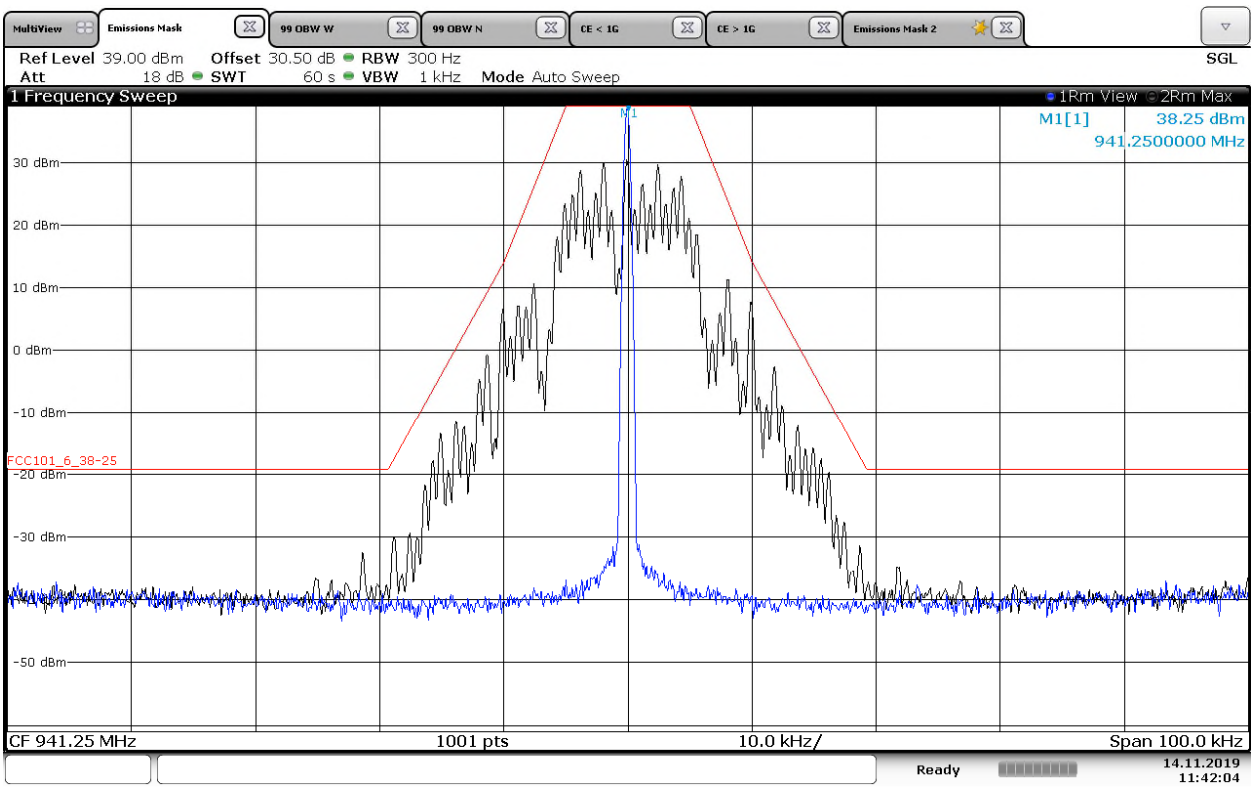


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Figure 7.2.2-15: 941.25 MHz – 25 kHz Channel Spacing – MPass 10kbps – High Power

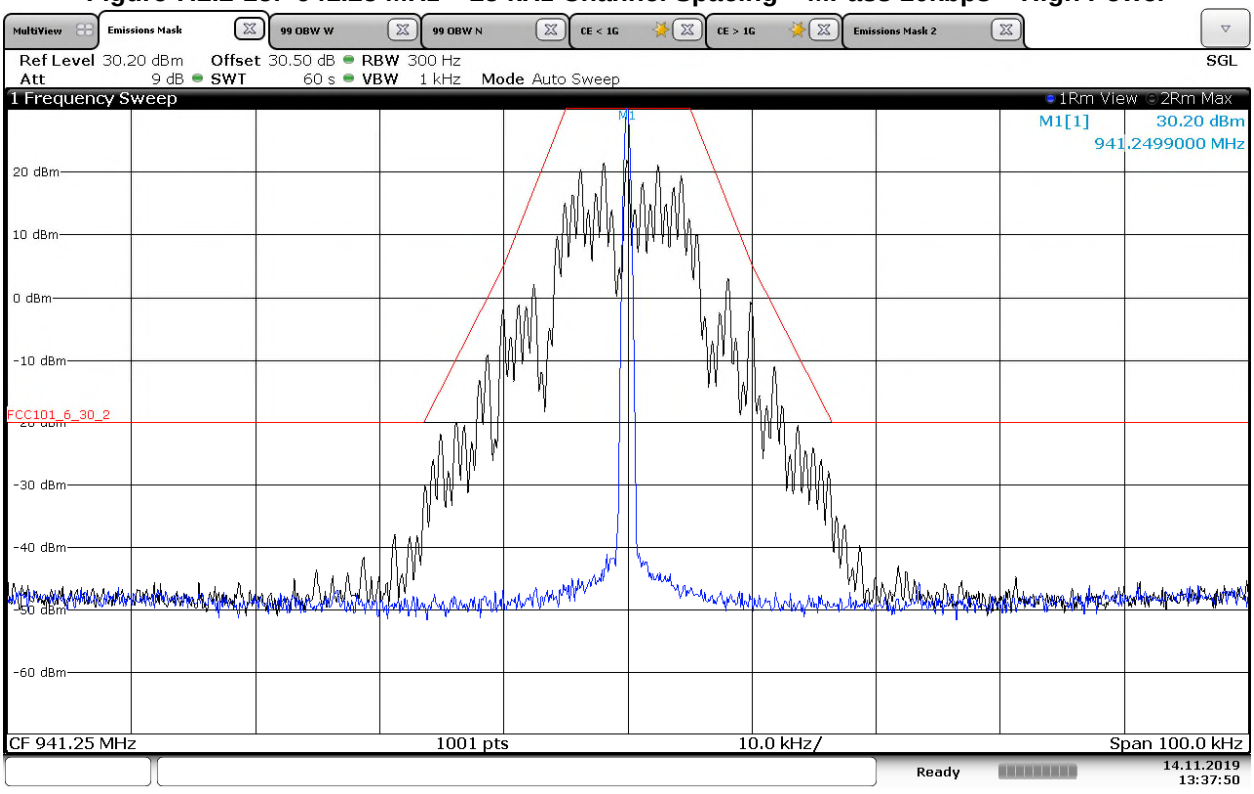

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Figure 7.2.2-16: 941.25 MHz – 25 kHz Channel Spacing – MPass 10kbps – Low Power

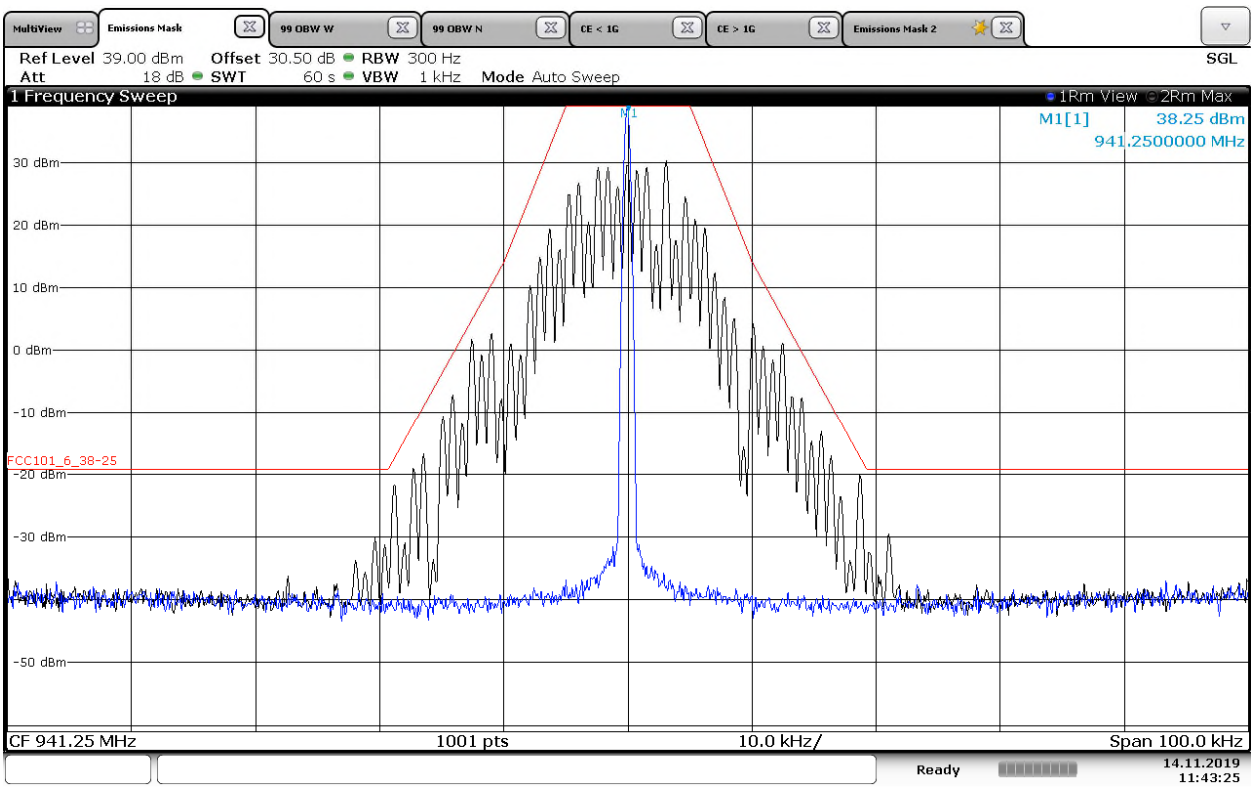

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Figure 7.2.2-17: 941.25 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – High Power

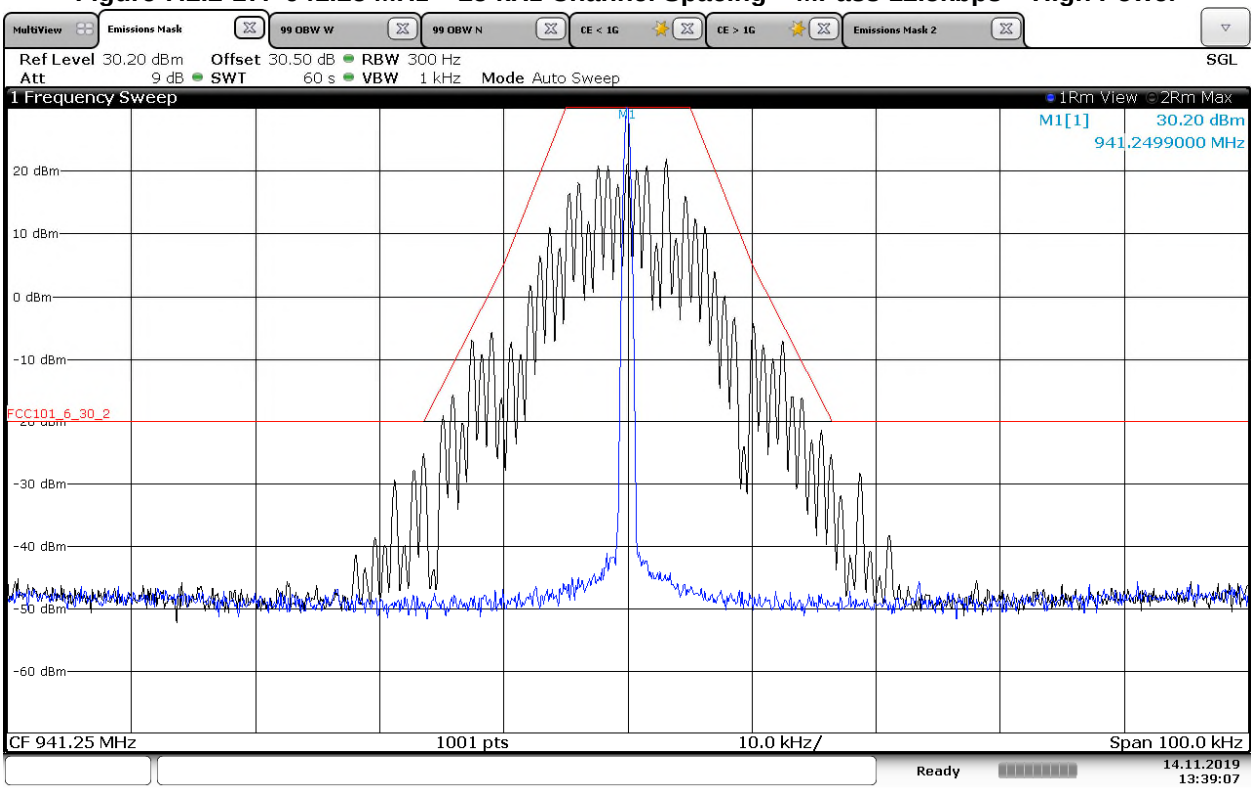

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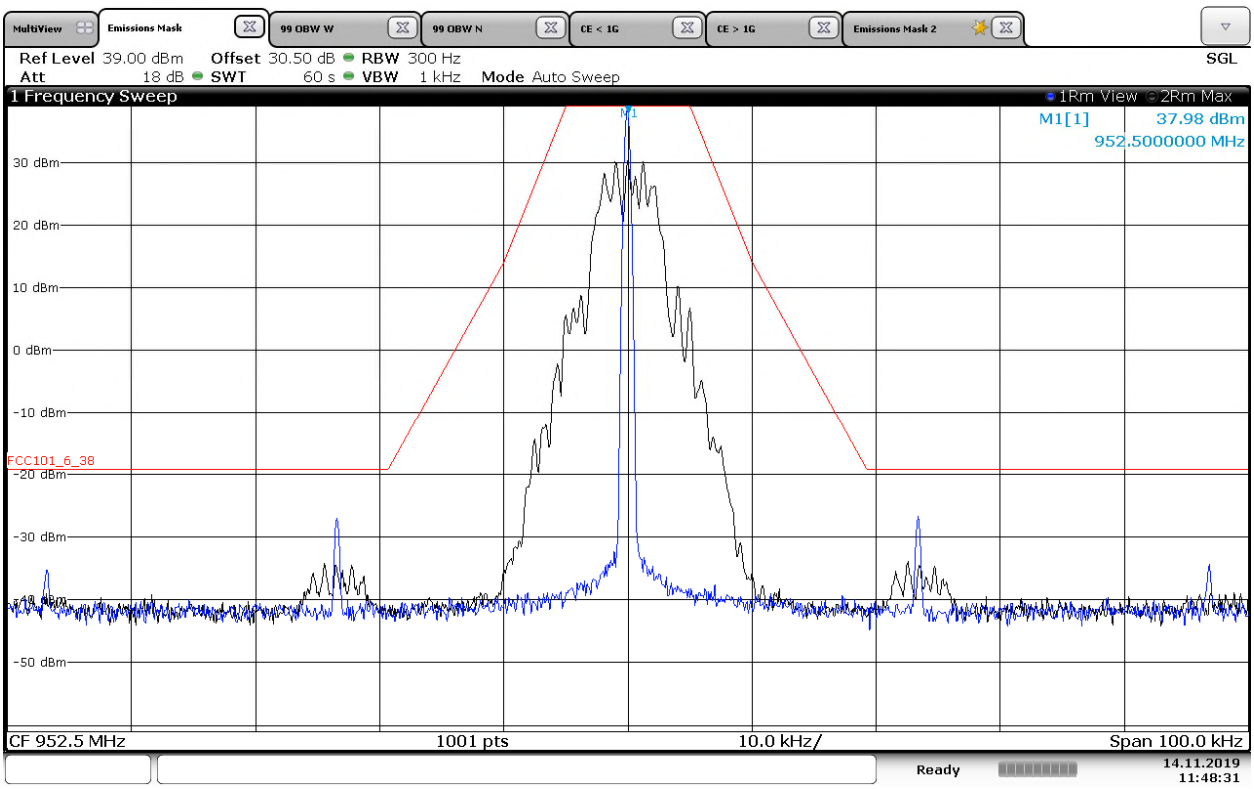
Figure 7.2.2-18: 941.25 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – Low Power



11:48:31 14.11.2019

Figure 7.2.2-19: 952.5 MHz – 25 kHz Channel Spacing – MPass 5kbps – High Power

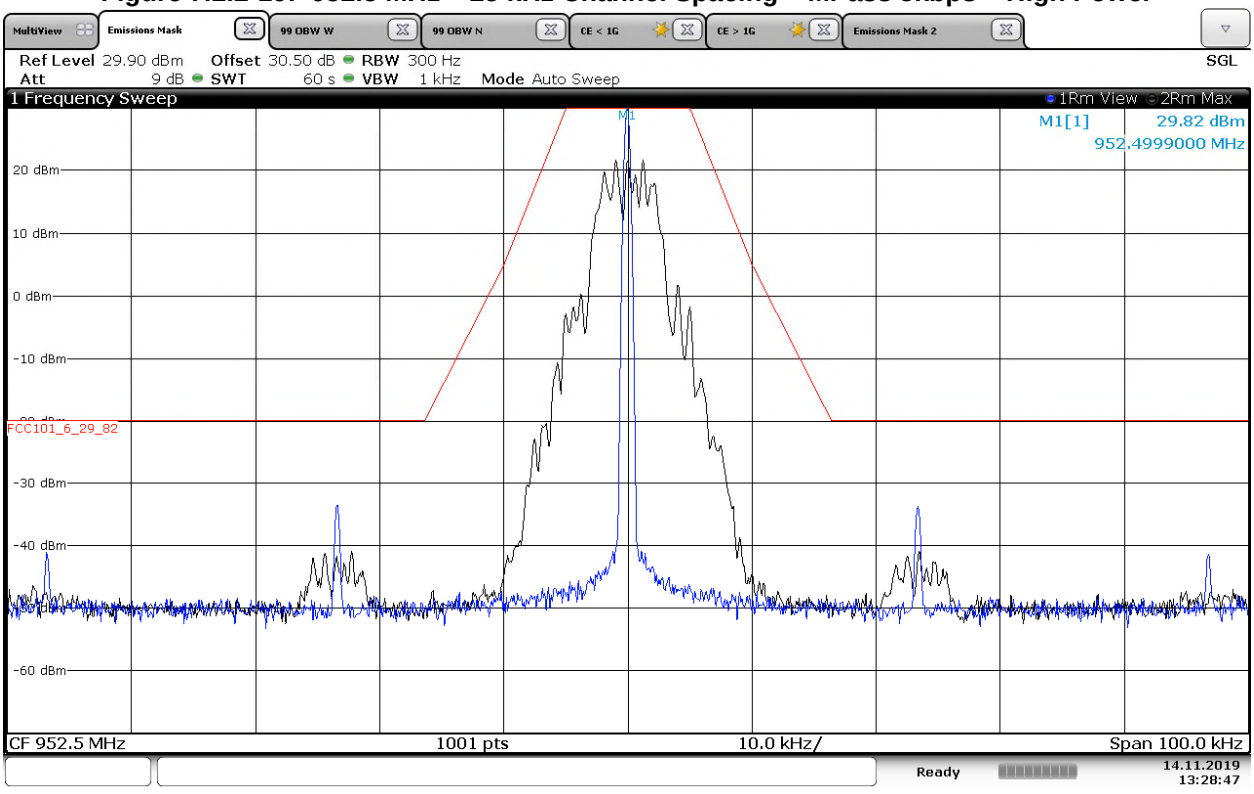


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Figure 7.2.2-20: 952.5 MHz – 25 kHz Channel Spacing – MPass 5kbps – Low Power

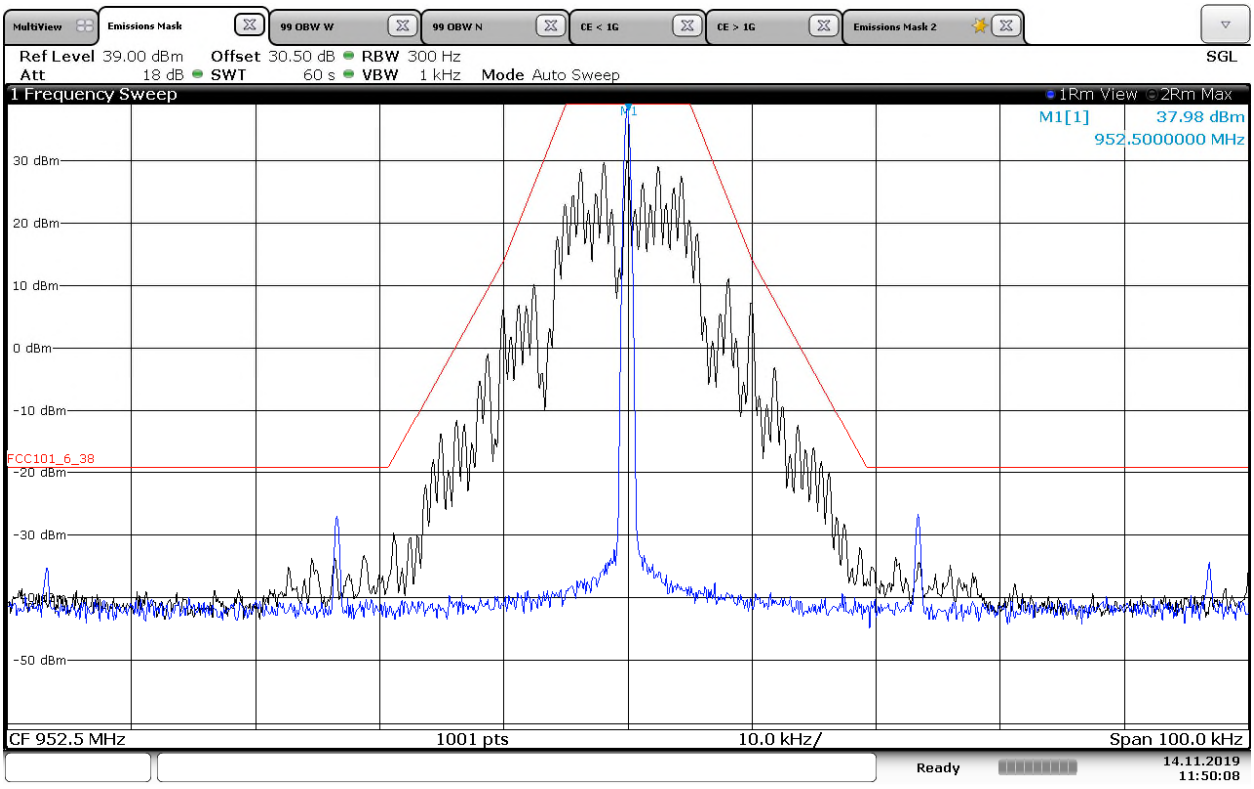

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Figure 7.2.2-21: 952.5 MHz – 25 kHz Channel Spacing – MPass 10kbps – High Power

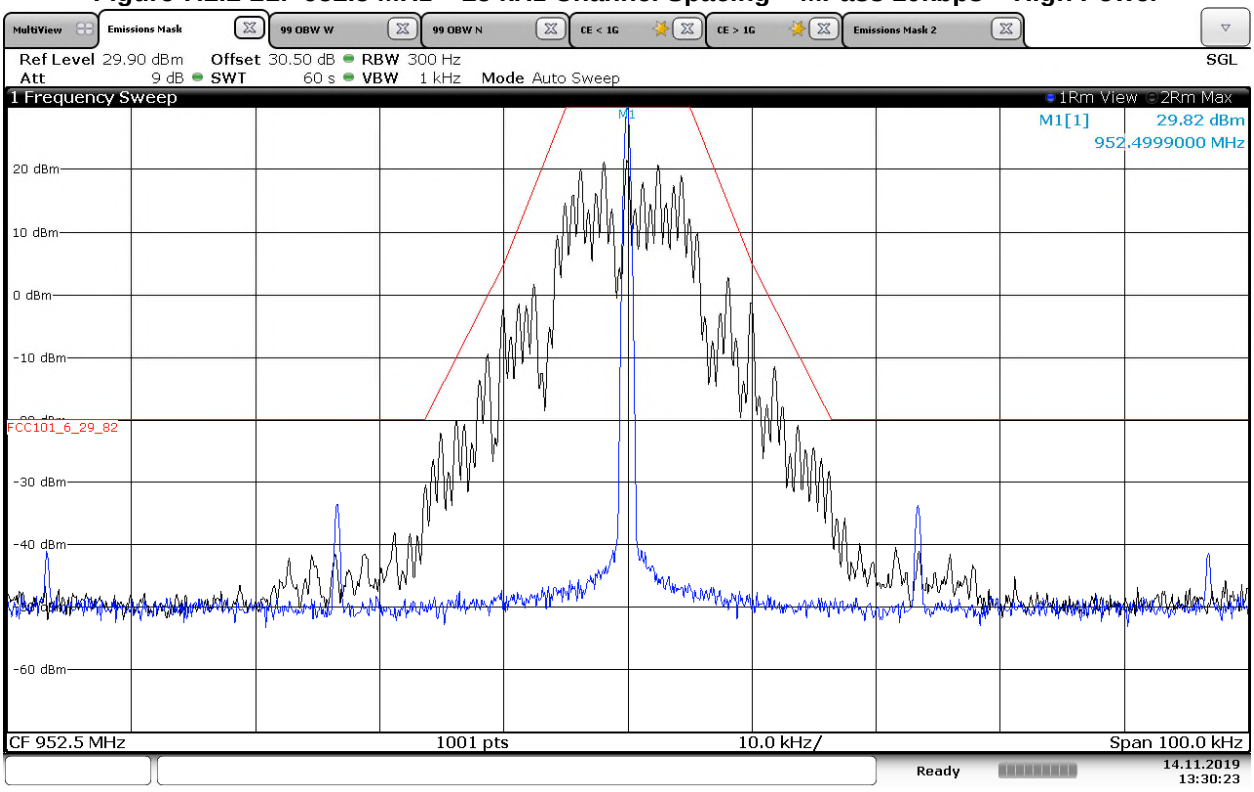

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Figure 7.2.2-22: 952.5 MHz – 25 kHz Channel Spacing – MPass 10kbps – Low Power

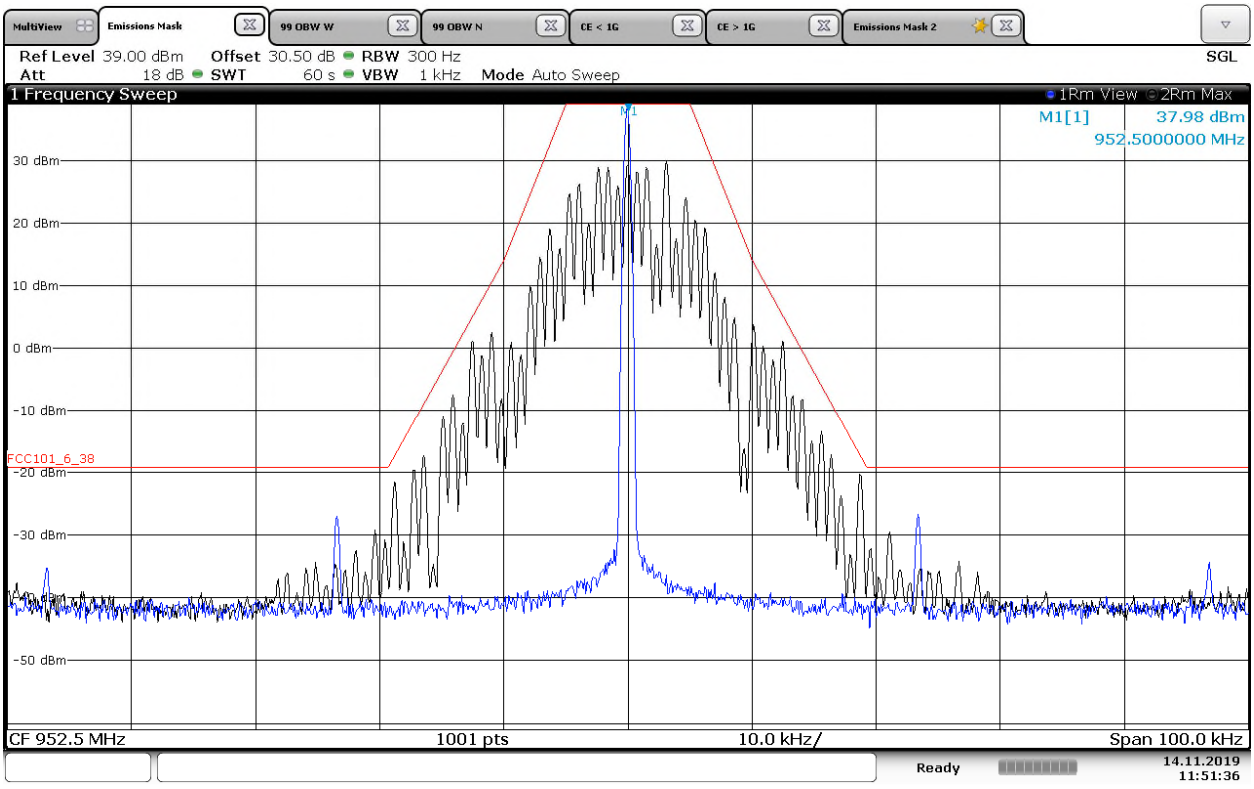

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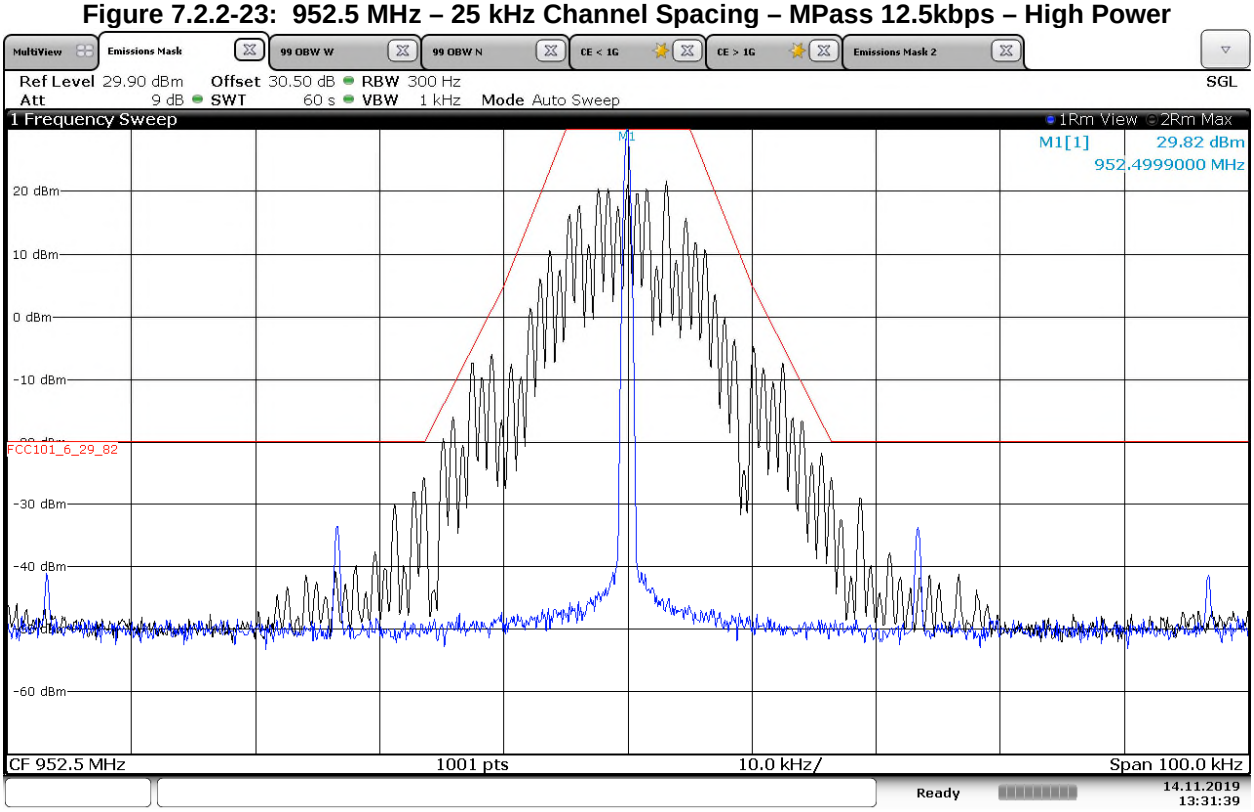
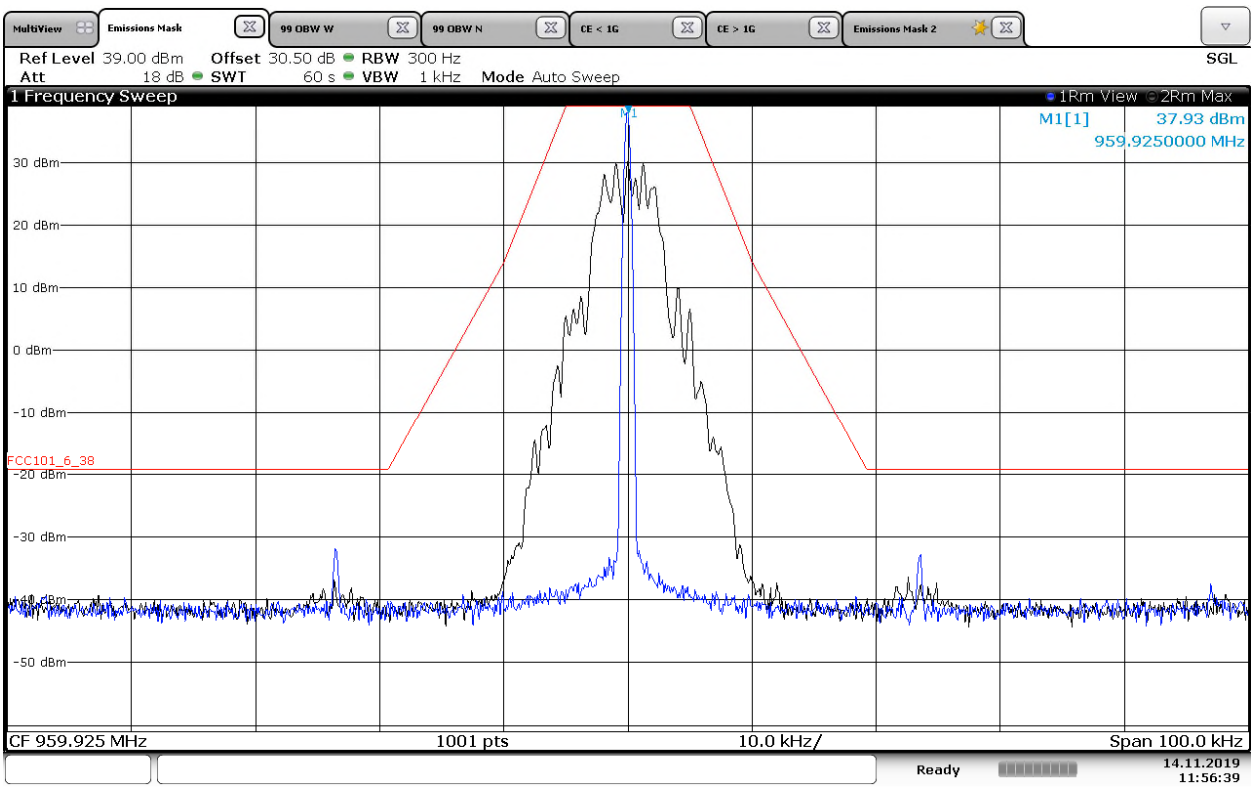
Figure 7.2.2-23: 952.5 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – High Power



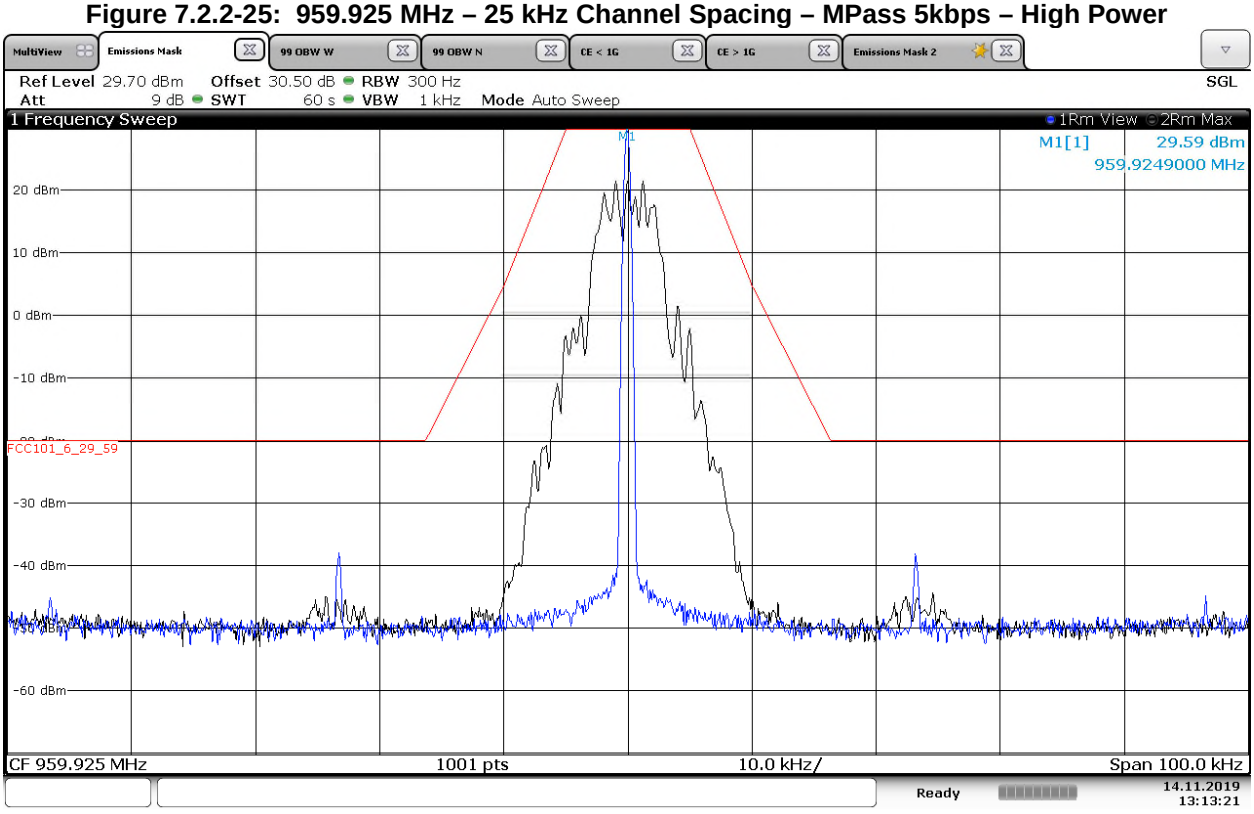
13:31:40 14.11.2019

Figure 7.2.2-24: 952.5 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – Low Power



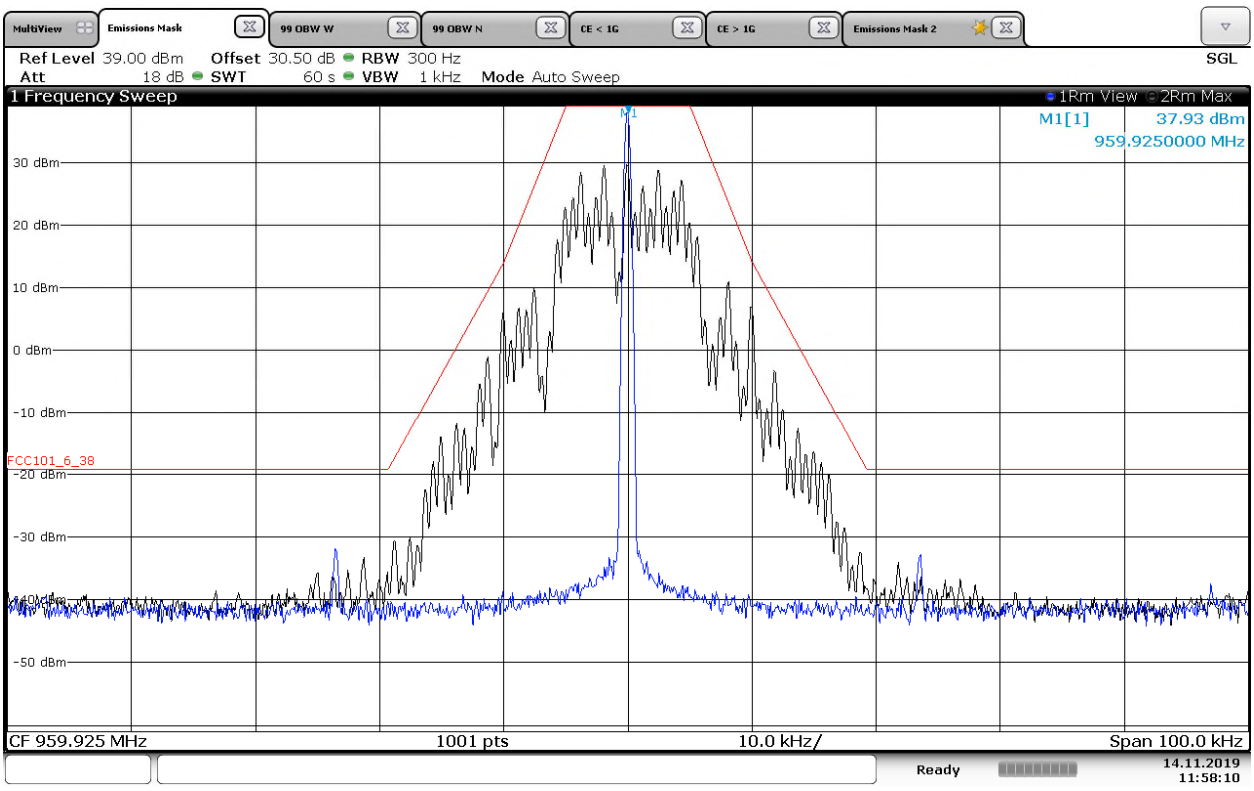
11:56:39 14.11.2019

Figure 7.2.2-25: 959.925 MHz – 25 kHz Channel Spacing – MPass 5kbps – High Power



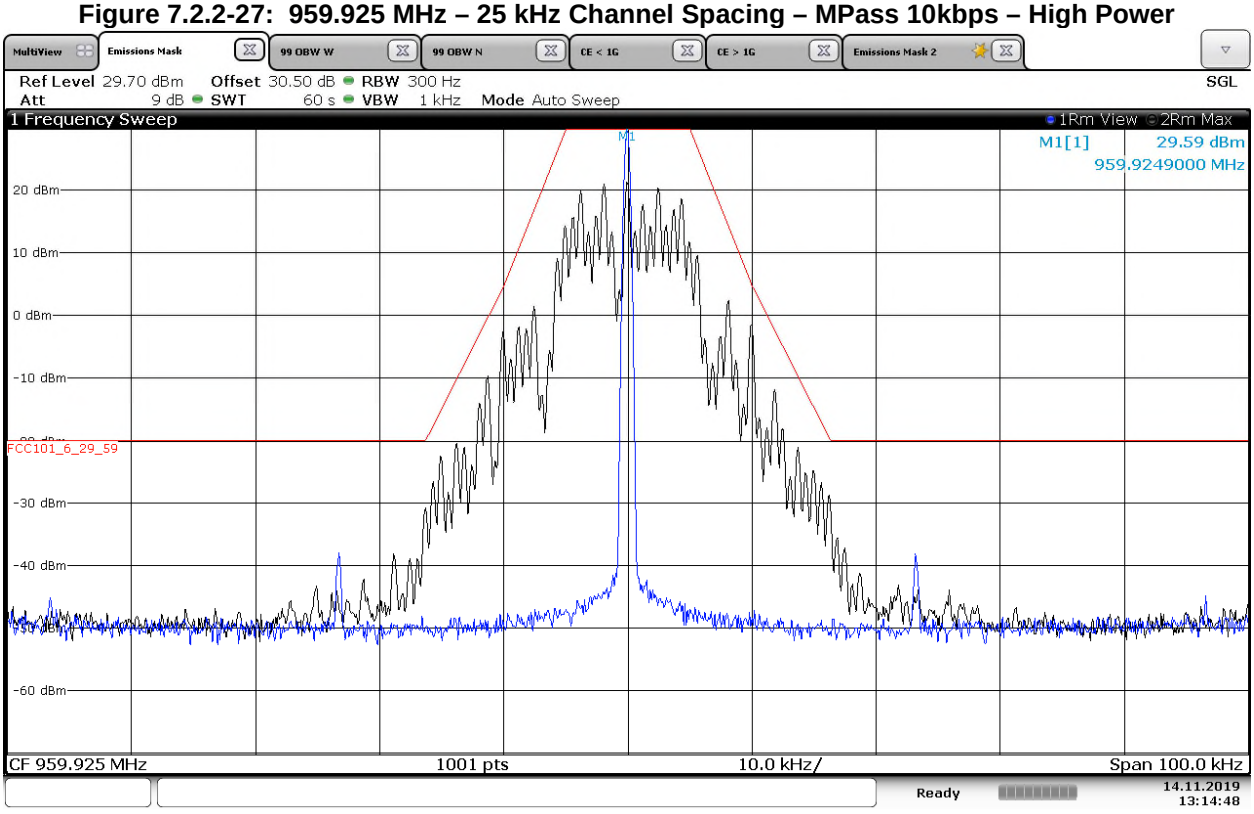
13:13:21 14.11.2019

Figure 7.2.2-26: 959.925 MHz – 25 kHz Channel Spacing – MPass 5kbps – Low Power



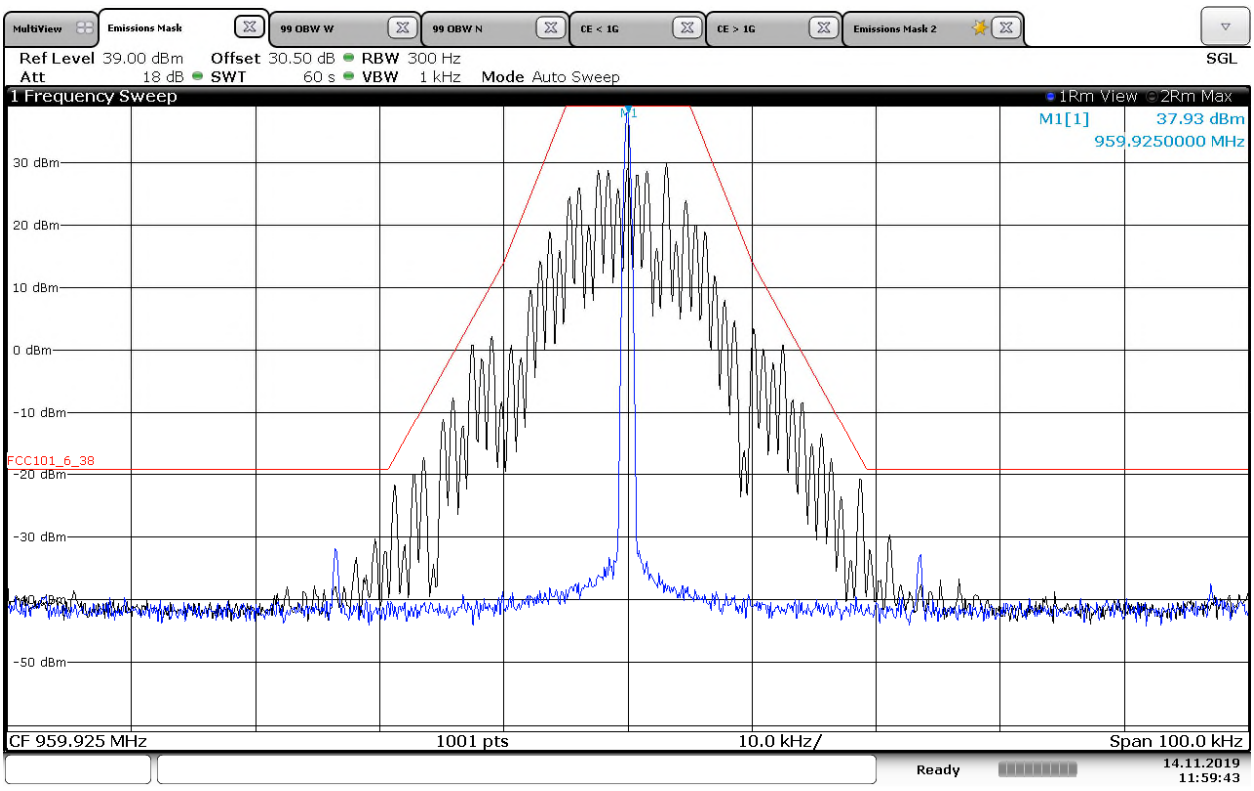
11:58:11 14.11.2019

Figure 7.2.2-27: 959.925 MHz – 25 kHz Channel Spacing – MPass 10kbps – High Power



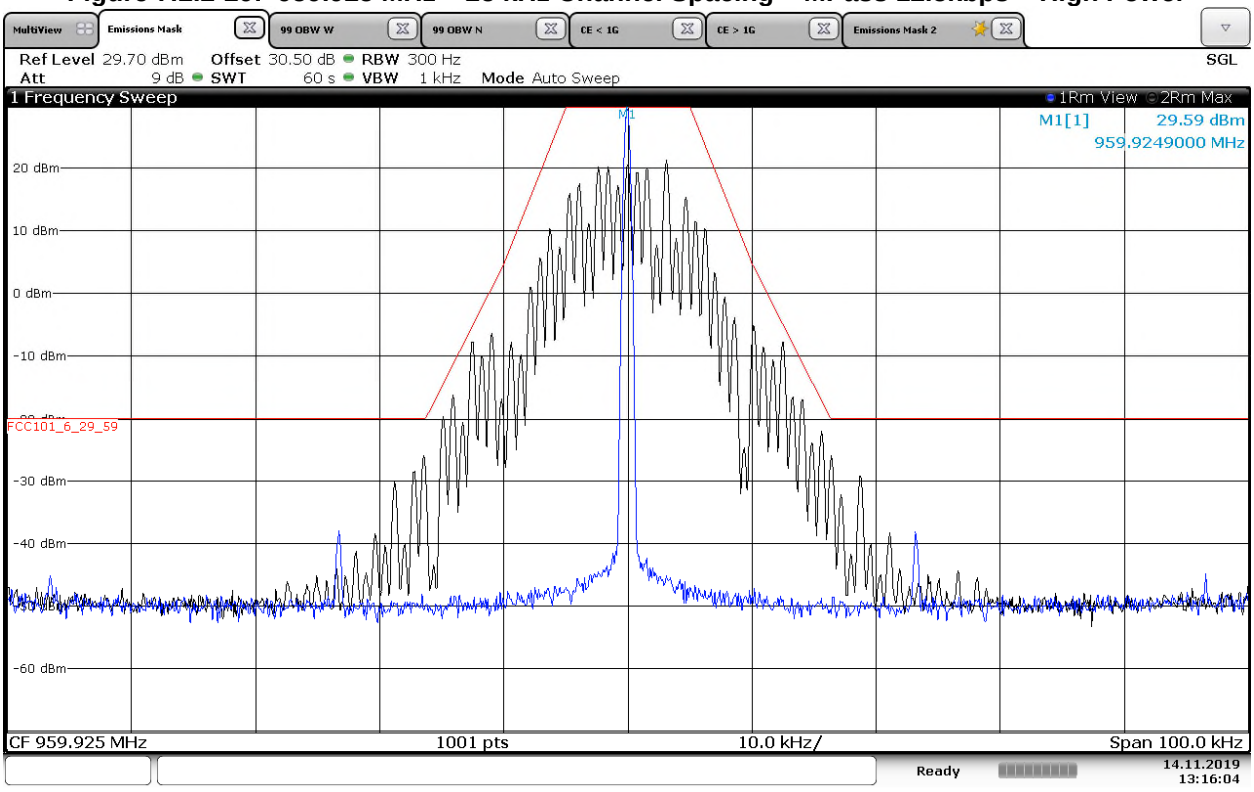
13:14:48 14.11.2019

Figure 7.2.2-28: 959.925 MHz – 25 kHz Channel Spacing – MPass 10kbps – Low Power



11:59:44 14.11.2019

Figure 7.2.2-29: 959.925 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – High Power



13:16:05 14.11.2019

Figure 7.2.2-30: 959.925 MHz – 25 kHz Channel Spacing – MPass 12.5kbps – Low Power

7.3 99% Bandwidth

7.3.1 Measurement Procedure (ANSI 63.26: 2015 Section 5.4.4)

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 30.5dB of passive attenuation. The internal correction factors of the spectrum analyzer were employed to correct for any cable and attenuator losses.

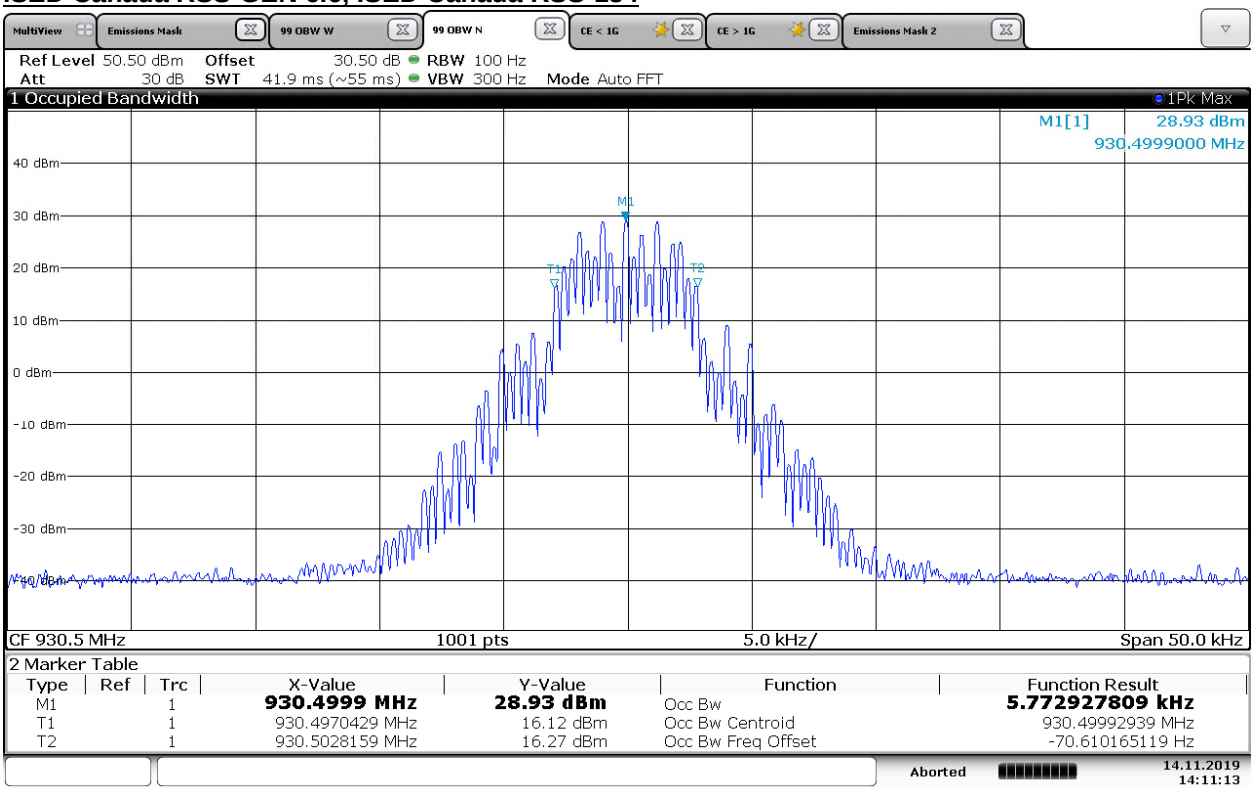
The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts. The nominal IF filter 3 dB bandwidth (RBW) is in the range of 1% to 5% of the OBW, and the VBW was set ≥ 3 × RBW. The reference level was set to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. The measurements were made using the spectrum analyzer's 99% BW function.

7.3.2 Measurement Results

Performed by: Chris Gormley

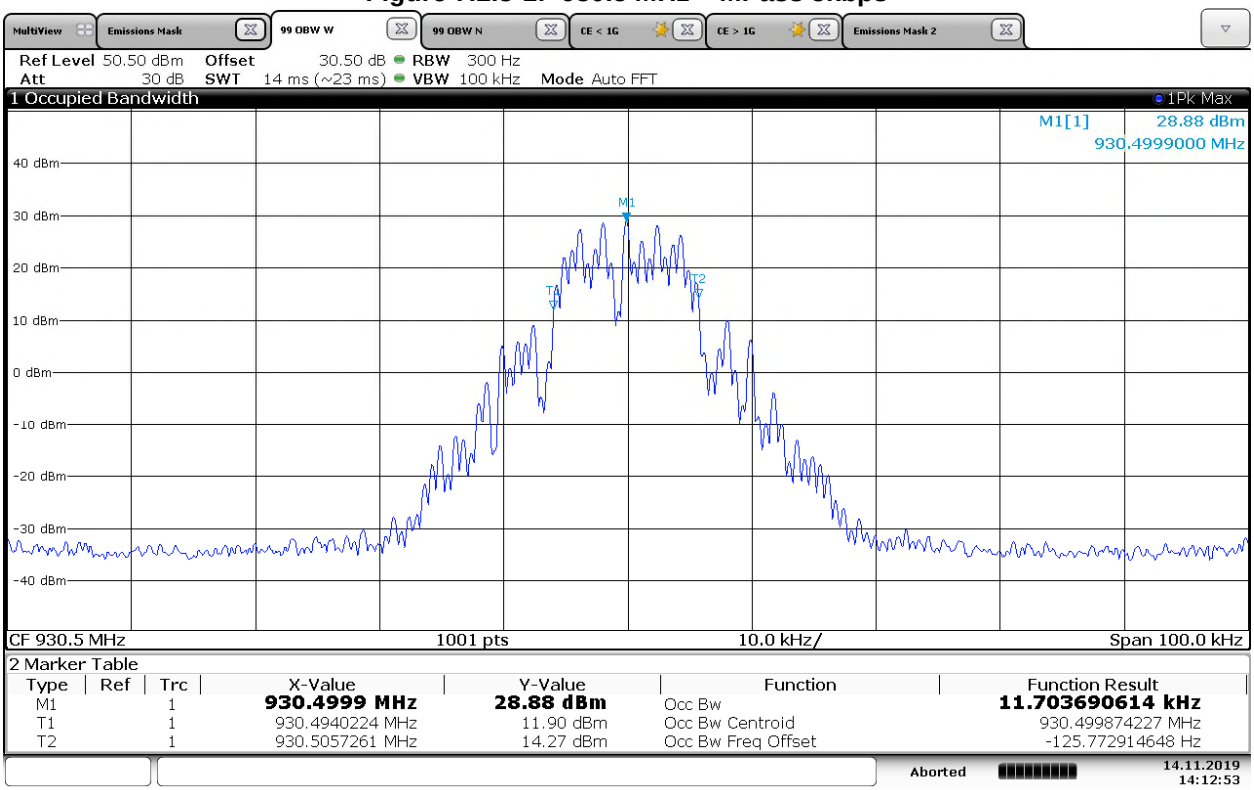
Frequency (MHz)	Mode of Operation	99% Bandwidth (kHz)
930.5	MPass 5k	5.77
930.5	MPass 10k	11.70
930.5	MPass 12.5k	13.50
940.5	MPass 5k	5.78
940.5	MPass 10k	11.71
940.5	MPass 12.5k	13.50
941.25	MPass 5k	5.77
941.25	MPass 10k	11.69
941.25	MPass 12.5k	13.52
952.5	MPass 5k	5.81
952.5	MPass 10k	11.72
952.5	MPass 12.5k	13.52
959.925	MPass 5k	5.77
959.925	MPass 10k	11.69
959.925	MPass 12.5k	13.52

ISED Canada RSS-GEN 6.6, ISED Canada RSS-134



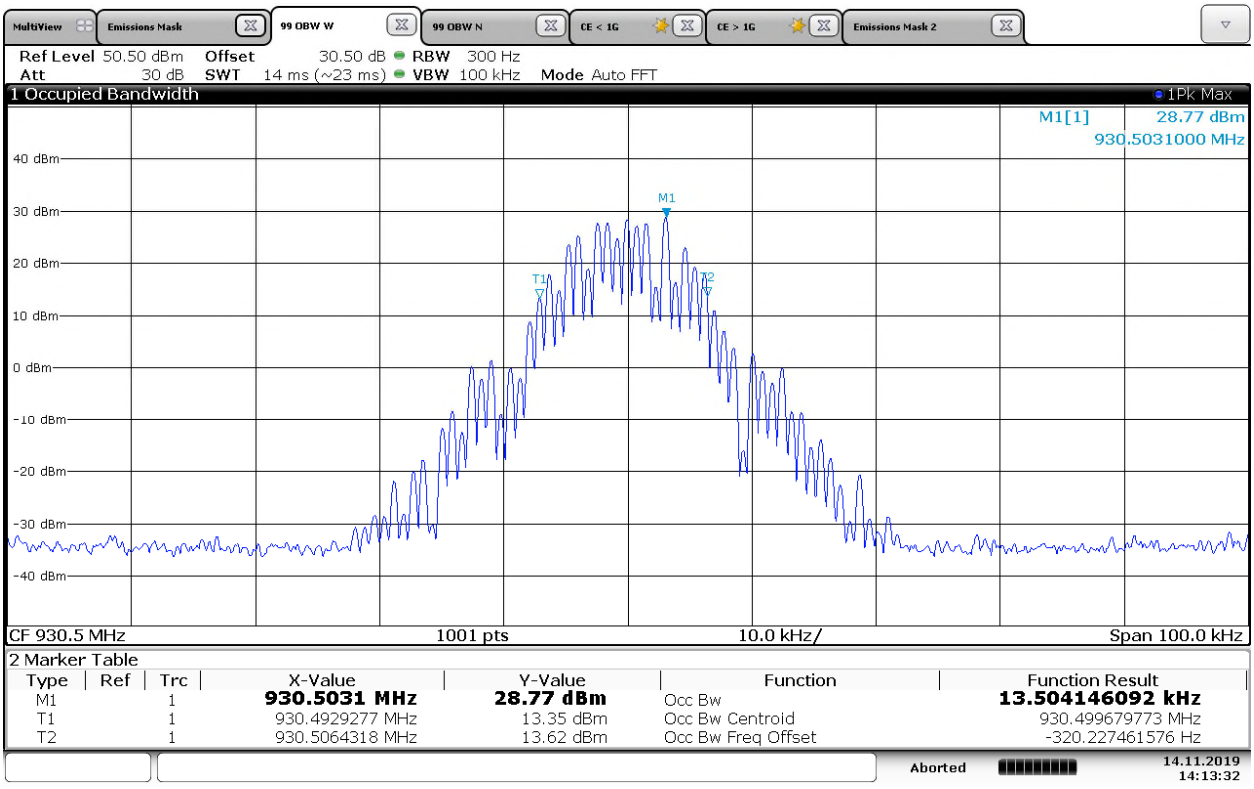
14:11:13 14.11.2019

Figure 7.2.3-1: 930.5 MHz – MPass 5kbps



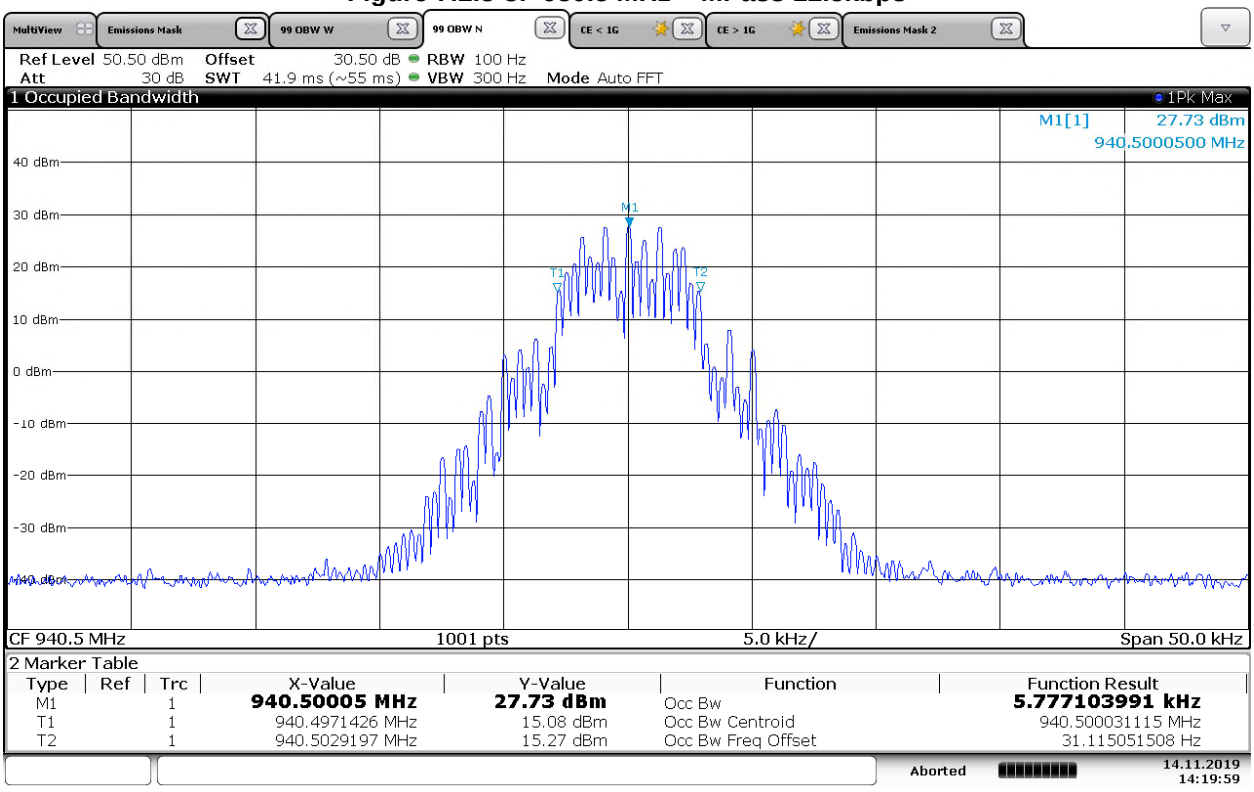
14:12:53 14.11.2019

Figure 7.2.3-2: 930.5 MHz – MPass 10kbps



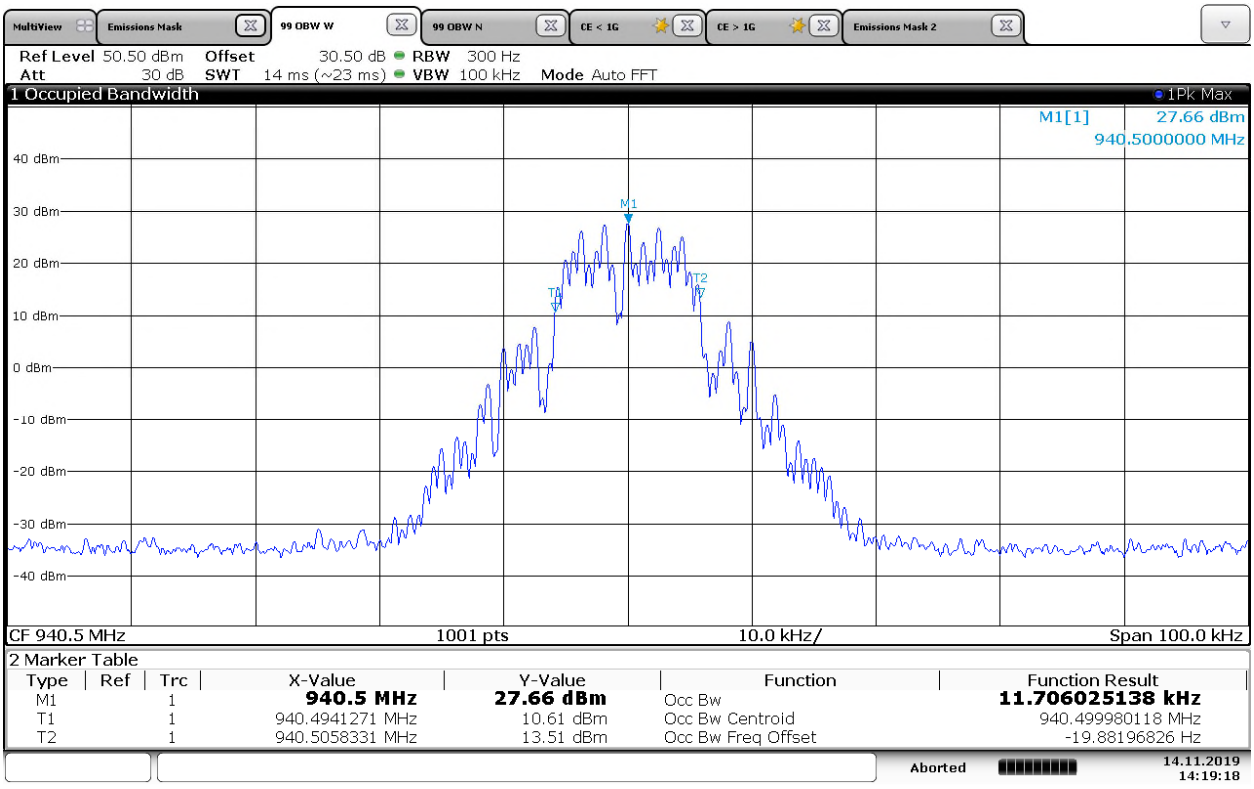
14:13:32 14.11.2019

Figure 7.2.3-3: 930.5 MHz – MPass 12.5kbps



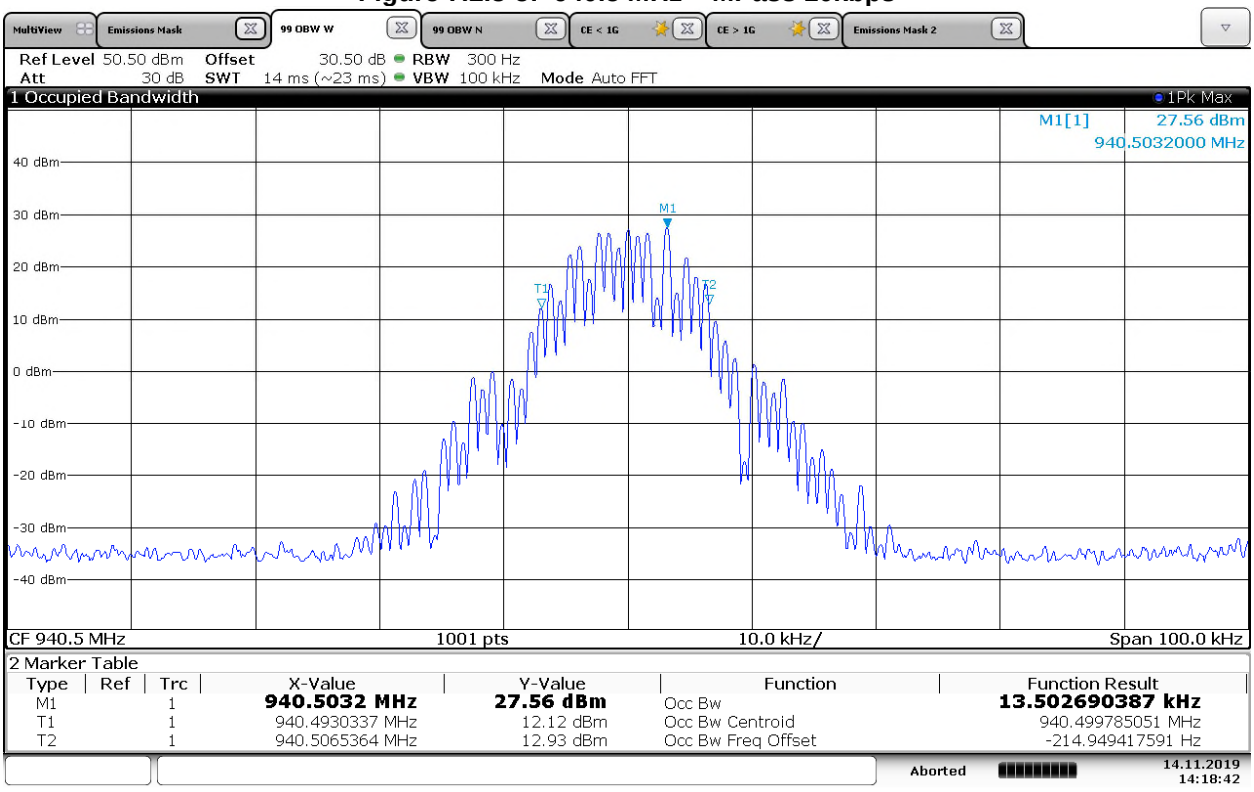
14:19:59 14.11.2019

Figure 7.2.3-4: 940.5 MHz – MPass 5kbps



14:19:19 14.11.2019

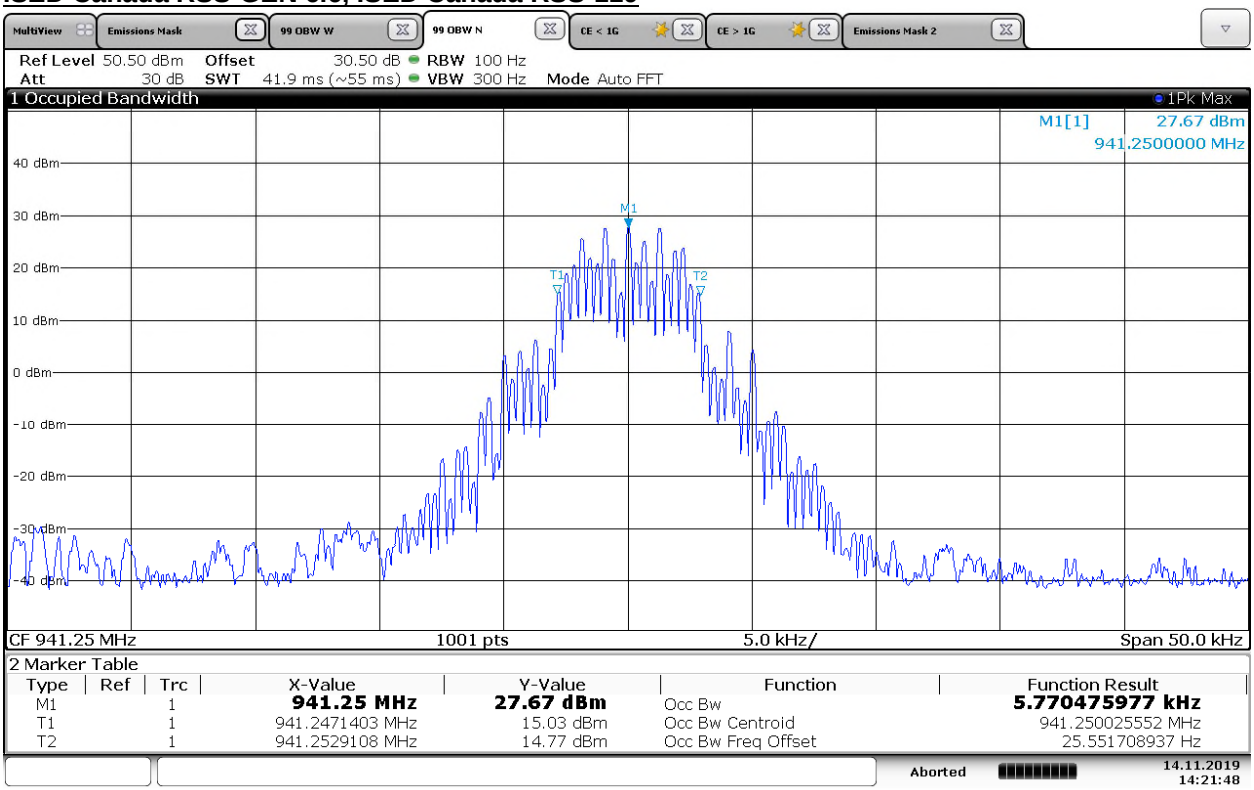
Figure 7.2.3-5: 940.5 MHz – MPass 10kbps



14:18:43 14.11.2019

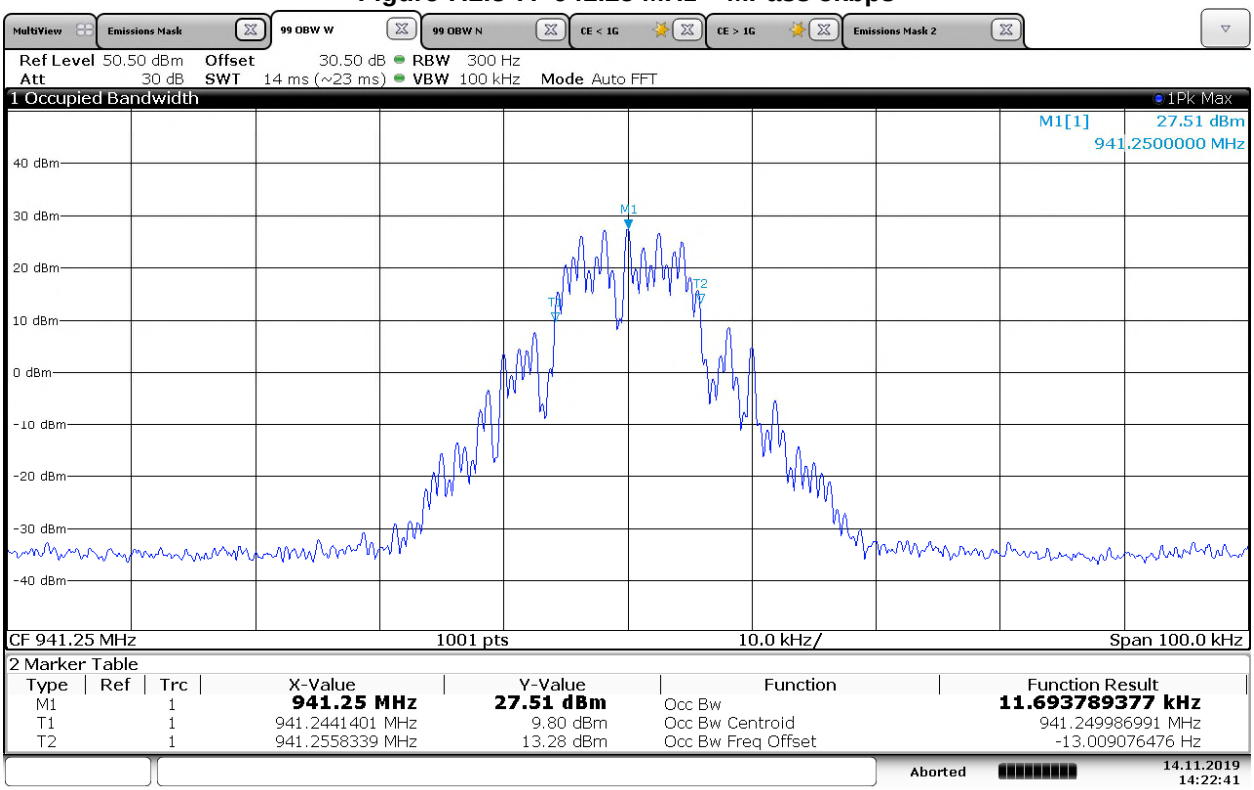
Figure 7.2.3-6: 940.5 MHz – MPass 12.5kbps

ISED Canada RSS-GEN 6.6, ISED Canada RSS-119



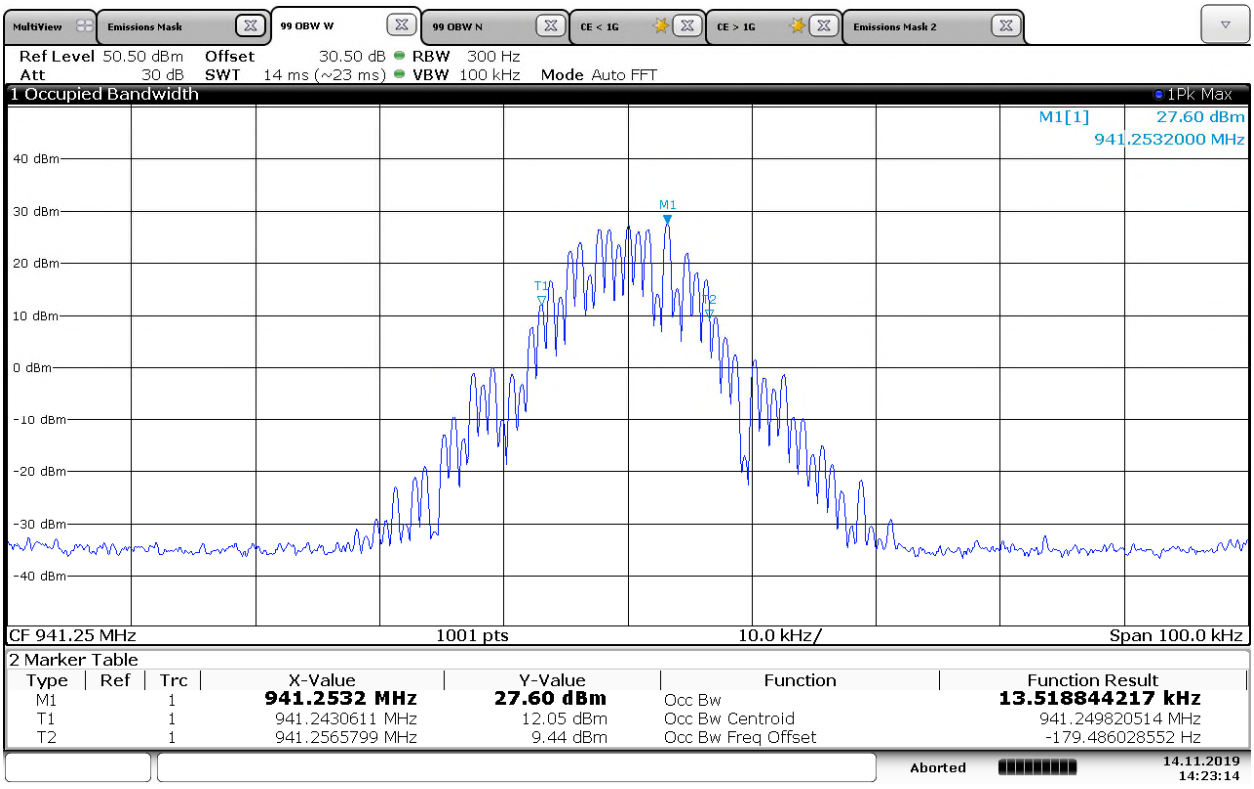
14:21:48 14.11.2019

Figure 7.2.3-7: 941.25 MHz – MPass 5kbps



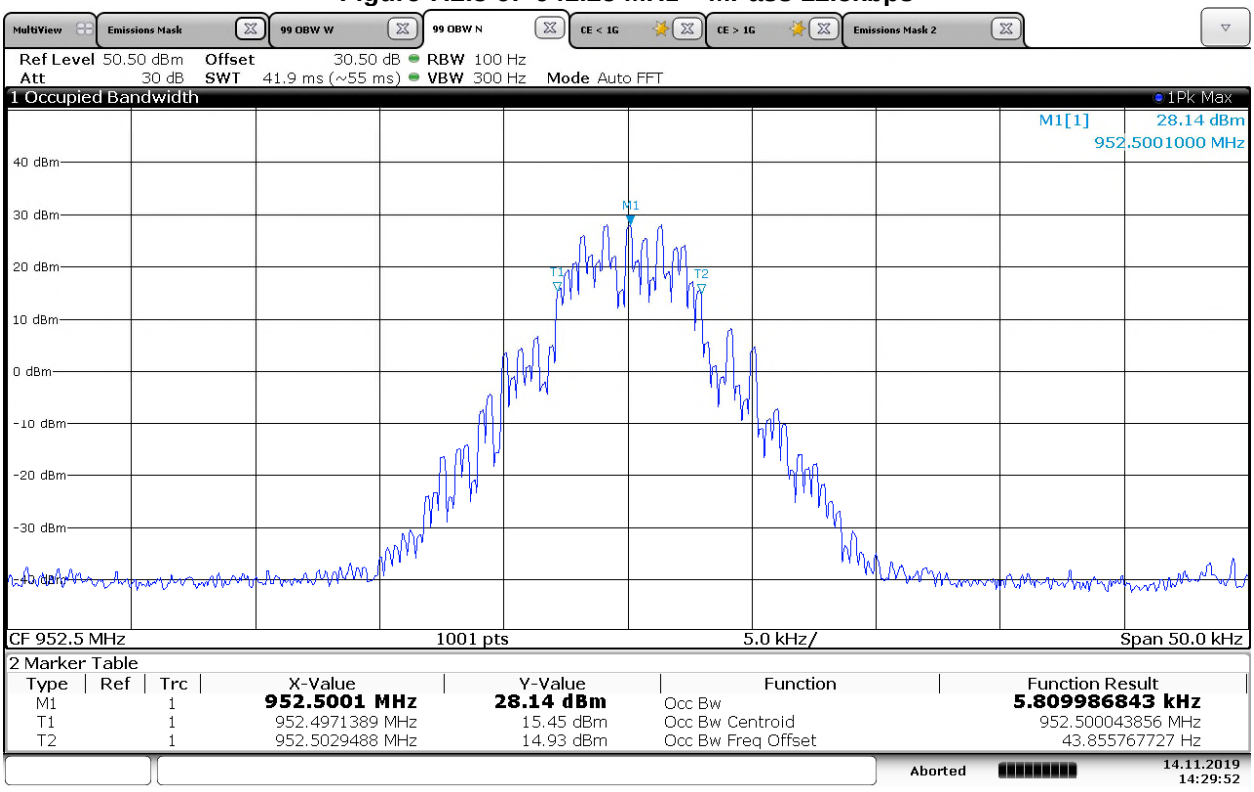
14:22:42 14.11.2019

Figure 7.2.3-8: 941.25 MHz – MPass 10kbps



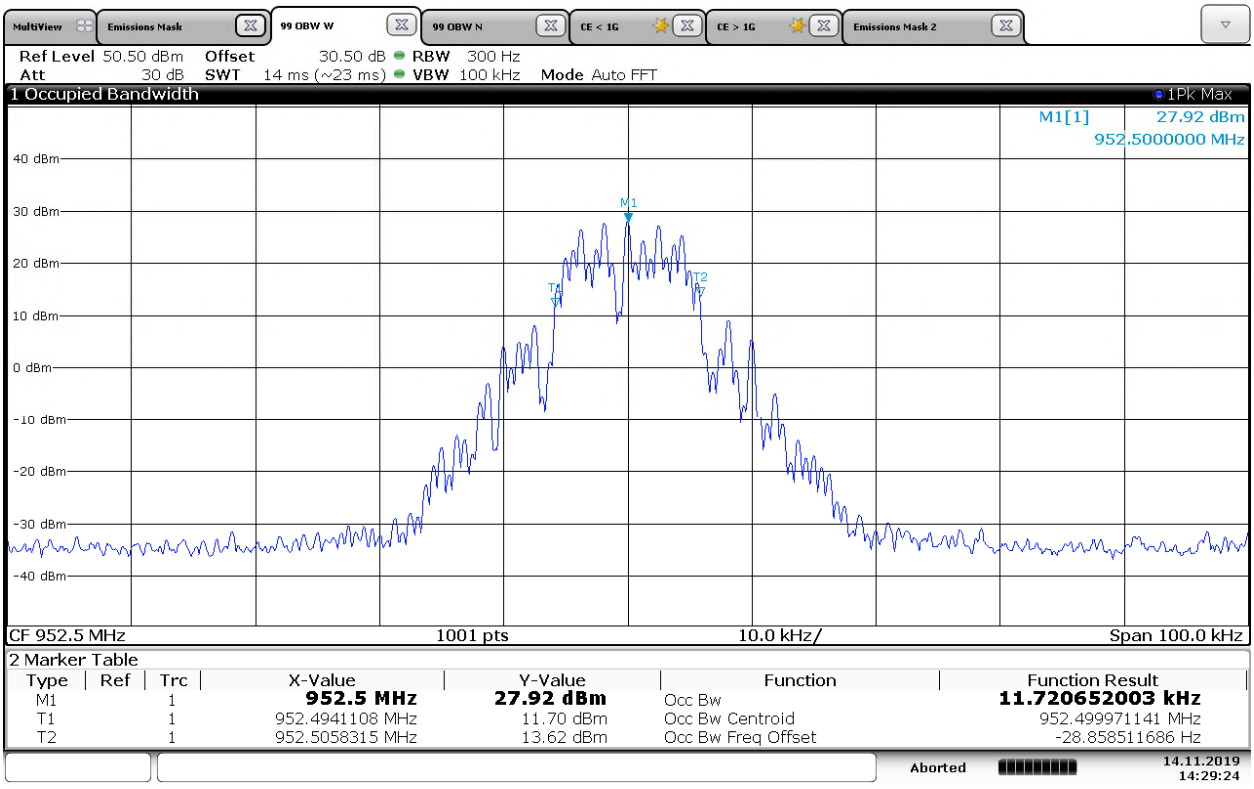
14:23:14 14.11.2019

Figure 7.2.3-9: 941.25 MHz – MPass 12.5kbps



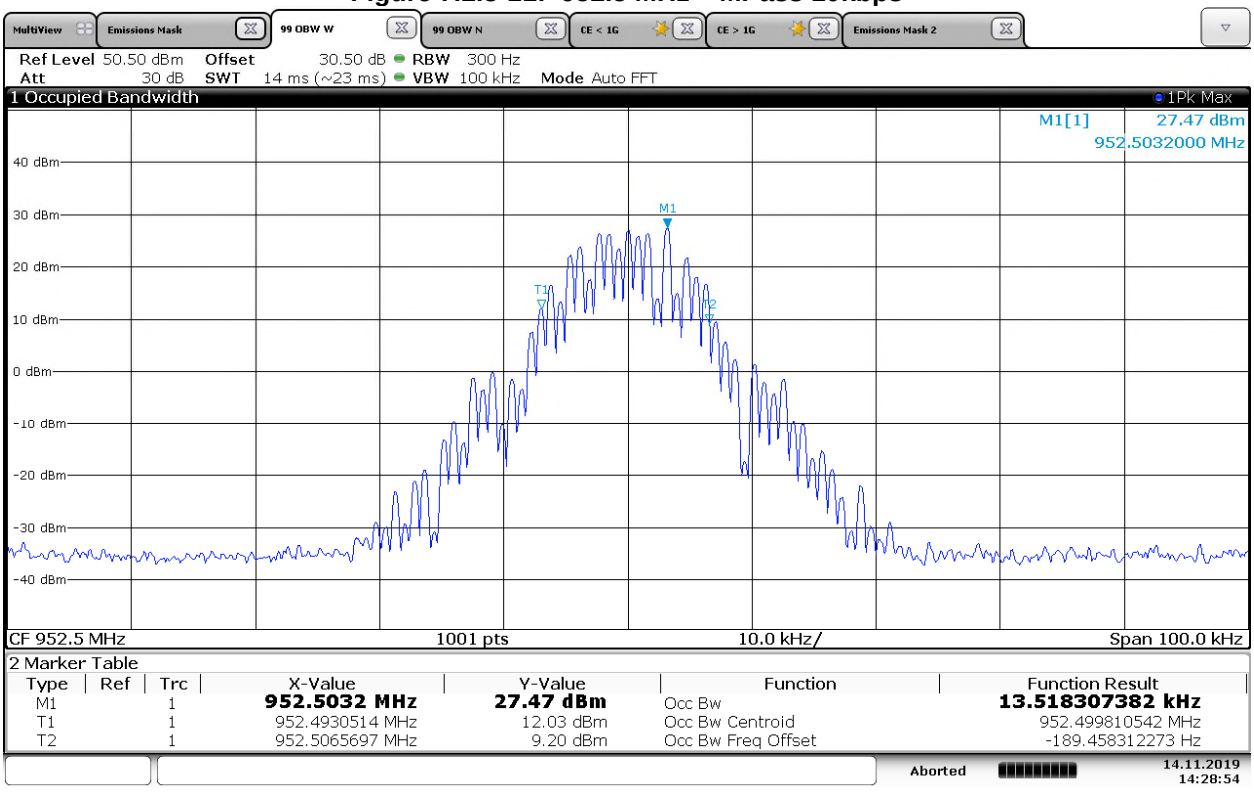
14:29:53 14.11.2019

Figure 7.2.3-10: 952.5 MHz – MPass 5kbps



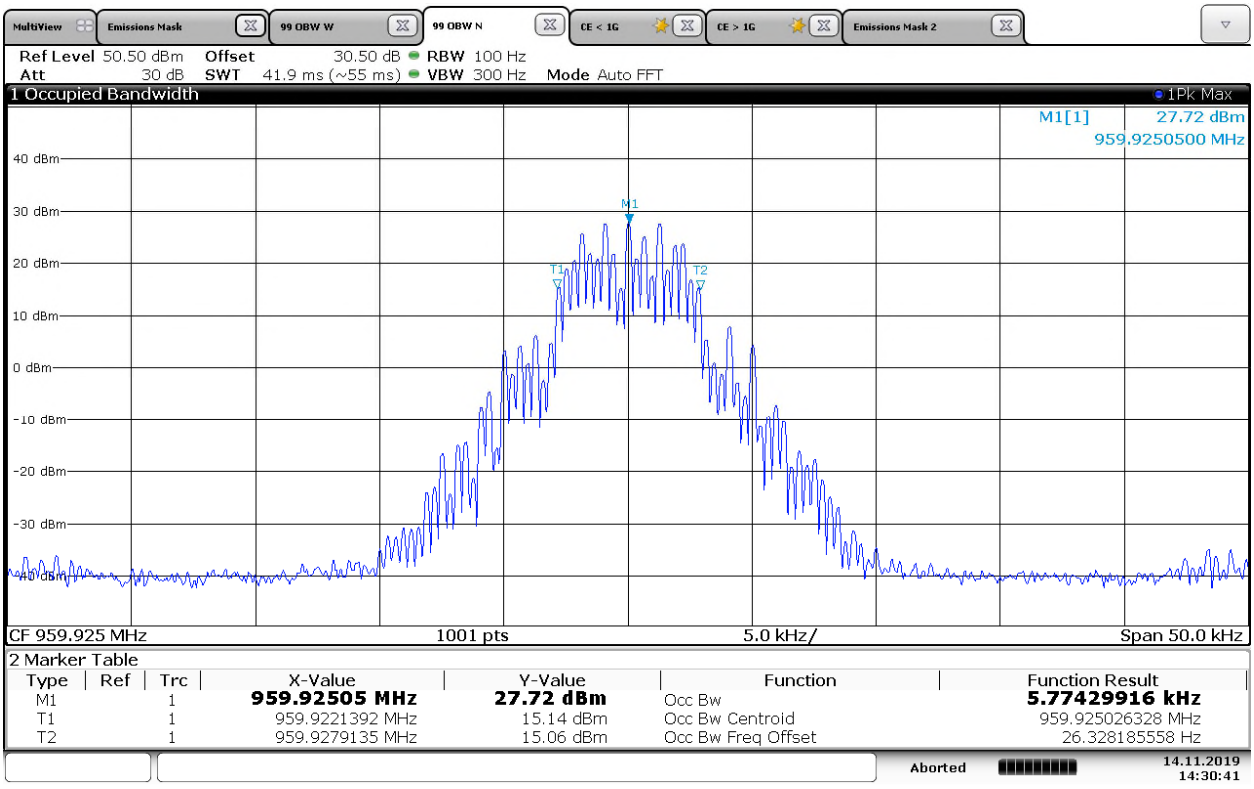
14:29:24 14.11.2019

Figure 7.2.3-11: 952.5 MHz – MPass 10kbps



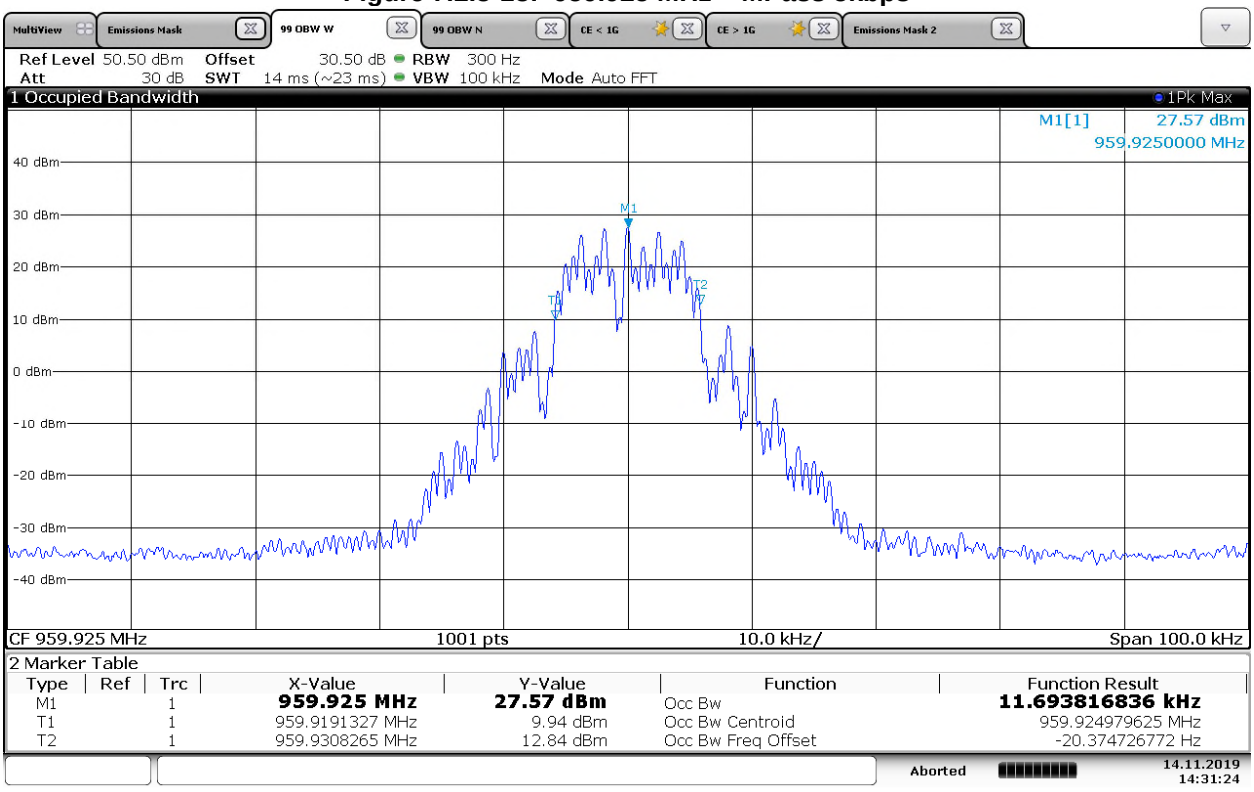
14:28:54 14.11.2019

Figure 7.2.3-12: 952.5 MHz – MPass 12.5kbps



14:30:42 14.11.2019

Figure 7.2.3-13: 959.925 MHz – MPass 5kbps



14:31:25 14.11.2019

Figure 7.2.3-14: 959.925 MHz – MPass 10kbps

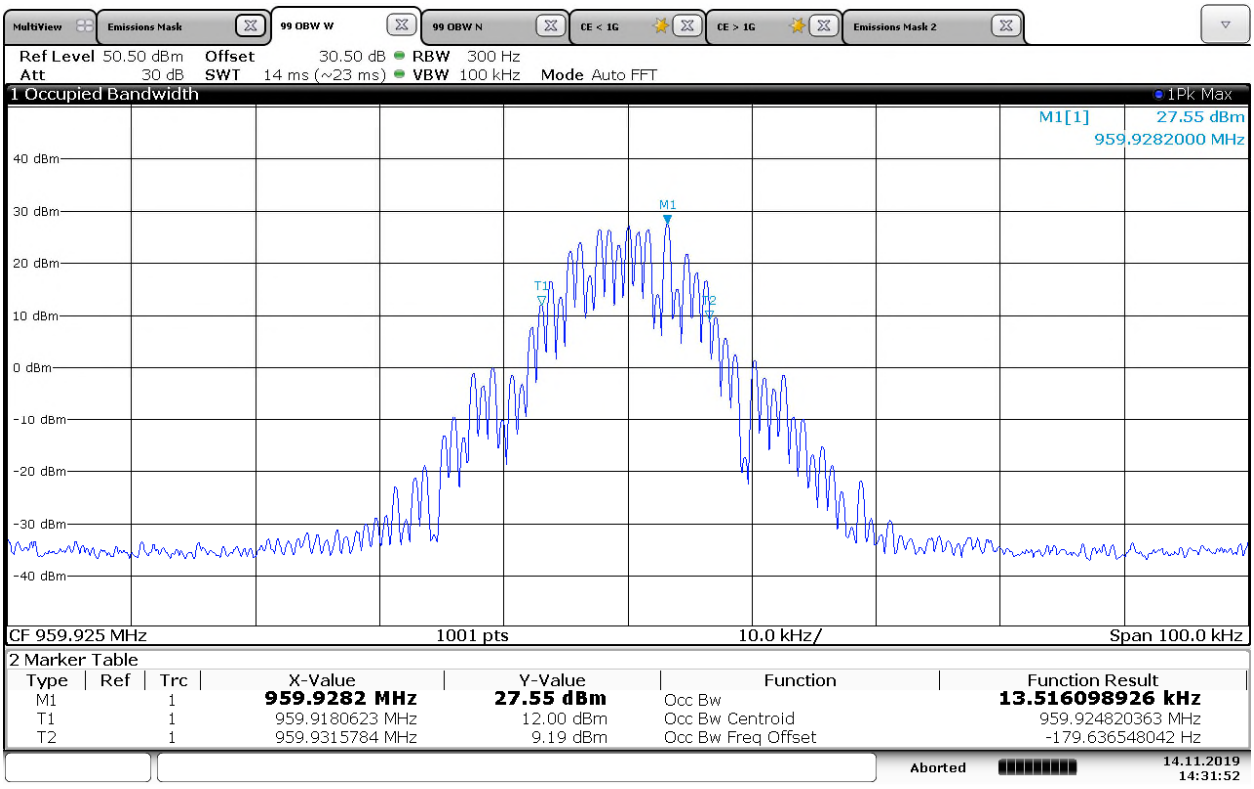


Figure 7.2.3-15: 959.925 MHz – MPass 12.5kbps

7.4 Spurious Emissions at Antenna Terminals

7.4.1 Measurement Procedure (ANSI 63.26: 2015 Section 5.7.4)

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 30.5dB of passive attenuation. The spectrum analyzer resolution bandwidth was set to 100 kHz below 1000 MHz and 1 MHz above 1000 MHz. The internal correction factors of the spectrum analyzer were employed to correct for any cable, attenuator or filter losses. The spectrum was investigated in accordance to CFR 47 Part 2.1057. There were no significant emissions from 9 kHz or lowest frequency generated to 30 MHz. Results are shown below.

7.4.2 Measurement Results

Performed by: Chris Gormley

Part 24.133 a(1), a(2), ISED Canada RSS-134 4.4.1 (a), (b), 4.4.2 (a), (b)

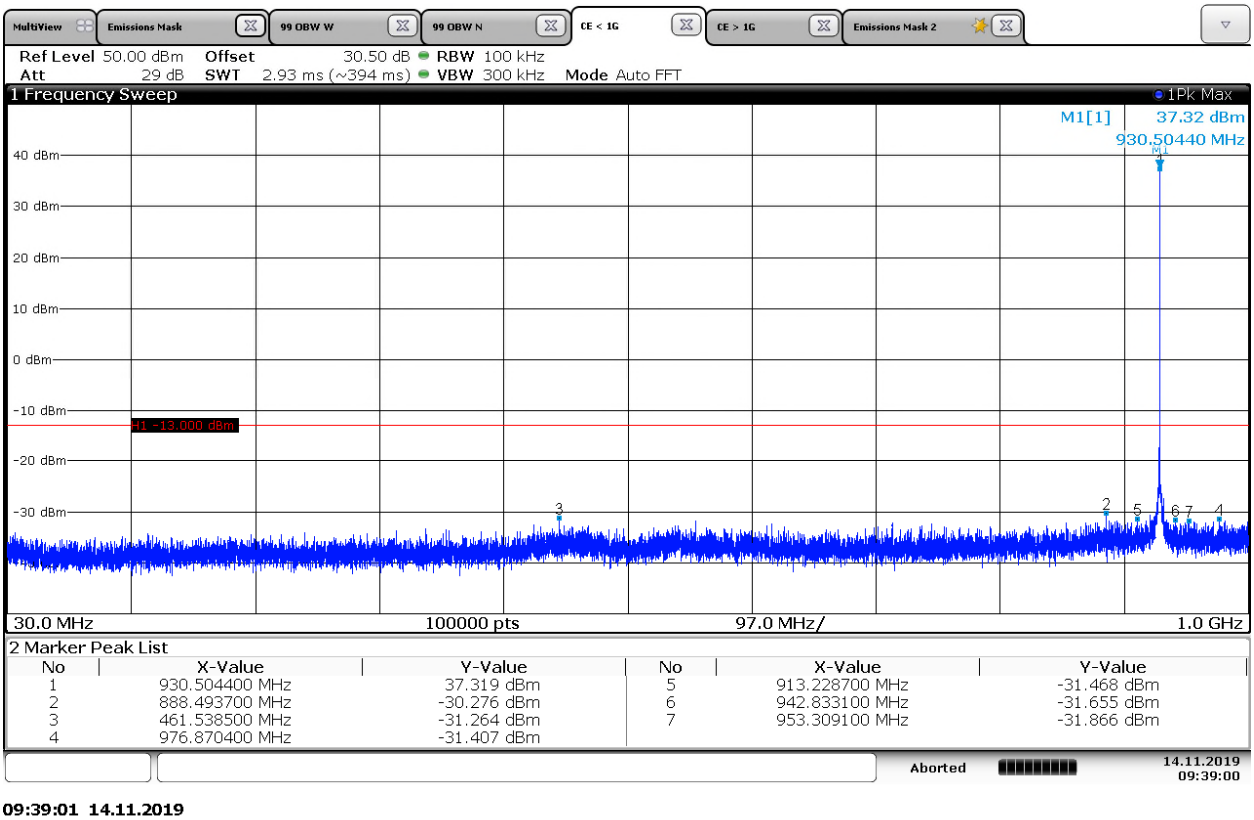
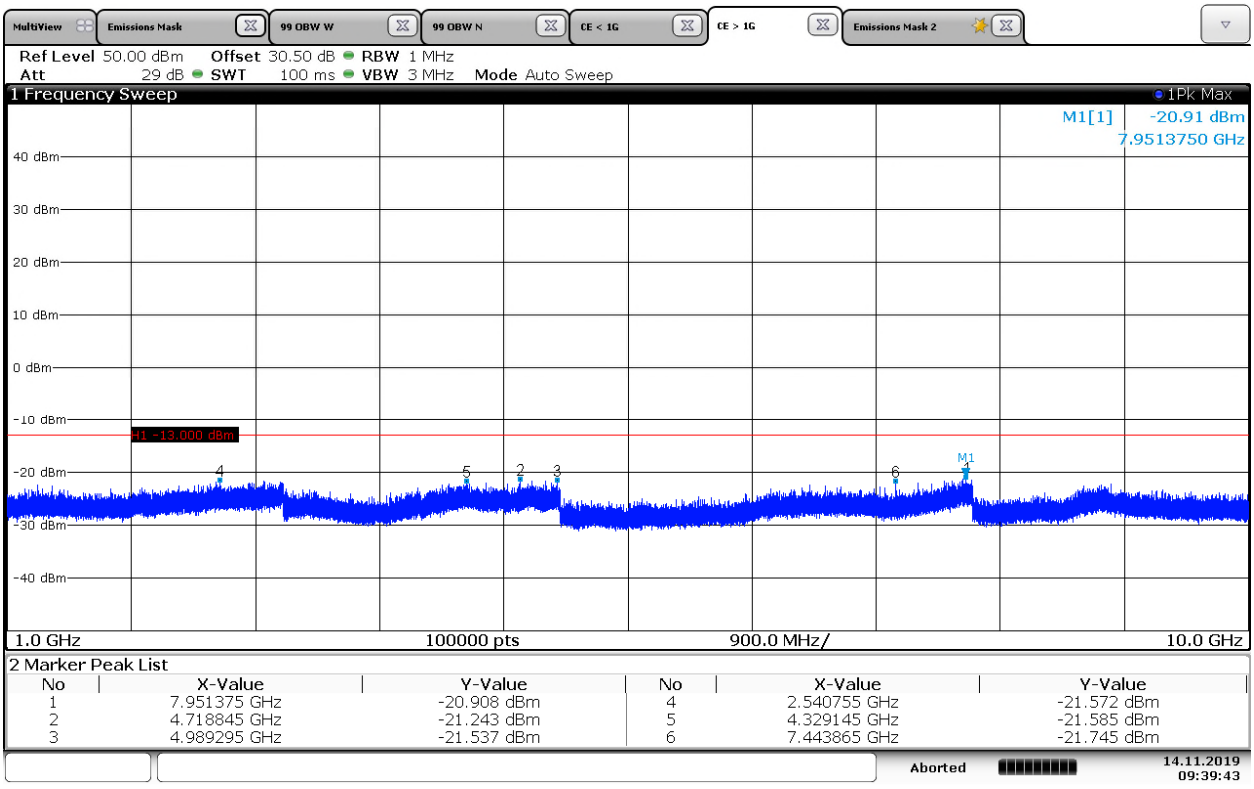
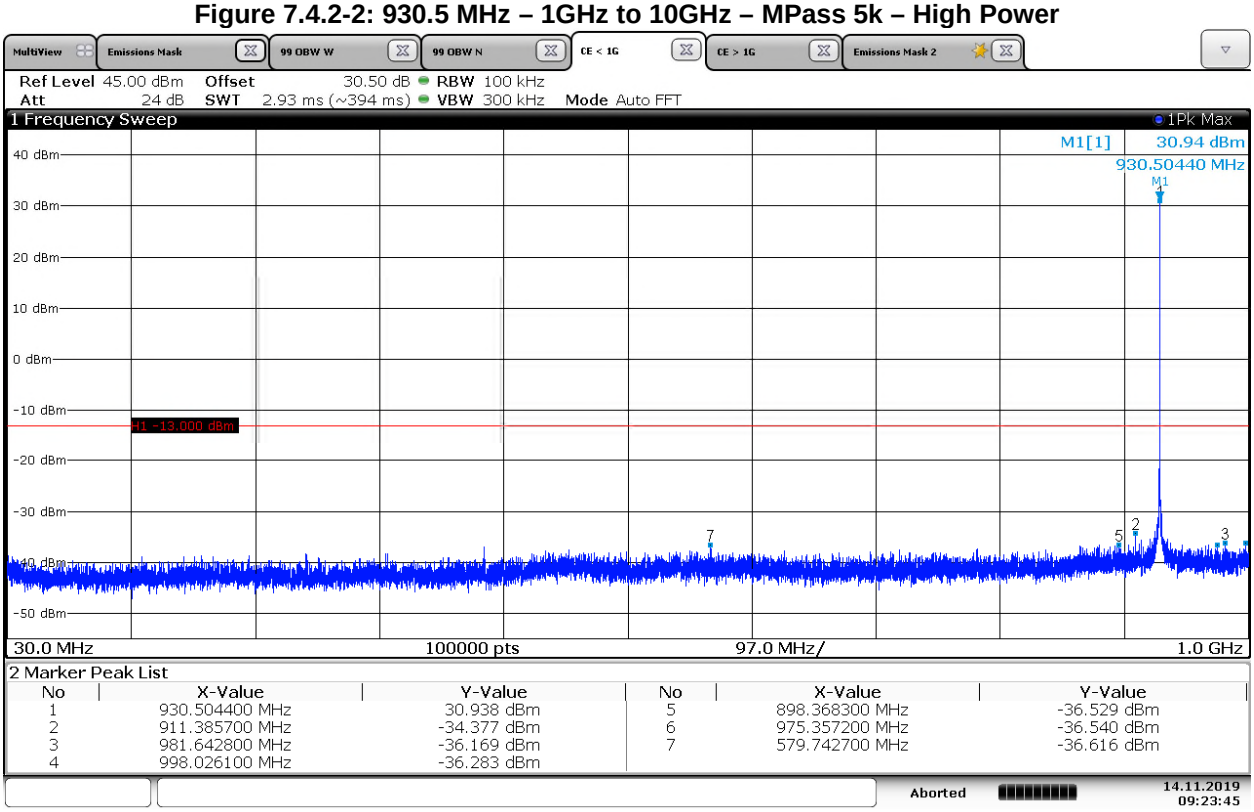


Figure 7.4.2-1: 930.5 MHz – 30MHz to 1GHz – MPass 5k – High Power



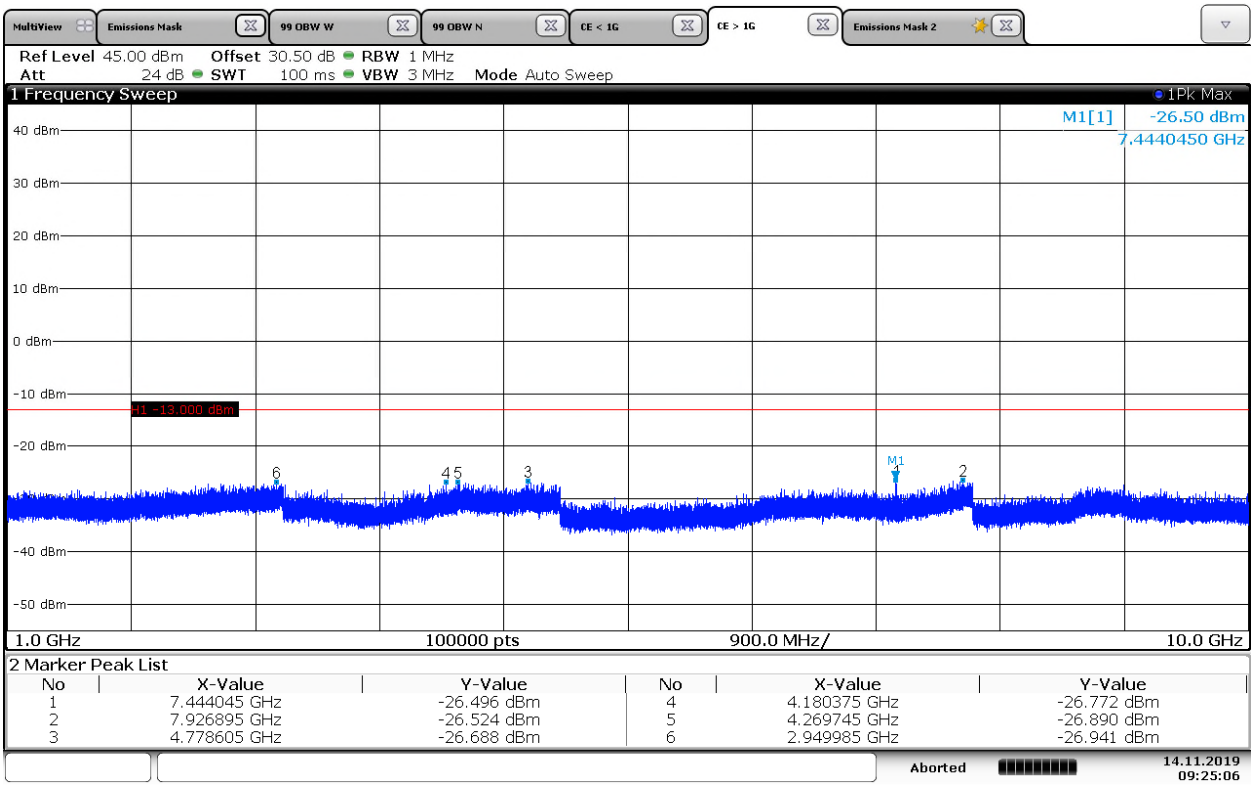
09:39:43 14.11.2019

Figure 7.4.2-2: 930.5 MHz – 1GHz to 10GHz – MPass 5k – High Power



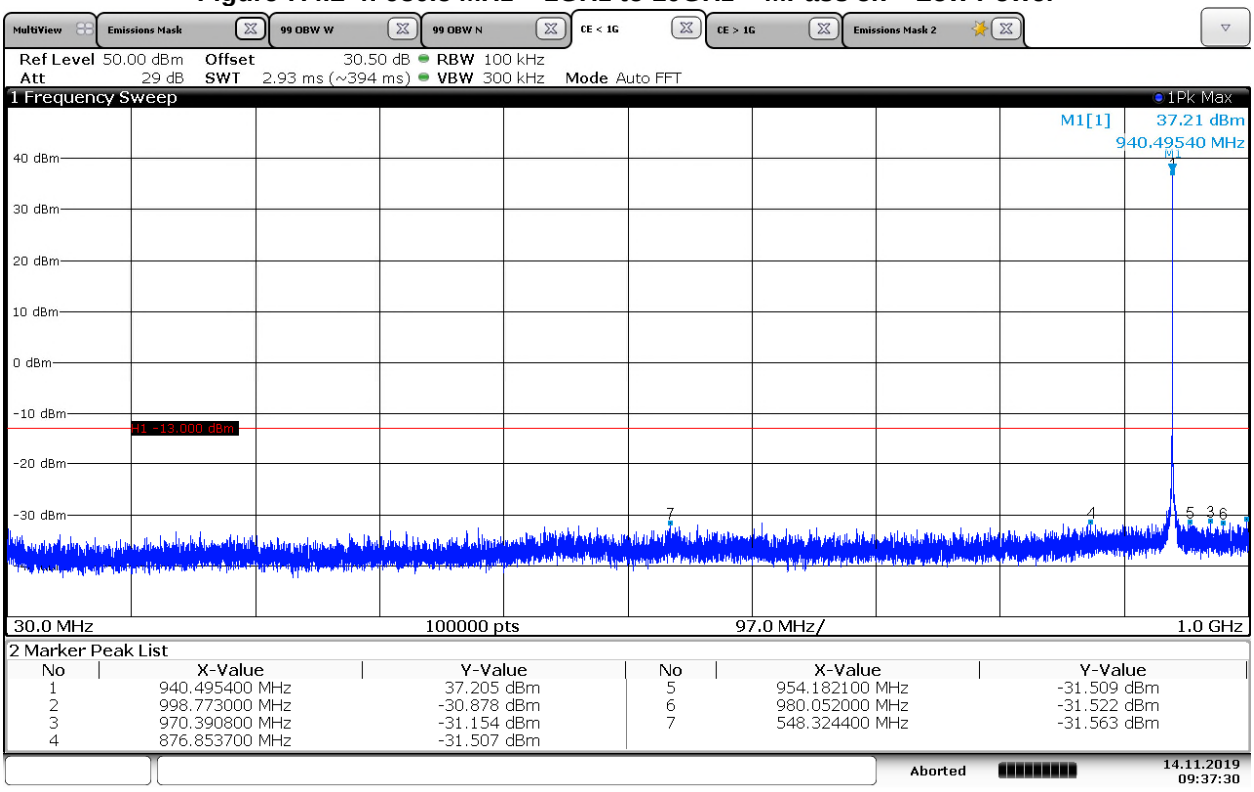
09:23:45 14.11.2019

Figure 7.4.2-3: 930.5 MHz – 30MHz to 1GHz – MPass 5k – Low Power



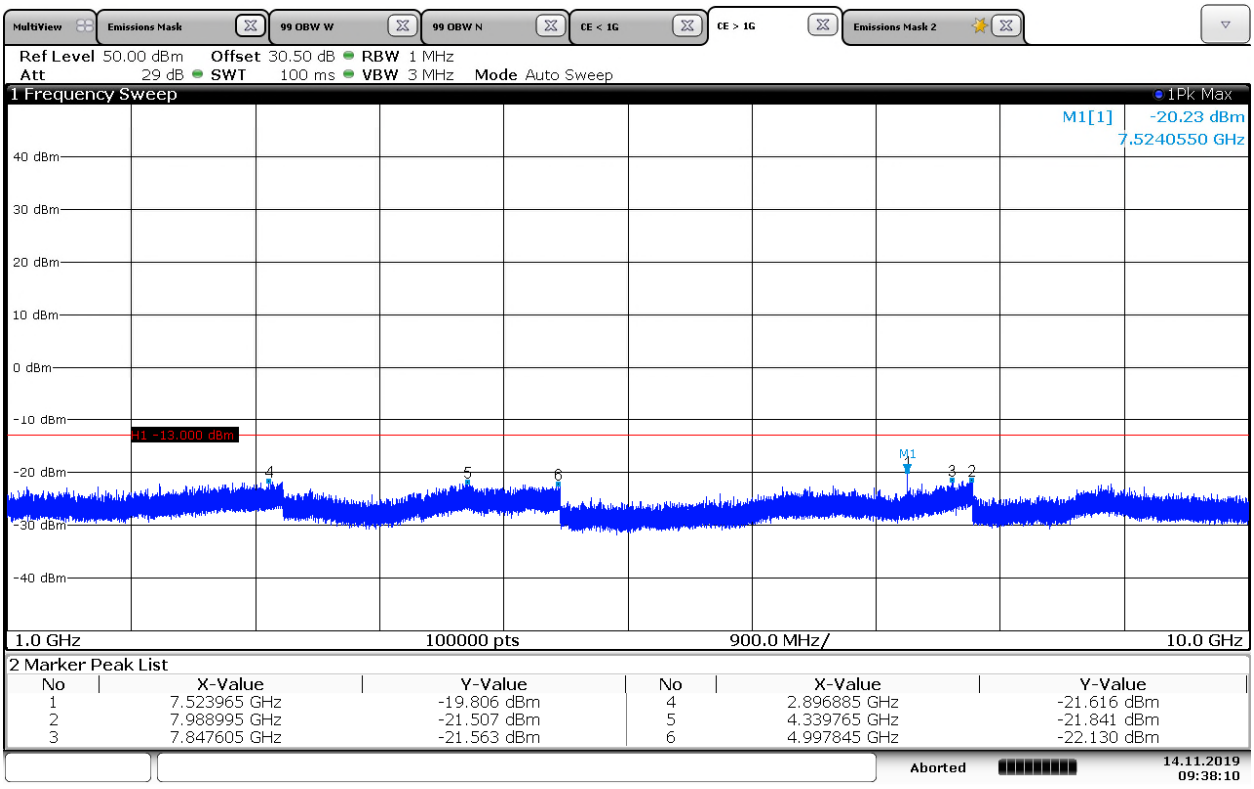
09:25:06 14.11.2019

Figure 7.4.2-4: 930.5 MHz – 1GHz to 10GHz – MPass 5k – Low Power



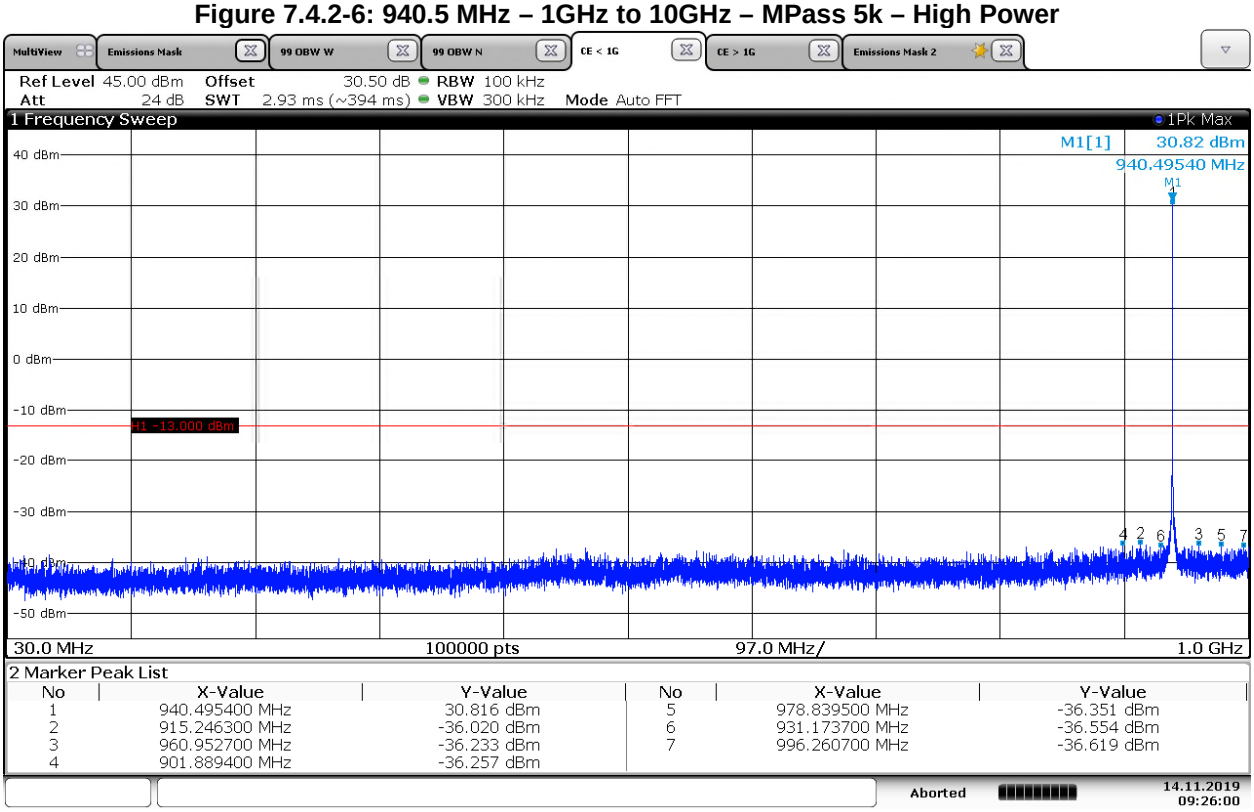
09:37:30 14.11.2019

Figure 7.4.2-5: 940.5 MHz – 30MHz to 1GHz – MPass 5k – High Power



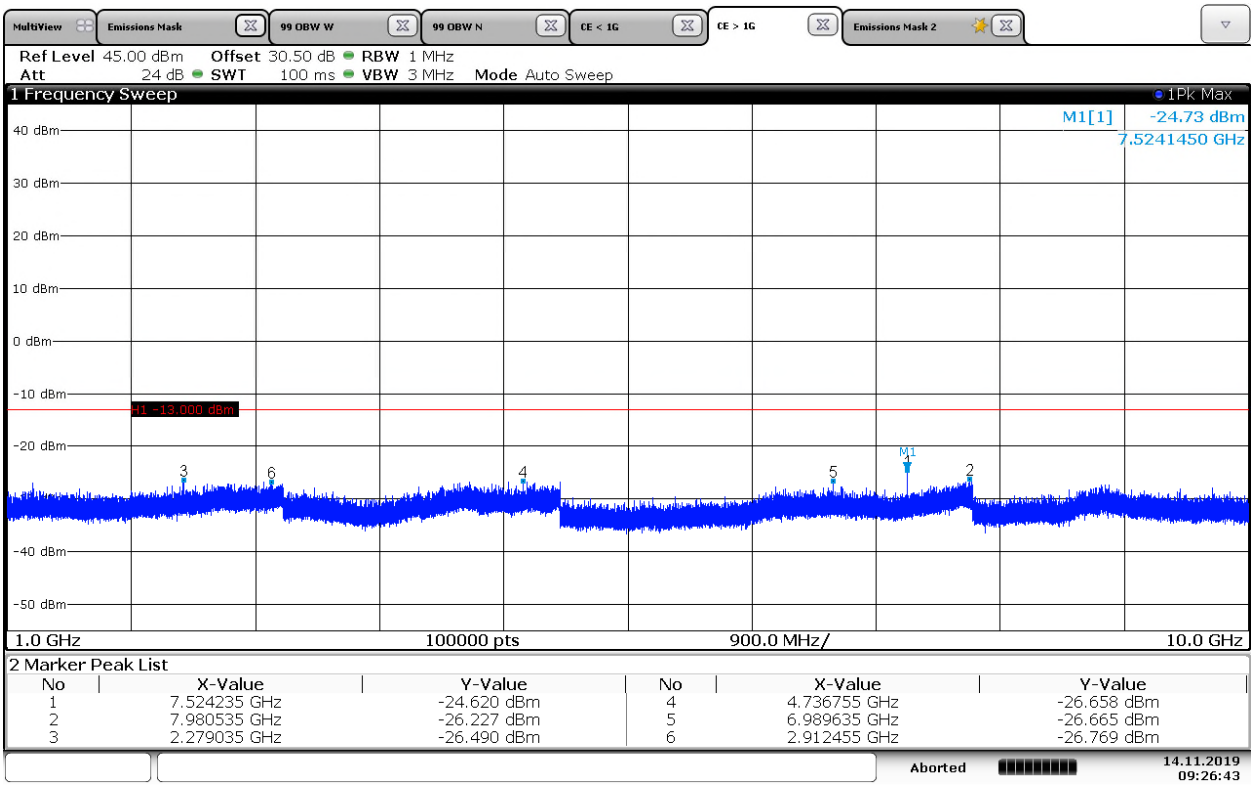
09:38:10 14.11.2019

Figure 7.4.2-6: 940.5 MHz – 1GHz to 10GHz – MPass 5k – High Power



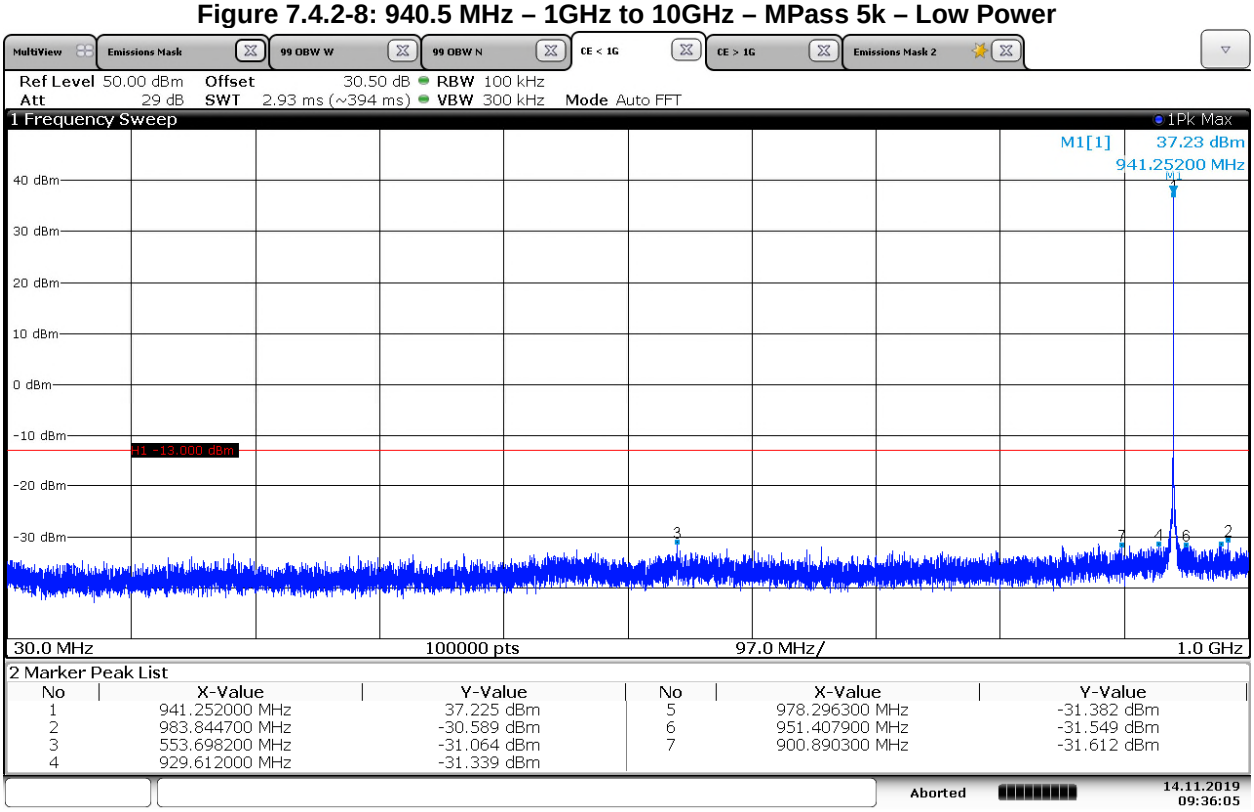
09:26:00 14.11.2019

Figure 7.4.2-7: 940.5 MHz – 30MHz to 1GHz – MPass 5k – Low Power



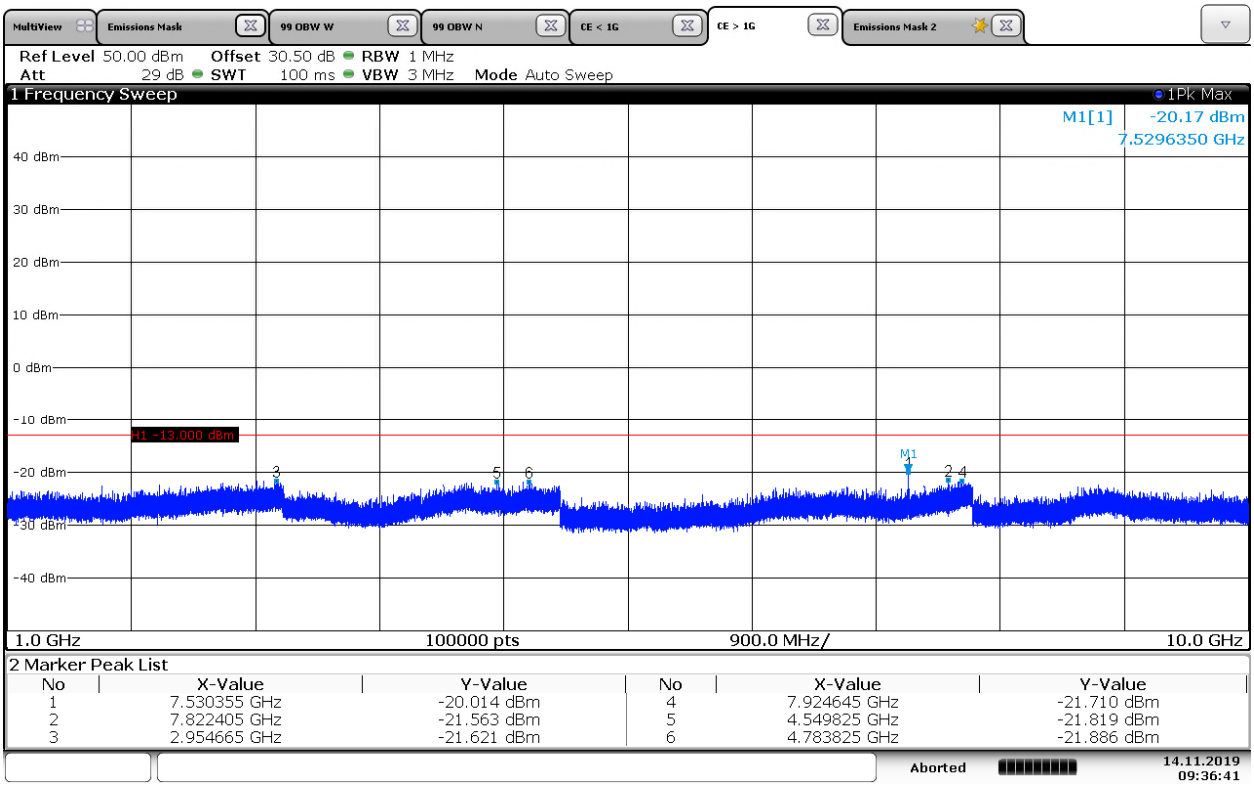
09:26:43 14.11.2019

Figure 7.4.2-8: 940.5 MHz – 1GHz to 10GHz – MPass 5k – Low Power



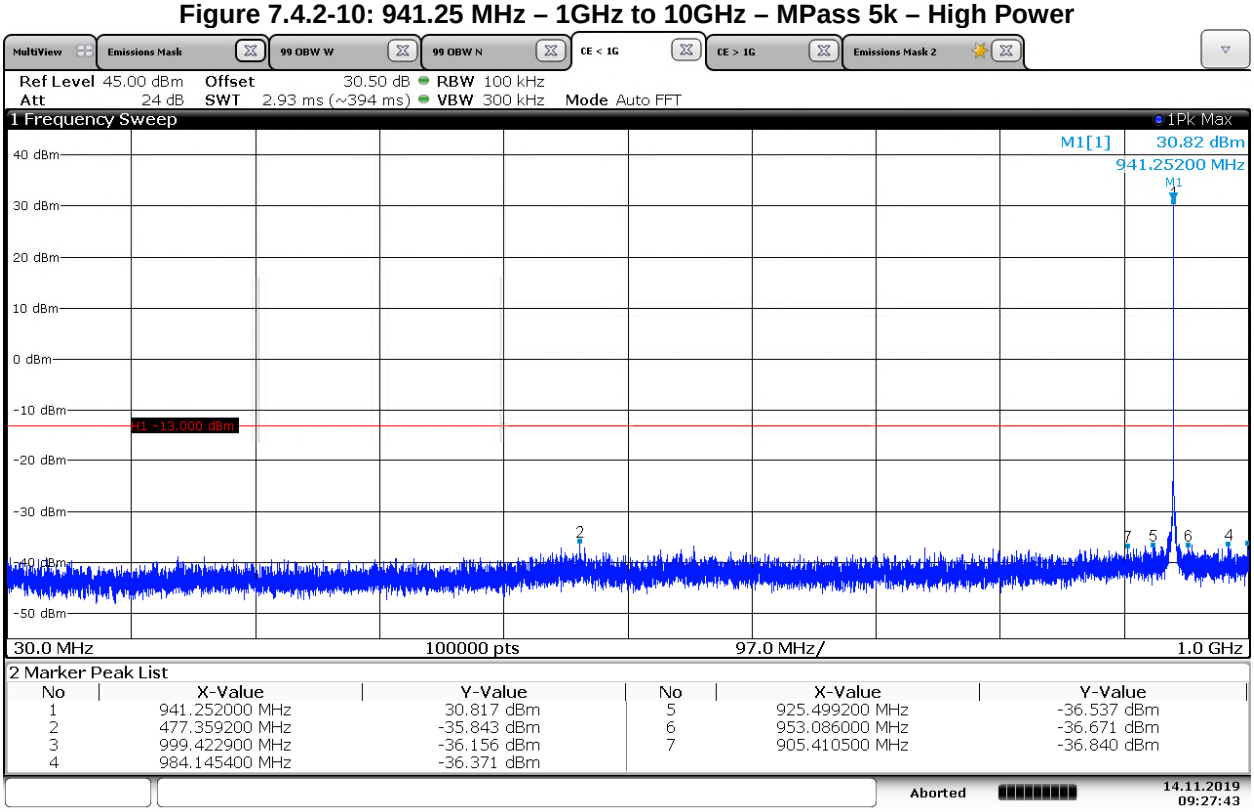
09:36:05 14.11.2019

Figure 7.4.2-9: 941.25 MHz – 30MHz to 1GHz – MPass 5k – High Power



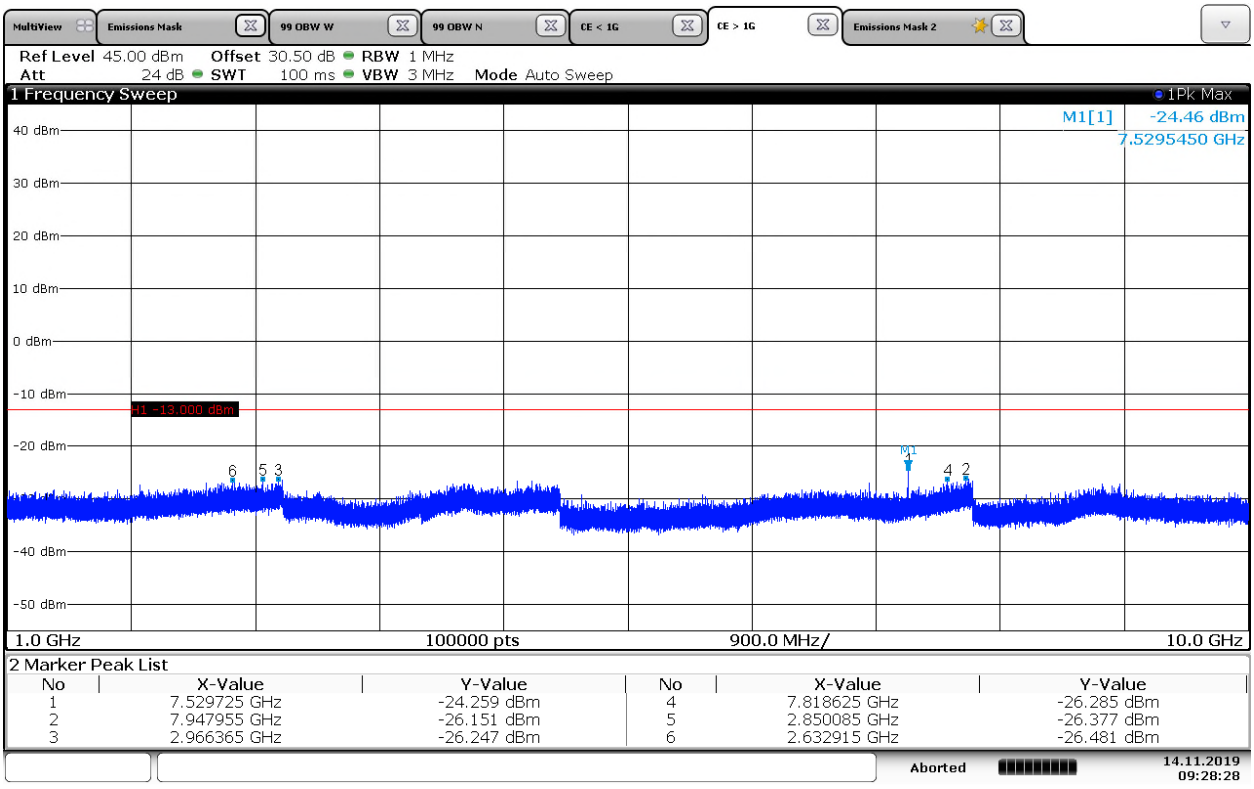
09:36:42 14.11.2019

Figure 7.4.2-10: 941.25 MHz – 1GHz to 10GHz – MPass 5k – High Power



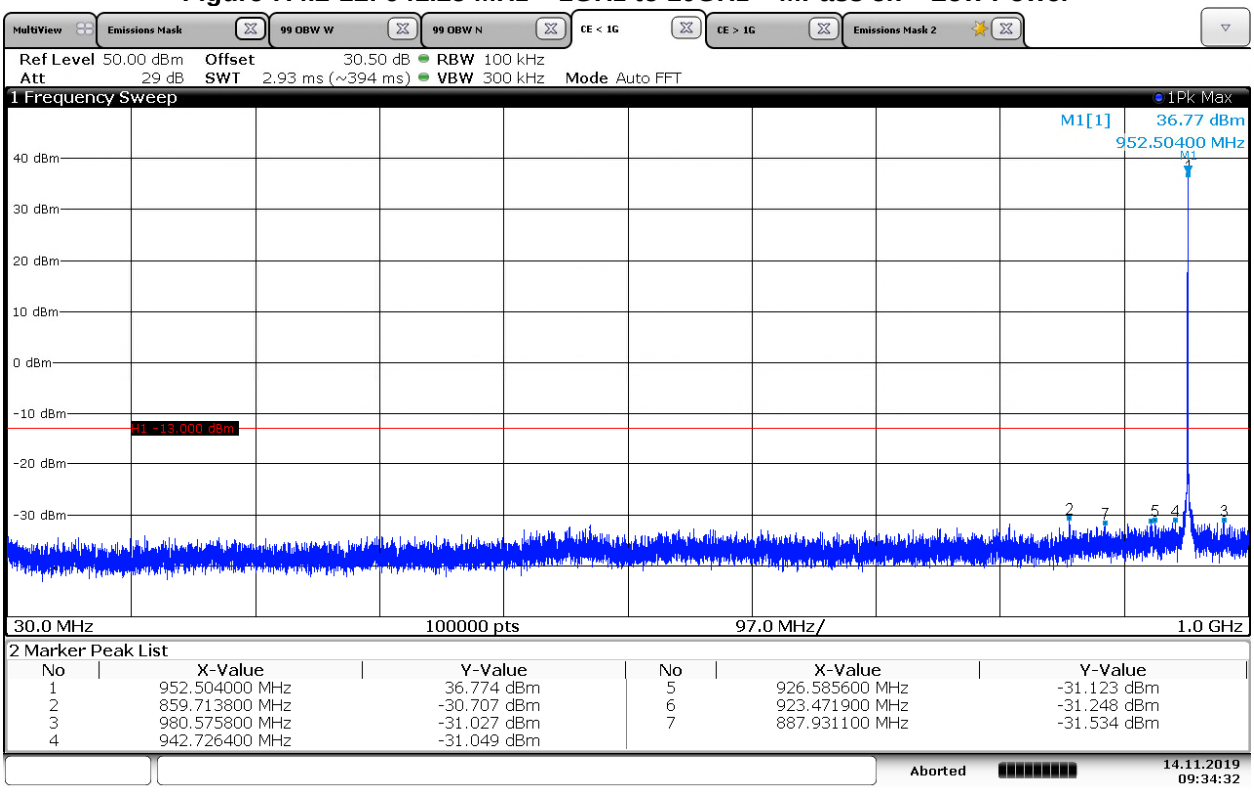
09:27:44 14.11.2019

Figure 7.4.2-11: 941.25 MHz – 30MHz to 1GHz – MPass 5k – Low Power



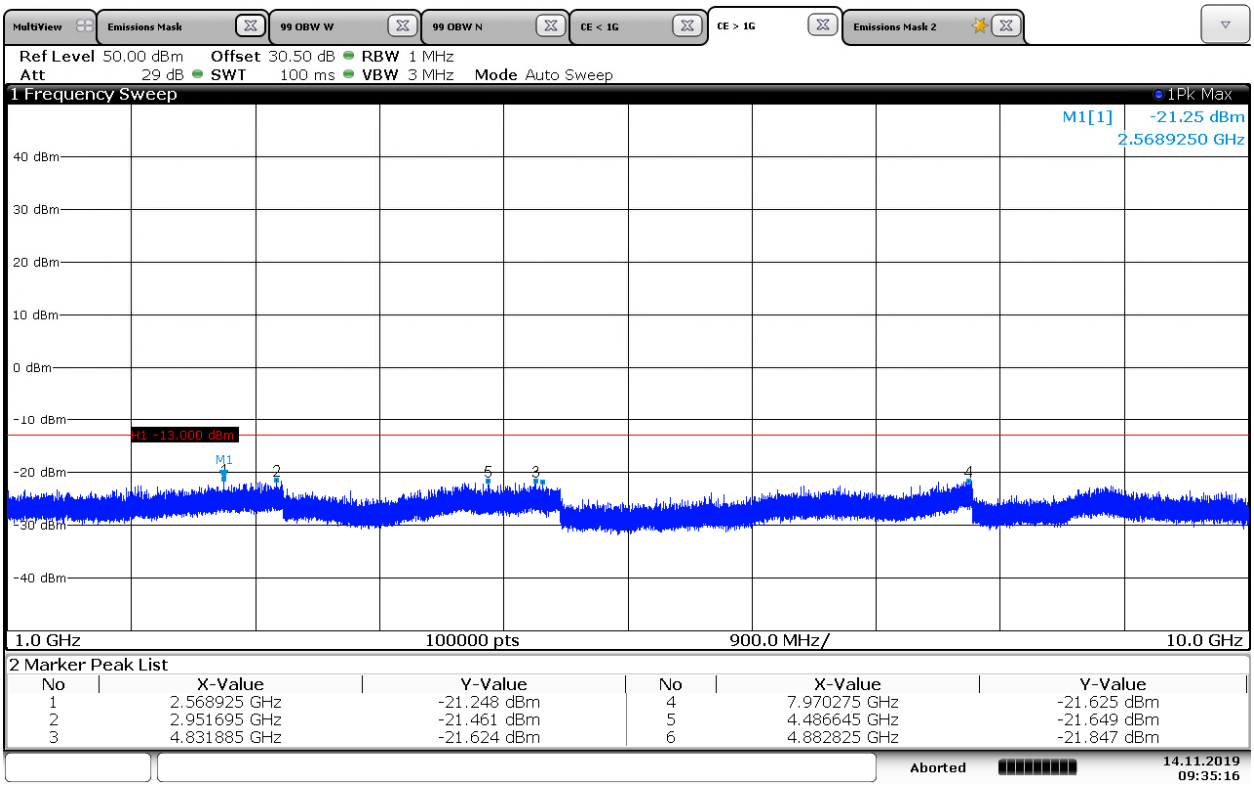
09:28:28 14.11.2019

Figure 7.4.2-12: 941.25 MHz – 1GHz to 10GHz – MPass 5k – Low Power



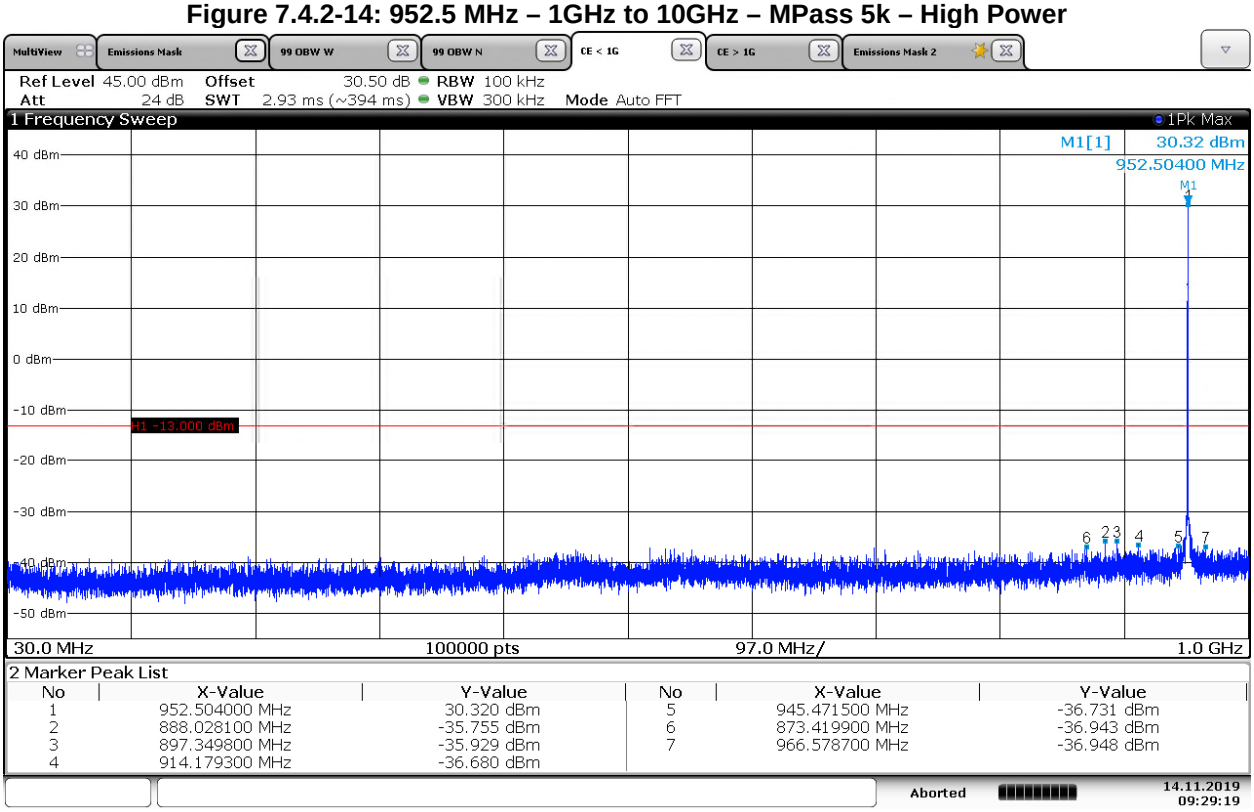
09:34:32 14.11.2019

Figure 7.4.2-13: 952.5 MHz – 30MHz to 1GHz – MPass 5k – High Power



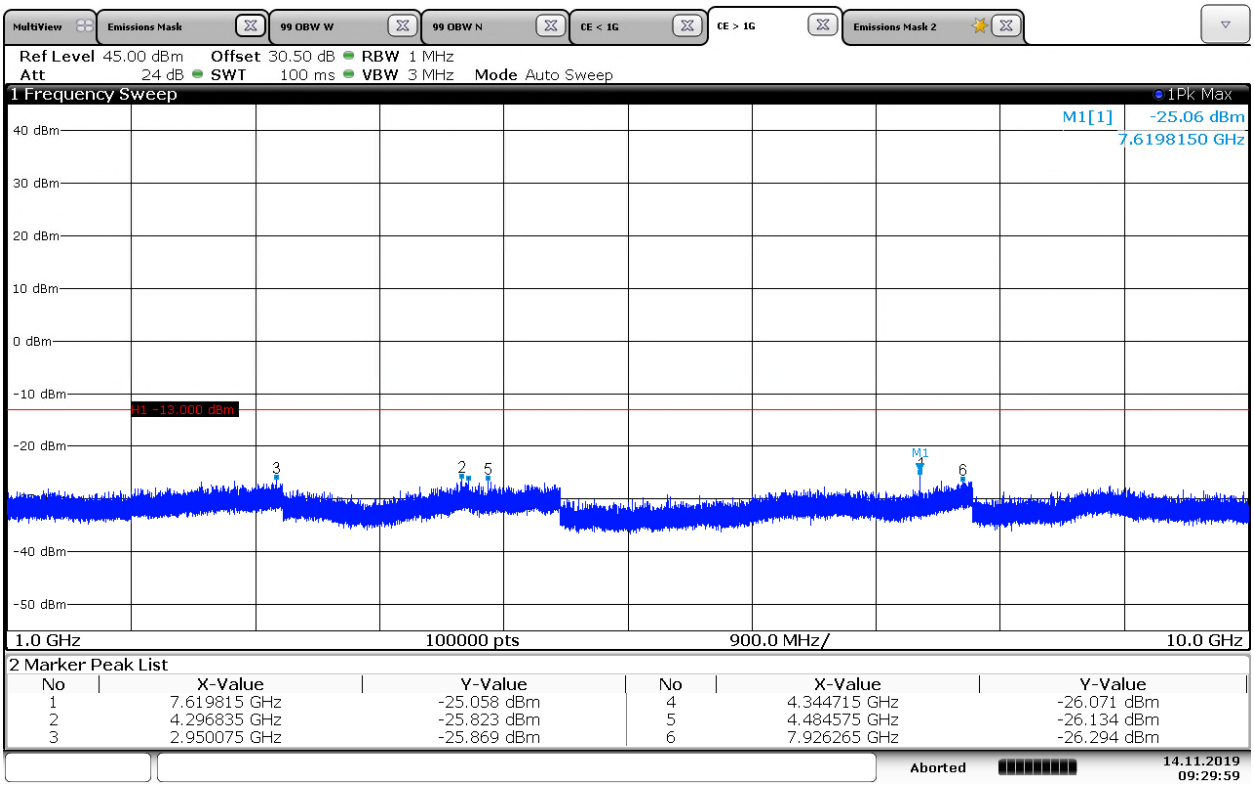
09:35:17 14.11.2019

Figure 7.4.2-14: 952.5 MHz – 1GHz to 10GHz – MPass 5k – High Power



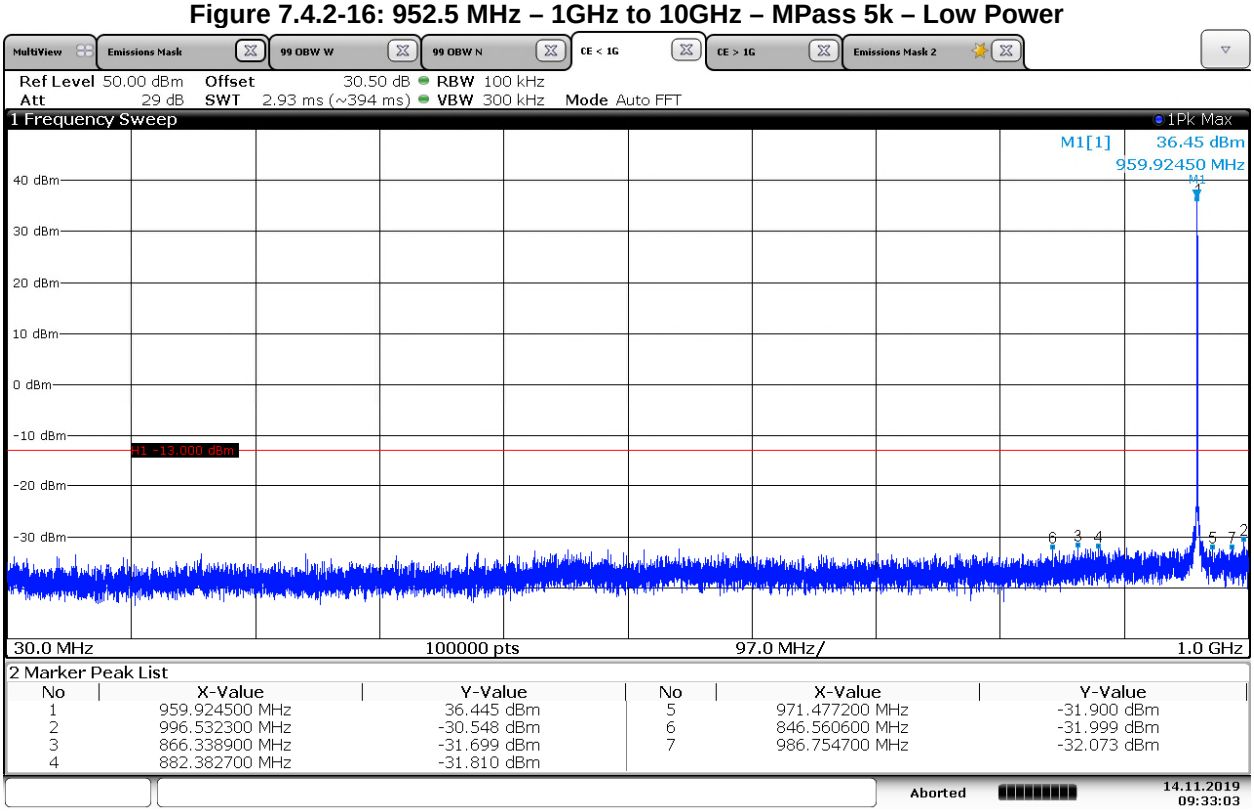
09:29:20 14.11.2019

Figure 7.4.2-15: 952.5 MHz – 30MHz to 1GHz – MPass 5k – Low Power



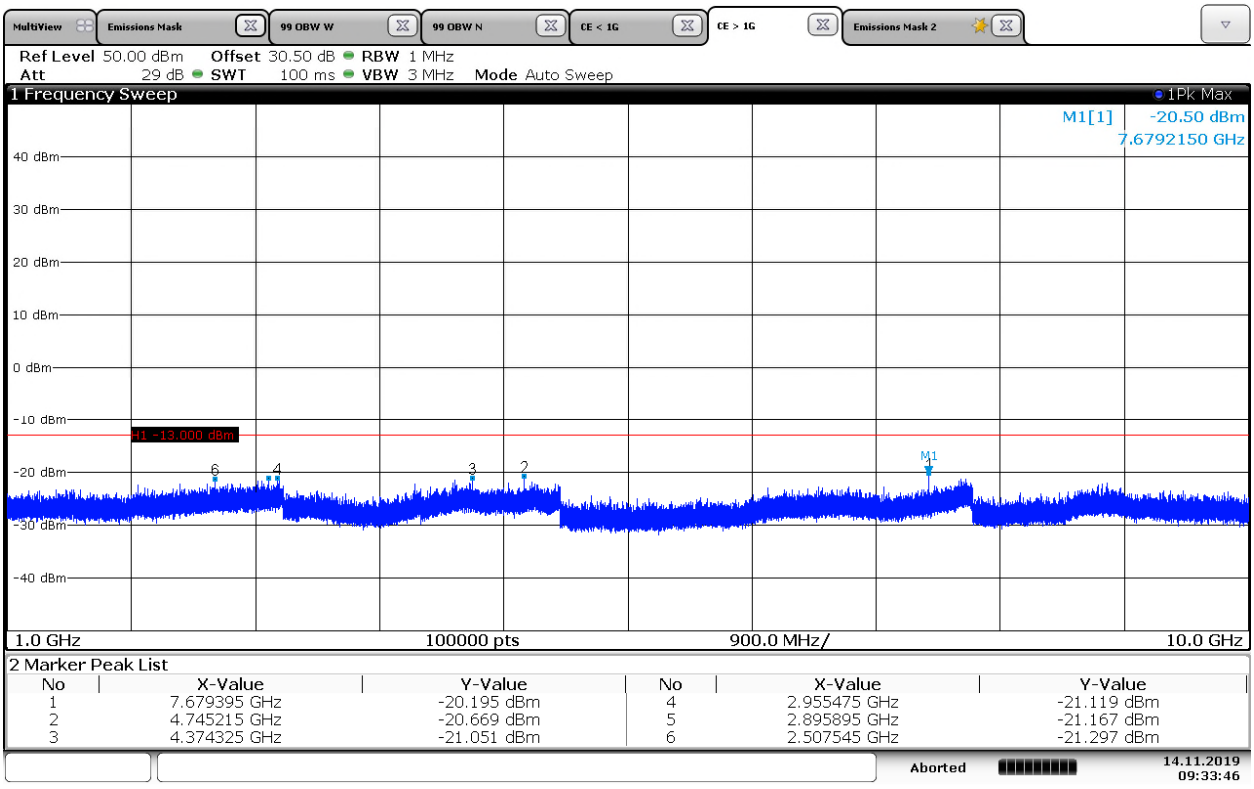
09:29:59 14.11.2019

Figure 7.4.2-16: 952.5 MHz – 1GHz to 10GHz – MPass 5k – Low Power



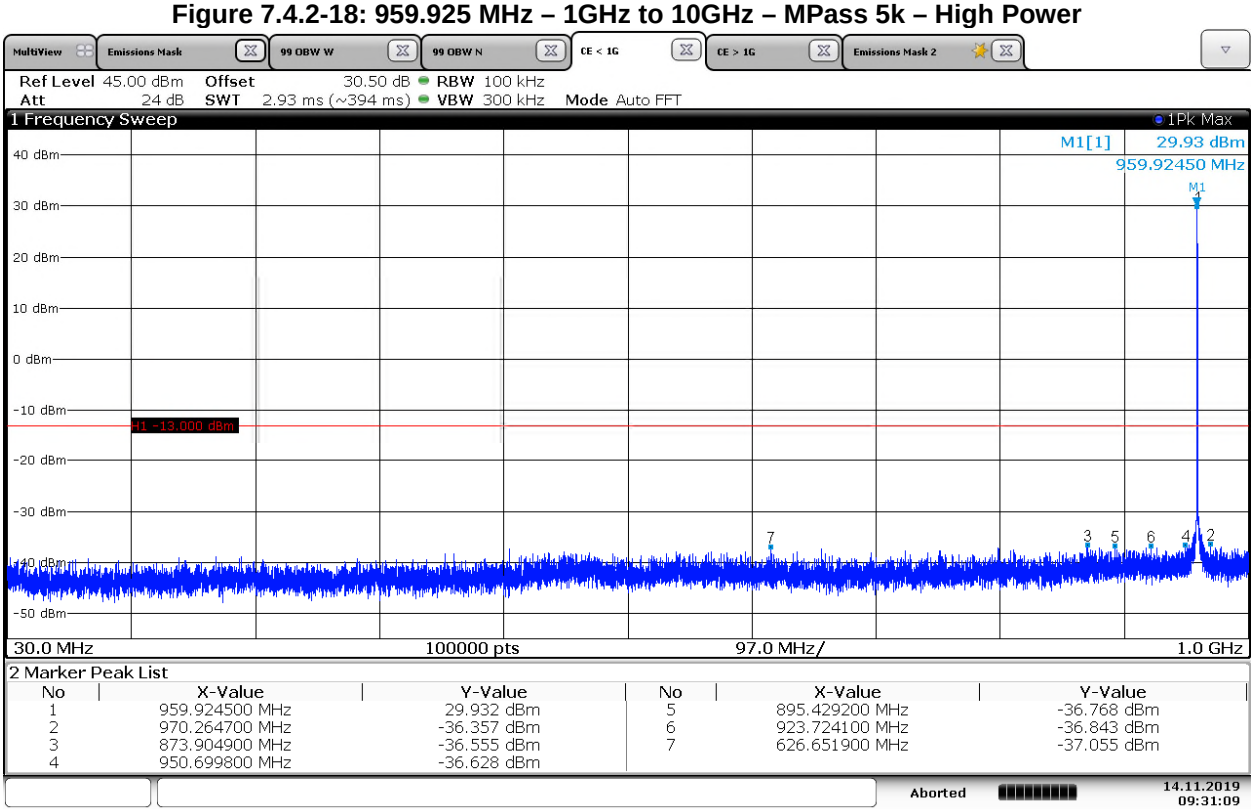
09:33:04 14.11.2019

Figure 7.4.2-17: 959.925 MHz – 30MHz to 1GHz – MPass 5k – High Power



09:33:47 14.11.2019

Figure 7.4.2-18: 959.925 MHz – 1GHz to 10GHz – MPass 5k – High Power



09:31:09 14.11.2019

Figure 7.4.2-19: 959.925 MHz – 30MHz to 1GHz – MPass 5k – Low Power

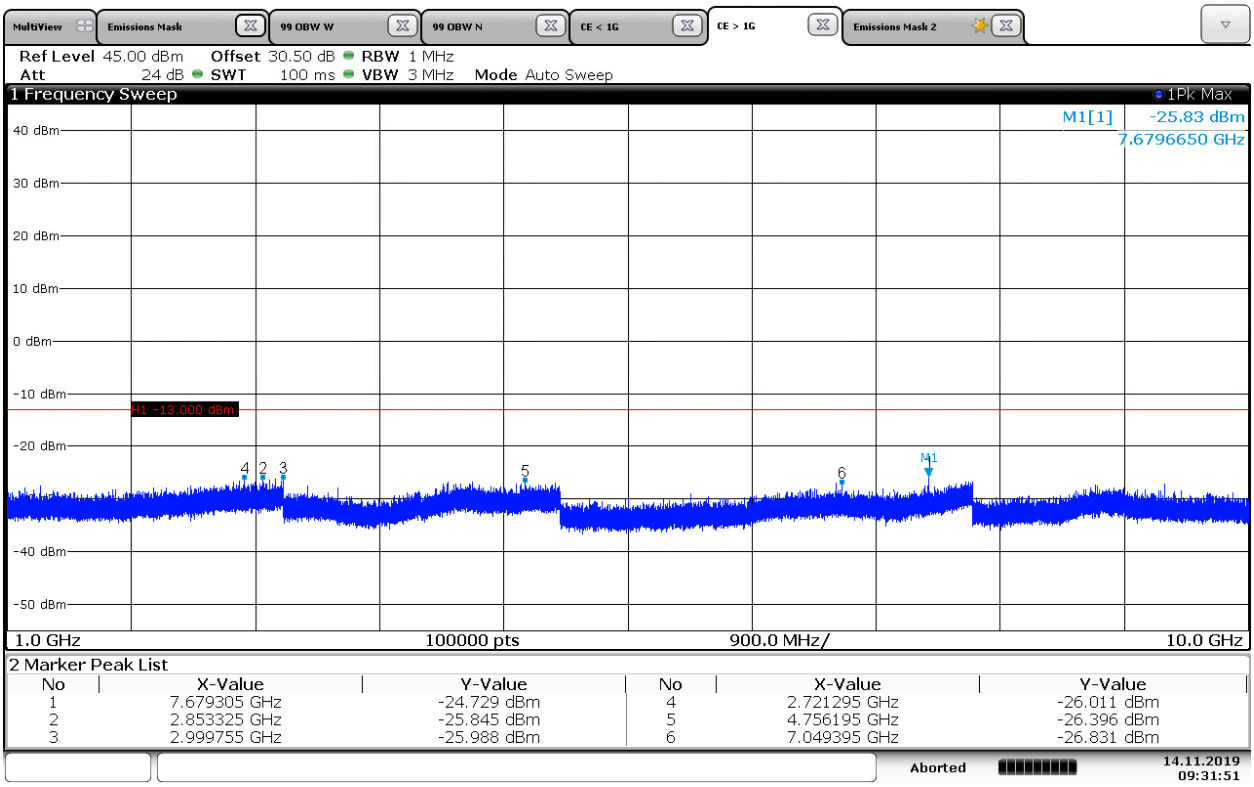


Figure 7.4.2-20: 959.925 MHz – 1GHz to 10GHz – MPass 5k – Low Power

7.5 Field Strength of Spurious Emissions

7.5.1 Measurement Procedure (ANSI 63.26: 2015 Section 5.5.2.3.1)

The equipment under test is placed in the Semi-Anechoic Chamber (described in section 2.3.1) on a table at the turntable center. Below 1 GHz the table height was 80cm and above 1 GHz the table height was 1.5m. For each spurious emission, the antenna mast is raised and lowered from one (1) to four (4) meters and the turntable is rotated 360º and the maximum reading on the spectrum analyzer is recorded. This was repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. The signal generator's frequency is set to that of the spurious emission recorded from the equipment under test. The antenna mast is raised and lowered from one (1) to four (4) meters to obtain a maximum reading on the spectrum analyzer. The output of the signal generator is then adjusted until the reading on the spectrum analyzer matches that obtained from the equipment under test. The signal generator level is recorded. The power in dBm of each spurious emission is calculated by correcting the signal generator level for the cable loss and gain of the substitution antenna referenced to a dipole. The spectrum was investigated in accordance to CFR 47 Part 2.1057.

The magnitude of all spurious emissions not reported were attenuated below the noise floor of the measurement system and therefore not specified in this report. Results are shown below.

7.5.2 Measurement Results

Performed by: Chris Gormley

Part 24.133 a(1), a(2), RSS-134 4.4.1 (a), (b), 4.4.2 (a), (b)

Table 7.5.2-1: Field Strength of Spurious Emissions – 930.5 MHz – mPass 10kHz

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
2791.5	69.5	H	-29.97	-13.00	16.97
3722	72.9	H	-22.20	-13.00	9.20
4652.5	51.1	H	-42.65	-13.00	29.65
5583	55.2	H	-38.34	-13.00	25.34
6513.5	48.9	H	-43.48	-13.00	30.48
7444	40.1	H	-56.89	-13.00	43.89

NOTE: All frequencies not listed were greater than 20dB below the limit.

Table 7.5.2-2: Field Strength of Spurious Emissions – 940.5 MHz – mPass 10kHz

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
2821.5	83.2	H	-16.18	-13.00	3.18
3762	63.4	H	-32.39	-13.00	19.39
4702.5	60	H	-32.87	-13.00	19.87
5643	48.4	H	-46.35	-13.00	33.35
6583.5	47.4	H	-45.37	-13.00	32.37
7524	47	H	-42.84	-13.00	29.84

NOTE: All frequencies not listed were greater than 20dB below the limit.

Part 101.111a(5) & a(6), RSS-119 5.8.6

Table 7.5.2-3: Field Strength of Spurious Emissions – 941.25 MHz – mPass 10kHz

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1882.5	42.1	V	-67.19	-13.00	54.19
2823.75	82.9	V	-16.38	-13.00	3.38
3765	60.6	H	-35.19	-13.00	22.19
4706.25	60.4	H	-32.68	-13.00	19.68
5647.5	47	H	-48.15	-13.00	35.15
6588.75	44.9	H	-49.18	-13.00	36.18
7530	42.8	H	-49.43	-13.00	36.43

NOTE: All frequencies not listed were greater than 20dB below the limit.

Table 7.5.2-4: Field Strength of Spurious Emissions – 952.5 MHz – mPass 10kHz

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1905	45.4	H	-60.91	-13.00	47.91
2857.5	82.8	H	-16.80	-13.00	3.80
3810	57.7	H	-38.18	-13.00	25.18
4762.5	58.2	H	-35.41	-13.00	22.41
6667.5	45.8	H	-48.88	-13.00	35.88
7620	44.8	V	-48.85	-13.00	35.85
8572.5	46.7	V	-41.30	-13.00	28.30

NOTE: All frequencies not listed were greater than 20dB below the limit.

Table 7.5.2-5: Field Strength of Spurious Emissions – 959.925 MHz – mPass 10kHz

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
2879.775	86	H	-13.51	-13.00	0.51
3839.7	56.6	H	-39.37	-13.00	26.37
4799.625	63.5	H	-29.70	-13.00	16.70
6719.475	50.2	H	-42.64	-13.00	29.64
7679.4	58.5	V	-31.70	-13.00	18.70
8639.325	54.2	H	-32.81	-13.00	19.81

NOTE: All frequencies not listed were greater than 20dB below the limit.

Figure 7.5.2-1: 30MHz to 1GHz Emission Profile – 940MHz

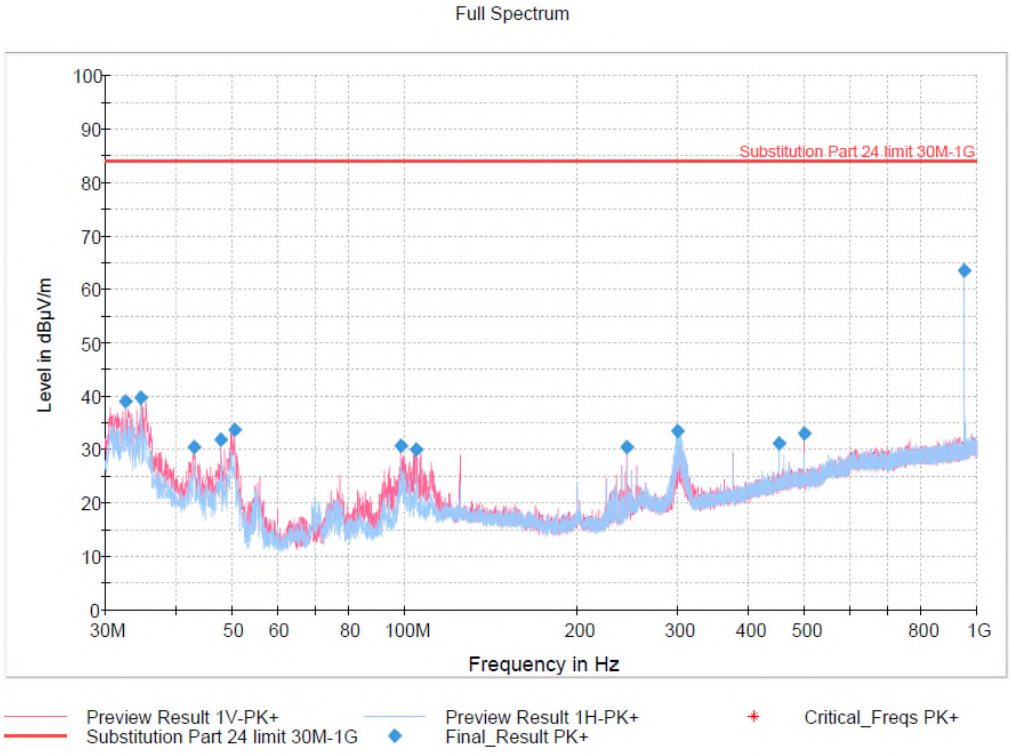
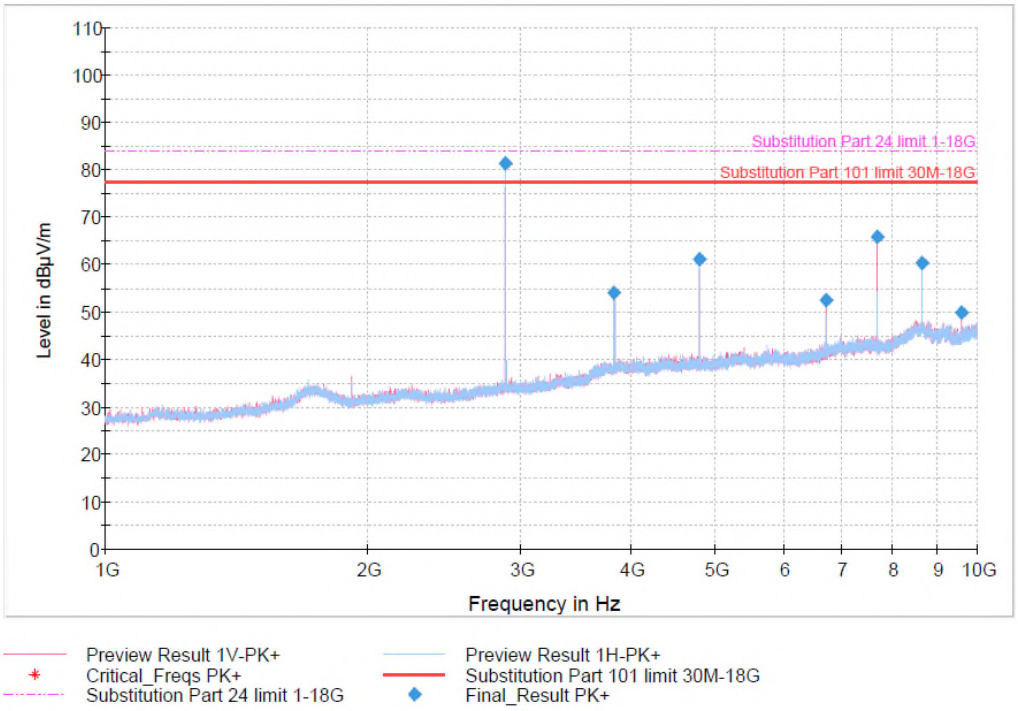


Figure 7.5.2-2: 1GHz to 10GHz Emission Profile – 940MHz



7.6 Frequency Stability

7.6.1 Measurement Procedure (ANSI C63.26 Section 5.6.3)

The equipment under test is placed inside an environmental chamber. The RF output is directly coupled to the input of the measurement equipment and a power supply is attached to the primary supply voltage.

Frequency measurements were made at the extremes of the of temperature range -30º C to +50º C and at intervals of 10º C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. The equipment operates at 12VDC. Measurements were made to the equipment under test at a temperature of 20º C and at 85% and 115% variation of 12VDC. The maximum variation of frequency was recorded.

7.6.2 Measurement Results
Performed by: Chris Gormley

Part 24.135, RSS-134 (4.5)

Frequency Stability

Frequency (MHz): 930.5
Deviation Limit (PPM): 1.0

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**930.499657**	**-0.369**	100%	12.00
-20 C	**930.499841**	**-0.171**	100%	12.00
-10 C	**930.499886**	**-0.123**	100%	12.00
0 C	**930.499954**	**-0.049**	100%	12.00
10 C	**930.499921**	**-0.085**	100%	12.00
20 C	**930.499740**	**-0.279**	100%	12.00
30 C	**930.499981**	**-0.020**	100%	12.00
40 C	**930.500006**	**0.006**	100%	12.00
50 C	**930.499955**	**-0.048**	100%	12.00
20 C	**930.499987**	**-0.014**	85%	10.20
20 C	**930.500021**	**0.023**	115%	13.80

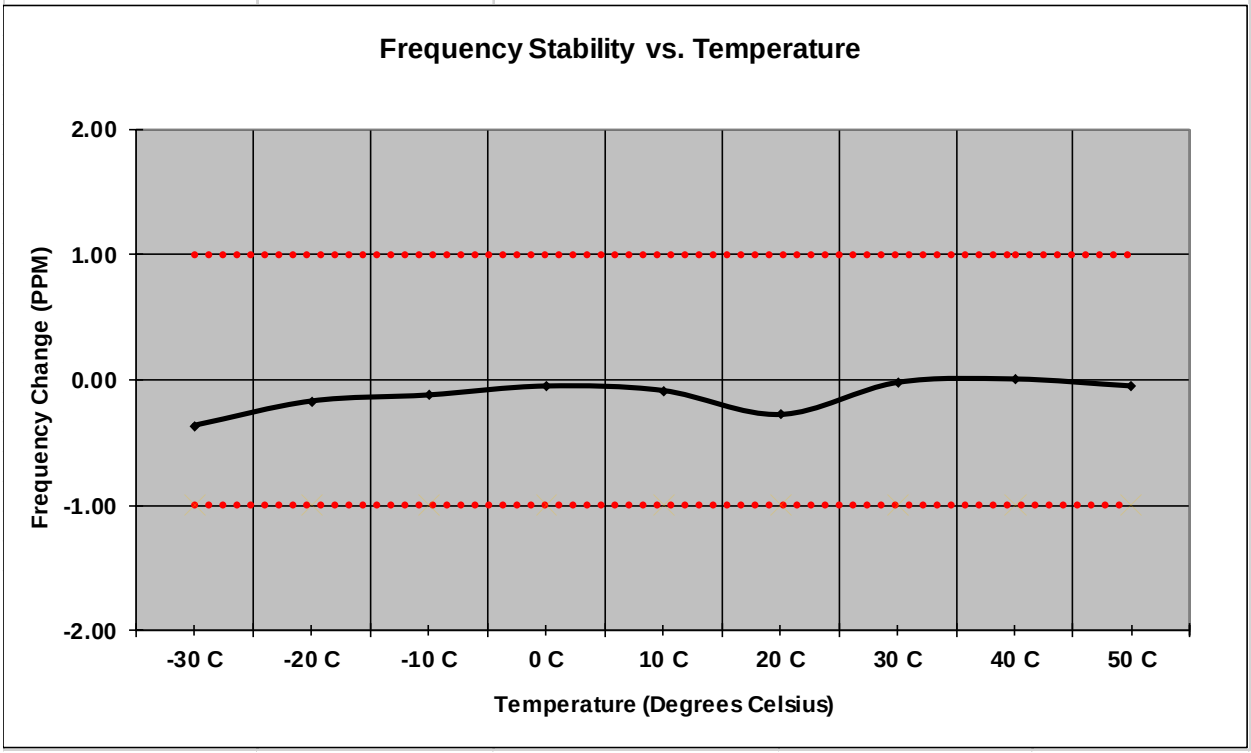


Figure 7.6.2-1: Frequency Stability – 930.5 MHz

Frequency Stability

Frequency (MHz): 940.5

Deviation Limit (PPM): 1.0

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**940.499735**	**-0.282**	100%	12.00
-20 C	**940.499789**	**-0.224**	100%	12.00
-10 C	**940.499973**	**-0.029**	100%	12.00
0 C	**940.499914**	**-0.091**	100%	12.00
10 C	**940.499925**	**-0.080**	100%	12.00
20 C	**940.500002**	**0.002**	100%	12.00
30 C	**940.499991**	**-0.010**	100%	12.00
40 C	**940.500002**	**0.002**	100%	12.00
50 C	**940.499948**	**-0.055**	100%	12.00
20 C	**940.499998**	**-0.002**	85%	10.20
20 C	**940.499982**	**-0.019**	115%	13.80

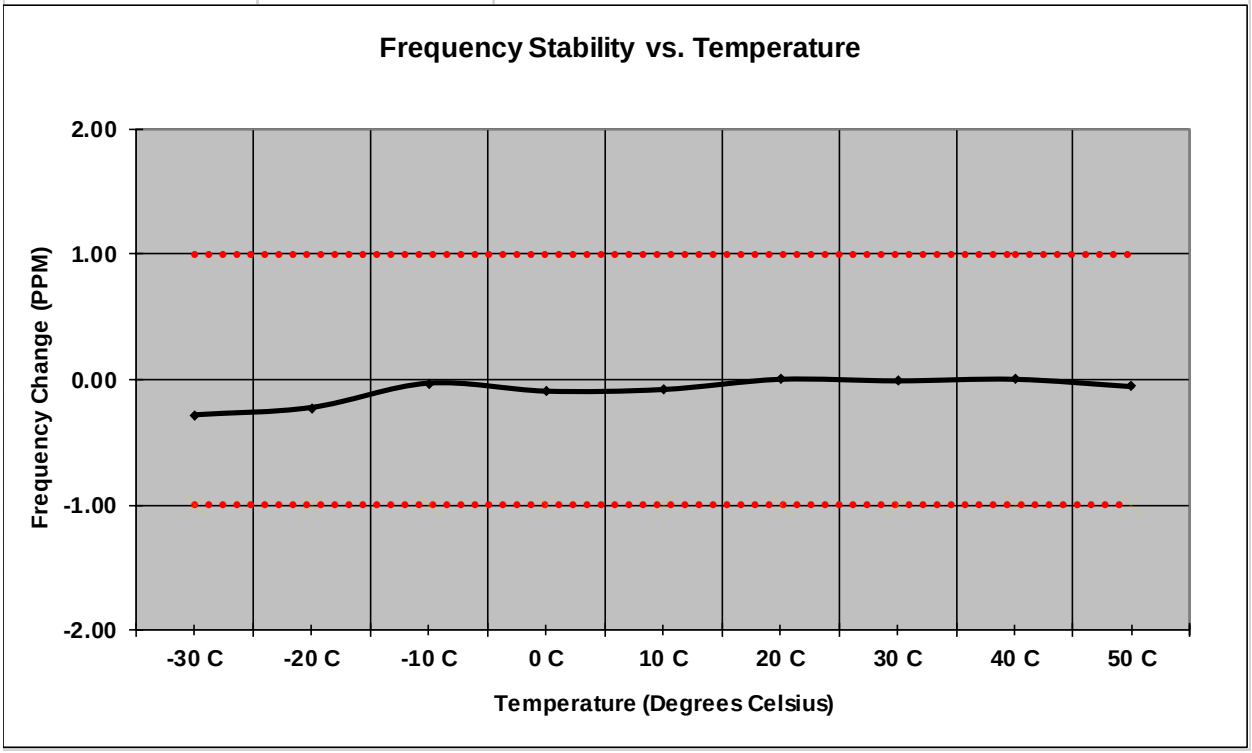


Figure 7.6.2-2: Frequency Stability – 940.5 MHz

Part 101.107, RSS-119 5.3

Frequency Stability

Frequency (MHz): 941.25

Deviation Limit (PPM): 1.0

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**941.249809**	**-0.203**	100%	12.00
-20 C	**941.249804**	**-0.208**	100%	12.00
-10 C	**941.249991**	**-0.010**	100%	12.00
0 C	**941.249930**	**-0.074**	100%	12.00
10 C	**941.249944**	**-0.059**	100%	12.00
20 C	**941.250003**	**0.003**	100%	12.00
30 C	**941.250010**	**0.011**	100%	12.00
40 C	**941.250007**	**0.007**	100%	12.00
50 C	**941.249960**	**-0.042**	100%	12.00
20 C	**941.250009**	**0.010**	85%	10.20
20 C	**941.250007**	**0.007**	115%	13.80

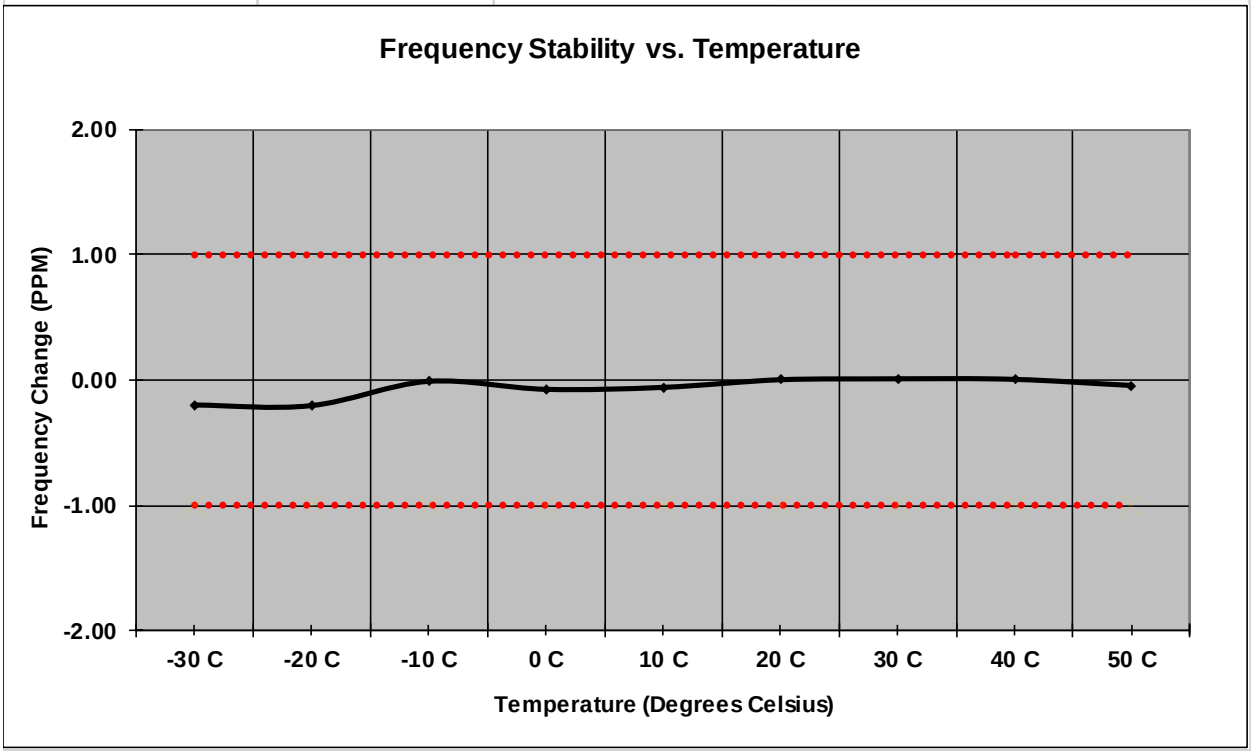


Figure 7.6.2-3: Frequency Stability – 941.25 MHz

Frequency Stability

Frequency (MHz): 952.5

Deviation Limit (PPM): 1.0

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**952.499784**	**-0.227**	100%	12.00
-20 C	**952.499745**	**-0.268**	100%	12.00
-10 C	**952.499996**	**-0.004**	100%	12.00
0 C	**952.499944**	**-0.059**	100%	12.00
10 C	**952.499962**	**-0.040**	100%	12.00
20 C	**952.500013**	**0.014**	100%	12.00
30 C	**952.500015**	**0.016**	100%	12.00
40 C	**952.499985**	**-0.016**	100%	12.00
50 C	**952.499957**	**-0.045**	100%	12.00
20 C	**952.500008**	**0.008**	85%	10.20
20 C	**952.500003**	**0.003**	115%	13.80

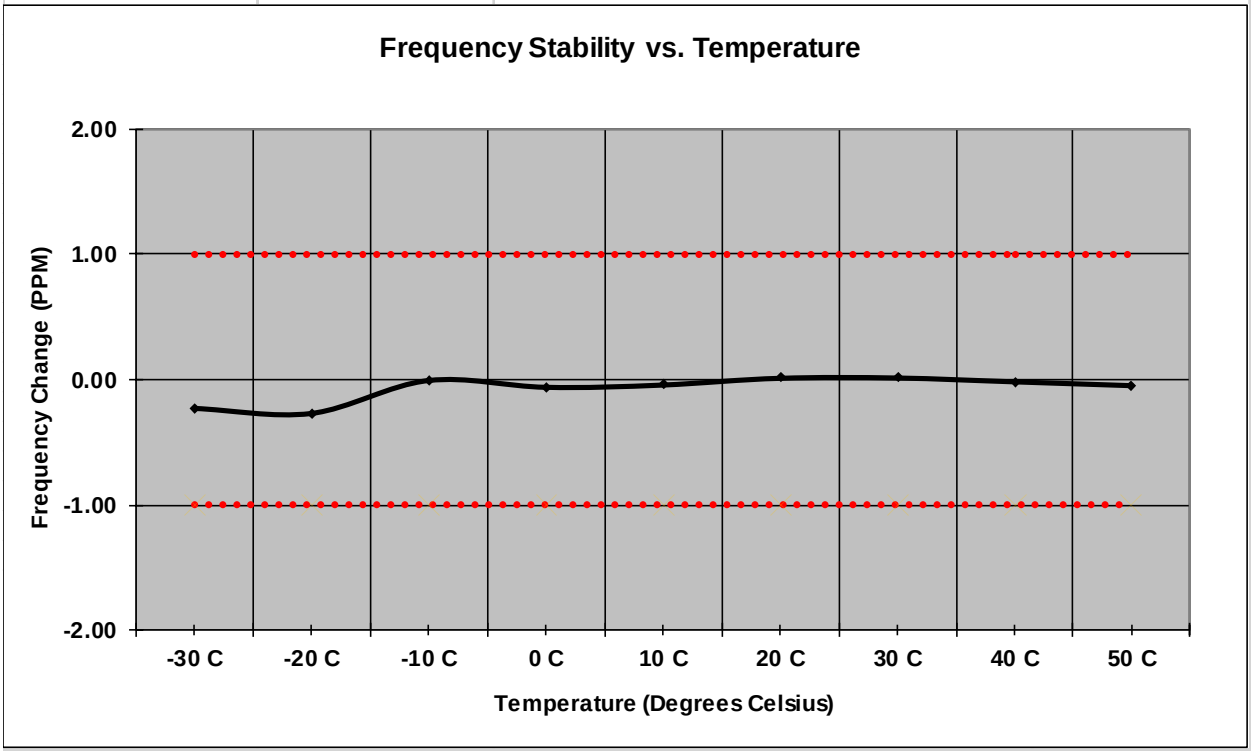


Figure 7.6.2-4: Frequency Stability – 952.5 MHz

Frequency Stability

Frequency (MHz): 959.925

Deviation Limit (PPM): 1.0

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**959.924782**	**-0.227**	100%	12.00
-20 C	**959.924742**	**-0.269**	100%	12.00
-10 C	**959.924988**	**-0.013**	100%	12.00
0 C	**959.924960**	**-0.042**	100%	12.00
10 C	**959.924962**	**-0.040**	100%	12.00
20 C	**959.924947**	**-0.055**	100%	12.00
30 C	**959.925034**	**0.035**	100%	12.00
40 C	**959.924913**	**-0.091**	100%	12.00
50 C	**959.924962**	**-0.040**	100%	12.00
20 C	**959.924978**	**-0.023**	85%	10.20
20 C	**959.924989**	**-0.011**	115%	13.80

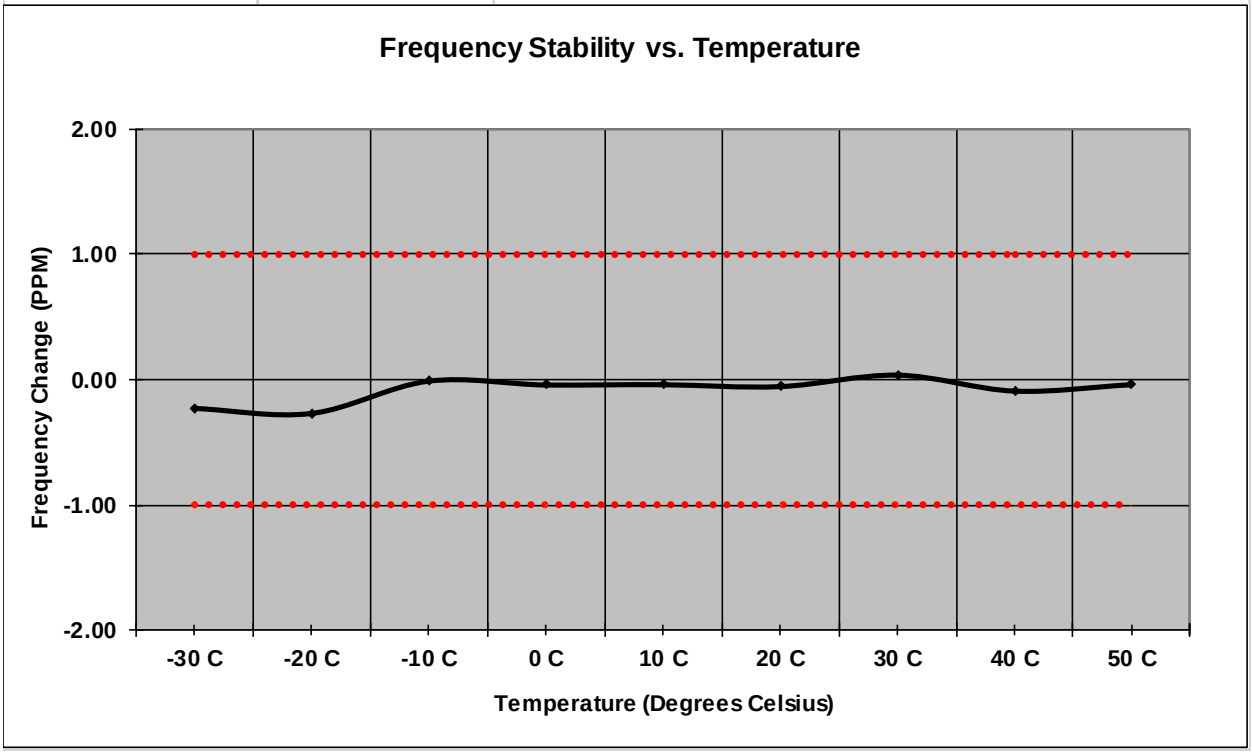


Figure 7.6.2-5: Frequency Stability – 959.925 MHz

8.0 MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Parameter	U_{lab}
Occupied Channel Bandwidth	**± 0.004%**
RF Conducted Output Power	**± 0.689 dB**
Power Spectral Density	**±0.5 dB**
Antenna Port Conducted Emissions	**± 2.717 dB**
Radiated Emissions	**± 5.877 dB**
Temperature	**± 0.860 °C**
Radio Frequency	**±2.832 x 10-8**
AC Power Line Conducted Emissions	**±2.85**

9.0 CONCLUSION

In the opinion of TÜV SÜD America Inc. the model VGBM4700, manufactured by Sensus USA, Inc., meets all the requirements of FCC Part 24D, Part 101, and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-119/134 for the tests documented in this test report.

End Report