Modular Approval Certification Test Report

FCC ID: SDBFXZIG210
IC: 2220A-FXZIG210

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

TÜV SÜD Report Number: RD72127191.100

Applicant: Sensus Metering Systems, Inc.
Model: FXZIG210

Test Begin Date: April 25, 2017
Test End Date: May 26, 2017

Report Issue Date: May 31, 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.

Prepared by:	**Reviewed by:**
Randle Sherian **EMC Technician** **TÜV SÜD America Inc.**	**Thierry Jean-Charles** **Team Lead** **TÜV SÜD America Inc.**

This report contains 58 pages

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1.0 GENERAL

1.1 Purpose

The purpose of this modular approval 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 FXZIG210 is a transceiver module that incorporates a Sensus FLEXNET 900MHz transceiver and a Zigbee 2.4GHz transceiver.

The FXZIG210 is meant as an endpoint state-of-the-art supporting communications WAN and HAN communication. The electronics package is designed to be installed in the Aclara I210+c meter. The Aclara I210+c meter is Aclara's flagship residential meter product supporting Demand, TOU, LP as well as a service switch.
The FXZIG210 is manufactured using any one of three TCXOs (KDS/CBA, KDS/MEA, or Taiten) for the FLEXNET 900MHz transceiver.

Antenna: ¼ wave printed monopole, 2.77 dBi

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

Test Sample Serial Numbers:

TCXO Manufacturer	TX Radiated	RF Conducted/Frequency Stability
KDS/CBA	3000381	3000380
KDS/MEA	3000382	3000383
Taitien	3000378	3000379

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 (where the TCXO is KDS/CBA). Taitien, KDS/CBA, and KDS/MEA brands of TCXOs were evaluated.

The EUT was evaluated in 3 orthogonal planes and the Y orientation (upright) being the worst case.
The EUT was tested standalone, and a power supply was used to power the EUT.
The client provided software to exercise the EUT.

The evaluation of the Zigbee 2.4GHz transmitter and unintentional emissions is documented in a separate report.

The FXZIG210 FLEXNET 900MHz transceiver and the Zigbee transceiver are capable of simultaneous transmission. Therefore, an intermod investigation has been performed and the product meets the requirements.

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	901.0 - 902.0
24D	930.0 - 931.0
24D	940.0 - 941.0
101	928.85 - 929.0
101	932.0 - 932.5
101	941.0 - 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.
24D	901.0 - 902.0	Middle	901.5000
101	928.85 - 929.0	Middle	928.9250
24D	930.0 - 931.0	Middle	930.5000
101	932.0 - 932.5	Middle	932.2500
24D	940.0 - 941.0	1 near top and 1 near bottom	940.0125
101	941.0 - 941.5		941.4875
101	952.0 – 953.0	Middle	952.5000
101	959.85 – 960.0	Middle	959.9250

1.4 Emission Designators

The FXZIG210 transmitter produces six distinct modulation types. The emission designators for the modulation types used by the FXZIG210 transmitter calculated using the baud rate defined in the Theory of Operation are as follows:

EMISSIONS DESIGNATORS

Mode	Emission Designator	Modulation
Normal	9K60F2D	7-FSK
Double Density	9K60F2D	13-FSK
C & I (Half Baud)	4K80F2D	7-FSK
Priority	4K80F2D	13-FSK
MPass (5 kbps)	5K90F1D	2-GFSK
MPass (10 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 Registered Test Site Number: 637011
ISED Canada Test Site Registration Number: 4175A

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:

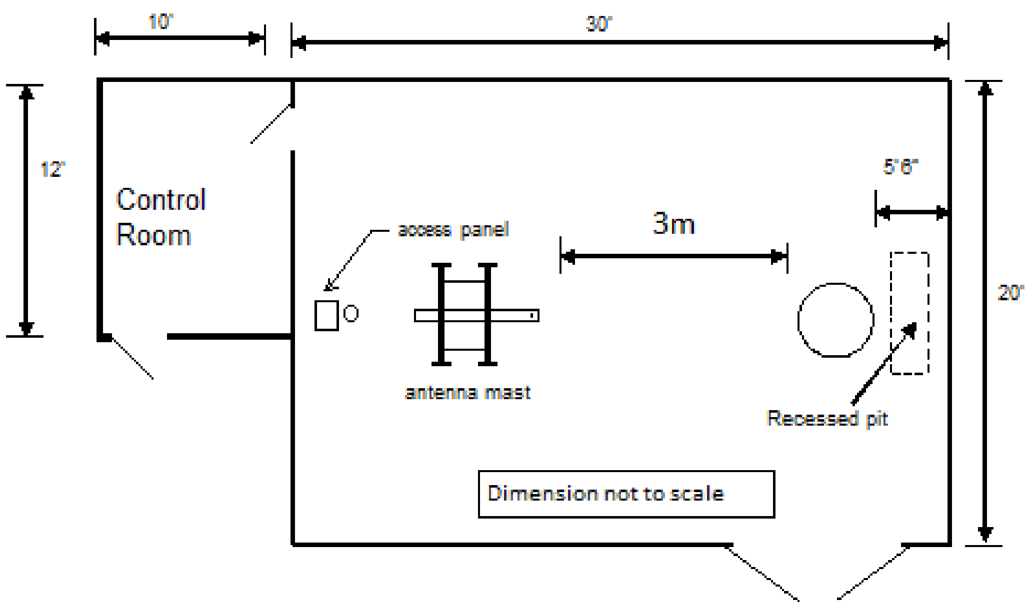

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

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:

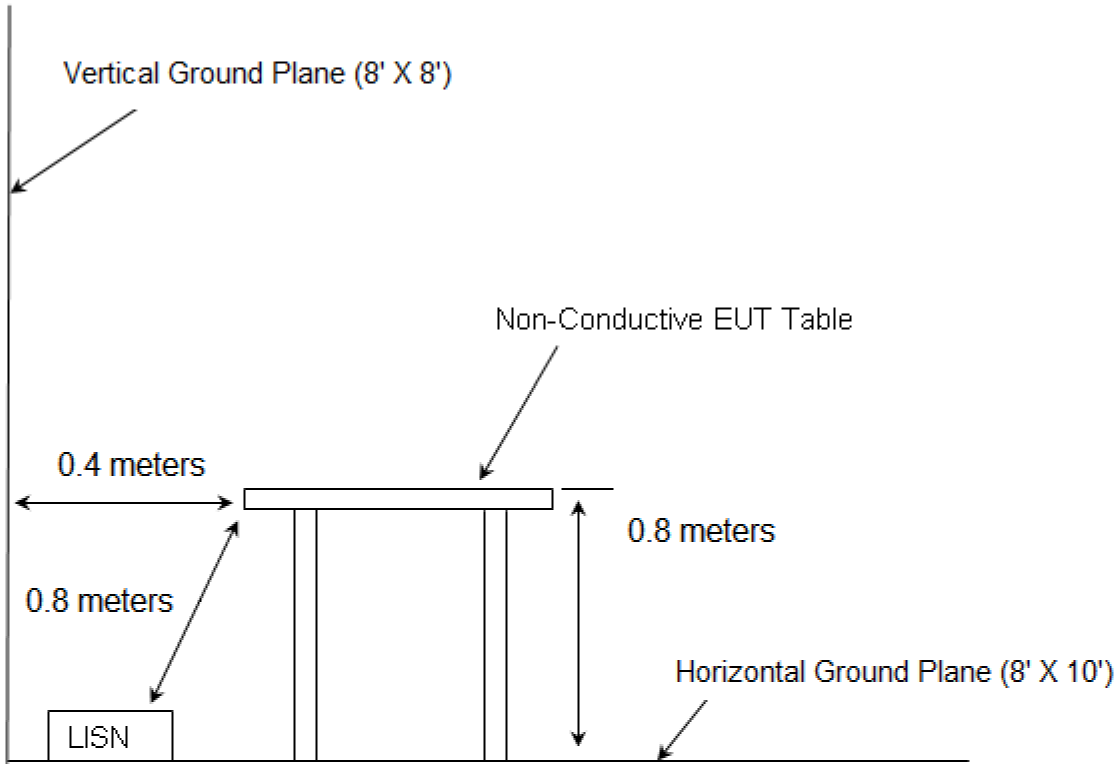

Figure 2.3.2-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40GHz
- 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
- US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services -2017
- TIA-603-D: Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards – 2010
- 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 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	7/14/2016	7/14/2017
626	EMCO	3110B	Antennas	9411-1945	3/21/2017	3/21/2019
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/12/2017	1/12/2018
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	9/20/2016	9/20/2017
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
3045	Aeroflex Inmet	18N10W-20	Attenuator	1437	1/3/2017	1/3/2018
3053	Fluke	115	Digital Multimeter	28840861	1/10/2017	1/10/2018
3055	Rohde & Schwarz	3005	Cables	3055	1/3/2017	1/3/2018
3065	Huber & Suhner	Succoflex104	Cables	120233/4	9/16/2016	9/16/2017
3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	8/9/2016	8/9/2017

NCR = No Calibration Required
DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.
Asset 3002: Firmware Version: ESU40 is 4.73 SP4
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	FXZIG210	7000380
2	Power Supply	Bk Precision	1694	258C12210

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Power	140cm	No	1 to 2

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

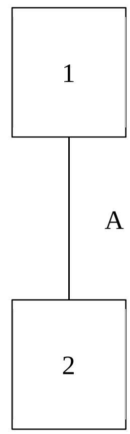

Figure 6-1: EUT Test Setup

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 20.1dB 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: Randle Sherian

KDS/CBA

Table 7.1.2-1: Peak Output Power

FCC Rule Part	Frequency (MHz)	Output Power High (dBm)	Output Power High (Watts)
24D	901.5000	31.6	1.45
24D	930.5000	31.1	1.29
24D	940.0125	31.09	1.29
101	928.9250	31.09	1.29
101	932.2500	30.71	1.18
101	941.4875	30.64	1.16
101	952.5000	30.3	1.07
101	959.9250	30.16	1.04

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 20.1dB 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: Randle Sherian

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

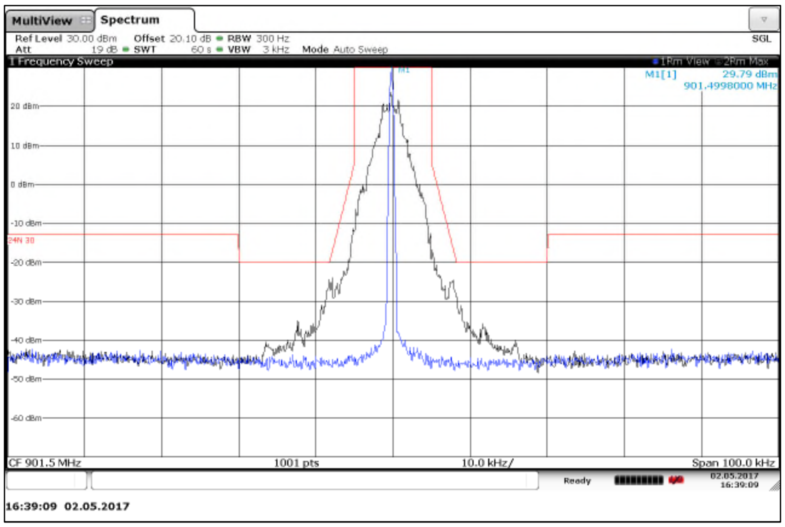

Figure 7.2.2-1: 901.5 MHz – 12.5 kHz Channel Spacing – C&I (Half Baud) Mode

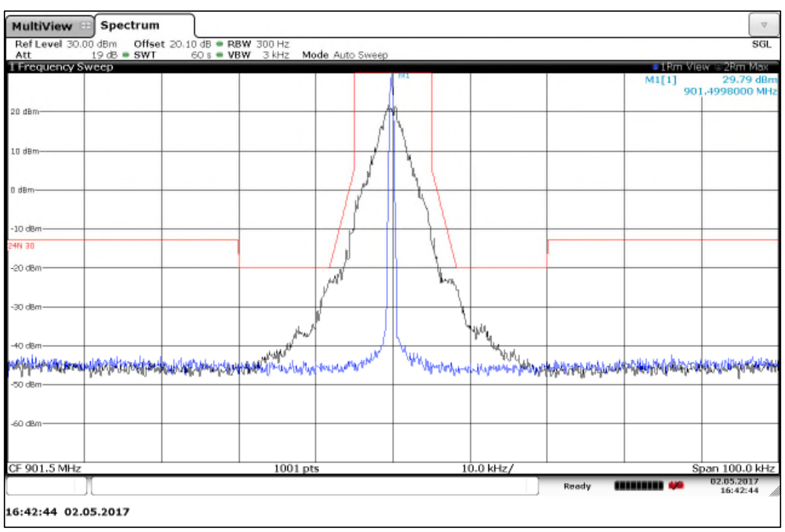

Figure 7.2.2-2: 901.5 MHz – 12.5 kHz Channel Spacing – Priority Mode

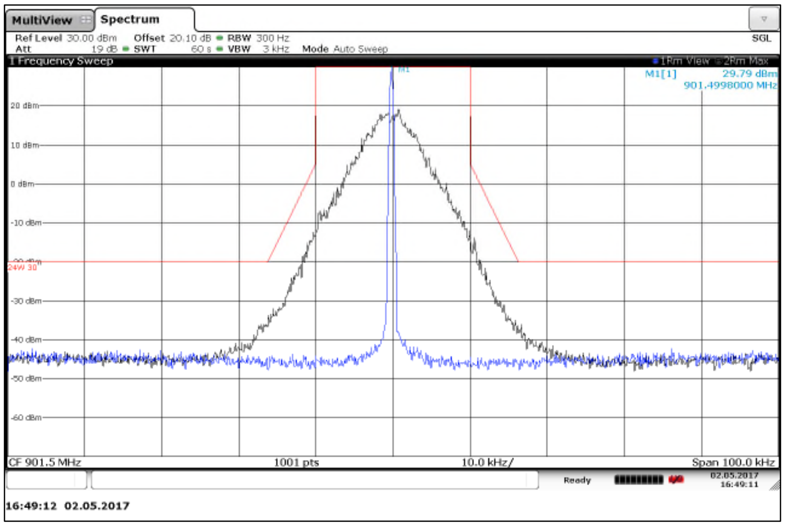

Figure 7.2.2-3: 901.5 MHz – 25 kHz Channel Spacing – Double Density Mode

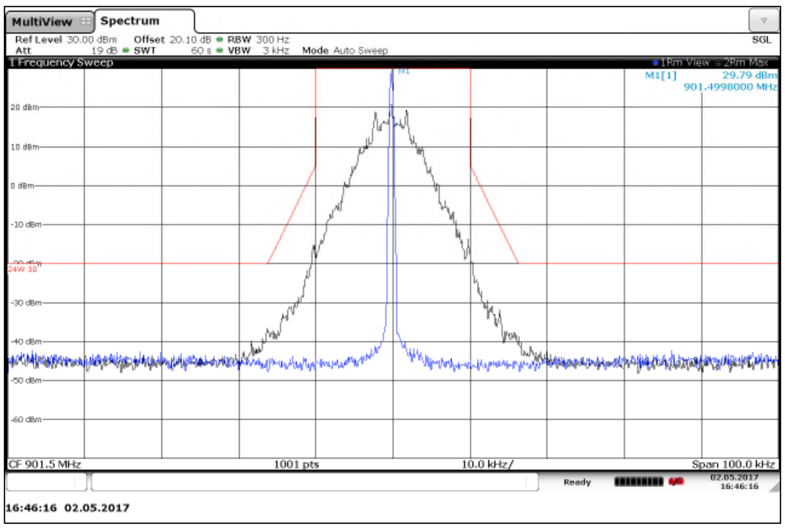

Figure 7.2.2-4: 901.5 MHz – 25 kHz Channel Spacing – Normal Mode

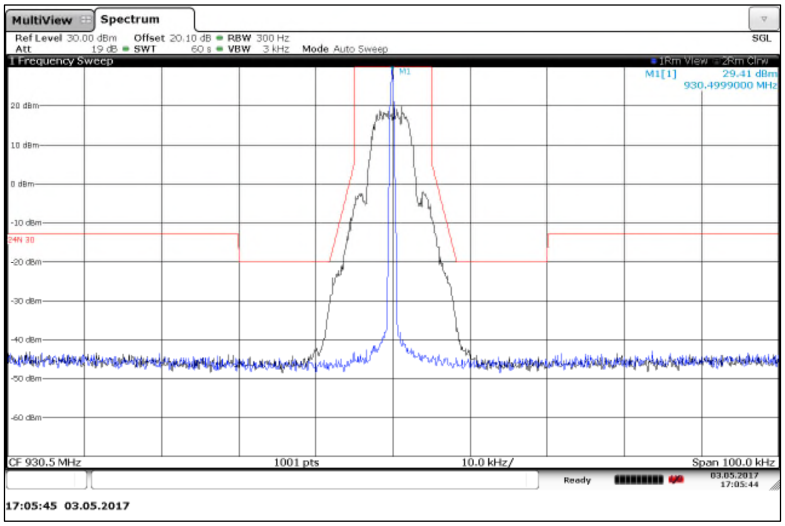

Figure 7.2.2-5: 930.5 MHz – 12.5 kHz Channel Spacing – MPass 5k Mode

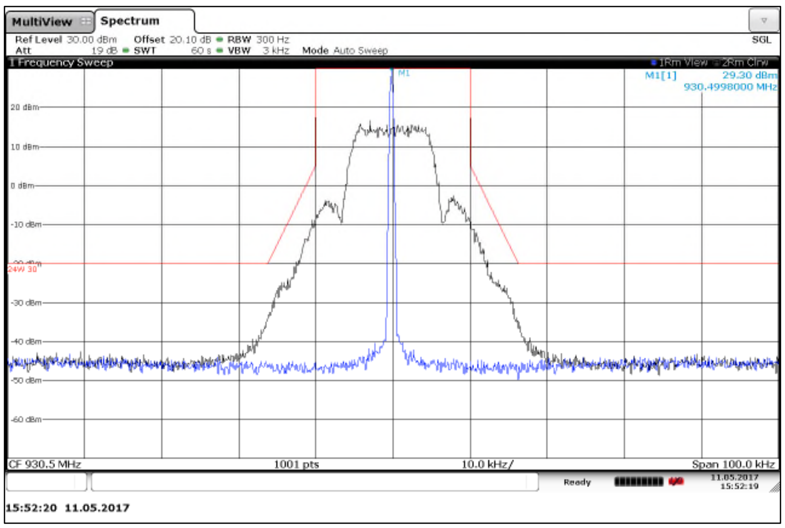

Figure 7.2.2-6: 930.5 MHz – 25 kHz Channel Spacing – MPass 10k Mode

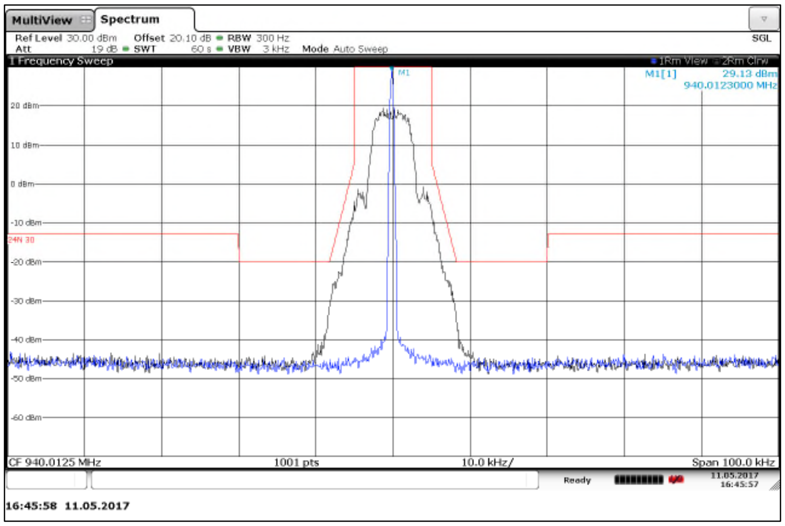

Figure 7.2.2-7: 940.0125 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

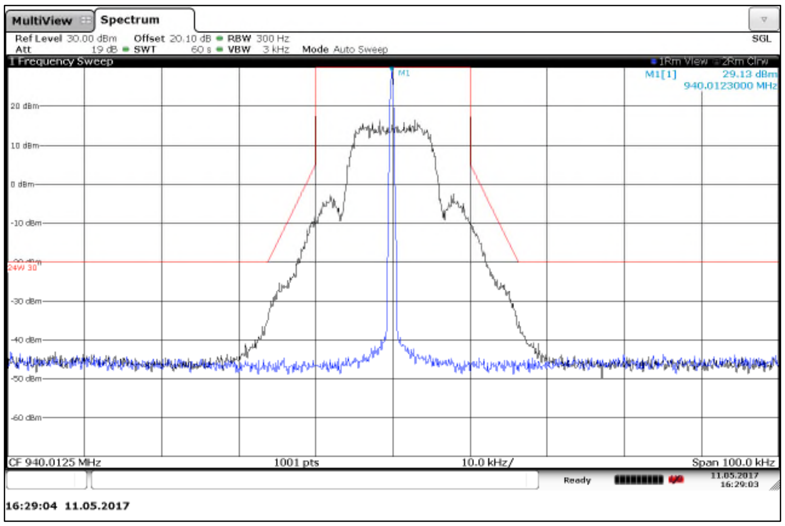

Figure 7.2.2-8: 940.0125 MHz – 25 kHz Channel Spacing – mPass 10k Mode

Part 101.111 a(5), a(6), RSS-119 5.8.6 (FCC Part 101.11 a(5) a(6) provides worst case)

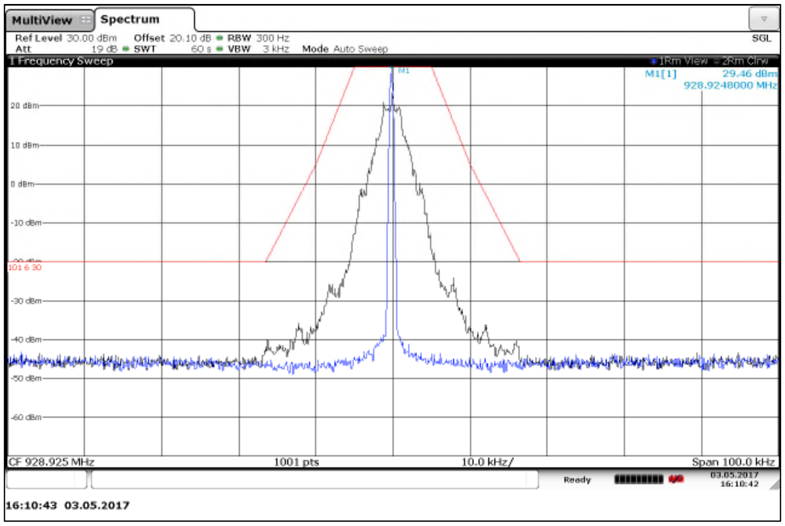

Figure 7.2.2-9: 928.925 MHz – 25 kHz Channel Spacing – C&I Mode

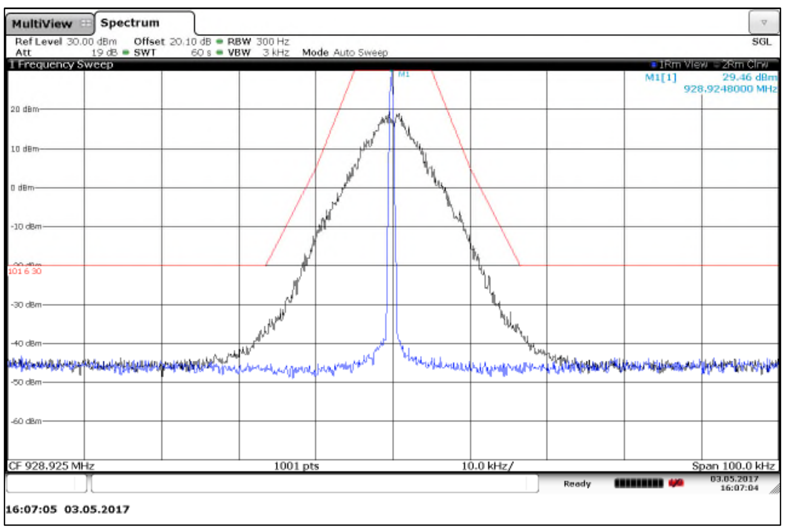

Figure 7.2.2-10: 928.925 MHz – 25 kHz Channel Spacing - Double Density Mode

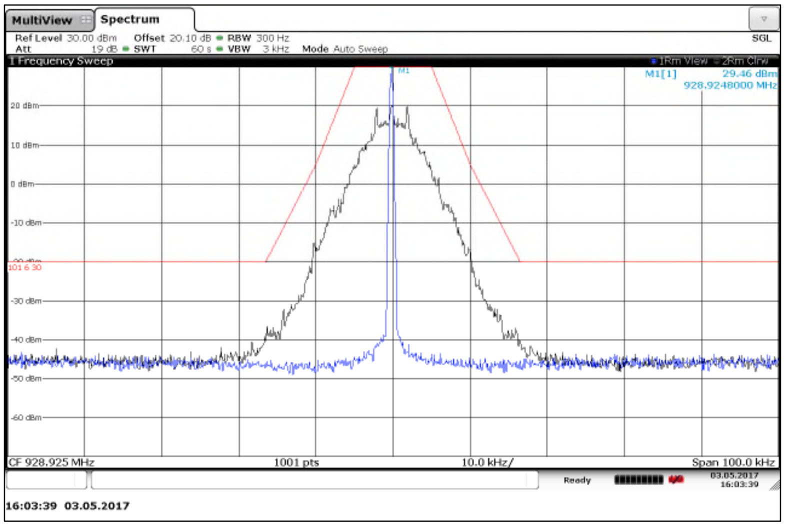

Figure 7.2.2-11: 928.925 MHz – 25 kHz Channel Spacing - Normal Mode

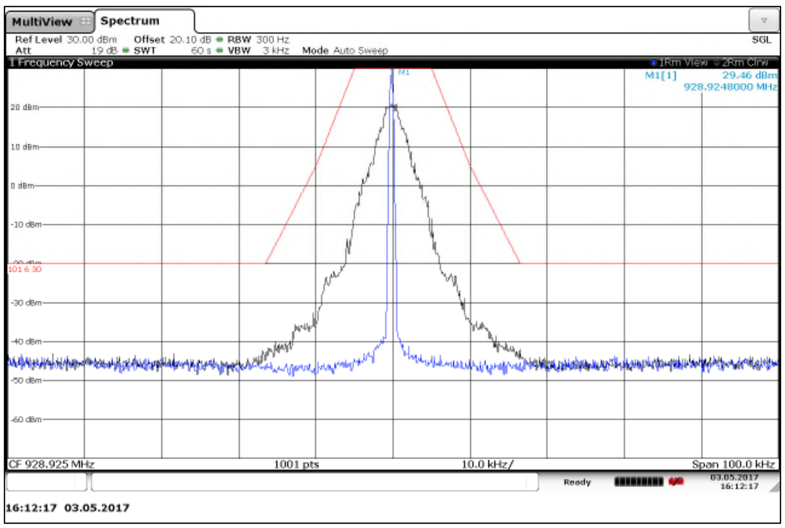

Figure 7.2.2-12: 928.925 MHz –– 25 kHz Channel Spacing - Priority Mode

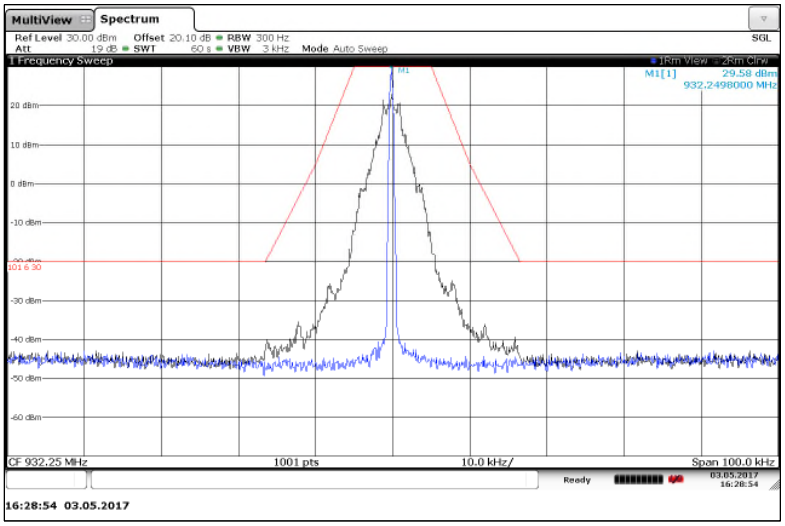

Figure 7.2.2-13: 932.25 MHz – 25 kHz Channel Spacing - C&I Mode

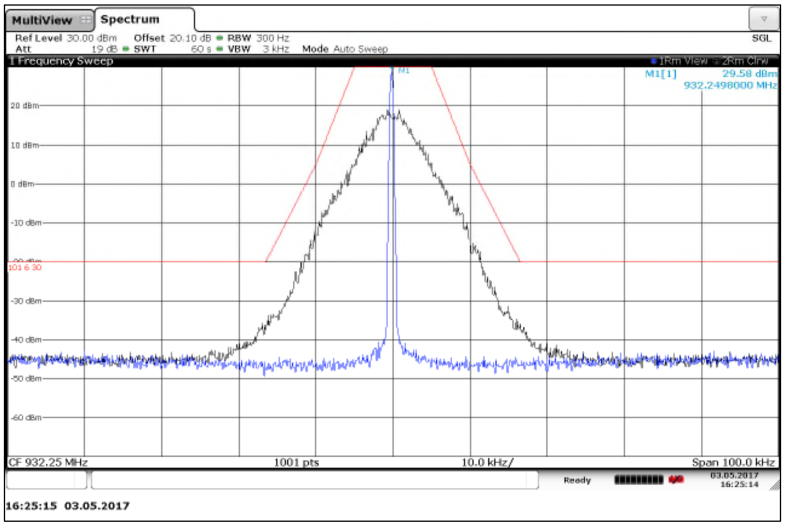

Figure 7.2.2-14: 932.25 MHz – 25 kHz Channel Spacing - Double Density Mode

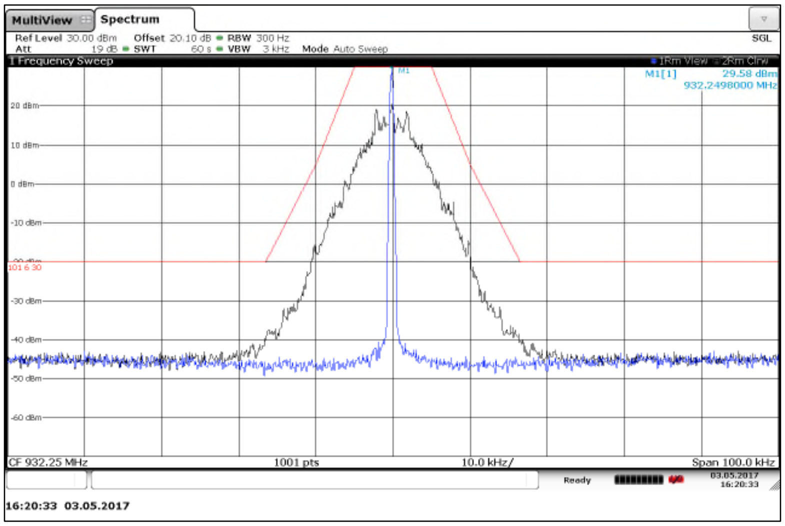

Figure 7.2.2-15: 932.25 MHz – 25 kHz Channel Spacing - Normal Mode

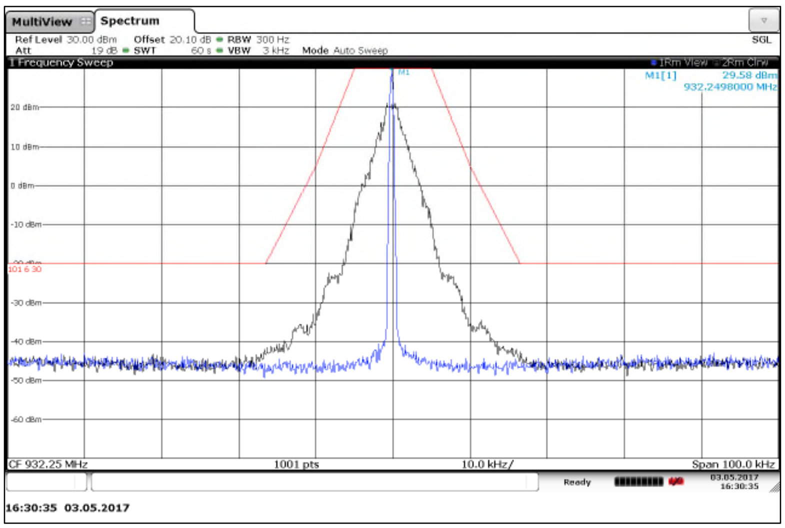

Figure 7.2.2-16: 932.25 MHz –– 25 kHz Channel Spacing - Priority Mode

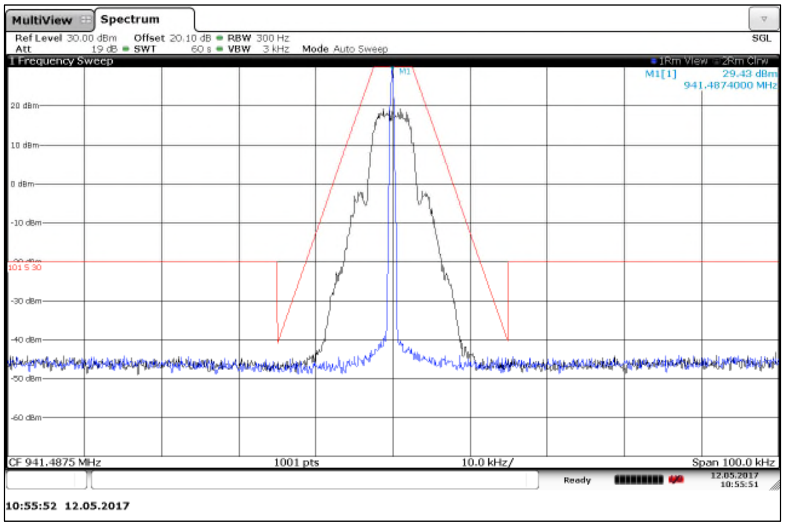

Figure 7.2.2-17: 941.4875 MHz - 12.5 kHz Channel Spacing – mPass 5k Mode

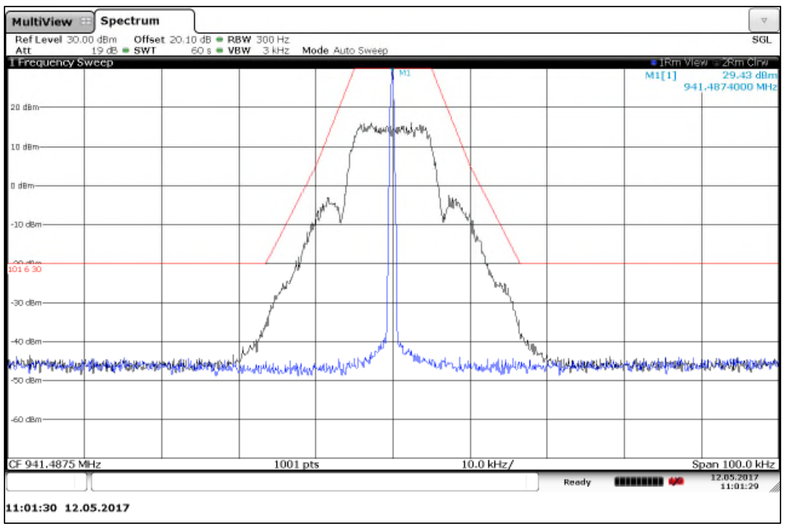

Figure 7.2.2-18: 941.4875 MHz – 25 kHz Channel Spacing – mPass 10k Mode

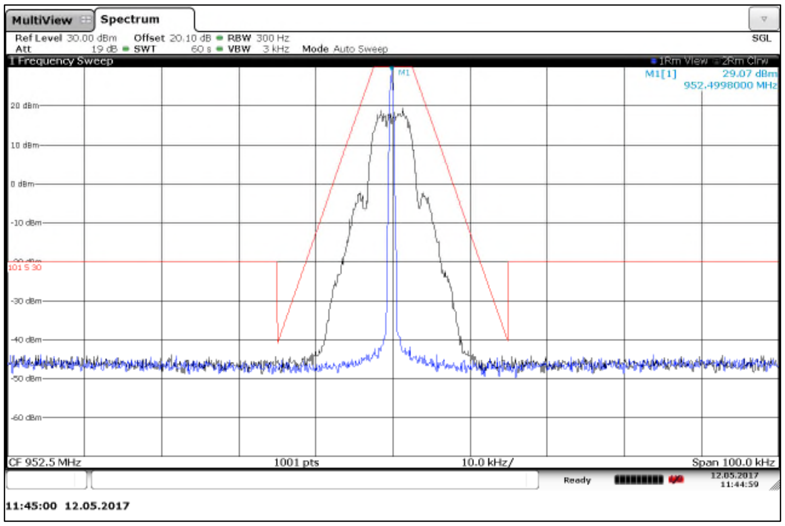

Figure 7.2.2-19: 952.5 MHz - 12.5 kHz Channel Spacing – mPass 5k Mode

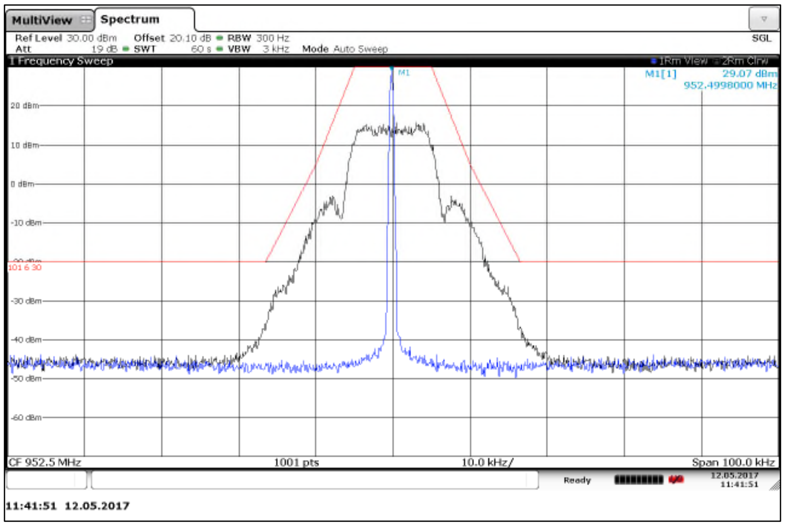

Figure 7.2.2-20: 952.5 MHz – 25 kHz Channel Spacing – mPass 10k Mode

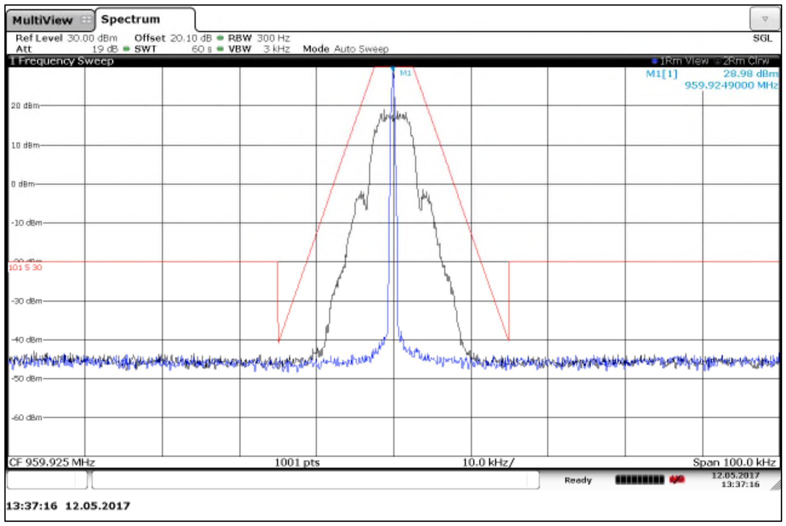

Figure 7.2.2-21: 959.925 MHz - 12.5 kHz Channel Spacing – mPass 5k Mode

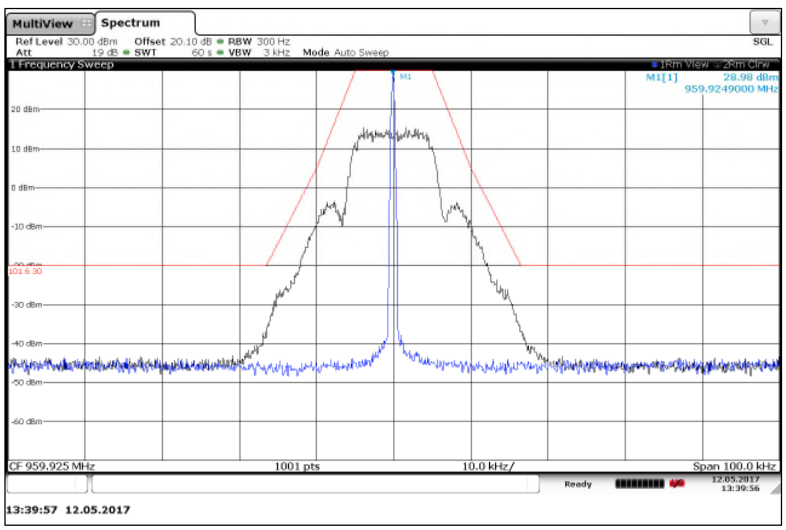

Figure 7.2.2-22: 959.925 MHz – 25 kHz Channel Spacing – mPass 10k Mode

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 20.1dB 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: Randle Sherian

Frequency (MHz)	ISED Canada Rule Part	Mode of Operation	99% Bandwidth (kHz)
901.5000	RSS-134	C&I (Half-Baud)	6.08
901.5000	RSS-134	Double Density	14.06
901.5000	RSS-134	Normal	12.02
901.5000	RSS-134	Priority	6.86
930.5000	RSS-134	MPass 5k	5.84
930.5000	RSS-134	MPass 10k	11.83
940.0125	RSS-134	MPass 5k	5.89
940.0125	RSS-134	MPass 10k	11.73
928.9250	RSS-119	C&I (Half-Baud)	6.20
928.9250	RSS-119	Double Density	13.77
928.9250	RSS-119	Normal	12.08
928.9250	RSS-119	Priority	6.79
932.2500	RSS-119	C&I (Half-Baud)	6.14
932.2500	RSS-119	Double Density	13.87
932.2500	RSS-119	Normal	11.92
932.2500	RSS-119	Priority	6.88
941.4875	RSS-119	MPass 5k	5.85
941.4875	RSS-119	MPass 10k	11.80
952.5000	RSS-119	MPass 5k	5.85
952.5000	RSS-119	MPass 10k	11.80
959.9250	RSS-119	MPass 5k	5.79
959.9250	RSS-119	MPass 10k	11.82

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

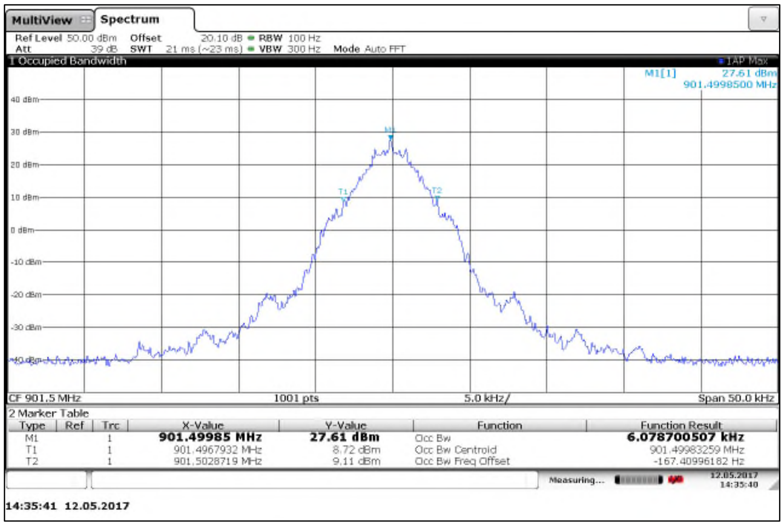

Figure 7.3.2-1: 901.5 MHz – C&I (Half Baud) Mode

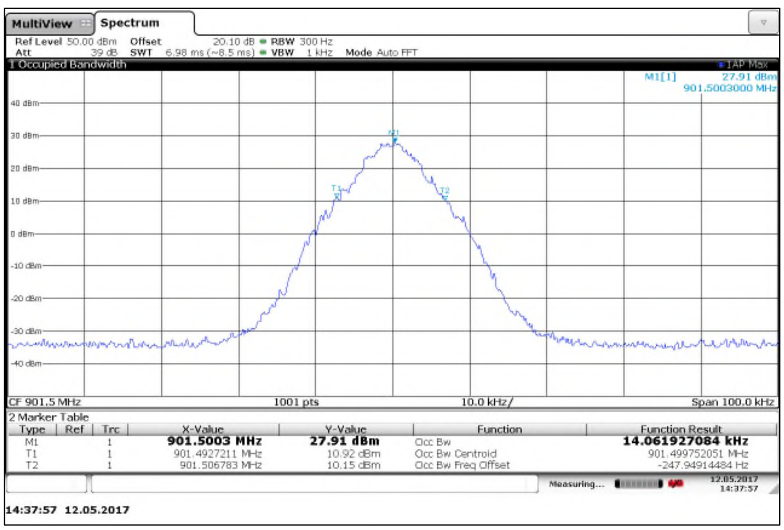

Figure 7.3.2-2: 901.5 MHz – Double Density Mode

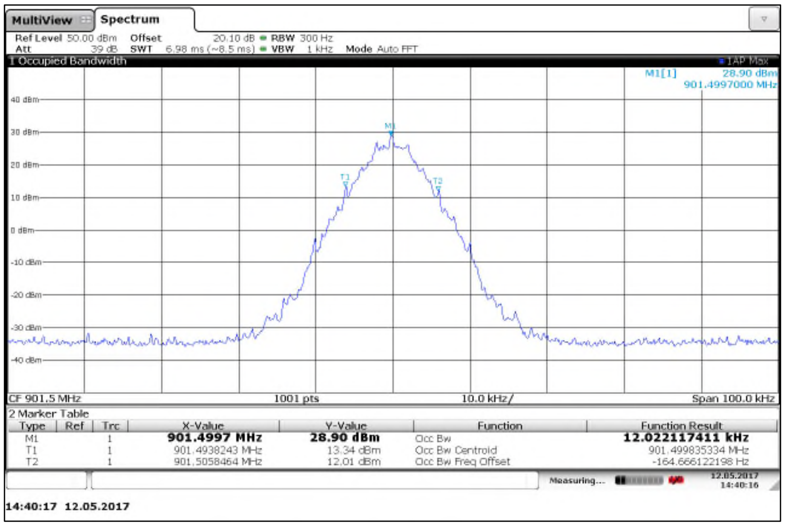

Figure 7.3.2-3: 901.5 MHz – Normal Mode

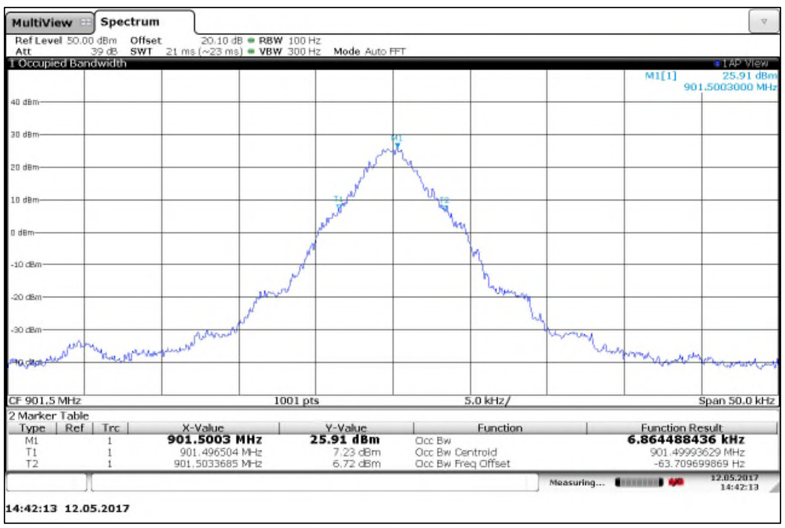

Figure 7.3.2-4: 901.5 MHz – Priority Mode

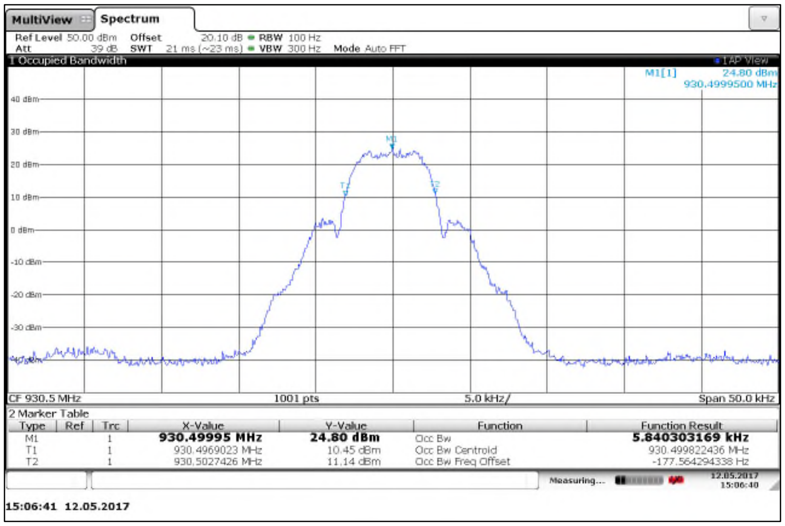

Figure 7.3.2-5: 930.5 MHz – MPass 5k Mode

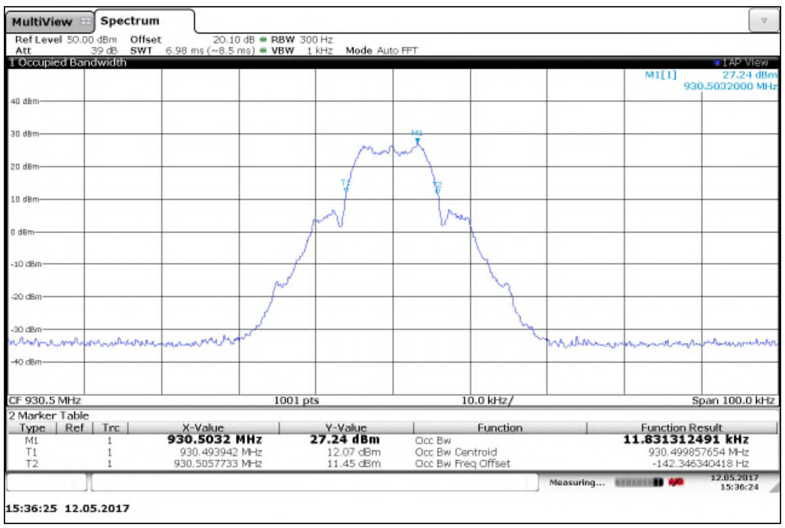

Figure 7.3.2-6: 930.5 MHz – MPass 10k Mode

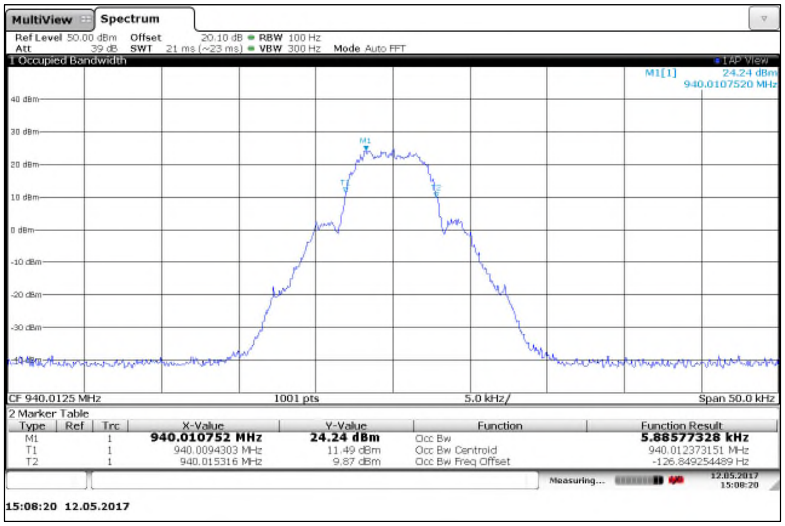

Figure 7.3.2-7: 940.0125 MHz – MPass 5k Mode

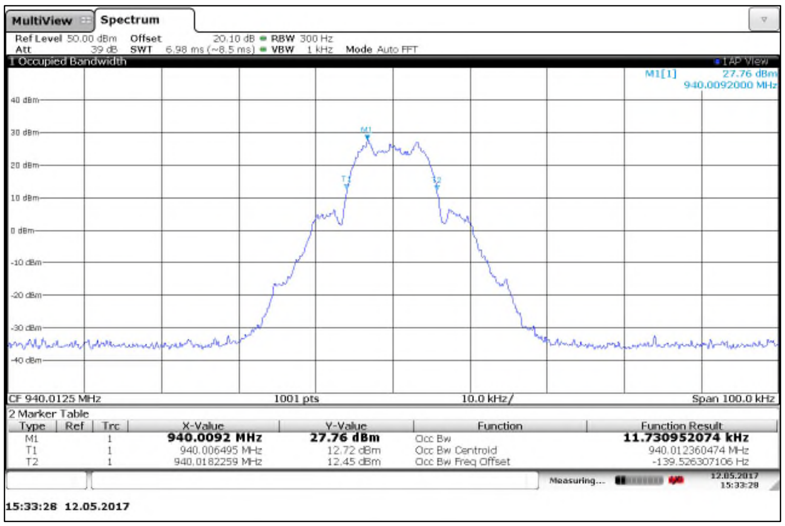

Figure 7.3.2-8: 940.0125 MHz – MPass 10k Mode

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

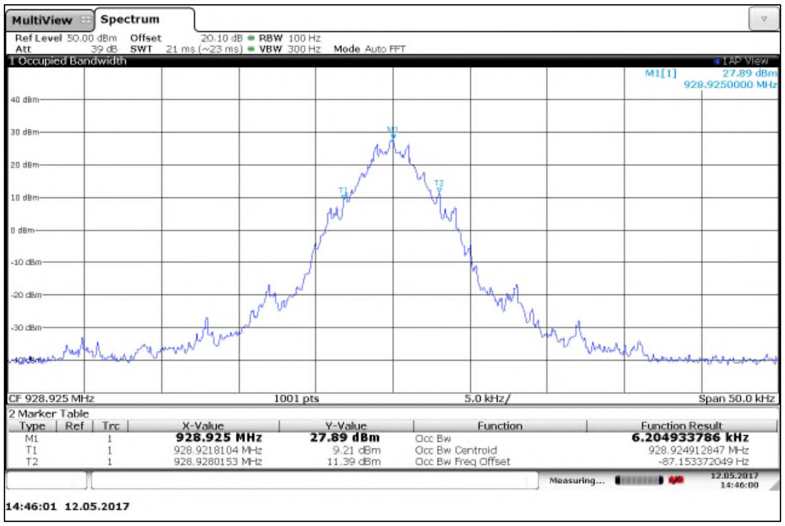

Figure 7.3.2-9: 928.925 MHz – C&I (Half Baud) Mode

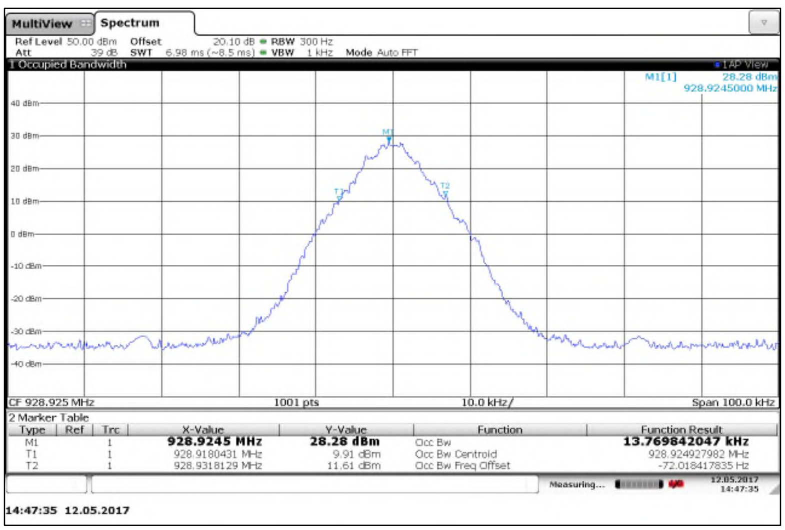

Figure 7.3.2-10: 928.925 MHz – Double Density Mode

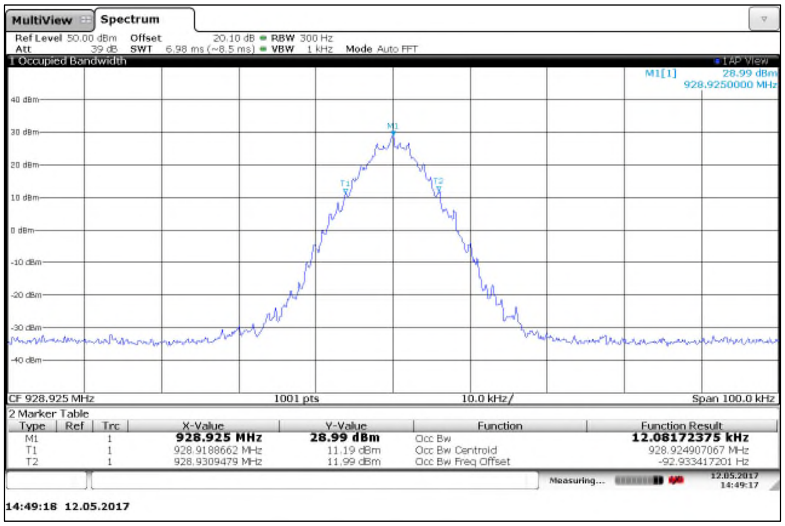

Figure 7.3.2-11: 928.925 MHz – Normal Mode

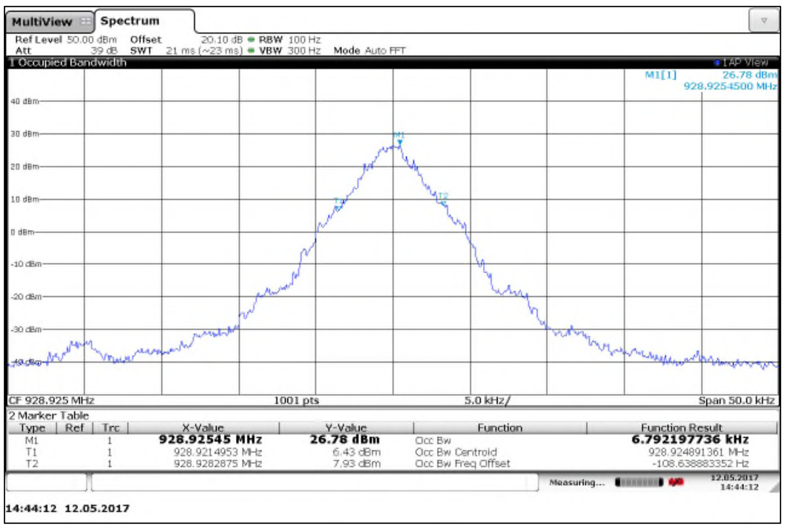

Figure 7.3.2-12: 928.925 MHz – Priority Mode

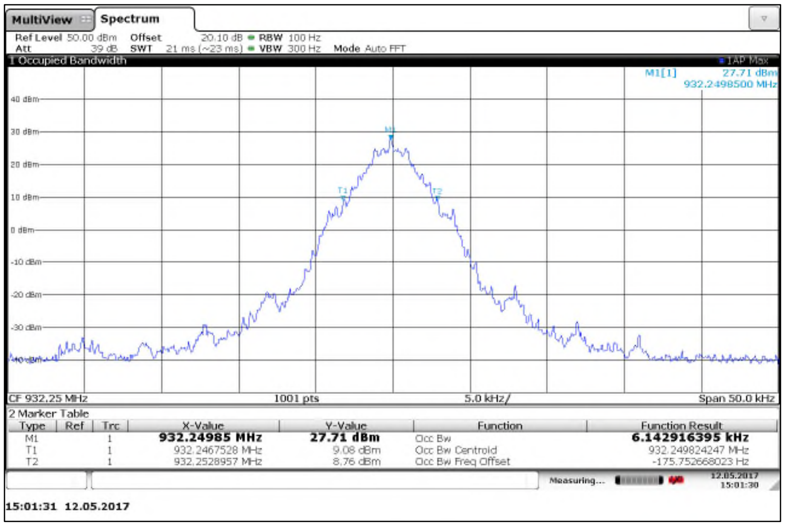

Figure 7.3.2-13: 932.25 MHz – C&I (Half Baud) Mode

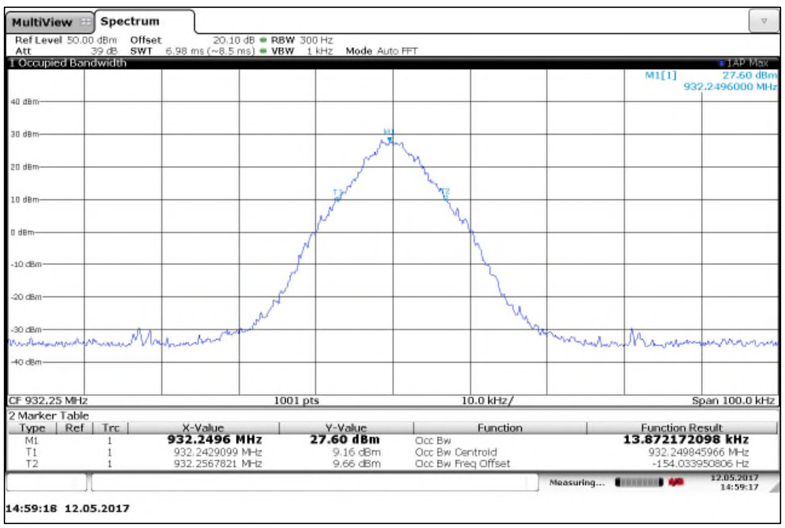

Figure 7.3.2-14: 932.25 MHz – Double Density Mode

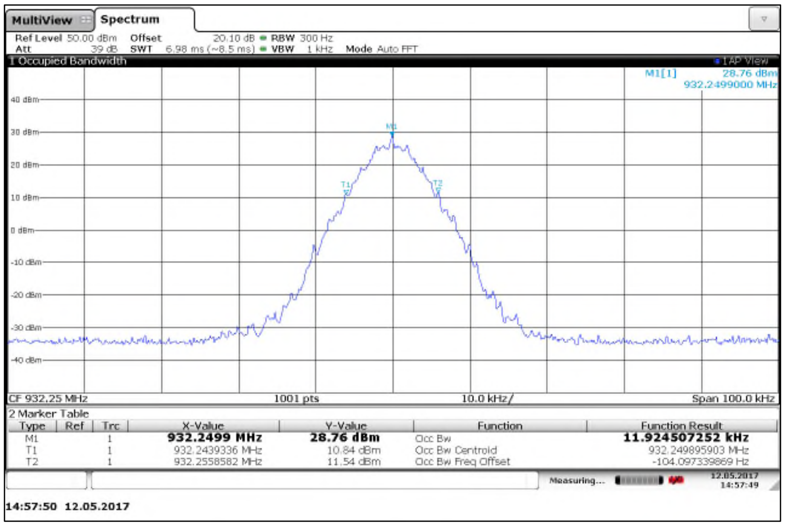

Figure 7.3.2-15: 932.25 MHz – Normal Mode

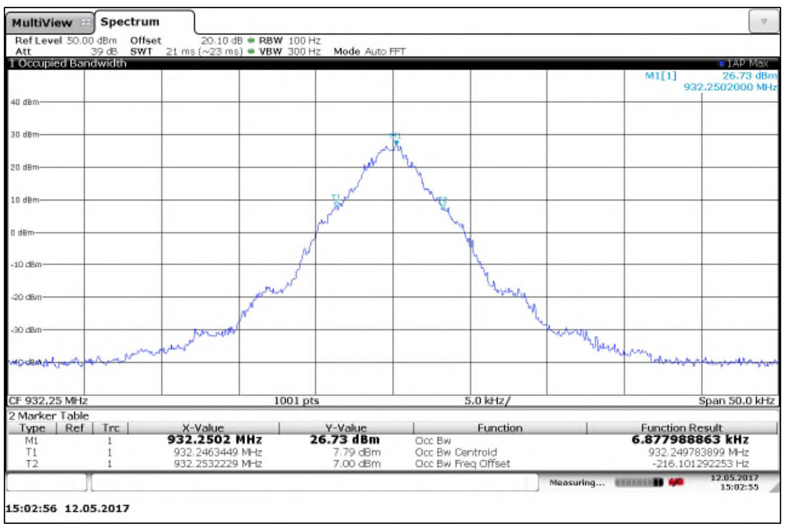

Figure 7.3.2-16: 932.25 MHz –– Priority Mode

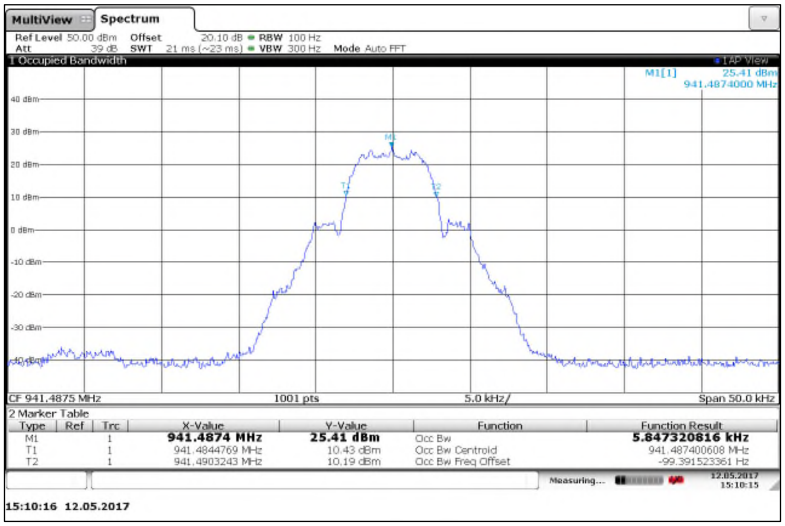

Figure 7.3.2-17: 941.4875 MHz – MPass 5k Mode

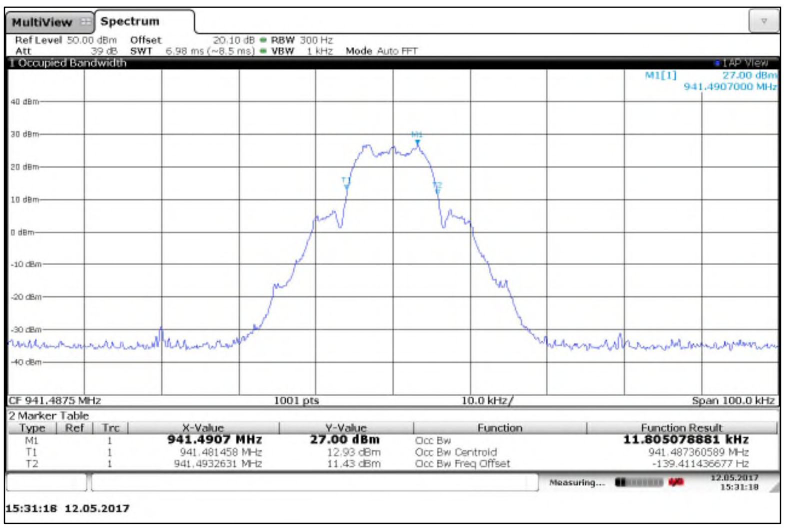

Figure 7.3.2-18: 941.4875 MHz – MPass 10k Mode

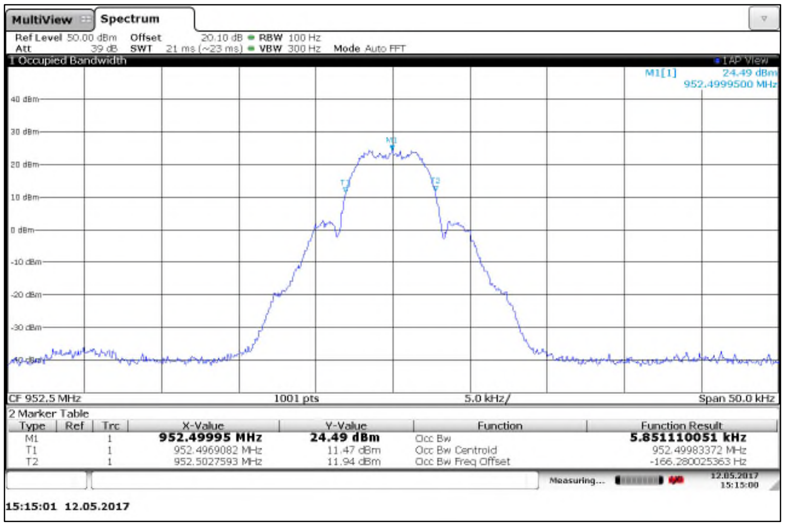

Figure 7.3.2-19: 952.5 MHz – MPass 5k Mode

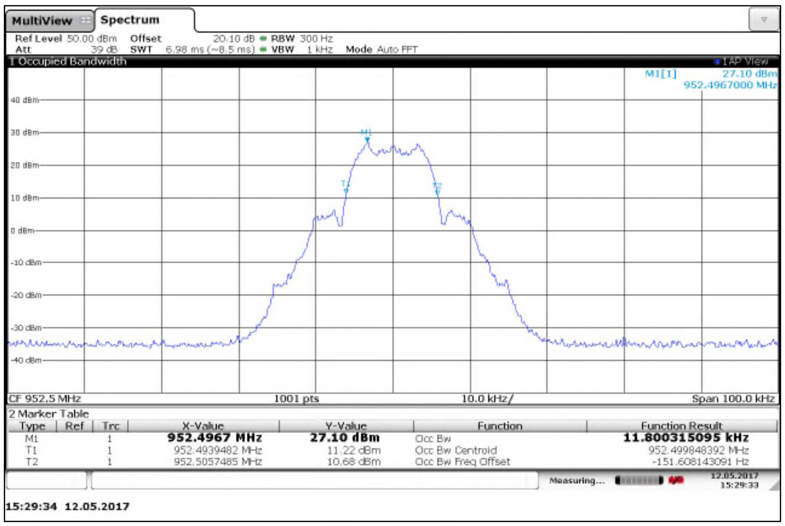

Figure 7.3.2-20: 952.5 MHz – MPass 10k Mode

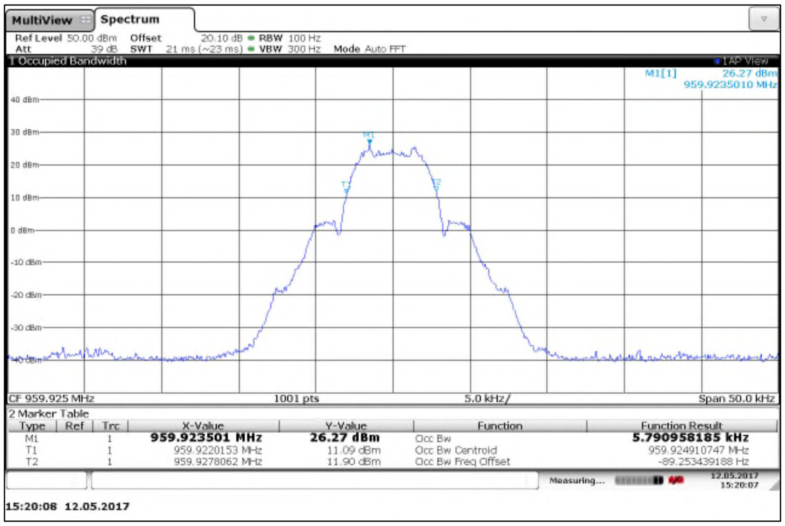

Figure 7.3.2-21: 959.925 MHz– mPass 5k Mode

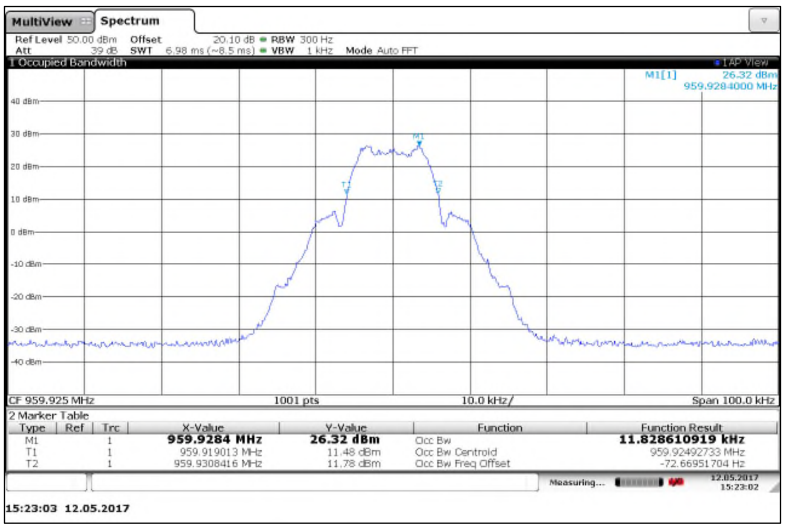

Figure 7.3.2-22: 959.925 MHz– mPass 10k Mode

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 20.1dB 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: Randle Sherian

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

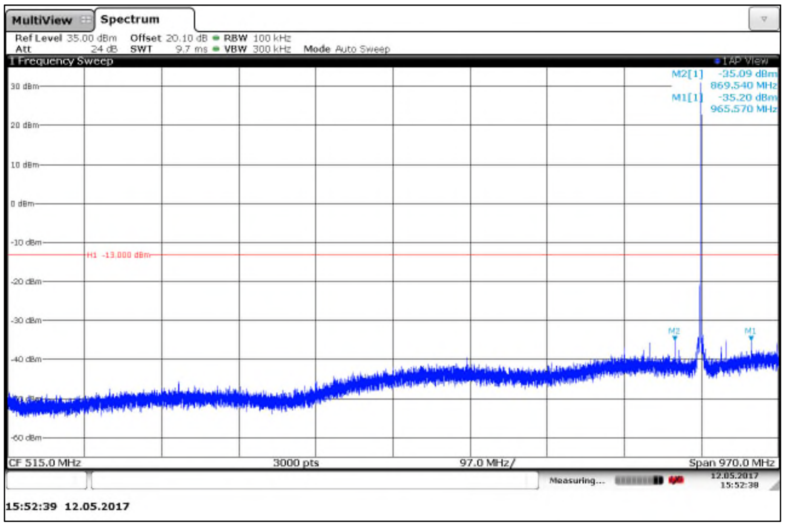

Figure 7.4.2-1: 901.5 MHz – 30MHz to 1GHz – Normal mode

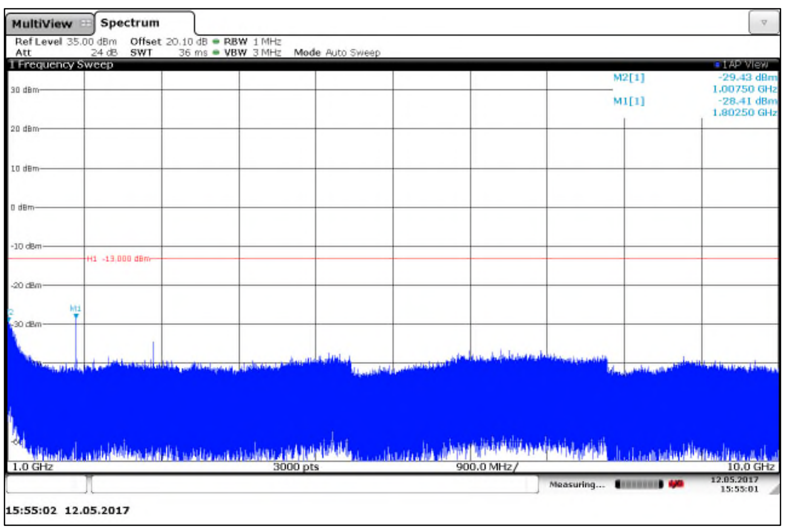

Figure 7.4.2-2: 901.5 MHz – 1GHz to 10GHz – Normal mode

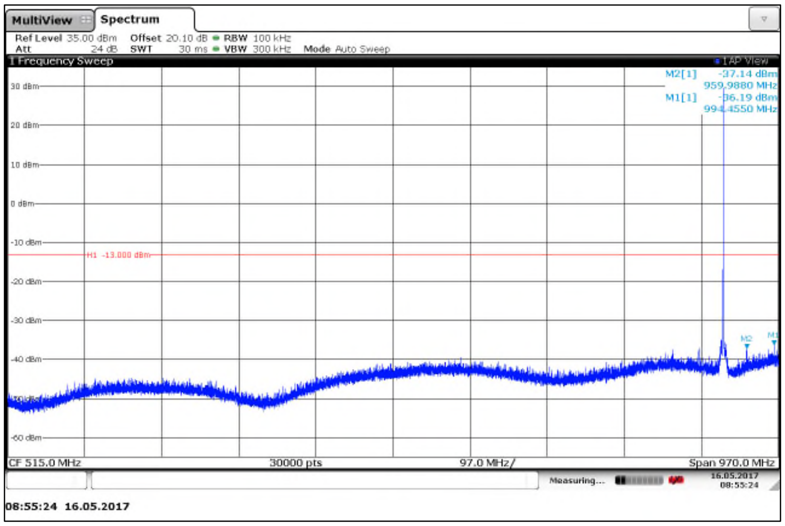

Figure 7.4.2-3: 930.5 MHz – 30MHz to 1GHz – Mpass5k mode

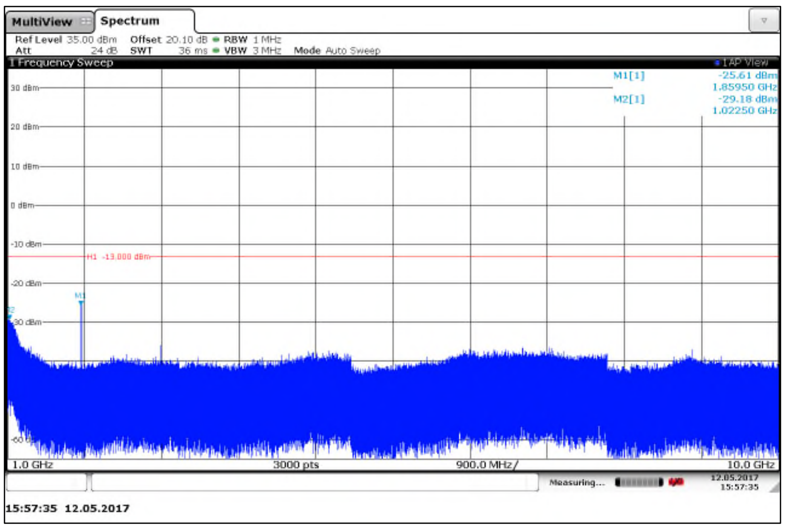

Figure 7.4.2-4: 930.5 MHz – 1GHz to 10GHz – Mpass 5k mode

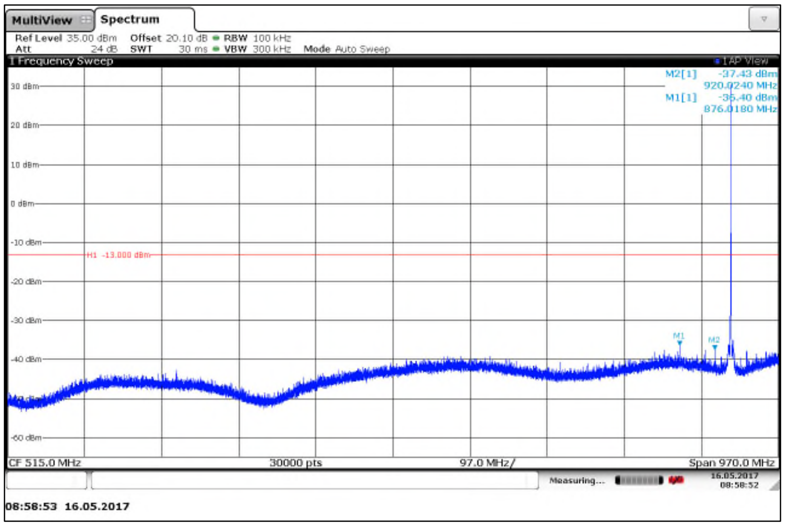

Figure 7.4.2-5: 940.0125 MHz – 30MHz to 1GHz – Mpass5k mode

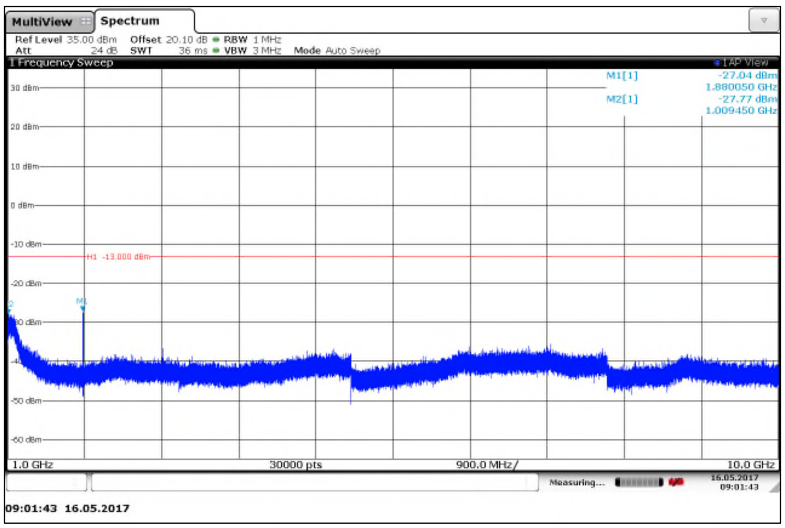

Figure 7.4.2-6: 940.0125 MHz – 1GHz to 10GHz – Mpass5k mode

Part 101.111 a(6), RSS-119 5.8.6

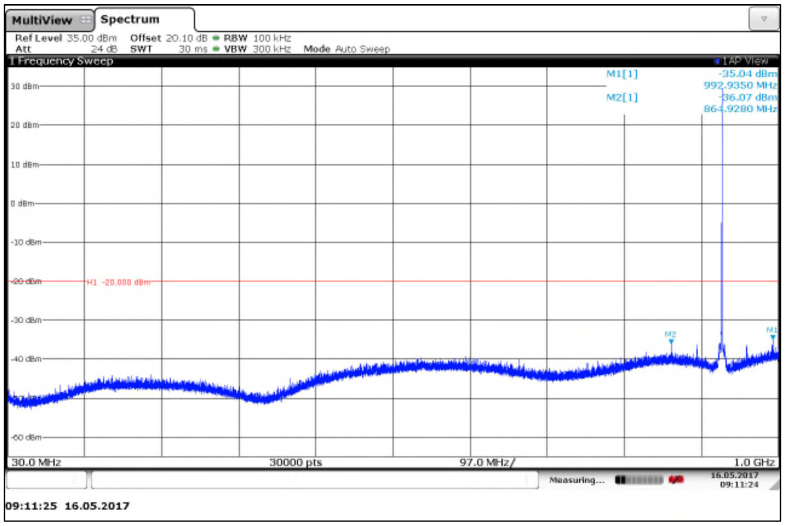

Figure 7.4.2-7: 928.925 MHz – 30MHz to 1GHz – Normal mode

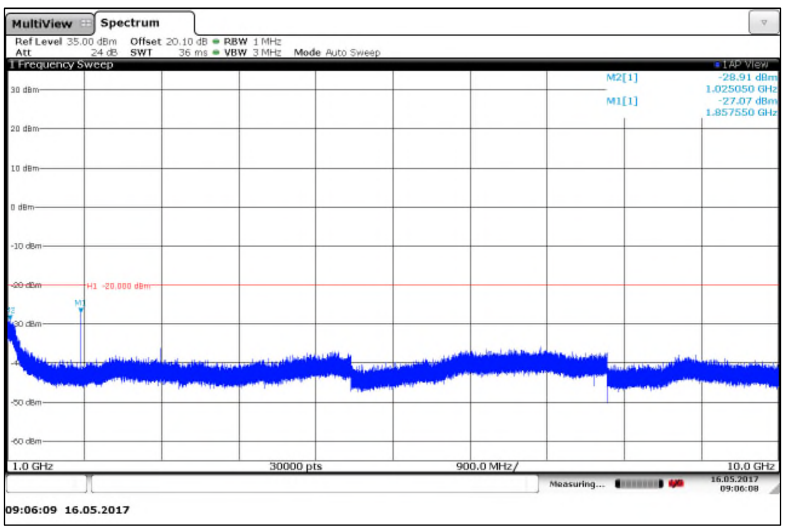

Figure 7.4.2-8: 928.925 MHz – 1GHz to 10GHz – Normal mode

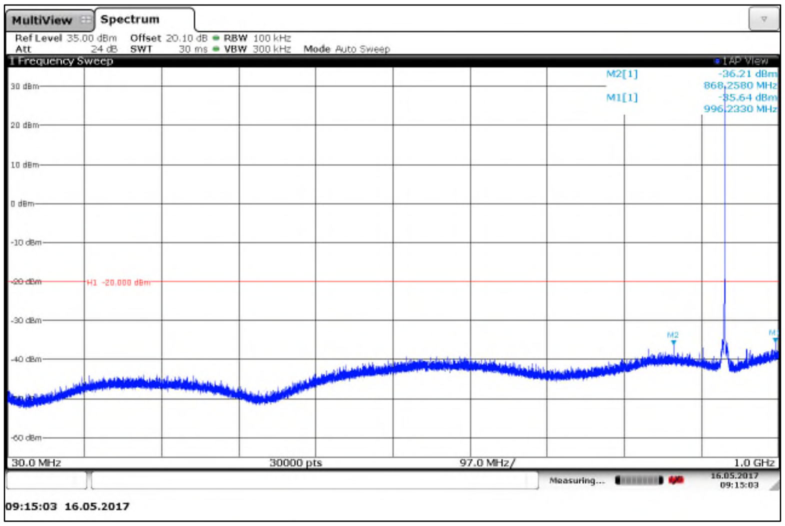

Figure 7.4.2-9: 932.25 MHz – 30MHz to 1GHz – Normal mode

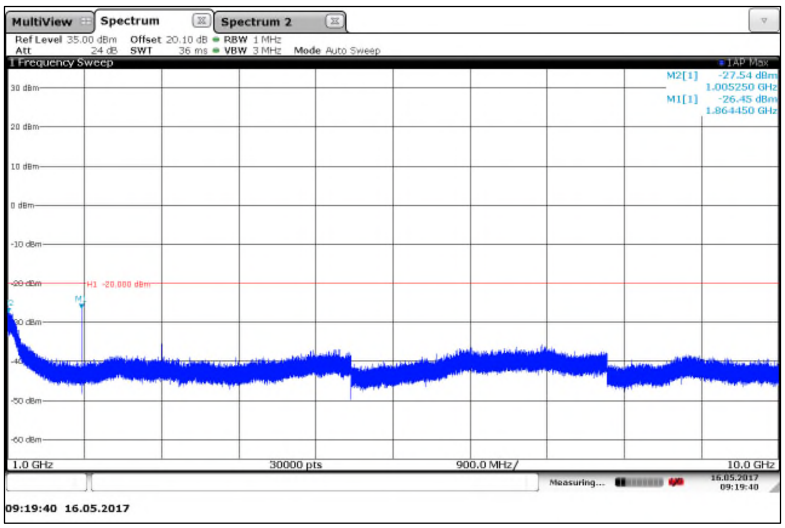

Figure 7.4.2-10: 932.25 MHz – 1GHz to 10GHz – Normal mode

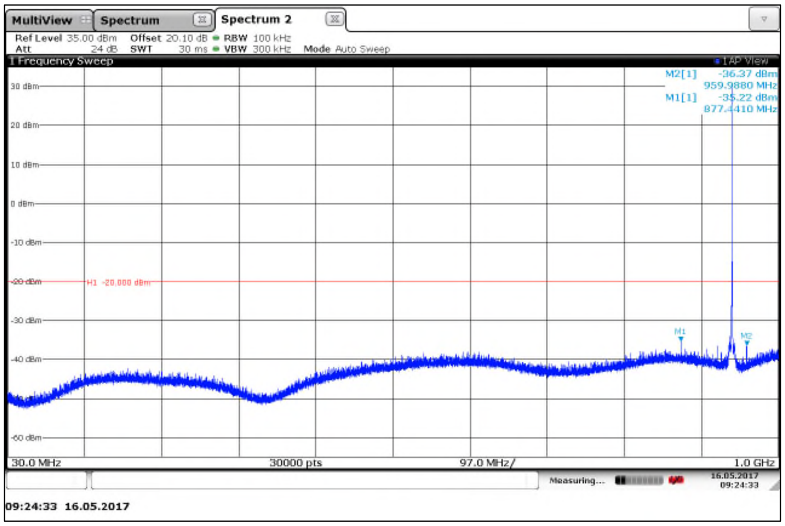

Figure 7.4.2-11: 941.4875 MHz – 30MHz to 1GHz – Mpass5k mode

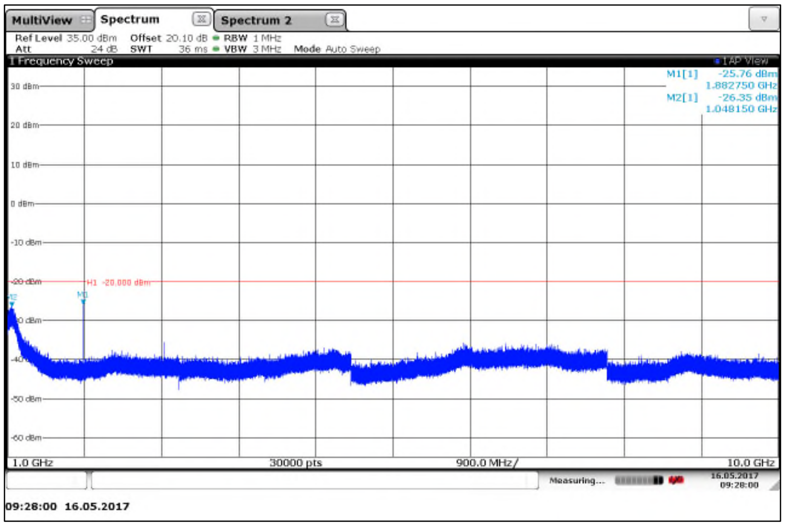

Figure 7.4.2-12: 941.4875 MHz – 1GHz to 10GHz – Mpass5k mode

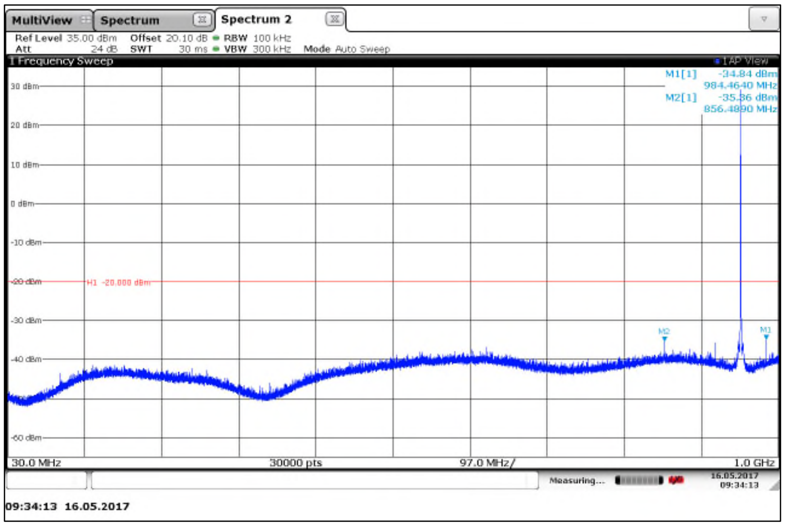

Figure 7.4.2-13: 952.5 MHz – 30MHz to 1GHz – Mpass5k mode

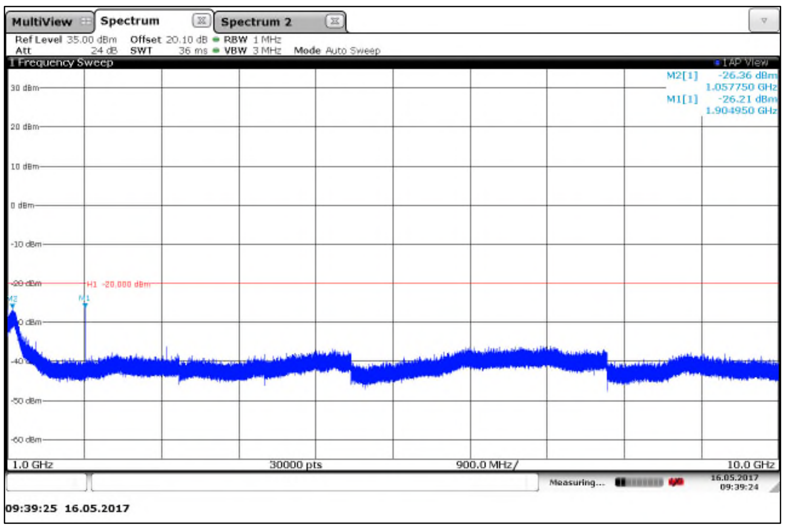

Figure 7.4.2-14: 952.5 MHz – 1GHz to 10GHz – Mpass5k mode

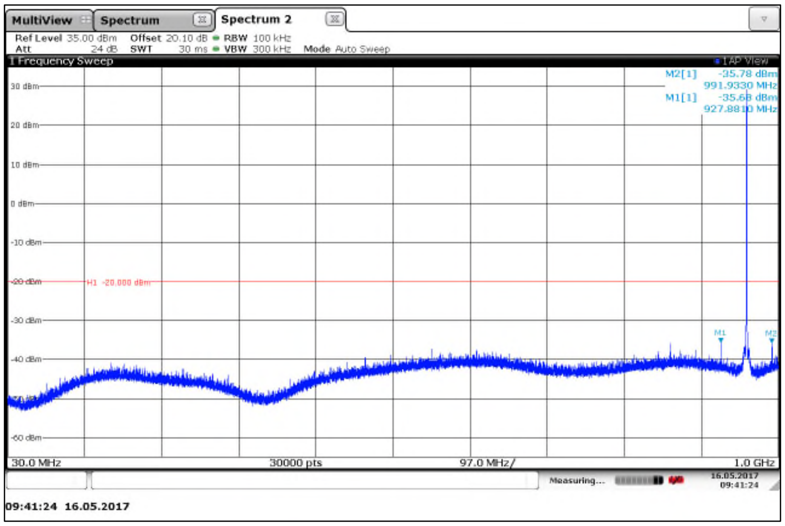

Figure 7.4.2-15: 959.925 MHz – 30MHz to 1GHz – Mpass5k mode

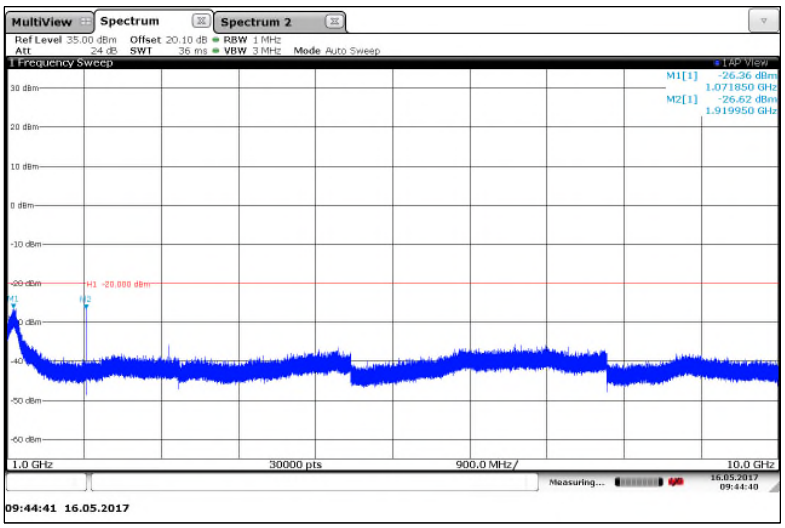

Figure 7.4.2-16: 959.925 MHz – 1GHz to 10GHz – Mpass5k mode

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: Randle Sherian

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

Table 7.5.2-1: Field Strength of Spurious Emissions – 901.5 MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBμV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1803	84.40	H	-17.17	-13.00	4.17
1803	80.2	V	-21.67	-13.00	8.67
2704.5	59.5	H	-39.01	-13.00	26.01
2704.5	63.9	V	-35.81	-13.00	22.81
1141.6	70.1	H	-34.02	-13.00	21.02
1141.6	66.3	V	-38.32	-13.00	25.32

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

Table 7.5.2-2: Field Strength of Spurious Emissions – 930.5 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1861	73.20	H	-27.78	-13.00	14.78
1861	69.8	V	-31.98	-13.00	18.98
2791.5	51.1	H	-48.33	-13.00	35.33
2791.5	55.5	V	-44.13	-13.00	31.13
1141.6	69.5	H	-34.62	-13.00	21.62
1141.6	64.5	V	-40.12	-13.00	27.12

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

Table 7.5.2-3: Field Strength of Spurious Emissions – 940.0125 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1880.025	67.70	H	-32.99	-13.00	19.99
1880.025	65.2	V	-37.09	-13.00	24.09
2820.0375	49.8	H	-49.54	-13.00	36.54
2820.0375	51.7	V	-47.44	-13.00	34.44
1141.6	71.2	H	-32.92	-13.00	19.92
1141.6	65.7	V	-38.92	-13.00	25.92

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

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

Table 7.5.2-4: Field Strength of Spurious Emissions – 928.925 MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1857.85	73.80	H	-26.88	-20.00	6.88
1857.85	70.6	V	-31.28	-20.00	11.28
2786.775	48.7	H	-50.63	-20.00	30.63
2786.775	55.5	V	-44.03	-20.00	24.03
1141.6	69.2	H	-34.92	-20.00	14.92
1141.6	64.1	V	-40.52	-20.00	20.52

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

Table 7.5.2-5: Field Strength of Spurious Emissions – 932.25 MHz – Normal Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1865	72.20	H	-27.78	-20.00	7.78
1865	69.9	V	-31.48	-20.00	11.48
2797.5	52	H	-47.34	-20.00	27.34
2797.5	54.6	V	-45.04	-20.00	25.04
1141.6	69.4	H	-34.72	-20.00	14.72
1141.6	65.4	V	-39.22	-20.00	19.22

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

Table 7.5.2-6: Field Strength of Spurious Emissions – 941.4875 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1882.975	67.30	H	-32.79	-20.00	12.79
1882.975	64	V	-38.09	-20.00	18.09
2824.4625	49	H	-50.64	-20.00	30.64
2824.4625	51.7	V	-47.74	-20.00	27.74
1141.6	71.7	H	-32.42	-20.00	12.42
1141.6	65.5	V	-39.12	-20.00	19.12

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

Table 7.5.2-7: Field Strength of Spurious Emissions – 952.5 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBμV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1905	62.20	H	-36.29	-20.00	16.29
1905	59.8	V	-41.19	-20.00	21.19
2857.5	46.3	H	-52.85	-20.00	32.85
2857.5	48.9	V	-50.25	-20.00	30.25
1141.6	72.2	H	-31.92	-20.00	11.92
1141.6	67.7	V	-36.92	-20.00	16.92
1905	62.20	H	-36.29	-20.00	16.29

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

Table 7.5.2-8: Field Strength of Spurious Emissions – 959.925 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBμV)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1919.85	59.90	H	-39.59	-20.00	19.59
1919.85	58.9	V	-41.79	-20.00	21.79
2879.775	47.6	H	-52.16	-20.00	32.16
2879.775	50.9	V	-48.46	-20.00	28.46
1141.6	73.3	H	-30.82	-20.00	10.82
1141.6	67.9	V	-36.62	-20.00	16.62

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 4 Vdc. Measurements were made to the equipment under test at a temperature of 20º C and at 85% and 115% variation of 4Vdc. The maximum variation of frequency was recorded.

At the clients request data for all 3 TCXO variants are included in the results below.

7.6.2 Measurement Results
Performed by: Randle Sherian

Part 24.135, RSS-134 (4.5)

Frequency Stability

	KDS-CBA	**Frequency (MHz):**	901.5	
	7000380	**Deviation Limit (PPM):**	1.0ppm	

Temperature C	Frequency MHz	Frequency Error (PPM)	Voltage (%)	Voltage (DC)
-30 C	**901.499881**	**-0.132**	0%	4.00
-20 C	**901.499943**	**-0.063**	0%	4.00
-10 C	**901.500031**	**0.034**	0%	4.00
0 C	**901.499992**	**-0.009**	0%	4.00
10 C	**901.499898**	**-0.113**	0%	4.00
20 C	**901.499843**	**-0.174**	0%	4.00
30 C	**901.499802**	**-0.220**	0%	4.00
40 C	**901.499685**	**-0.349**	0%	4.00
50 C	**901.499598**	**-0.446**	0%	4.00
20 C	**901.499879**	**-0.134**	15%	4.600
20 C	**901.499907**	**-0.103**	-15%	3.400

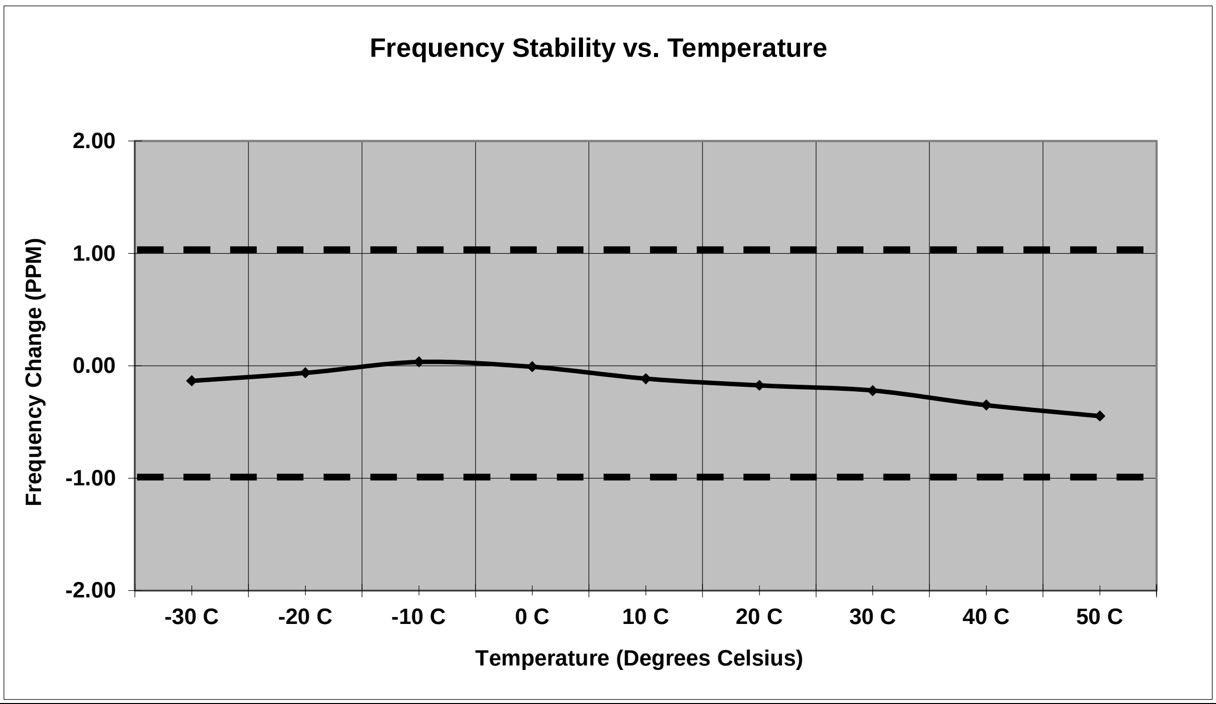

Figure 7.6.2-1: Frequency Stability – 901.5 MHz – KDS/CBA

Frequency Stability

KDS-MEA	**Frequency (MHz):**	901.5	
7000383	**Deviation Limit (PPM):**	1.0ppm	

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(DC)
-30 C	**901.499911**	**-0.099**	0%	4.00
-20 C	**901.499813**	**-0.207**	0%	4.00
-10 C	**901.499924**	**-0.084**	0%	4.00
0 C	**901.499852**	**-0.164**	0%	4.00
10 C	**901.499814**	**-0.206**	0%	4.00
20 C	**901.499794**	**-0.229**	0%	4.00
30 C	**901.499803**	**-0.219**	0%	4.00
40 C	**901.499745**	**-0.283**	0%	4.00
50 C	**901.499379**	**-0.689**	0%	4.00
20 C	**901.499838**	**-0.180**	15%	4.600
20 C	**901.499853**	**-0.163**	-15%	3.400

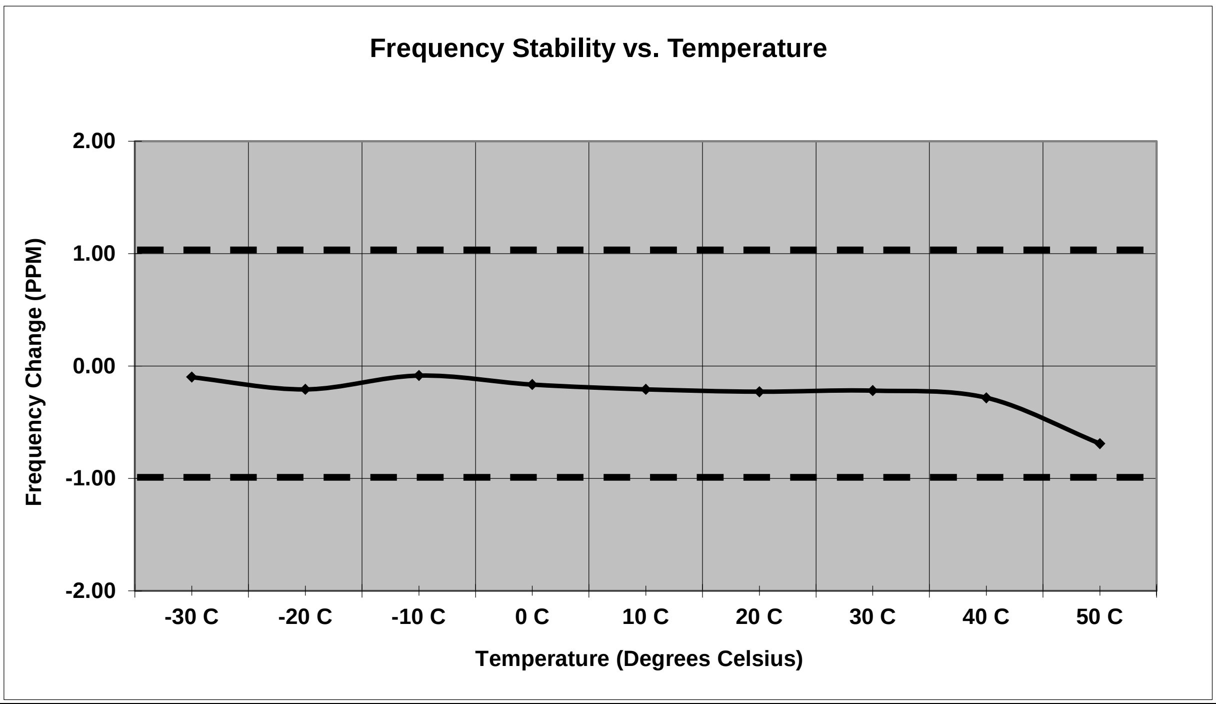

Figure 7.6.2-2: Frequency Stability – 901.5 MHz – KDS/MEA

Frequency Stability

Taitien	**Frequency (MHz):**	901.5	
7000379	**Deviation Limit (PPM):**	1.0ppm	

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(DC)
-30 C	**901.499610**	**-0.433**	0%	4.00
-20 C	**901.499631**	**-0.409**	0%	4.00
-10 C	**901.499584**	**-0.461**	0%	4.00
0 C	**901.499464**	**-0.595**	0%	4.00
10 C	**901.499432**	**-0.630**	0%	4.00
20 C	**901.499930**	**-0.078**	0%	4.00
30 C	**901.499974**	**-0.029**	0%	4.00
40 C	**901.500164**	**0.182**	0%	4.00
50 C	**901.500454**	**0.504**	0%	4.00
20 C	**901.500023**	**0.026**	15%	4.60
20 C	**901.499982**	**-0.020**	-15%	3.40

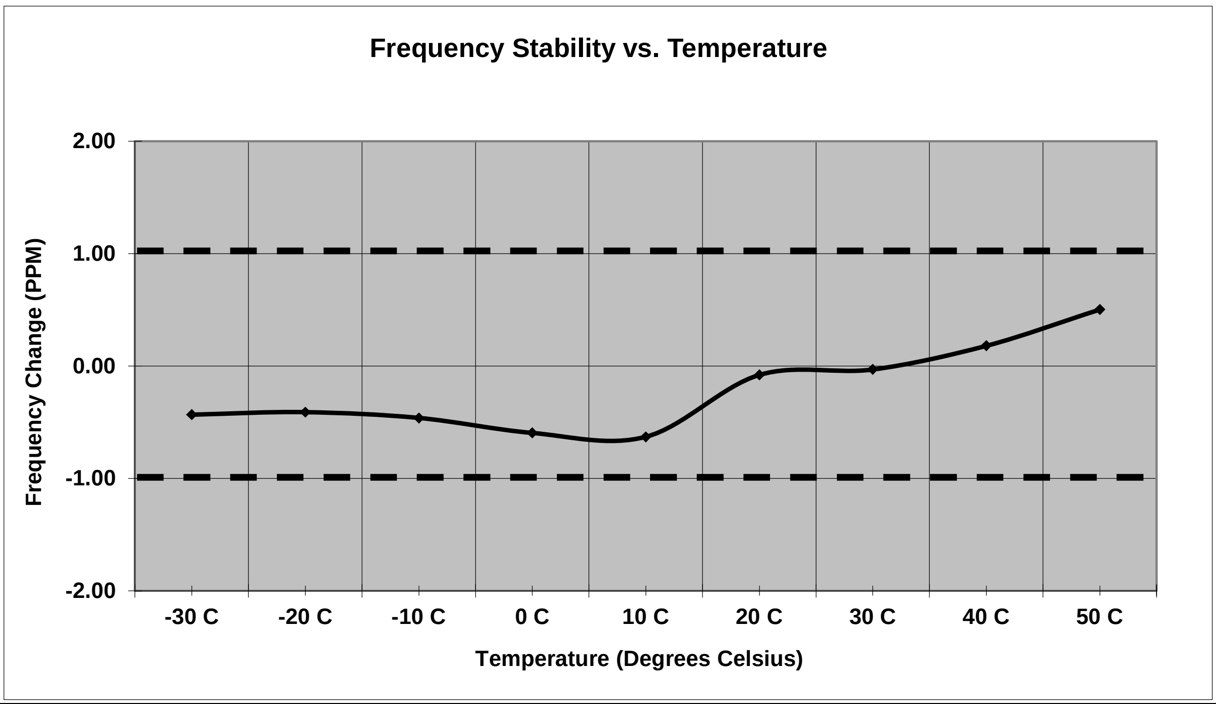

Figure 7.6.2-3: Frequency Stability – 901.5 MHz - Taitien

Part 24.135, RSS-134 (4.5)

Frequency Stability

KDS-CBA	**Frequency (MHz):**	930.5	
7000380	**Deviation Limit (PPM):**	1.0ppm	

Temperature C	Frequency MHz	Frequency Error (PPM)	Voltage (%)	Voltage (DC)
-30 C	**930.499856**	**-0.155**	0%	4.00
-20 C	**930.499889**	**-0.119**	0%	4.00
-10 C	**930.500112**	**0.120**	0%	4.00
0 C	**930.500012**	**0.013**	0%	4.00
10 C	**930.499906**	**-0.101**	0%	4.00
20 C	**930.499838**	**-0.174**	0%	4.00
30 C	**930.499817**	**-0.197**	0%	4.00
40 C	**930.499685**	**-0.339**	0%	4.00
50 C	**930.499655**	**-0.371**	0%	4.00
20 C	**930.499893**	**-0.115**	15%	4.600
20 C	**930.499926**	**-0.080**	-15%	3.400

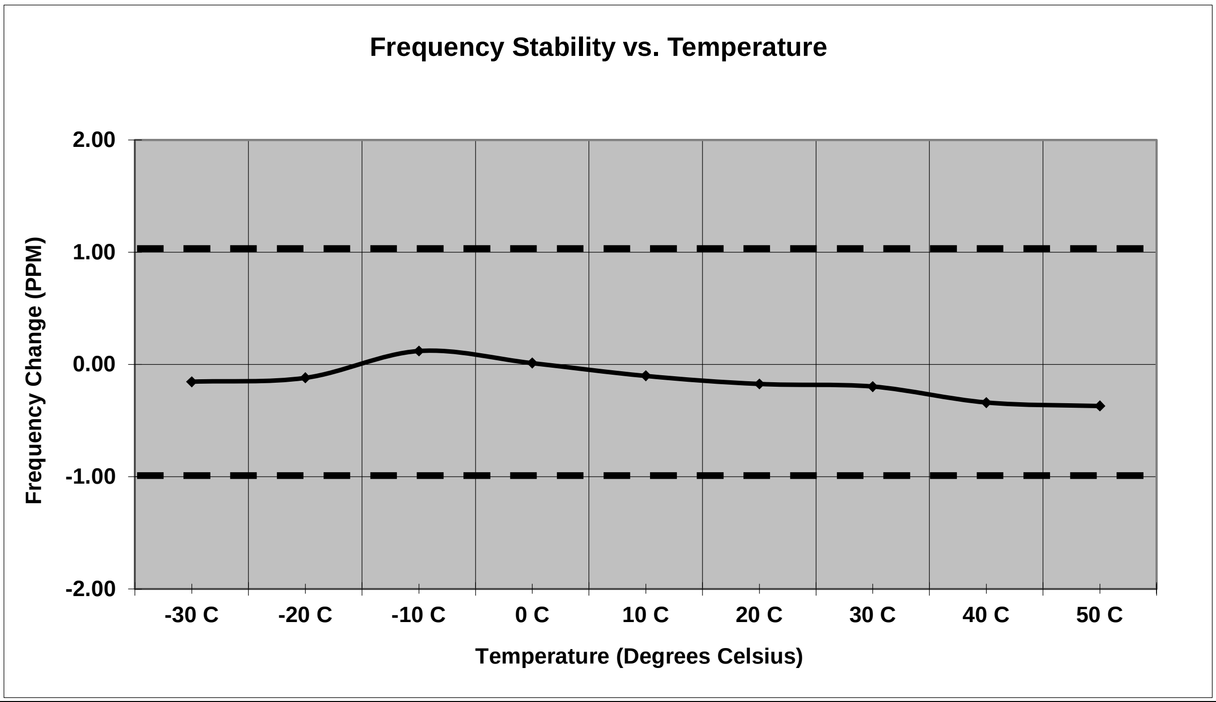

Figure 7.6.2-4: Frequency Stability – 930.5 MHz – KDS/CBA

Frequency Stability

KDS-MEA	**Frequency (MHz):**	930.5
700383	**Deviation Limit (PPM):**	1.0ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(DC)
-30 C	**930.499832**	**-0.181**	0%	4.00
-20 C	**930.499787**	**-0.229**	0%	4.00
-10 C	**930.499856**	**-0.155**	0%	4.00
0 C	**930.499750**	**-0.269**	0%	4.00
10 C	**930.499739**	**-0.280**	0%	4.00
20 C	**930.499783**	**-0.233**	0%	4.00
30 C	**930.499715**	**-0.306**	0%	4.00
40 C	**930.499644**	**-0.383**	0%	4.00
50 C	**930.499334**	**-0.716**	0%	4.00
20 C	**930.499765**	**-0.253**	15%	4.600
20 C	**930.499805**	**-0.210**	-15%	3.400

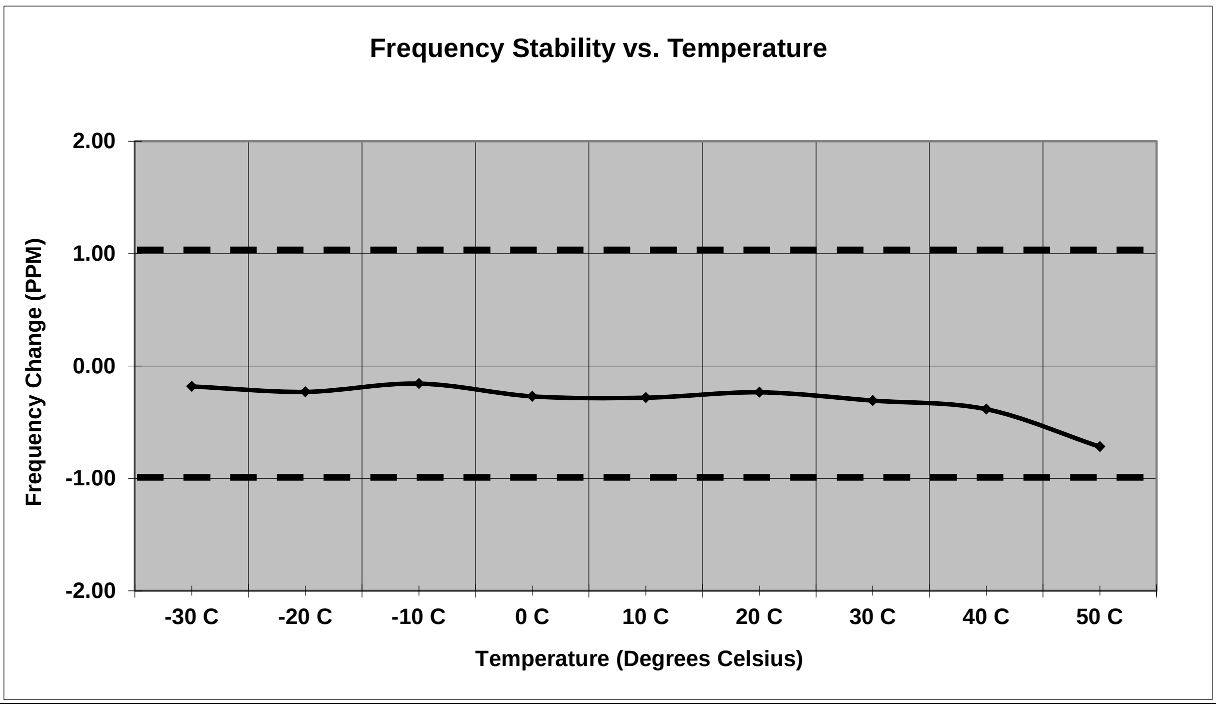

Figure 7.6.2-5: Frequency Stability – 930.5 MHz – KDS/MEA

Frequency Stability

Taitien	**Frequency (MHz):**	930.5	
7000379	**Deviation Limit (PPM):**	1.0ppm	

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(DC)
-30 C	**930.499404**	**-0.641**	0%	4.00
-20 C	**930.499511**	**-0.526**	0%	4.00
-10 C	**930.499373**	**-0.674**	0%	4.00
0 C	**930.499173**	**-0.889**	0%	4.00
10 C	**930.499194**	**-0.866**	0%	4.00
20 C	**930.499771**	**-0.246**	0%	4.00
30 C	**930.499557**	**-0.476**	0%	4.00
40 C	**930.499955**	**-0.048**	0%	4.00
50 C	**930.500181**	**0.195**	0%	4.00
20 C	**930.499701**	**-0.321**	15%	4.600
20 C	**930.499713**	**-0.308**	-15%	3.400

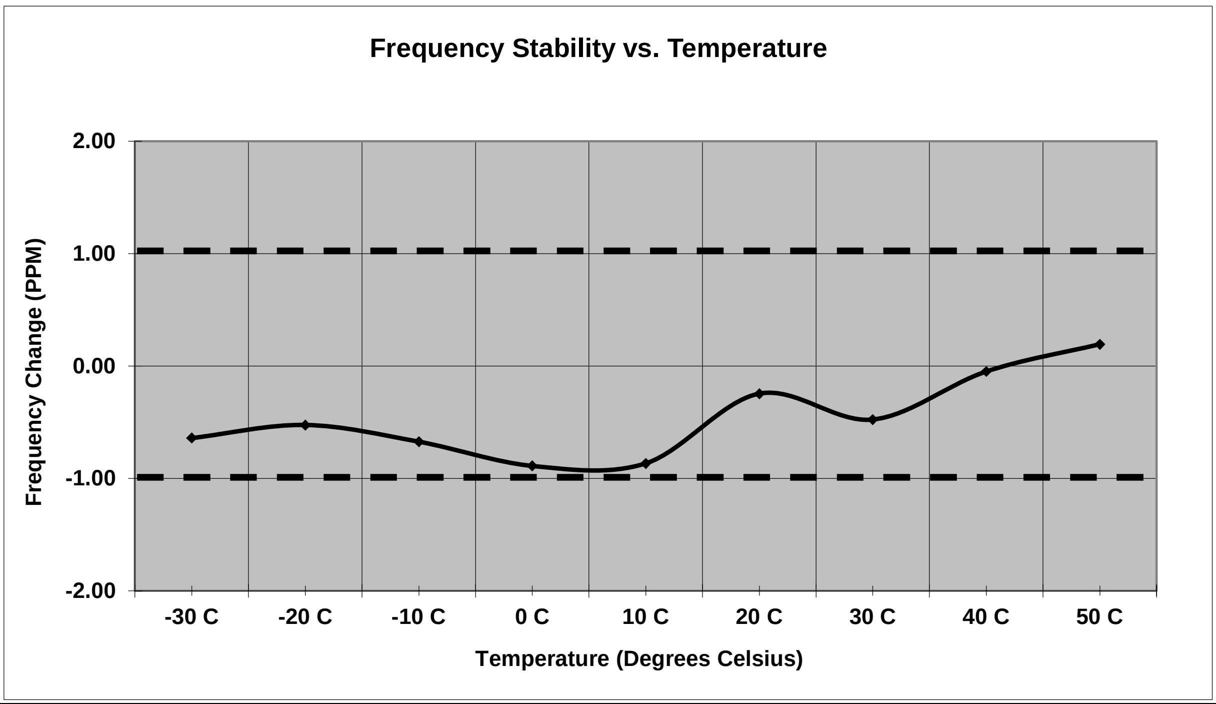

Figure 7.6.2-6: Frequency Stability – 930.5 MHz - Taitien

Part 101.107, RSS-119 5.3

Frequency Stability

	KDS-CBA	**Frequency (MHz):**	959.925
	7000380	**Deviation Limit (PPM):**	1.0ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(DC)
-30 C	**959.924890**	**-0.115**	0%	4.00
-20 C	**959.924893**	**-0.111**	0%	4.00
-10 C	**959.925100**	**0.104**	0%	4.00
0 C	**959.925740**	**0.771**	0%	4.00
10 C	**959.924931**	**-0.072**	0%	4.00
20 C	**959.924902**	**-0.102**	0%	4.00
30 C	**959.924858**	**-0.148**	0%	4.00
40 C	**959.924758**	**-0.252**	0%	4.00
50 C	**959.924653**	**-0.361**	0%	4.00
20 C	**959.924938**	**-0.065**	15%	4.600
20 C	**959.924958**	**-0.044**	-15%	3.400

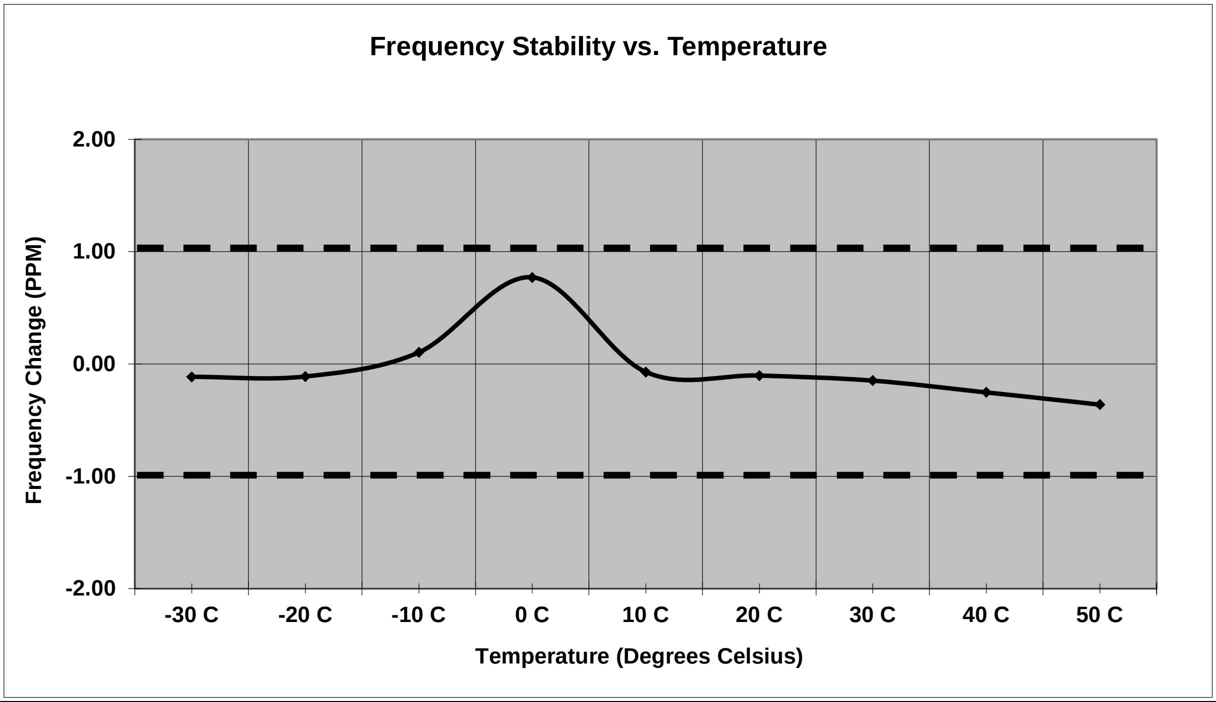

Figure 7.6.2-7: Frequency Stability – 959.925 MHz – KDS/CBA

Frequency Stability

KDS-MEA	**Frequency (MHz):**	959.925
7000383	**Deviation Limit (PPM):**	1.0ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(DC)
-30 C	**959.924754**	**-0.256**	0%	4.00
-20 C	**959.924686**	**-0.327**	0%	4.00
-10 C	**959.924729**	**-0.282**	0%	4.00
0 C	**959.924659**	**-0.355**	0%	4.00
10 C	**959.924637**	**-0.378**	0%	4.00
20 C	**959.924649**	**-0.366**	0%	4.00
30 C	**959.924613**	**-0.403**	0%	4.00
40 C	**959.924554**	**-0.465**	0%	4.00
50 C	**959.924311**	**-0.718**	0%	4.00
20 C	**959.924685**	**-0.328**	15%	4.600
20 C	**959.924708**	**-0.304**	-15%	3.400

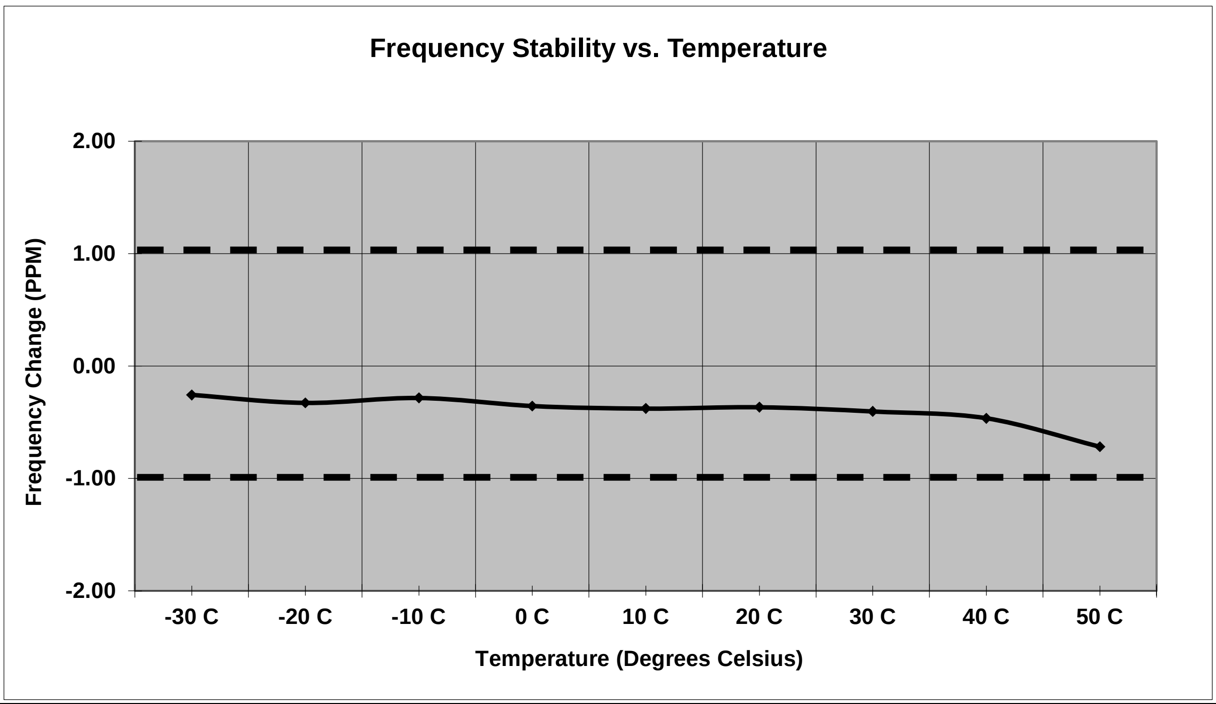

Figure 7.6.2-8: Frequency Stability – 959.925 MHz – KDS/MEA

Frequency Stability

	Taitien	Frequency (MHz):	959.925
	3000379	Deviation Limit (PPM):	1.0ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(DC)
-30 C	**959.924157**	**-0.878**	0%	4.00
-20 C	**959.924326**	**-0.702**	0%	4.00
-10 C	**959.924174**	**-0.860**	0%	4.00
0 C	**959.924289**	**-0.741**	0%	4.00
10 C	**959.924344**	**-0.683**	0%	4.00
20 C	**959.924512**	**-0.508**	0%	4.00
30 C	**959.924299**	**-0.730**	0%	4.00
40 C	**959.924695**	**-0.318**	0%	4.00
50 C	**959.924934**	**-0.069**	0%	4.00
20 C	**959.924484**	**-0.538**	15%	4.60
20 C	**959.924432**	**-0.592**	-15%	3.40

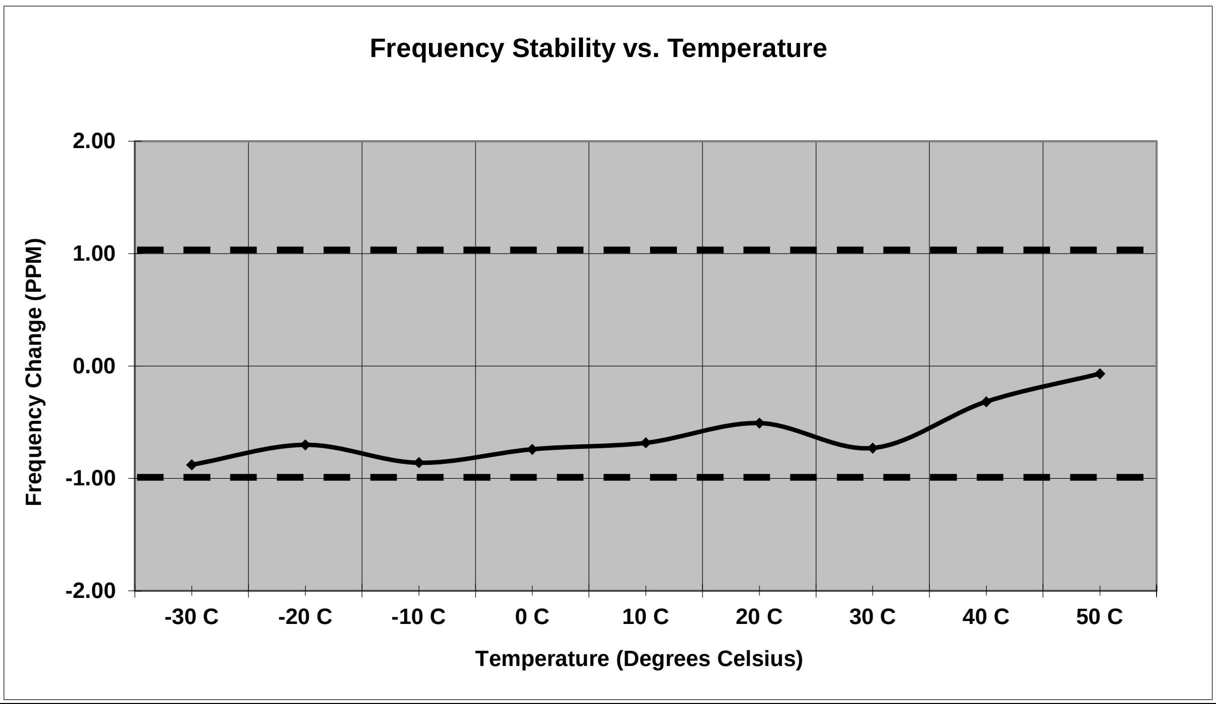

Figure 7.6.2-9: Frequency Stability – 959.925 MHz - Taitien

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 FXZIG210, manufactured by Sensus Metering Systems, Inc., meets all the requirements of FCC Part 24D and Part 101 as well as ISED Canada RSS-119 and RSS-134 where applicable.

End Report