Certification Test Report

FCC ID: SDBEZL01
IC: 2220A-EZL01

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

TÜV SÜD Report Number: RD72131354.100

Applicant: Sensus Metering Systems, Inc.
Model: 5396390010002

Test Begin Date: September 27, 2017
Test End Date: October 5, 2017

Report Issue Date: October 10, 2017

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

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

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This report contains 31 pages

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1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 24 Subpart D of the FCC's Code of Federal Regulations, and ISED Canada Radio Standards Specification RSS-134 for a Class II permissive change to add a new model number 5396390010002.

The present evaluation covers the 930-931 MHz band of the Easylink model variant which integrates a 930MHz-942 MHz passive duplexer, the 930-931 MHz band being added to the original filing according to a class II permissive change. The 940-941.5 MHz band showed no degradation and the data in the original filing is representative of the new model.

1.2 Product Description

The EasyLink is a Full Duplex Capable XCVR intended for use in drive-by applications. The device is intended to extend the capabilities of the existing Flexnet VGB to allow reading of Itron ERT endpoints. The device incorporates a Flexnet Collector and a ERT Collector into a single enclosure. The device also contains a pre-approved Bluetooth transceiver, FCC ID: T9J-RN42.

Flexnet Antenna: OMNI PCTEL MUF9115 / 3.41dBi
ERT Antenna: OMNI Laird B8965CN / 3dBi
Minimum antenna cable length: 12 Ft

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

Test Sample Serial Numbers: EZ117 (MAC ID: 0006667F1D32)

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 all modulation types. Where applicable, data is provided for the unit having the worst-case emissions.

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

The FLEXNET 900MHz transceiver and the ERT transceiver are capable of simultaneous transmission. Therefore, an investigation of the intermodulation products has been performed and the results meet the requirements.

The present evaluation covers the 930-931 MHz band of the Easylink model variant which integrates a 930MHz-942 MHz passive duplexer, the 930-931 MHz band being added to the original filing according to a class II permissive change. The 940-941.5 MHz band showed no degradation and the data in the original filing is representative of the new model.

1.3.2 In-Band Testing Methodology

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.
24D	930.0 - 931.0	1 in middle	930.5

1.4 Emission Designators

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

EMISSIONS DESIGNATORS

Mode	Emission Designator	Modulation
MPass 4-FSK (10 kbps)	8K75F1D	4-FSK
MPass 4-FSK (20 kbps)	17K5F1D	4-FSK
MPass 2-FSK (12.5 kbps)	14K8F1D	2-FSK
MPass 2-FSK (5 kbps)	5K90F1D	2-FSK
MPass 2-FSK (10 kbps)	11K8F1D	2-FSK

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 Registered Test Site Number: 637011
ISED Canada Test Site Registration Number: 20446

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. (Durham) is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board/ANAB accreditation program, and has been issued certificate number AT-1921 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:

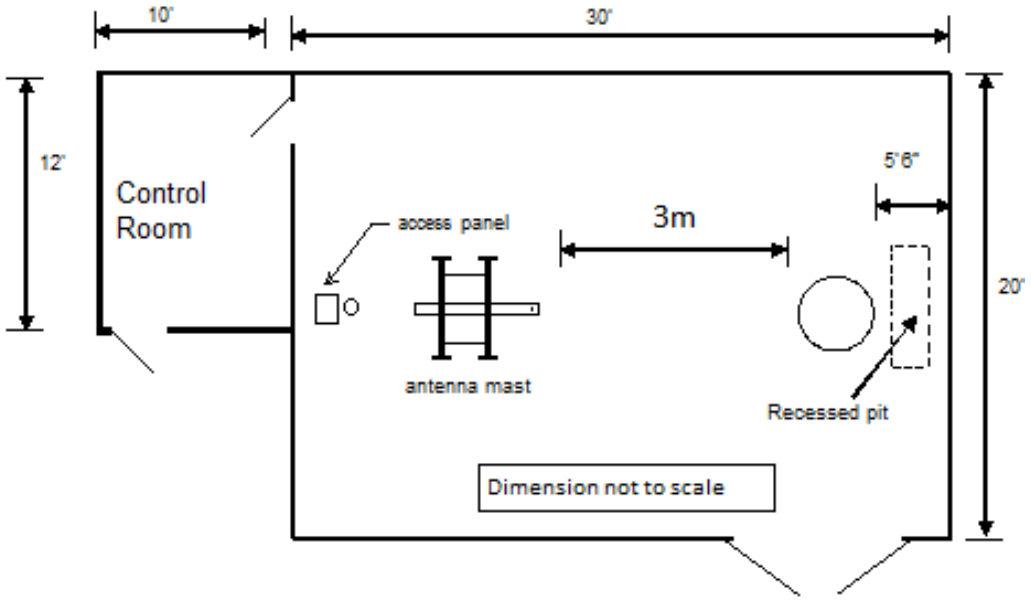

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 10' sheet galvanized steel horizontal ground reference plane (GRP) bonded every 6" to an 8' X 8' aluminum vertical ground plane.

A diagram of the room is shown below in figure 2.3.2-1:

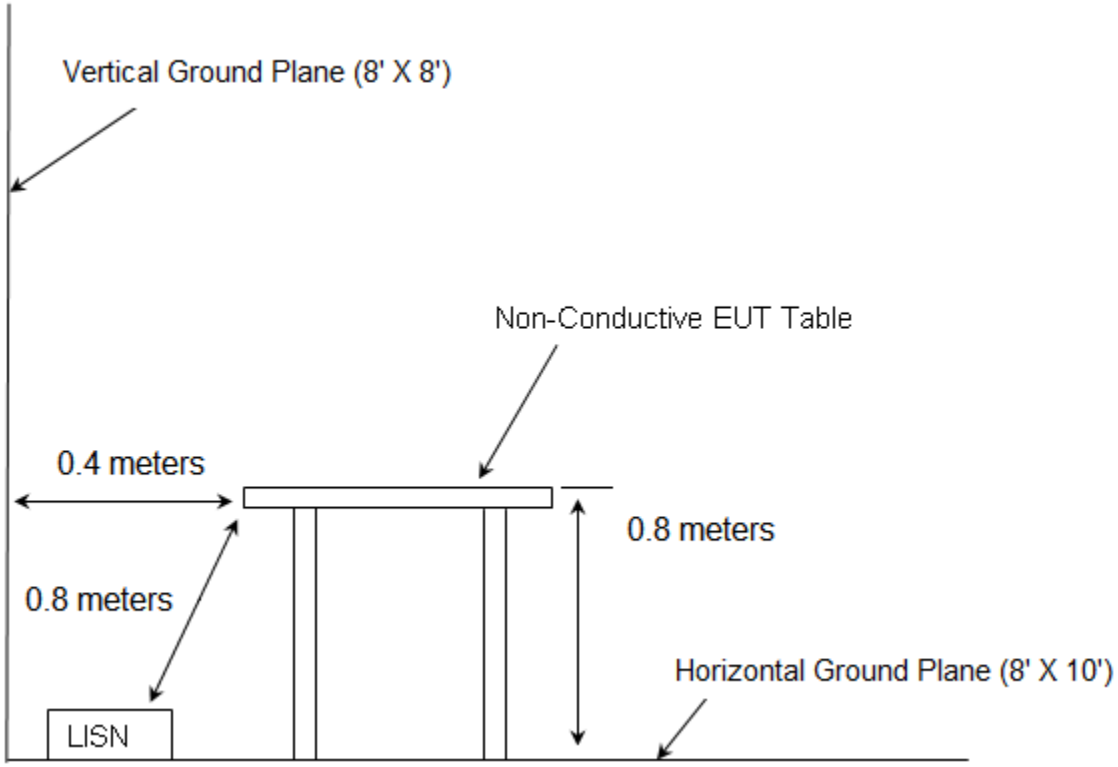

Figure 2.3.2-1: AC Mains Conducted EMI Site

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 - 2017
- US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communications Services – 2017
- 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 4, November 2014.

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

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
277	EMCO	93146	Antennas	9904-5199	9/12/2016	9/12/2018
426	Thermotron	S-8 Mini Max	Environmental Chamber	25-2888-10	7/14/2017	1/14/2018
626	EMCO	3110B	Antennas	9411-1945	3/21/2017	3/21/2019
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	1/11/2017	1/11/2018
3008	Rohde & Schwarz	NRP2	Meter	103131	2/6/2017	2/6/2018
3009	Rohde & Schwarz	NRP-Z81	Meter	102397	2/6/2017	2/6/2018
3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
3013	Agilent	53132A	Meters	MY40007729	1/11/2017	1/11/2018
3014	EMCO	3115	Antennas	9901-5653	3/3/2017	3/3/2019
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2018
3020	Rohde & Schwarz	SMB100A	Signal Generators	175943	1/10/2017	1/10/2018
3029	Micro-Tronics	HPM50108	Filter	134	1/13/2017	1/13/2018
3031	Hasco, Inc.	HLL335-S1-S1-96	Cables	3074	8/29/2017	8/29/2018
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/3/2017	1/3/2018
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/3/2017	1/3/2018
3042	Aeroflex Inmet	18N10W-10	Attenuator	1444	1/16/2017	1/16/2018
3045	Aeroflex Inmet	18N10W-20	Attenuator	1437	1/3/2017	1/3/2018
3054	Mountain View Cable	BMS-RG400-36.0-BMS	Cables	3054	1/3/2017	1/3/2018
3055	Rohde & Schwarz	3005	Cables	3055	1/3/2017	1/3/2018
3060	Weinschel Corp.	47-20-33	Attenuator	BJ0583	9/2/2015	9/2/2018
3072	ACS	3072	Electronic Load	ACS1	NCR	NCR
3073	ACS	3073	Electronic Load	ACS2	NCR	NCR
3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	6/9/2017	6/9/2018

NCR = No Calibration Required
Asset 3012: Software Version: EMC32-B is 9.15
Asset 3020: Firmware Rev: 2.20.382.113
Asset 3085: Instrument Firmware 2.41 SP1

5.0 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Sensus	EASYLINK	EZ-117
2	Power Supply	Bk Precision	1694	258C12210

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Power	2.1 m	No	1 to 2
B	Power cord	1.8 m	No	2 to AC Mains

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

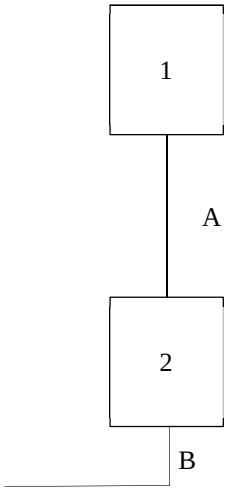

Figure 6-1: EUT Test Setup

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 39.9dB of passive attenuation. The results are shown below.

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

7.1.2 Measurement Results

Performed by: Jean Tezil

Table 7.1.2-1: Peak Output Power - FlexNet

FCC Rule Part	Frequency (MHz)	Output Power High (dBm)	Output Power High (Watts)	Output Power Low (dBm)	Output Power Low (Watts)
24D	930.5	36.15	4.12	31.44	1.39

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 40dB of passive attenuation. The spectrum analyzer resolution and video bandwidths were set to 300 Hz and 3000 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: Jean Tezil

HIGH POWER

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

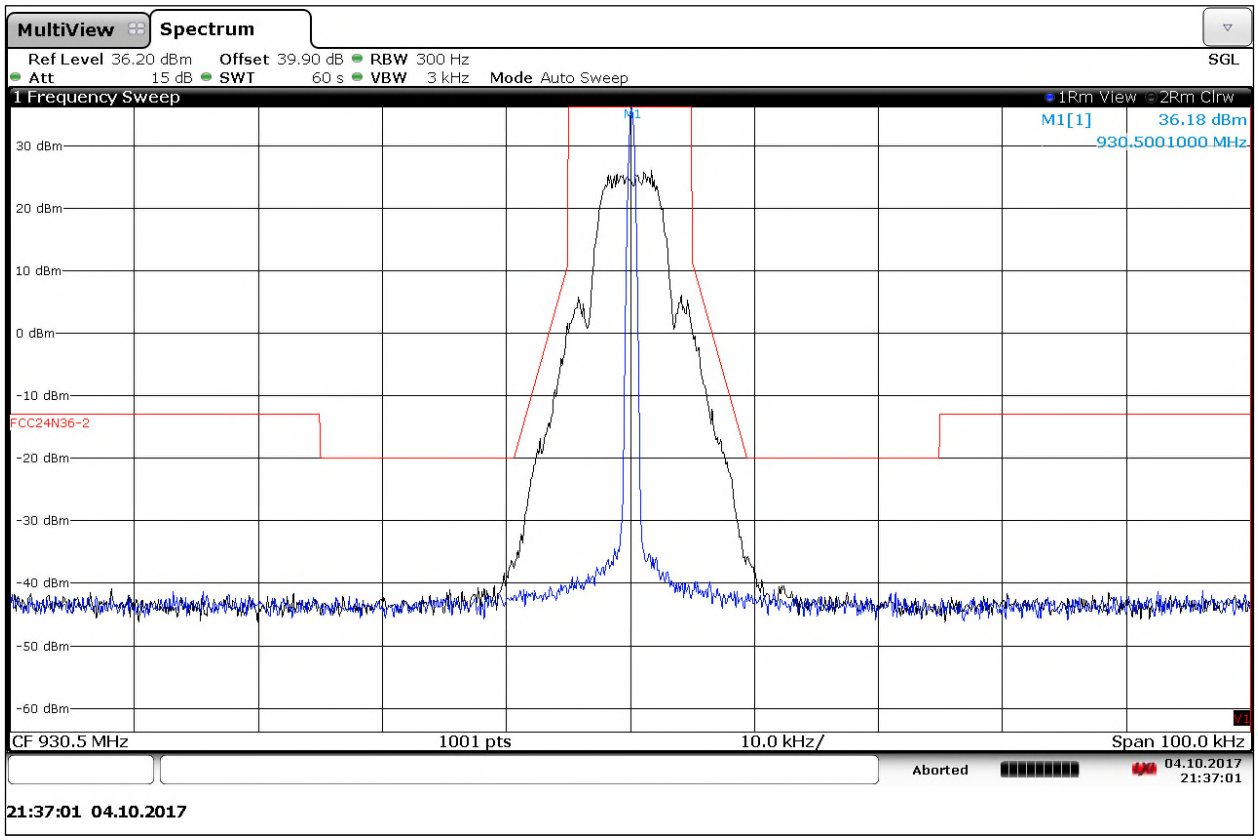

Figure 7.2.2-1: 930.5 MHz – 12.5 kHz Channel Spacing – m2pass 5k Mode

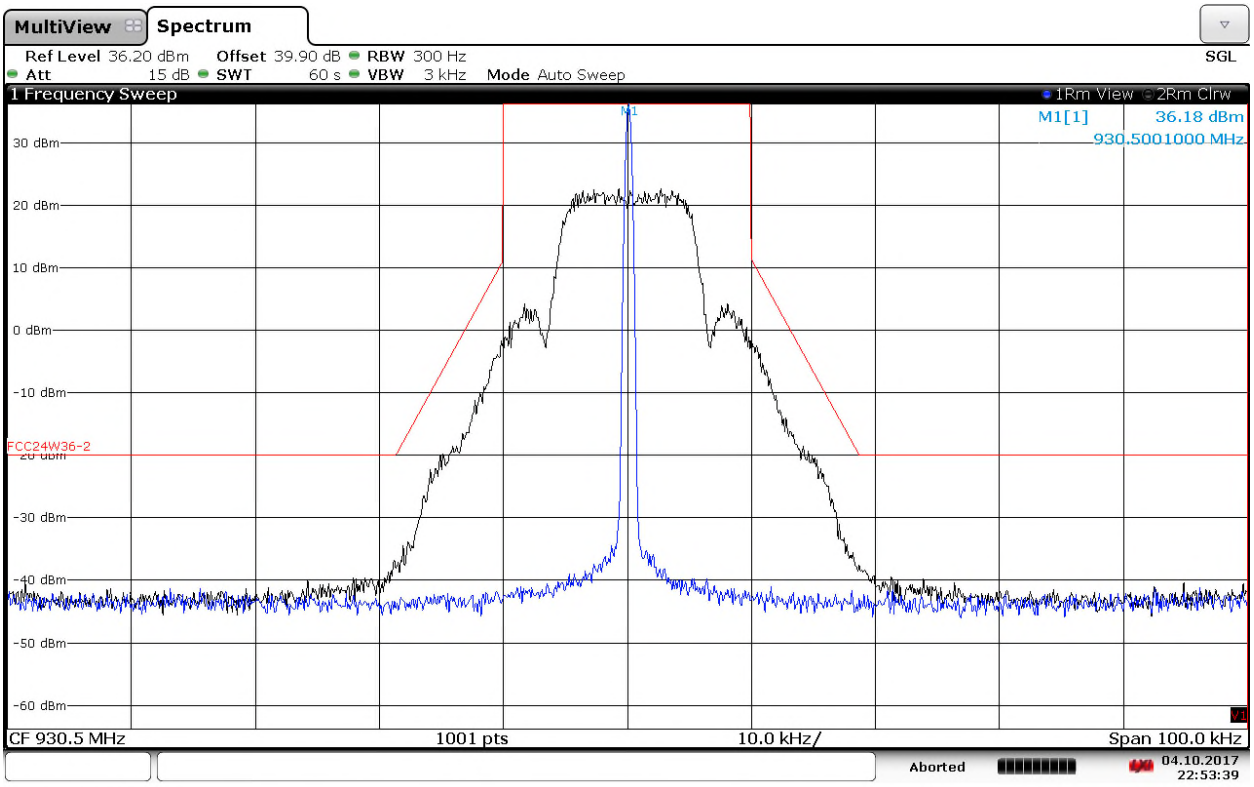

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Figure 7.2.2-2: 930.5 MHz – 25 kHz Channel Spacing – m2pass 10k Mode

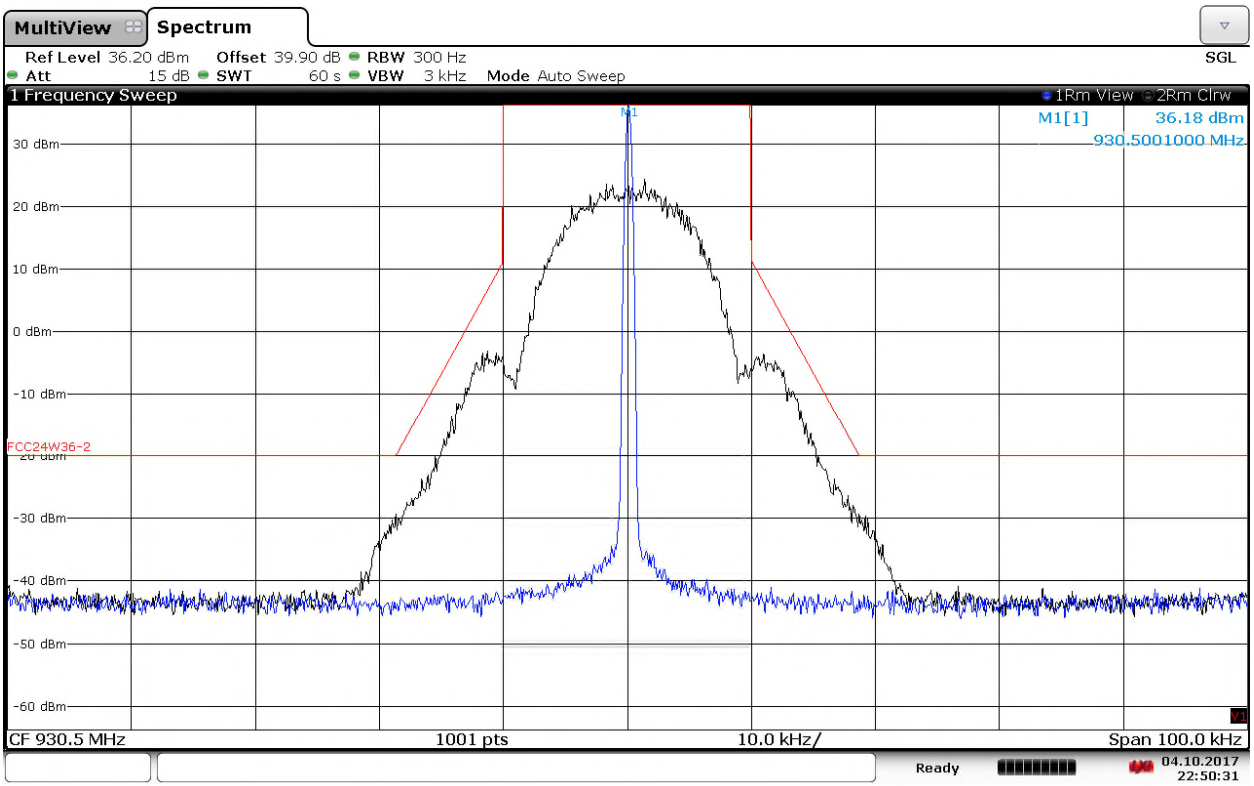

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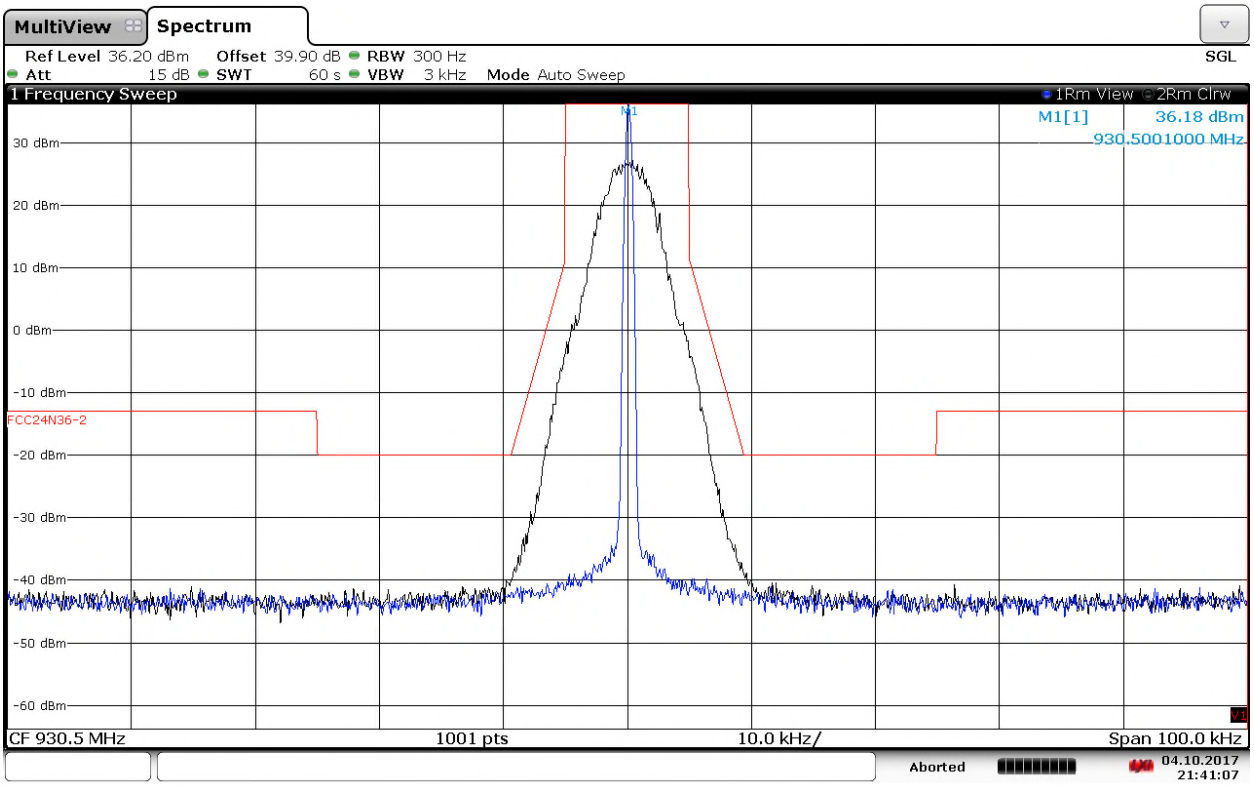
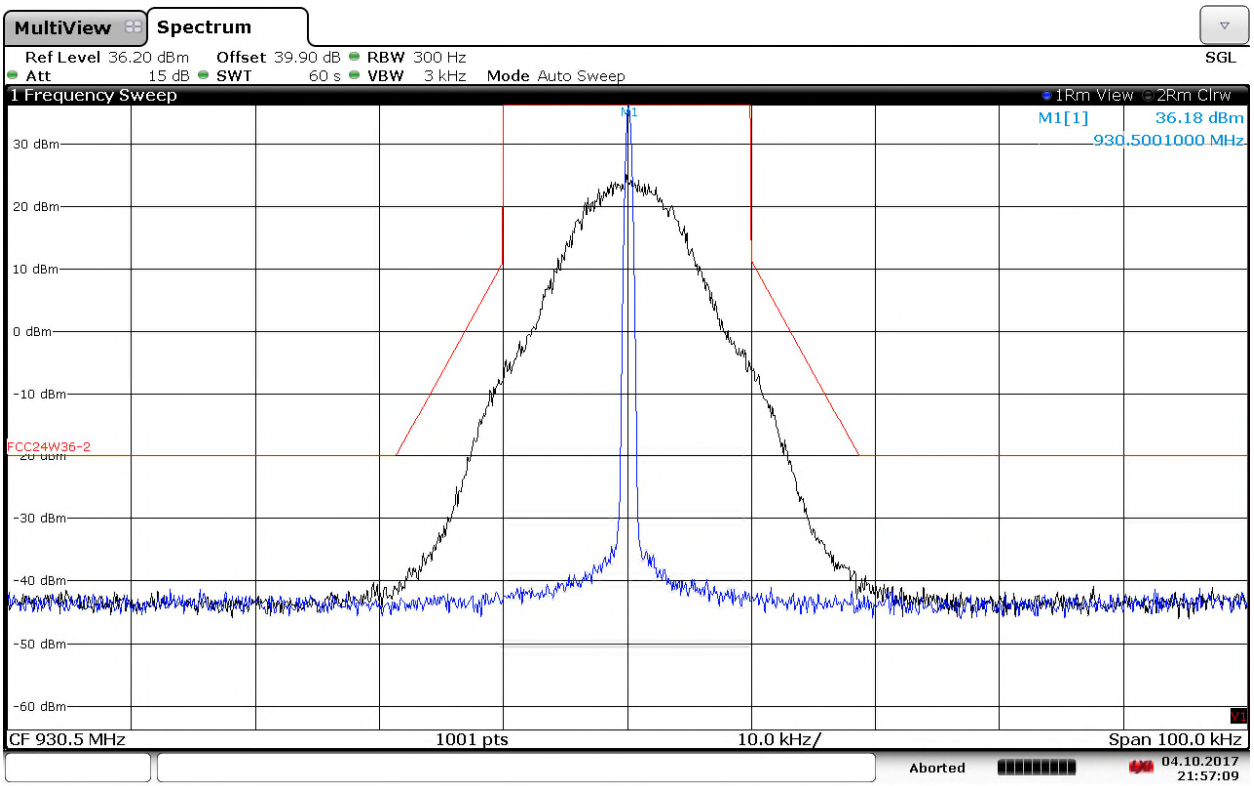
Figure 7.2.2-3: 930.5 MHz – 25 kHz Channel Spacing – m2pass 12.5k Mode



21:41:08 04.10.2017

Figure 7.2.2-4: 930.5 MHz – 12.5 kHz Channel Spacing – m4pass 10k Mode



21:57:09 04.10.2017

Figure 7.2.2-5: 930.5 MHz – 25 kHz Channel Spacing – m4pass 20k Mode

LOW POWER

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

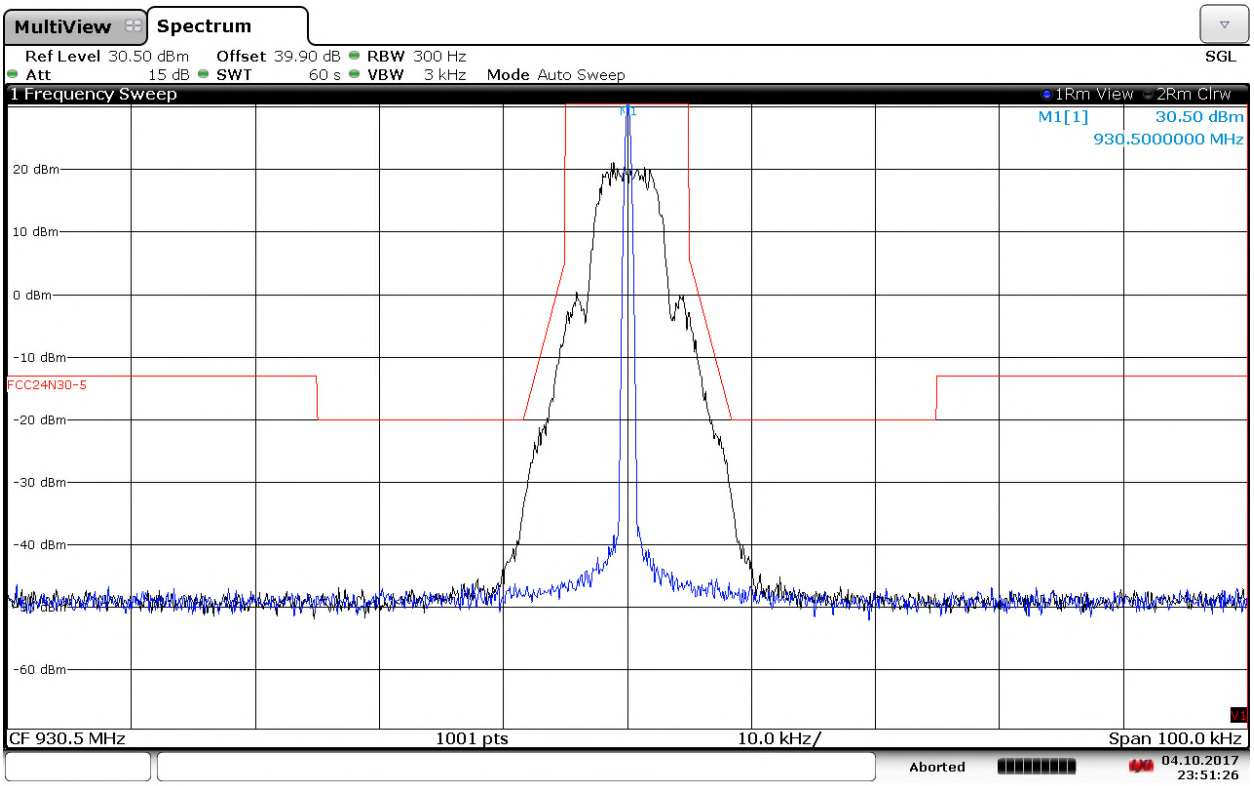


Figure 7.2.2-25: 930.5 MHz – 12.5 kHz Channel Spacing – m2pass 5k Mode

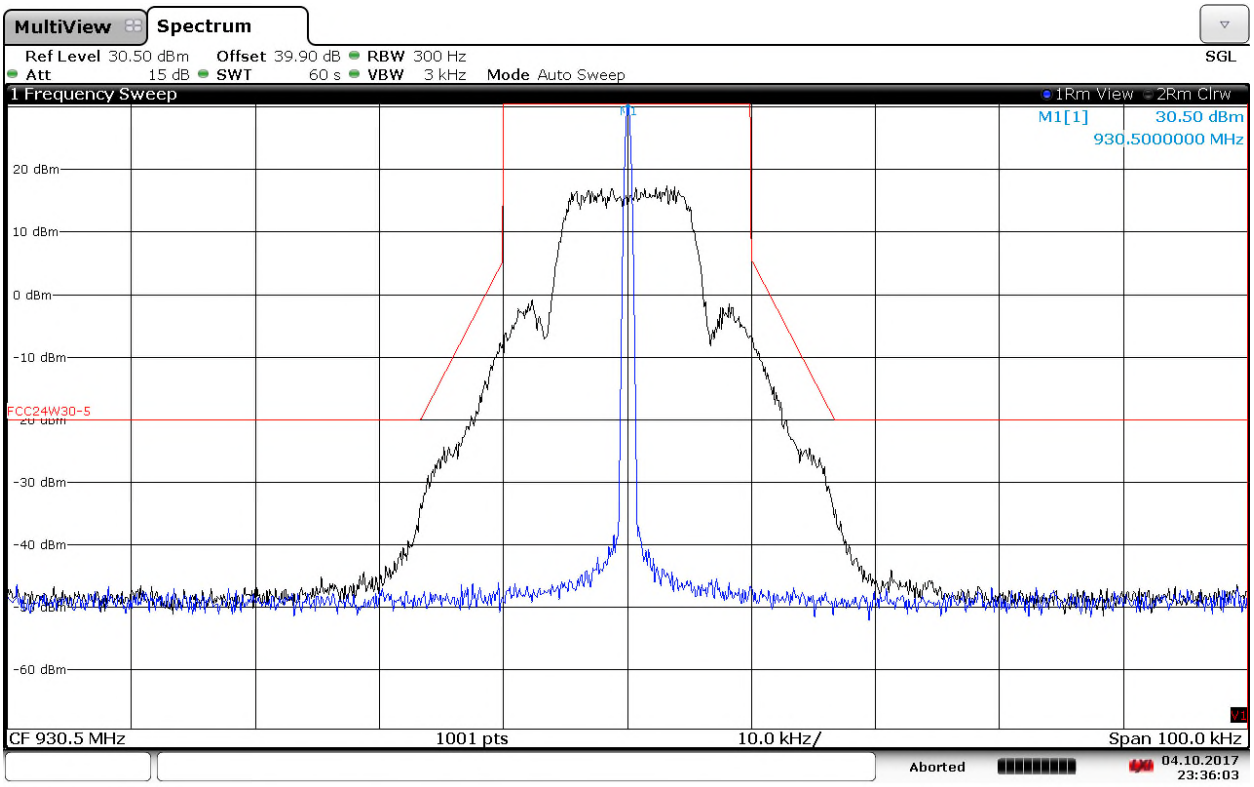


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Figure 7.2.2-26: 930.5 MHz – 25 kHz Channel Spacing – m2pass 10k Mode

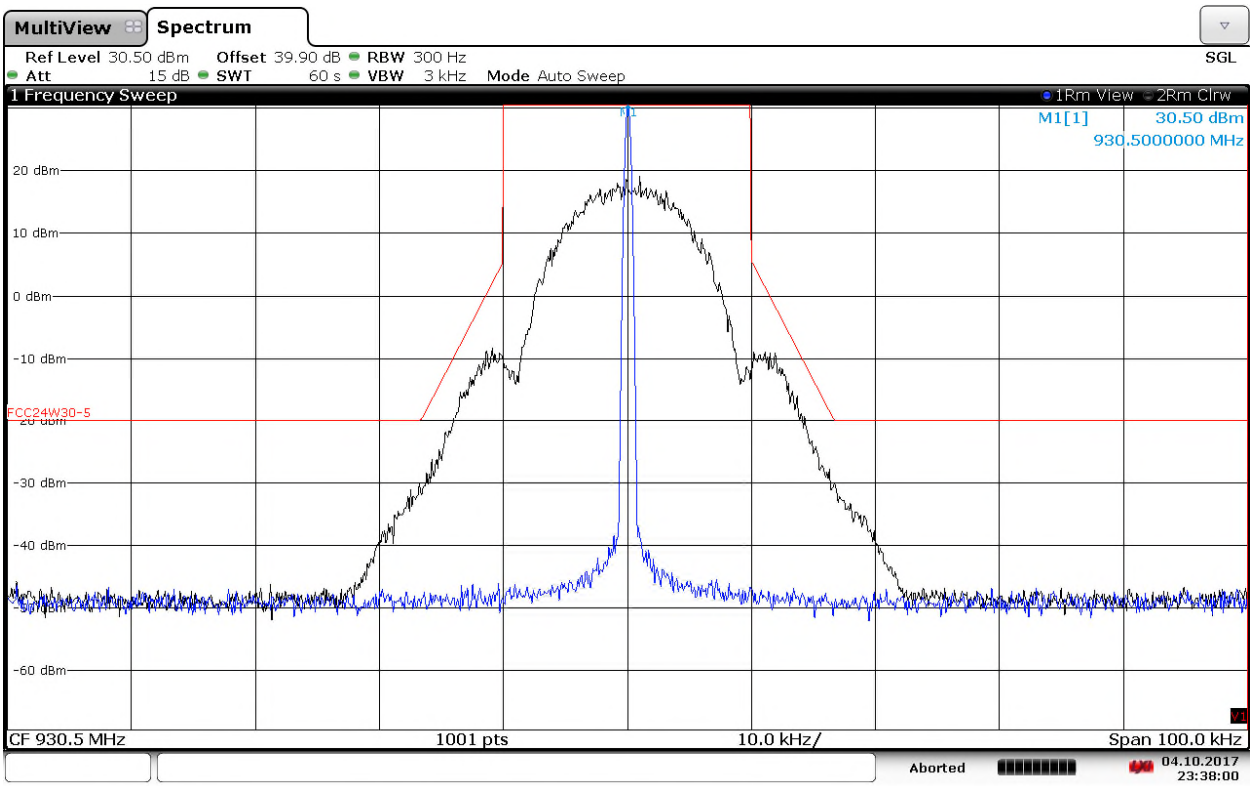

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Figure 7.2.2-27: 930.5 MHz – 25 kHz Channel Spacing – m2pass 12.5k Mode

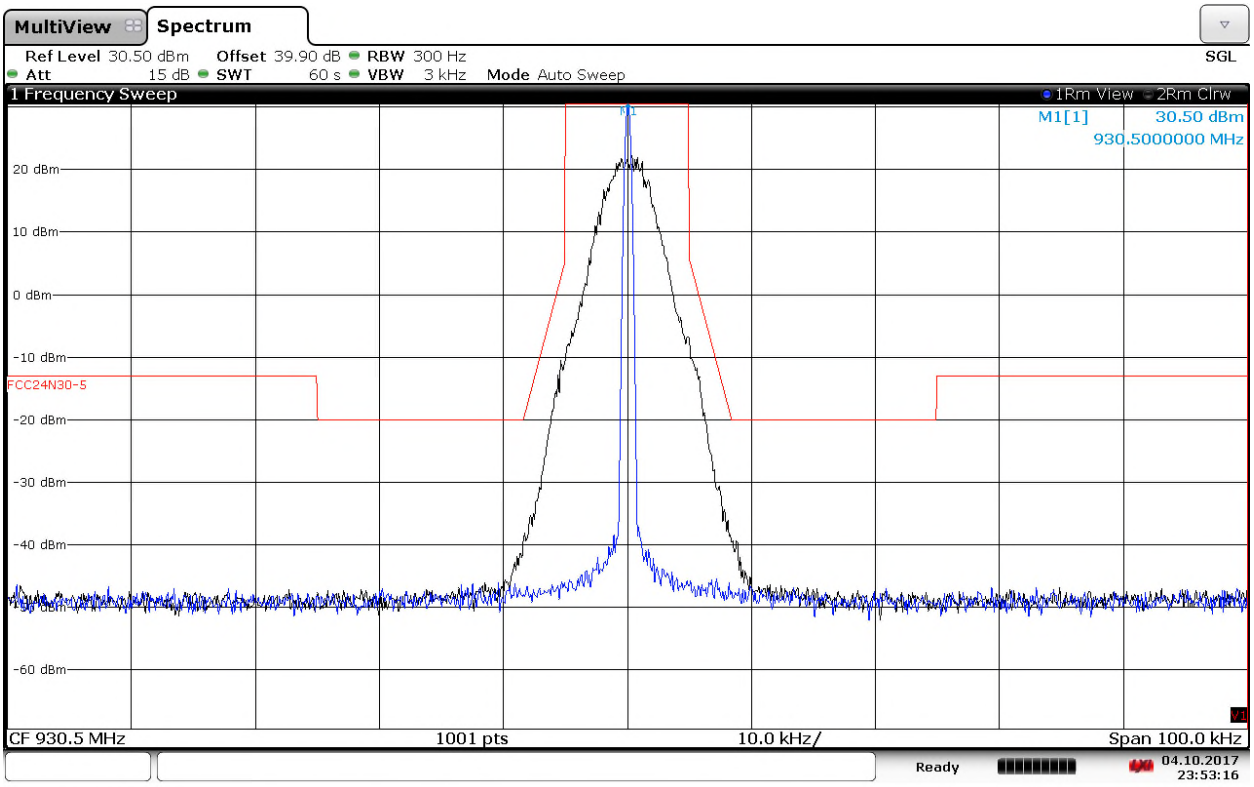

Figure 7.2.2-28: 930.5 MHz – 12.5 kHz Channel Spacing – m4pass 10k Mode

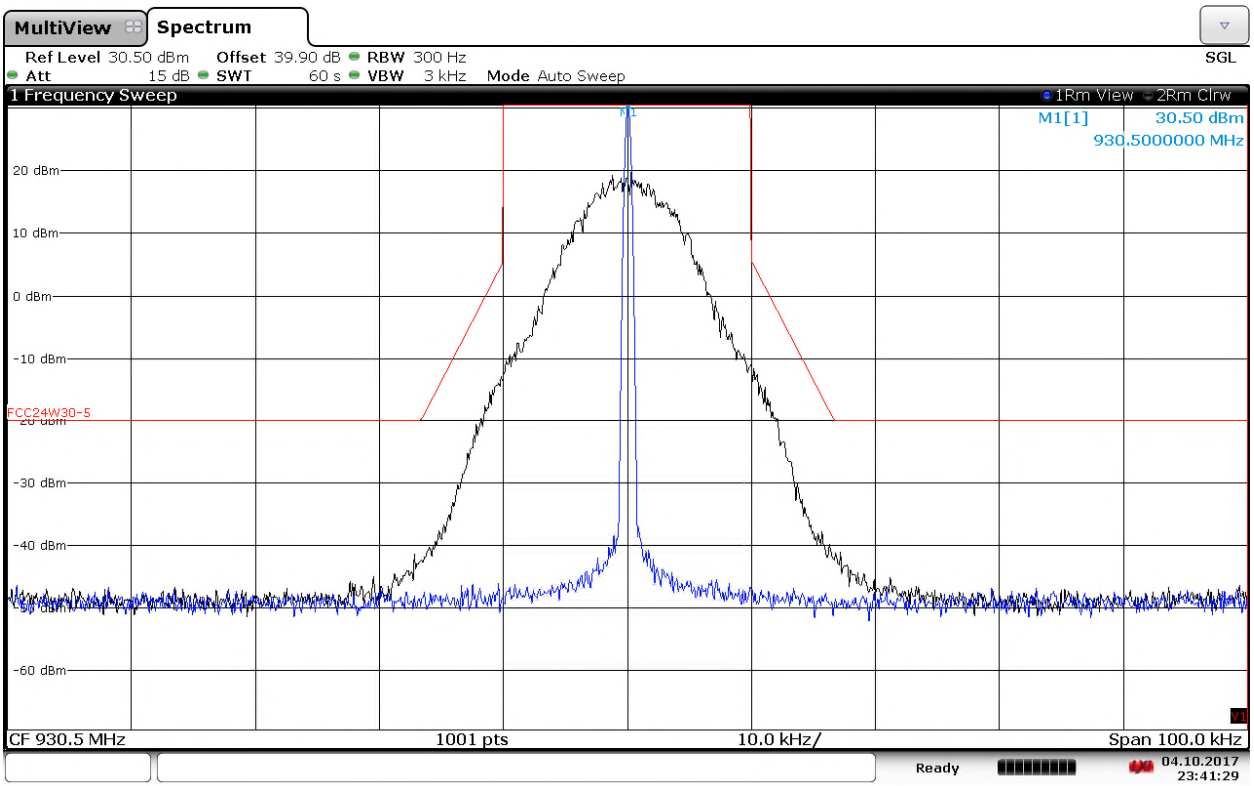

Figure 7.2.2-29: 930.5 MHz – 25 kHz Channel Spacing – m4pass 20k Mode

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 40dB 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: Jean Tezil

Frequency (MHz)	ISED Canada Rule Part	Mode of Operation	99% Bandwidth (kHz)
930.5	RSS-134	M2pass 5k	5.833
930.5	RSS-134	M2pass 10k	11.620
930.5	RSS-134	M2pass 12.5k	13.583
930.5	RSS-134	M4pass 10k	6.073
930.5	RSS-134	M4pass 20k	12.071

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

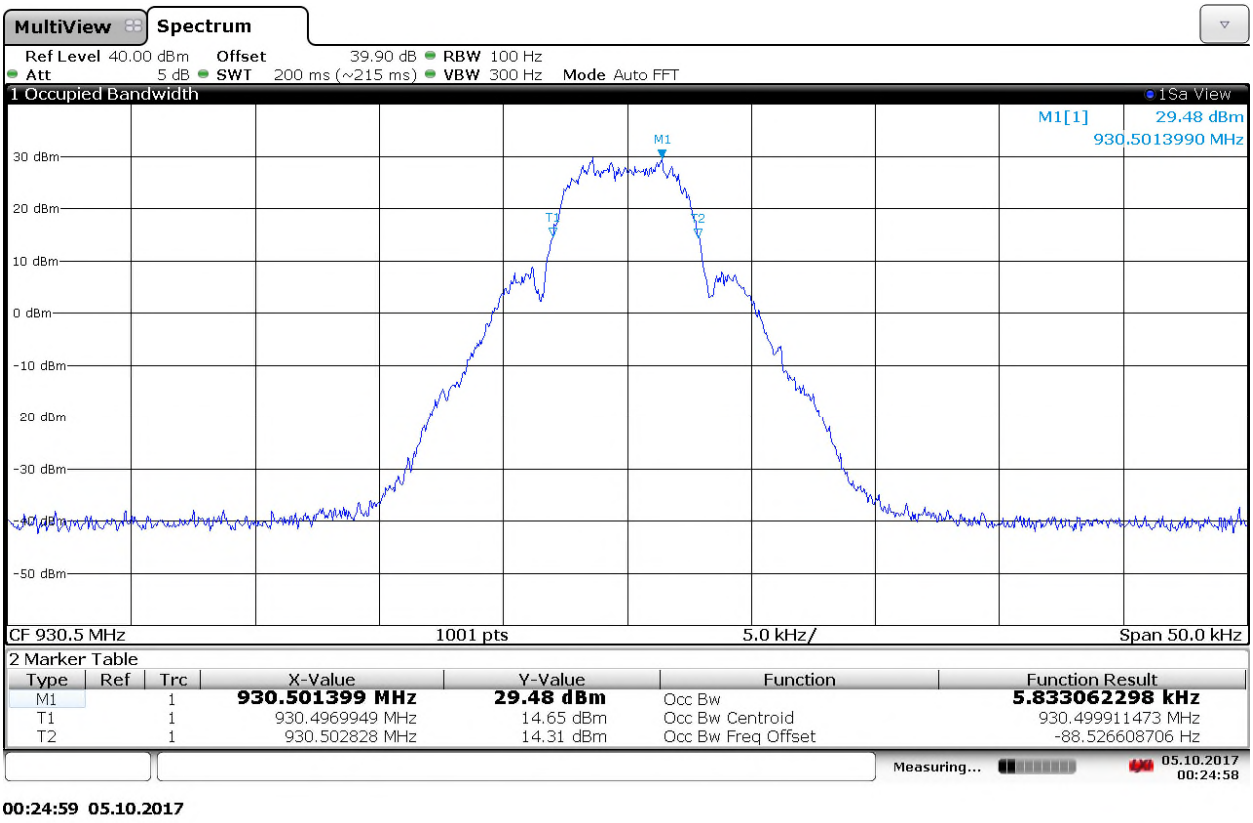

Figure 7.3.2-1: 930.5 MHz – M2pass 5k Mode

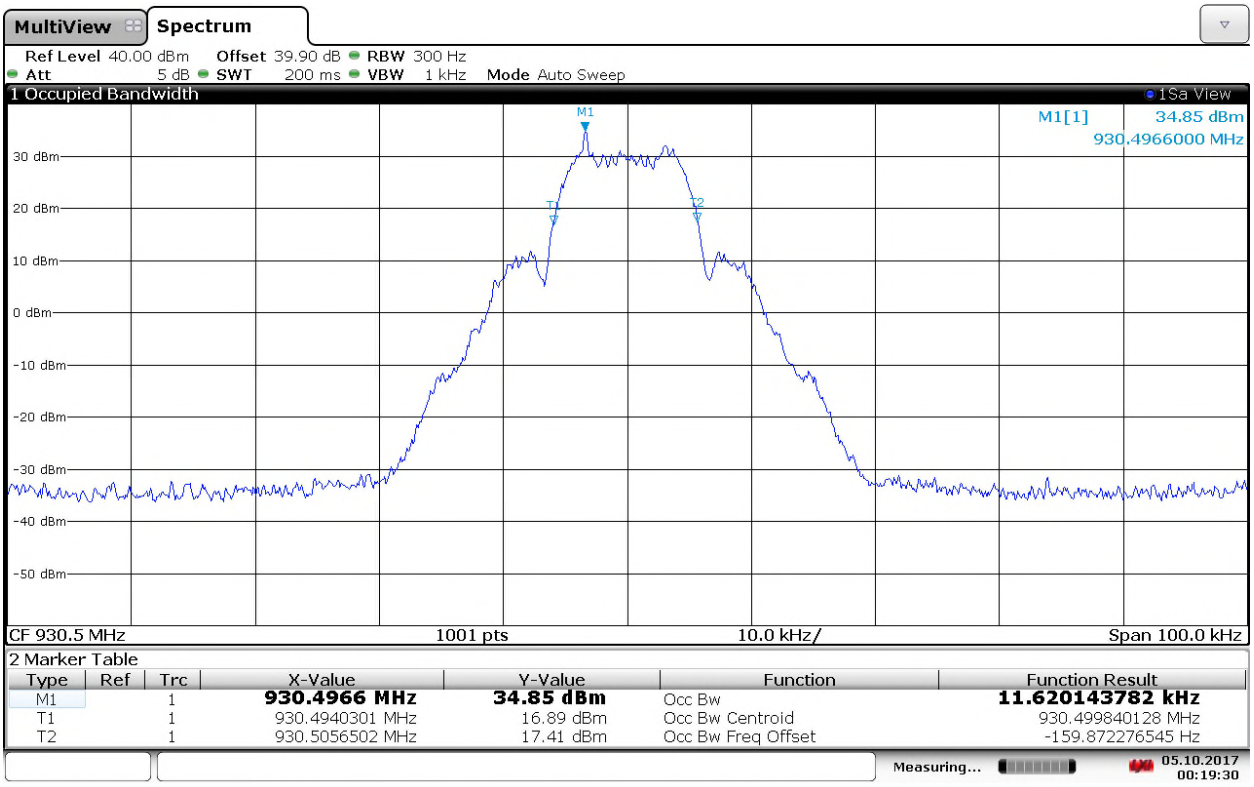

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Figure 7.3.2-2: 930.5 MHz – M2pass 10k Mode

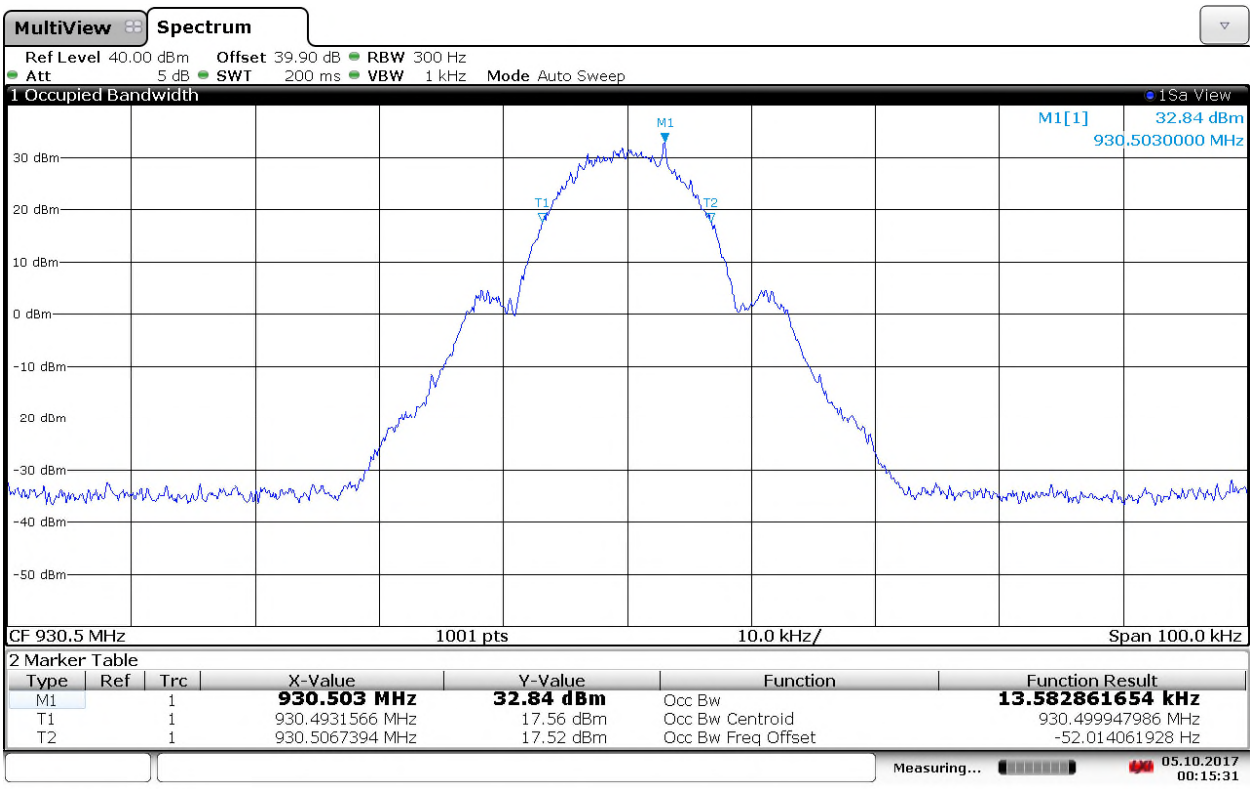

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Figure 7.3.2-3: 930.5 MHz – M2pass 12.5k Mode

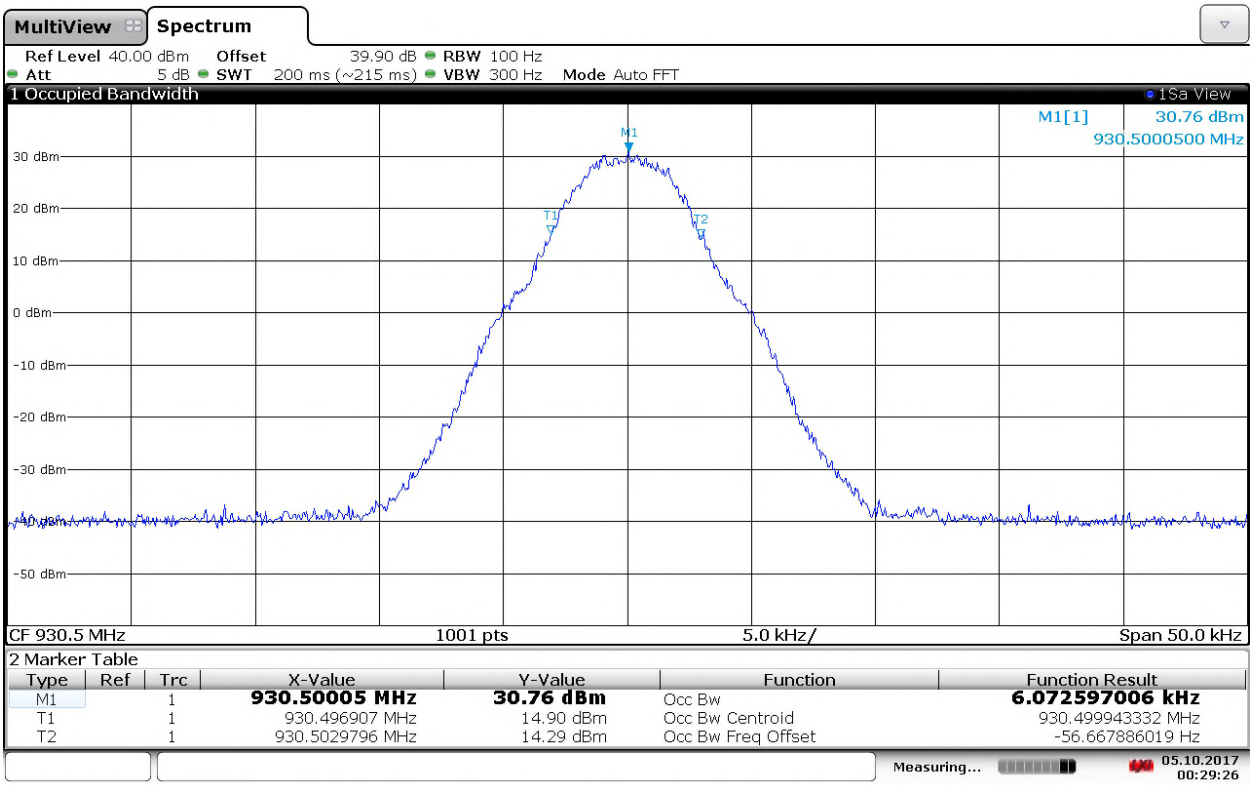

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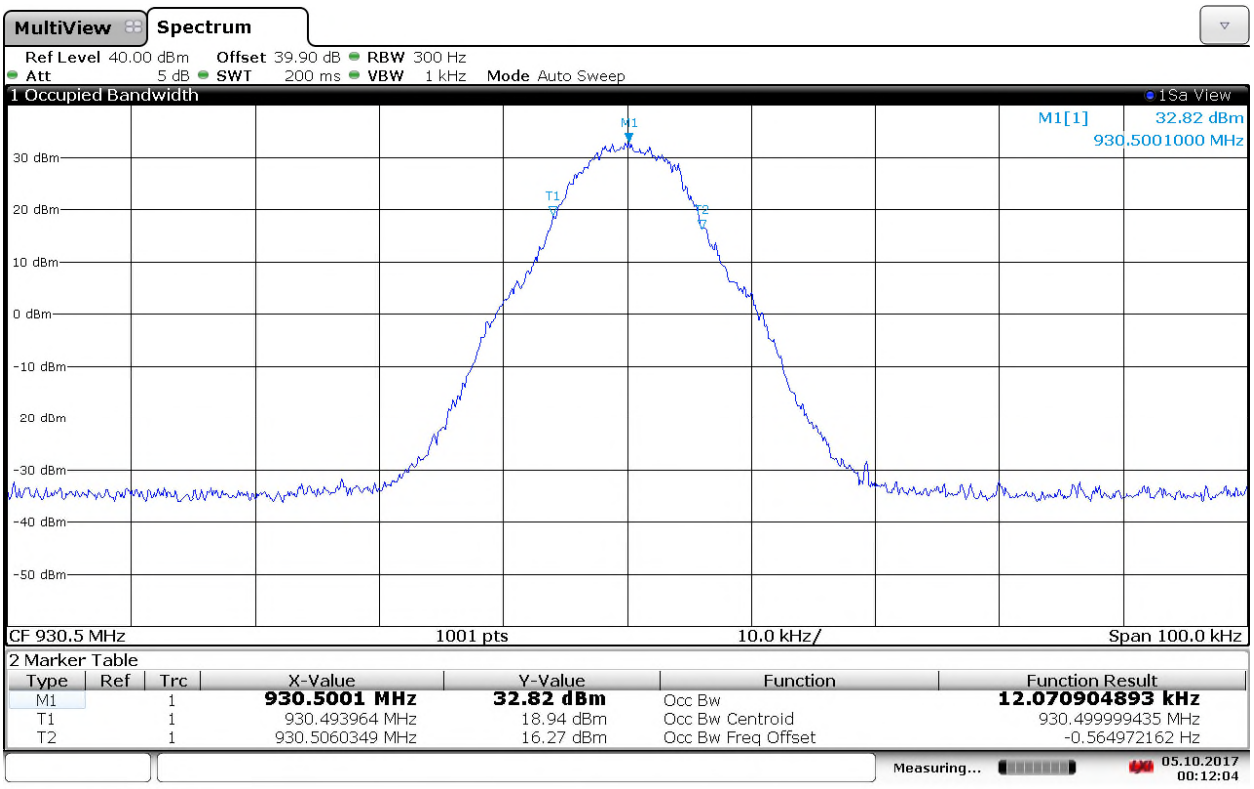
Figure 7.3.2-4: 930.5 MHz – M4pass 10k Mode



00:12:05 05.10.2017

Figure 7.3.2-5: 930.5 MHz – M4pass 20k Mode

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 39.9dB of passive attenuation below 1GHz, 20.9dB of passive attenuation with a 900MHz high pass filter above 1GHz. The spectrum analyzer resolution bandwidth was set to 100 kHz below 1000 MHz and 1 MHz above 1000MHz. 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 30MHz. Results are shown below.

7.4.2 Measurement Results

Performed by: Jean Tezil

High Power

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

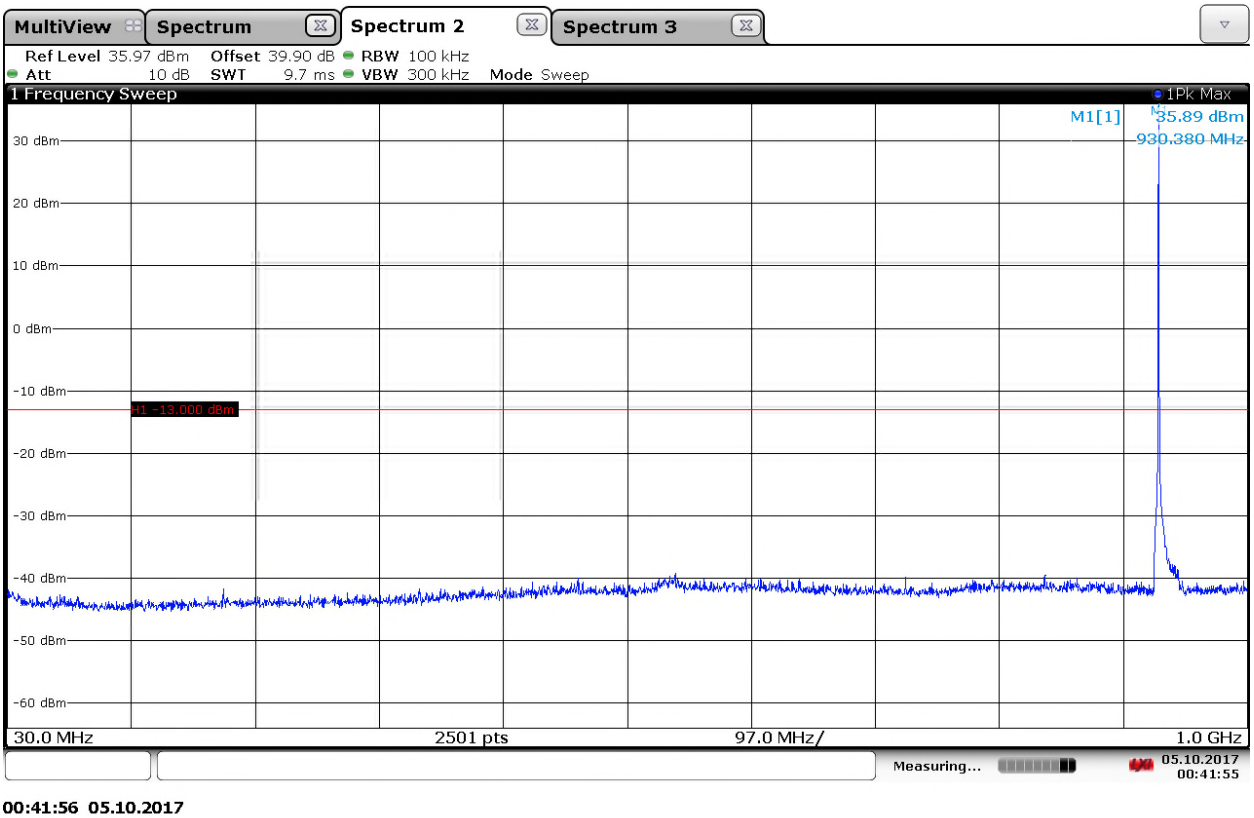


Figure 7.4.2-1: 930.5 MHz – 30MHz to 1GHz – M2pass5k mode

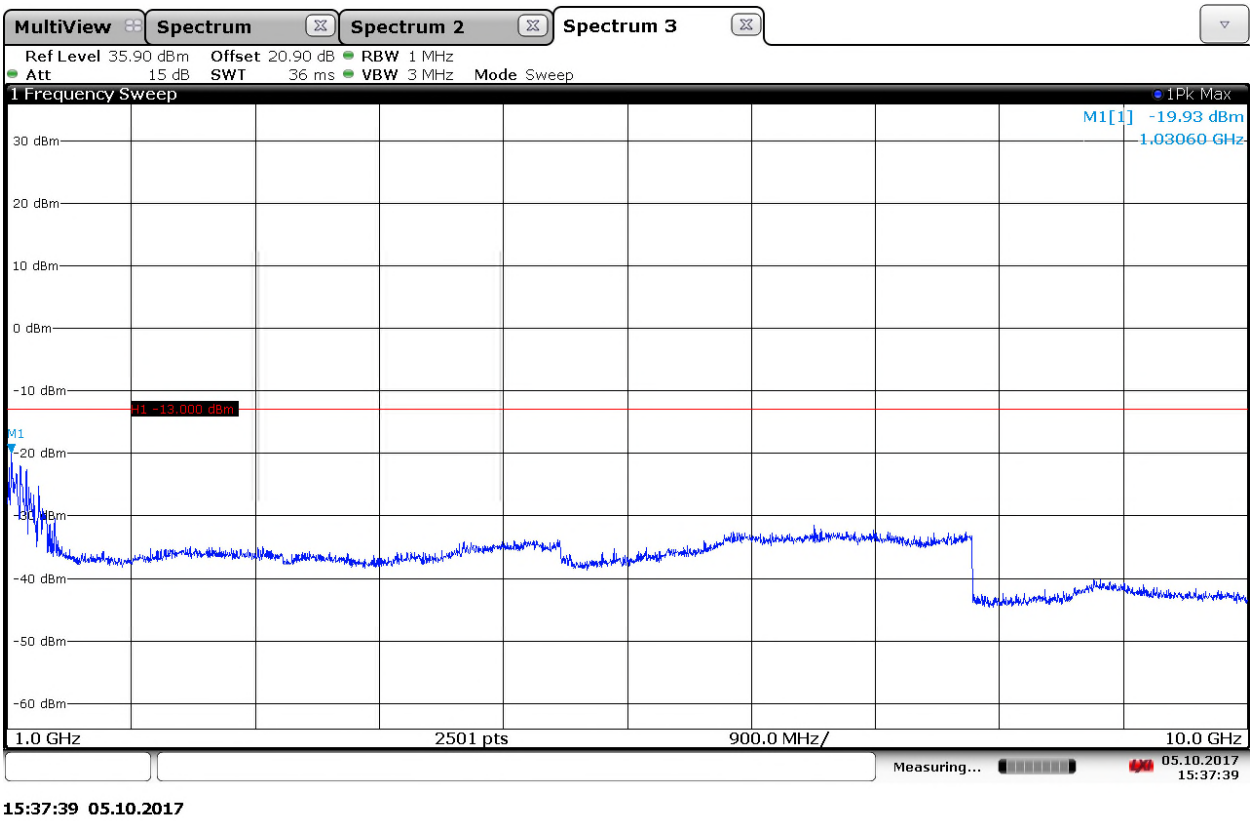


Figure 7.4.2-2: 930.5 MHz – 1GHz to 10GHz – M2pass5k mode

Low Power

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

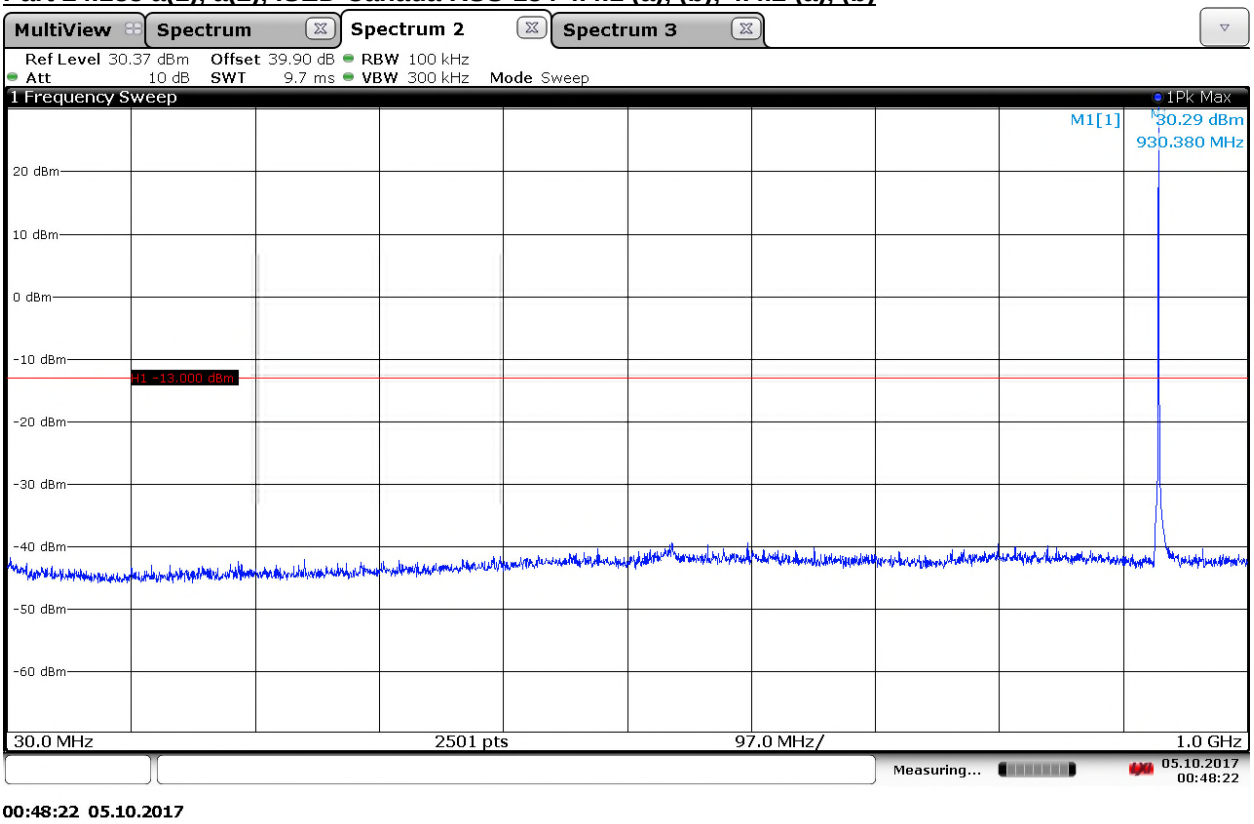


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Figure 7.4.2-13: 930.5 MHz – 30MHz to 1GHz – M2pass5k mode

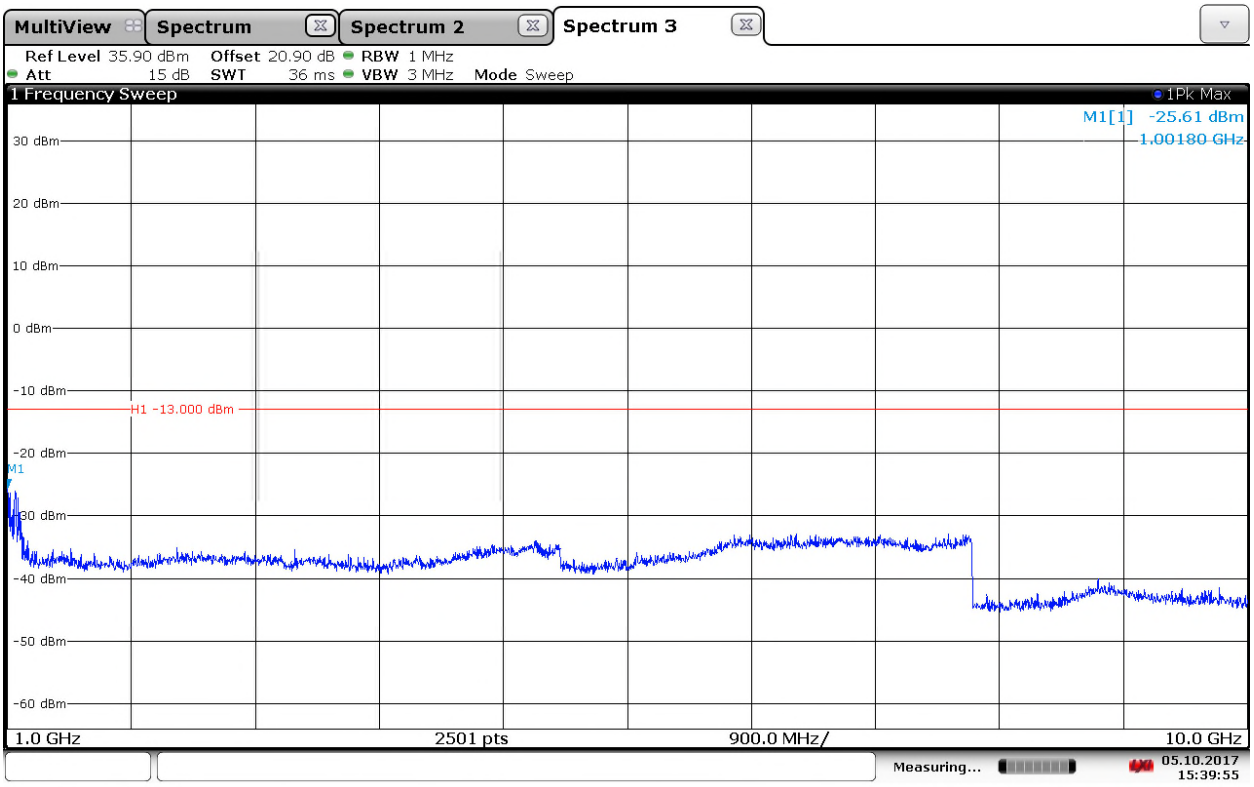


Figure 7.4.2-14: 930.5 MHz – 1GHz to 10GHz – M2pass5k mode

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: Jean Tezil

High Power

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 – m2pass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1861	59.20	H	-44.55	-13.00	31.55
1861	55.4	V	-47.71	-13.00	34.71
2791.5	54.5	H	-45.03	-13.00	32.03
2791.5	57.1	V	-48.03	-13.00	35.03
3722	51.1	H	-46.55	-13.00	33.55
3722	56.4	V	-41.64	-13.00	28.64
4652.5	66.1	H	-26.69	-13.00	13.69
4652.5	58.2	V	-37.43	-13.00	24.43
5583	57.8	H	-34.96	-13.00	21.96
5583	61.4	V	-32.76	-13.00	19.76
6513.5	54.1	H	-37.15	-13.00	24.15
6513.5	53.4	V	-39.64	-13.00	26.64

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

Low Power

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 – m2pass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1861	58.35	H	-45.64	-13.00	32.64
1861	55.81	V	-47.73	-13.00	34.73
2791.5	52.61	H	-47.43	-13.00	34.43
2791.5	52.6	V	-48.03	-13.00	35.03
3722	48.4	H	-51.15	-13.00	38.15
3722	48.7	V	-52.55	-13.00	39.55
4652.5	60.3	H	-32.99	-13.00	19.99
4652.5	53.7	V	-43.14	-13.00	30.14
5583	57.1	H	-35.86	-13.00	22.86
5583	60.1	V	-33.96	-13.00	20.96
6513.5	50.8	H	-42.15	-13.00	29.15
6513.5	52.1	V	-41.44	-13.00	28.44

NOTE: All frequencies not listed were below the noise floor of the spectrum analyzer.

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 12 Vdc. 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: Jean Tezil

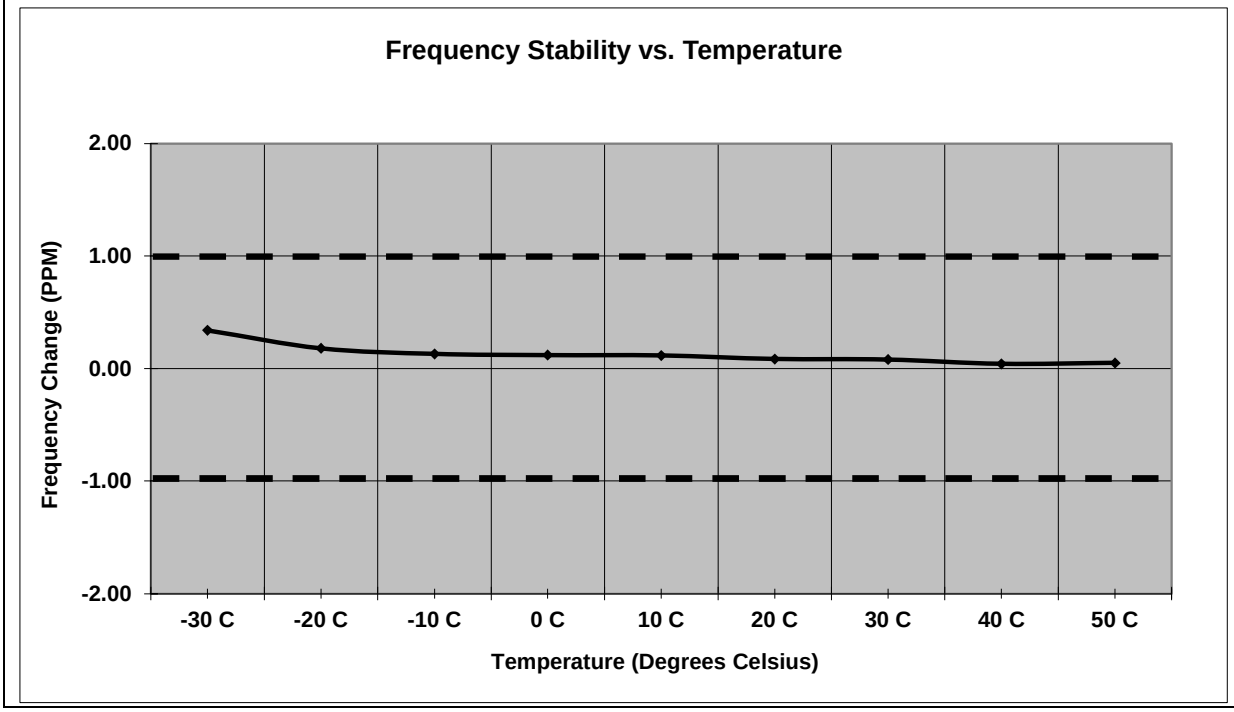
Part 24.135, RSS-134 (4.5)

Figure 7.6.2-9: Frequency Stability – 930.5 MHz

Frequency Stability

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

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**930.500316**	**0.340**	100%	12.00
-20 C	**930.500167**	**0.179**	100%	12.00
-10 C	**930.500121**	**0.130**	100%	12.00
0 C	**930.500111**	**0.119**	100%	12.00
10 C	**930.500107**	**0.115**	100%	12.00
20 C	**930.500079**	**0.085**	100%	12.00
30 C	**930.500074**	**0.080**	100%	12.00
40 C	**930.500038**	**0.041**	100%	12.00
50 C	**930.500046**	**0.049**	100%	12.00
20 C	**930.500097**	**0.104**	115%	13.80
20 C	**930.500096**	**0.103**	85%	10.20



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 5396390010002, manufactured by Sensus Metering Systems, Inc., meets all the requirements of FCC Part 24D as well as ISED Canada RSS-134 where applicable.

End Report