Excellence in Compliance Testing

Certification Test Report

FCC ID: SDBM400G2900
IC: 2220A-M400G2900
FCC Rule Part: CFR 47 Part 24 Subpart D, Part 101 Subpart C
ISED Canada's Radio Standards Specification: RSS 119, RSS 134

ACS Report Number: 16-3040.W06.1A

Applicant: Sensus Metering Systems, Inc.
Model: M400G2900

Test Begin Date: May 19, 2016
Test End Date: June 17, 2016

Report Issue Date: July 11, 2016

For The Scope of Accreditation Under Certificate Number 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 61 pages

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1.0 GENERAL

1.1 Purpose

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

1.2 Product Description

The Sensus FlexNet M400D Base Station transceiver consists of two circuit cards mounted in an Aluminum chassis to form a XCVR. The M400 uses an associated external PA module to provide up to a rated TX power of 35W. The transmitter is capable of variable power output controlled through software.

The M400D transceiver can either be used as a single unit or mounted in a 19" cabinet mount unit that will contain two M400D transceivers, two PAs, and one combiner.

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

Test Sample Condition: The EUT was in good functional condition with no physical damage.

Test software provided by the manufacturer was used to exercise the EUT.

The evaluation for unintentional emissions is documented separately in a verification report.

1.3 Test Methodology

1.3.1 Configurations and Justification

The EUT was tested together with its associated PA module. The combination was tested in both high and low power modes.

The unit was evaluated for radiated spurious emissions in its normal orientation and with the RF output port terminated in its characteristic impedance (50 ohms).

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	930.0 - 931.0
24D	940.0 - 941.0
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. MHz
24D	930.0 - 931.0	Middle	930.5000
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 M400D transmitter produces four distinct modulation formats. The emission designators for the modulation types used by the M400D transmitter were calculated using the baud rate defined in the Theory of Operation and are as follows.

Mode	Emission Designator	Modulation Type
MPass 5k	5K90F1D	FSK
MPass2 10k	11K8F1D	FSK
MPass4 10k	8K75F1D	FSK
MPass4 20k	17K5F1D	FSK

2.0 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions, Inc.
2320 Presidential Dr. Suite 101
Durham NC 27703
Phone: (919) 381-4235
www.acstestlab.com

FCC Test Firm Registration #: 637011
ISED Canada Lab Code: 20446

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS (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 turntable. 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:

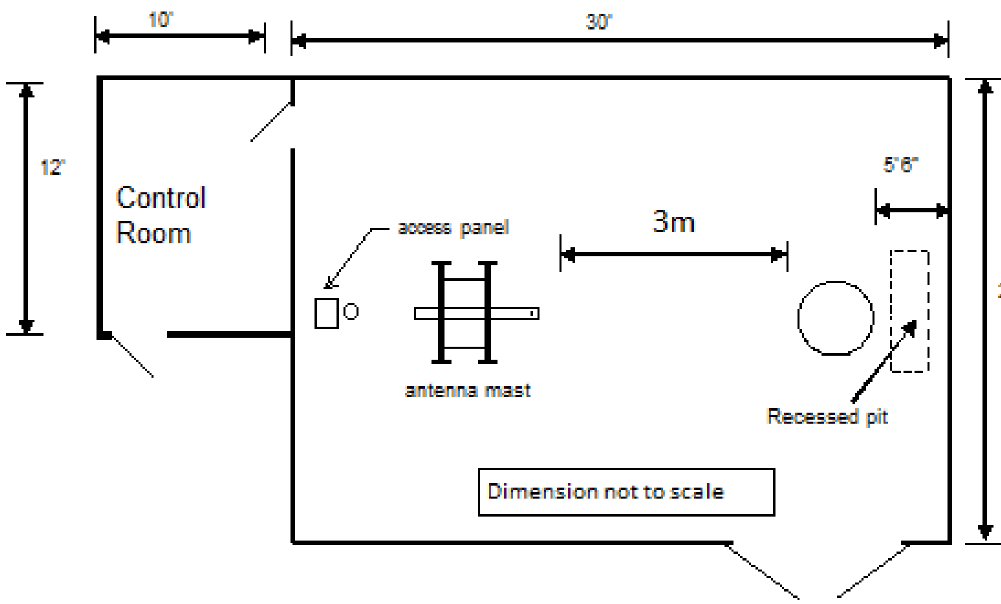

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

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:

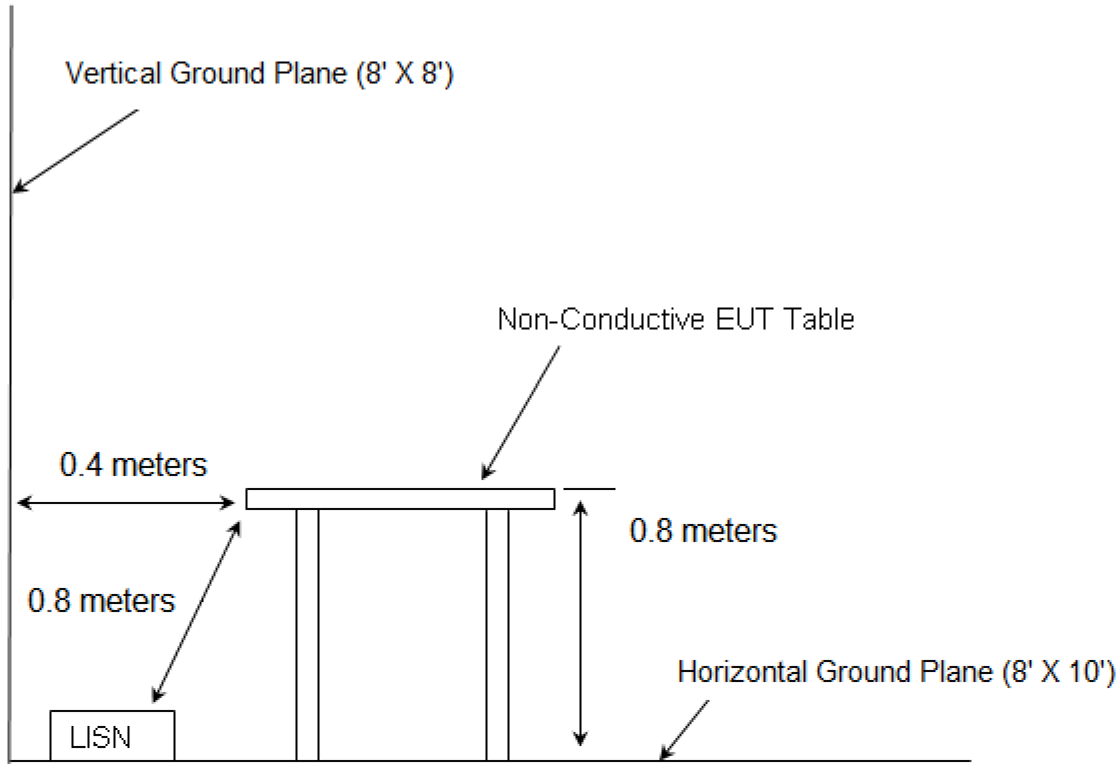

Figure 2.3.2-1: AC Mains Conducted EMI Site

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 - 2016
- US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communications Services – 2016
- US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services -2016
- 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

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
277	Emco	93146	Antennas	9904-5199	9/2/2014	9/2/2016
626	EMCO	3110B	Antennas	9411-1945	2/29/2016	2/28/2017
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/8/2016	1/8/2017
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	6/29/2015	6/29/2016
3008	Rohde & Schwarz	NRP2	Meter	103131	1/28/2016	1/28/2017
3009	Rohde & Schwarz	NRP-Z81	Wideband Sensor	102397	1/28/2016	1/28/2017
3012	Rohde & Schwarz	EMC32-EB	Software	100731	2/2/2016	8/2/2016
3014	Emco	3115	Antennas	9901-5653	2/10/2015	2/10/2017
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2018
3020	Rohde & Schwarz	SMB100A	Signal Generator	175943	7/14/2015	7/14/2016
3028	Micro-Tronics	HPM50111	Filter	122	12/21/2015	12/21/2016
3031	Hasco, Inc.	HLL335-S1-S1-96	Cables	3074	12/30/2015	12/30/2016
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	12/22/2015	12/22/2016
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	12/22/2015	12/22/2016
3041	Aeroflex Inmet	18N10W-30	Attenuator	1447	1/8/2016	1/8/2017
3042	Aeroflex Inmet	18N10W-10	Attenuator	1444	1/8/2016	1/8/2017
3045	Aeroflex Inmet	18N10W-20	Attenuator	1437	1/8/2016	1/8/2017
3060	Weinschel Corp.	47-20-33	Attenuator	BJ0583	9/2/2015	9/2/2017
RE183	Thermotron	S-1.2C	Environmental Chamber	19742	10/6/2015	10/6/2016

NCR = No Calibration Required
Firmware Version: ESU40 is 4.73 SP4
Software Version: EMC32-B is 9.15

5.0 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Sensus	M400D	ACS #1
2	PA module	Sensus	M400D	ACS #3
3	Power Supply	B&K	1694	258C12210

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	EUT power	1.8m	No	Power Supply
B	EUT to PA module	0.15m	Yes	PA module
C	Power supply	1.8m	No	Mains

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

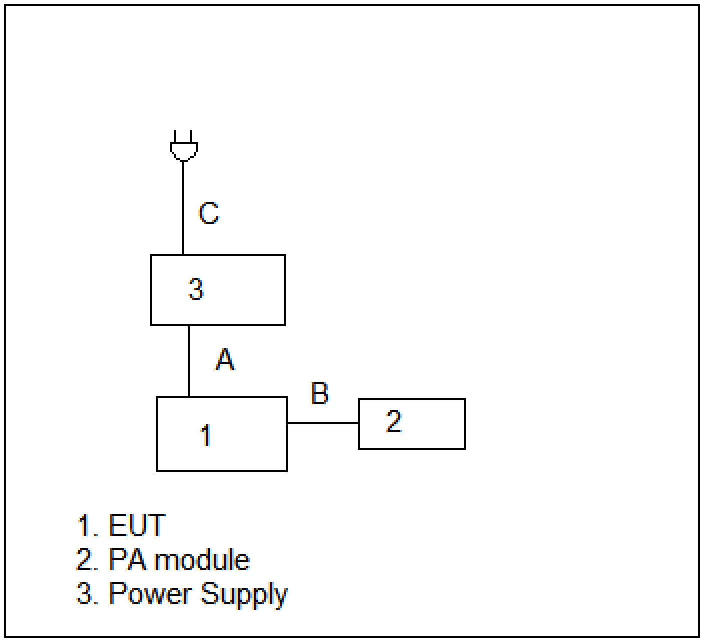

Figure 6-1: EUT Test Setup

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

The RF output was measured by directly connecting to the input of the RF peak power meter through suitable passive attenuation. The internal correction factor capabilities of the power meter were employed to correct for any cable or attenuator losses.

7.1.2 Measurement Results

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

Table 7.1.2-1: Peak Output Power

Frequency (MHz)	FCC Rule Part	Output Power (Low Power) (dBm)	Output Power (High Power) (dBm)
930.5	24D	24.63	46.06
940.0125	24D	24.62	45.91
941.4875	101	24.59	45.81
952.5	101	24.48	45.21
959.925	101	24.25	44.61

7.2 Occupied Bandwidth

7.2.1 Measurement Procedure

A spectrum analyzer was used for the occupied bandwidth plots using 60.3 dB of passive attenuation this consisted of 60 dB of attenuators and 0.3 dB in coax losses. The spectrum analyzer resolution bandwidth was set to 300 Hz the video bandwidth was set to a value greater than or equal to 3 times the resolution bandwidth. The internal correction factors of the spectrum analyzer were employed to correct for the cable and attenuator losses. Results of the test are shown below for all modes of operation.

For demonstration of compliance to both FCC Part 101.111 (a) (6) and RSS-119 mask G the mask of FCC Part 101 (a) (6) was used. This mask is stricter than the RSS-119 mask G.

7.2.2 Measurement Results – Emission Masks

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

Low Power

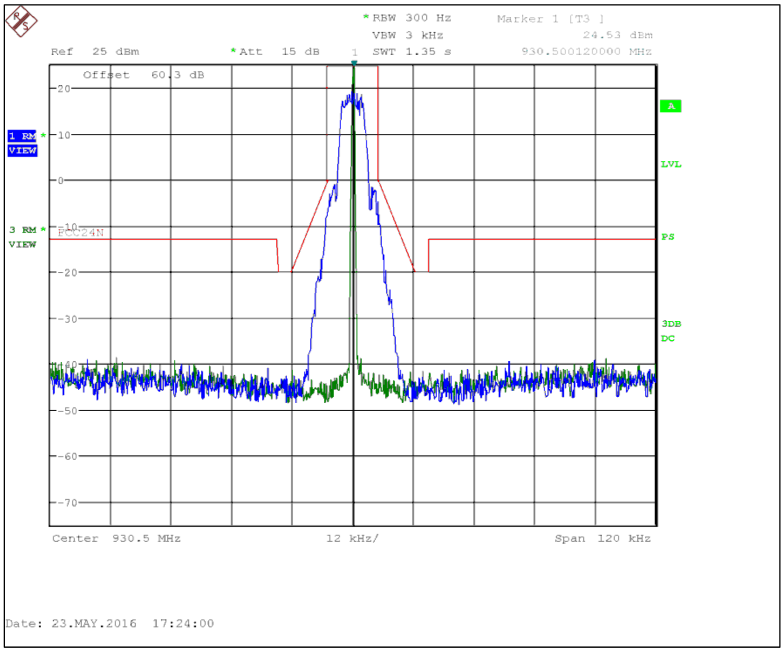

Figure 7.2.2-1: 930.5 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

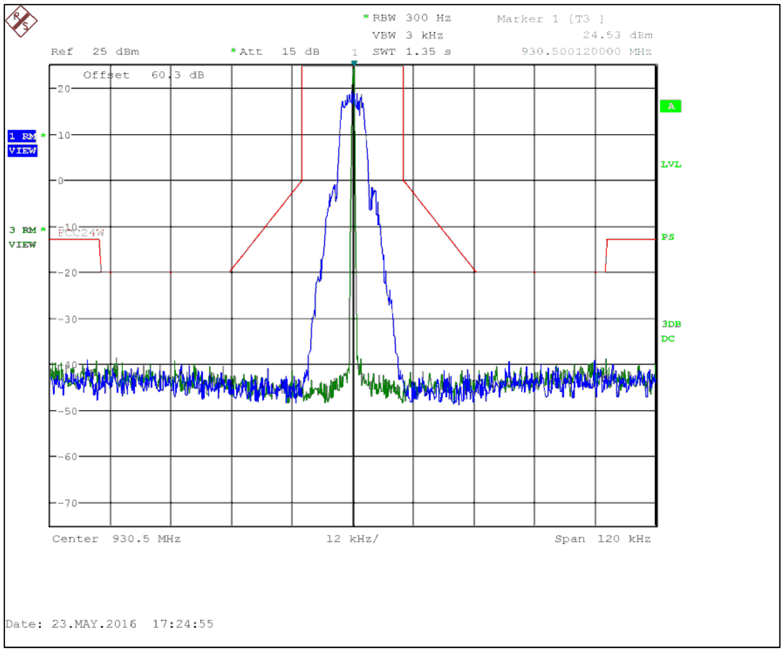

Figure 7.2.2-2: 930.5 MHz – 25 kHz Channel Spacing – mPass 5k Mode

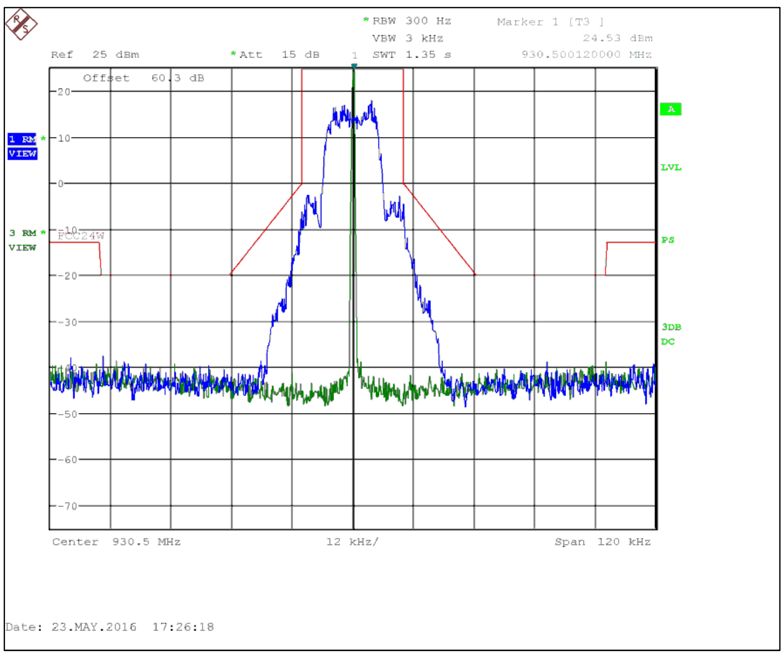

Figure 7.2.2-3: 930.5 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

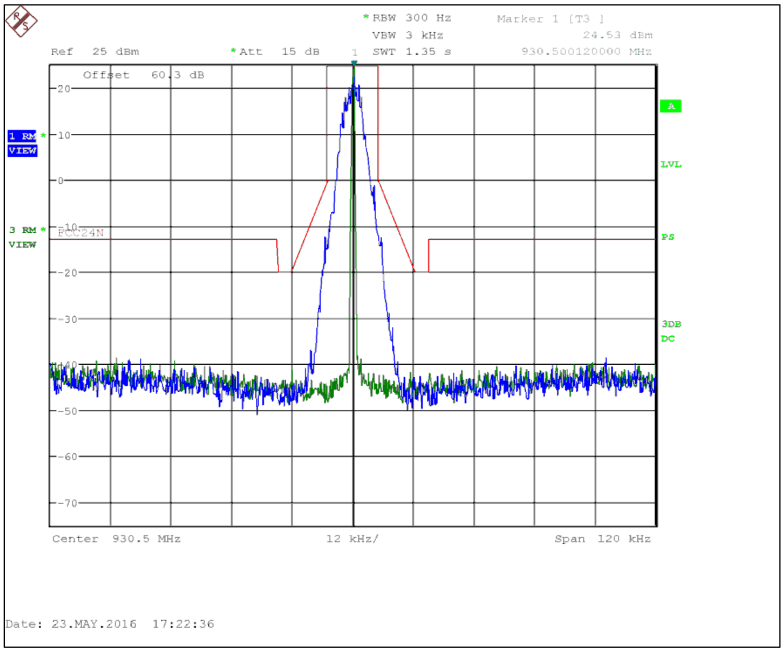

Figure 7.2.2-4: 930.5 MHz – 12.5 kHz Channel Spacing – mPass4 10k Mode

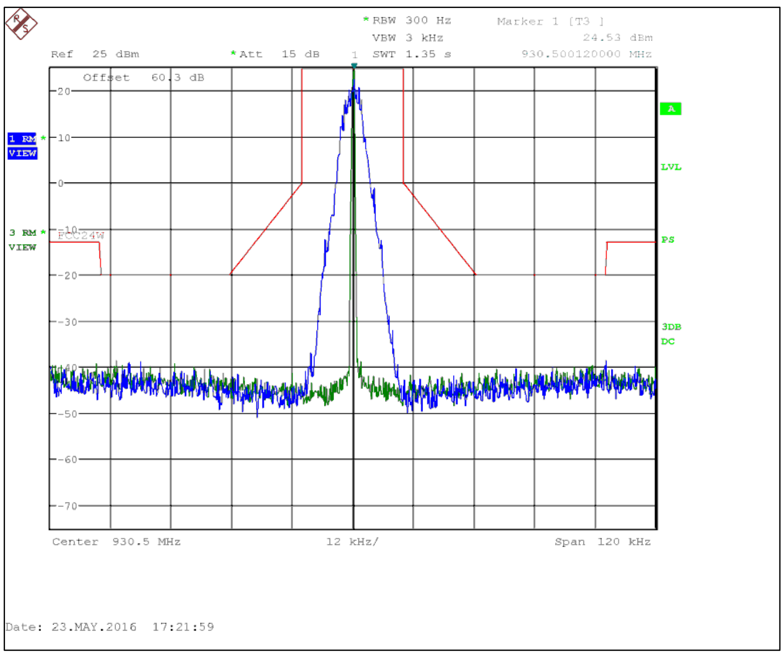

Figure 7.2.2-5: 930.5 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

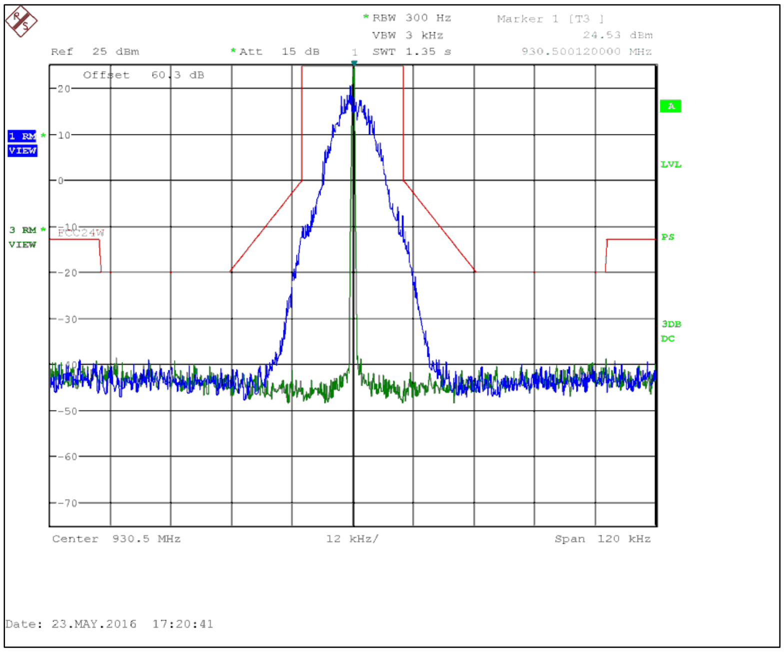

Figure 7.2.2-6: 930.5 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

High Power

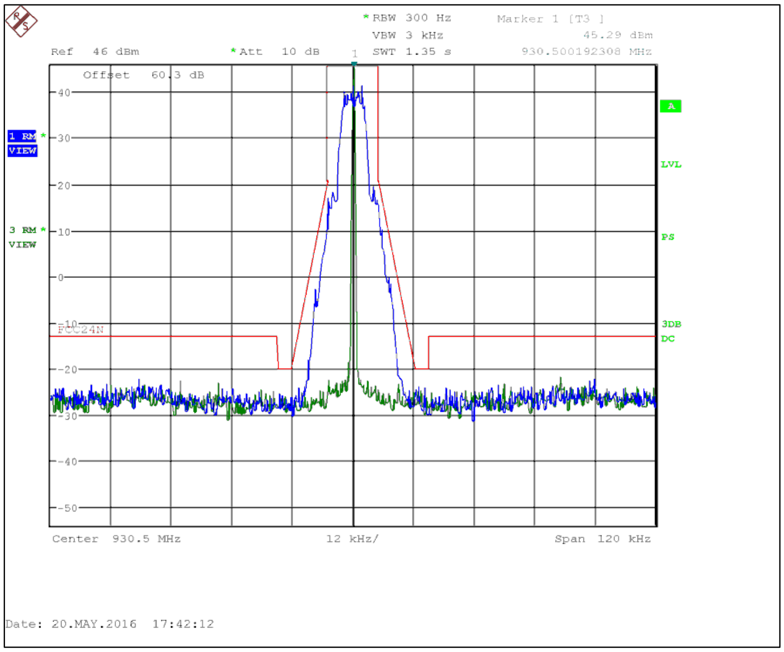

Figure 7.2.2-7: 930.5 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

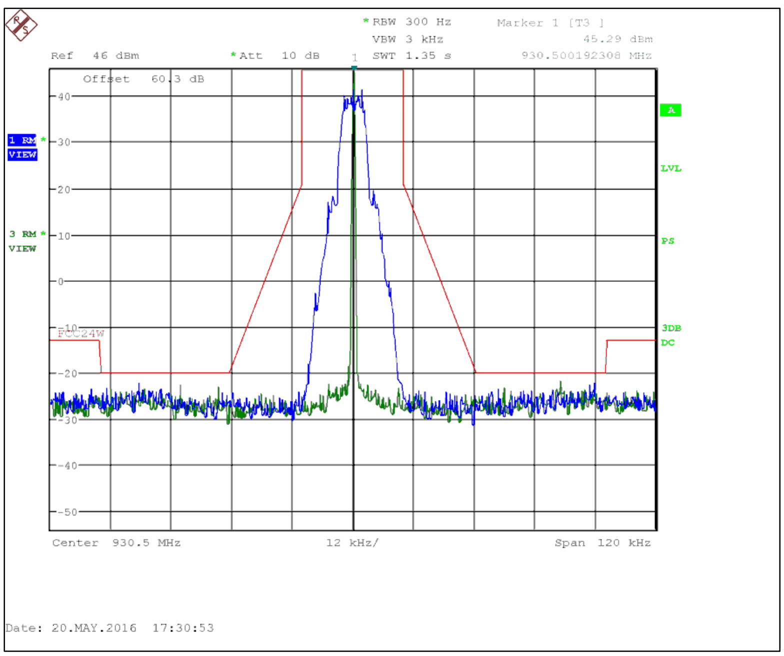

Figure 7.2.2-8: 930.5 MHz – 25 kHz Channel Spacing – mPass 5k Mode

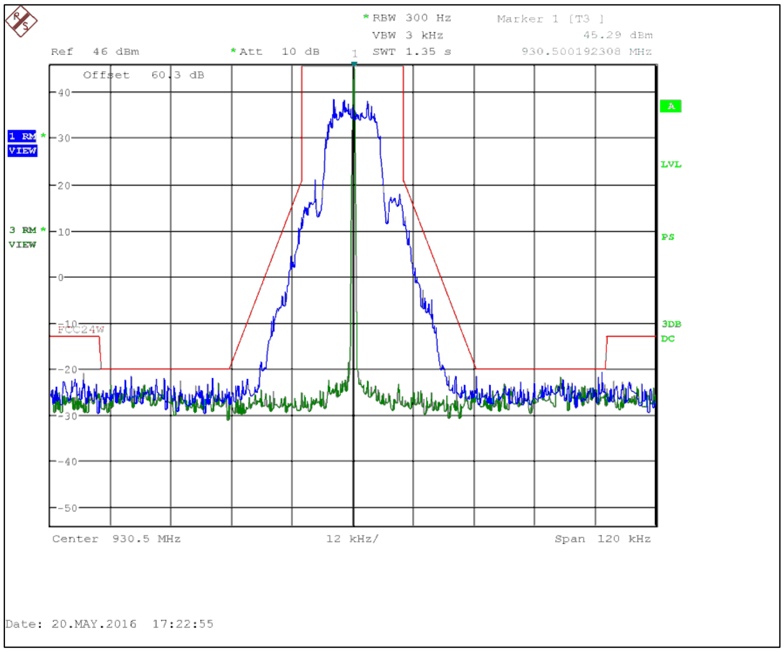

Figure 7.2.2-9: 930.5 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

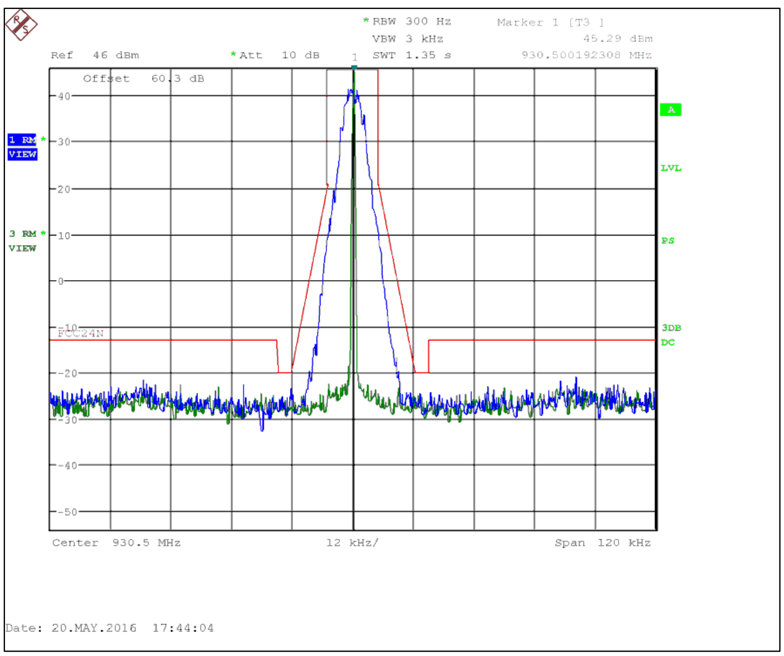

Figure 7.2.2-10: 930.5 MHz – 12.5 kHz Channel Spacing – mPass4 10k Mode

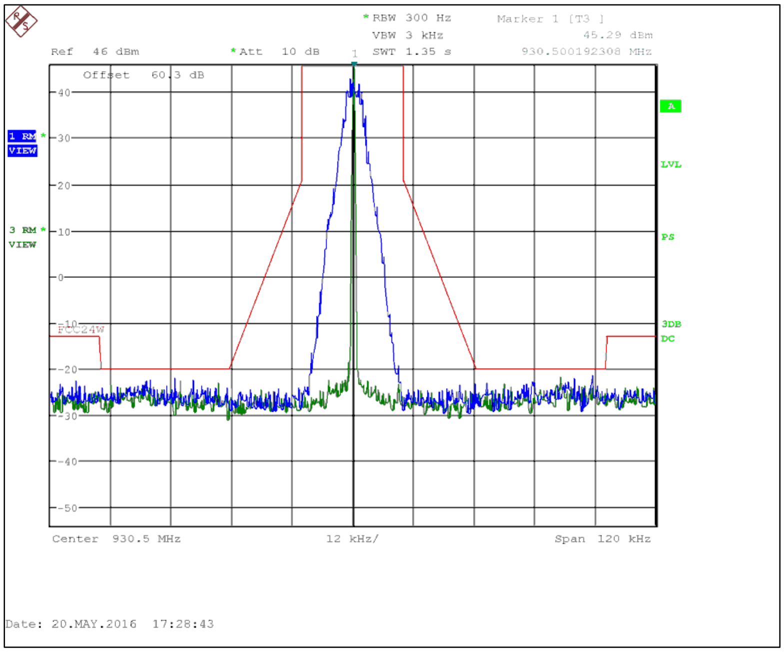

Figure 7.2.2-11: 930.5 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

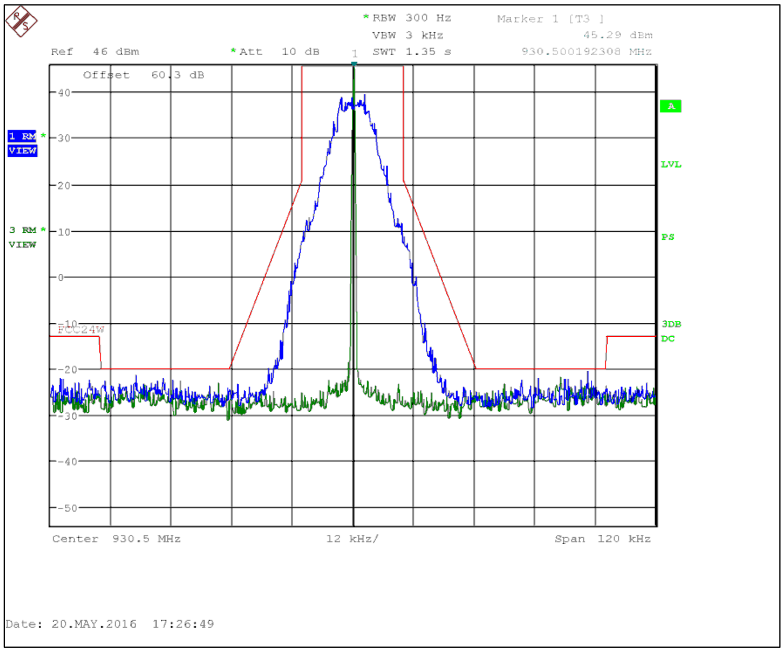

Figure 7.2.2-12: 930.5 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

Low Power

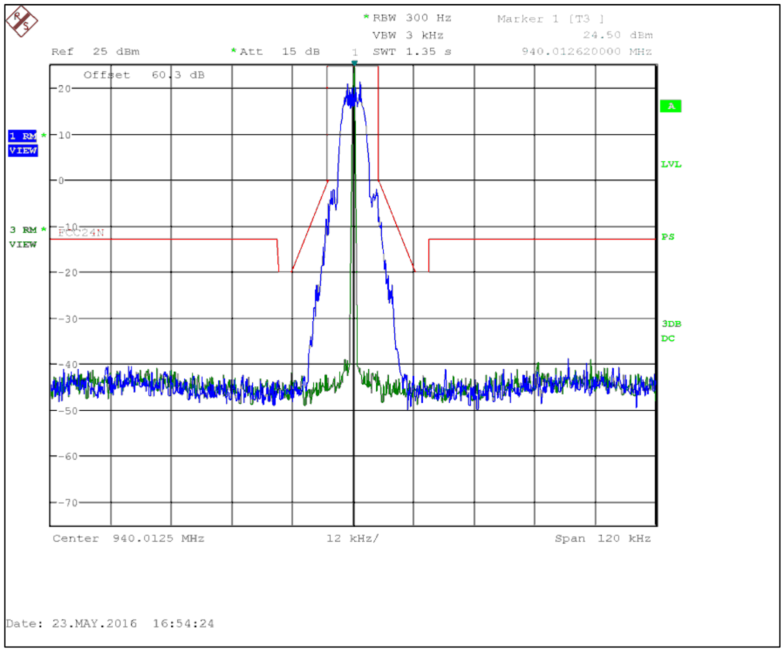

Figure 7.2.2-13: 940.0125 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

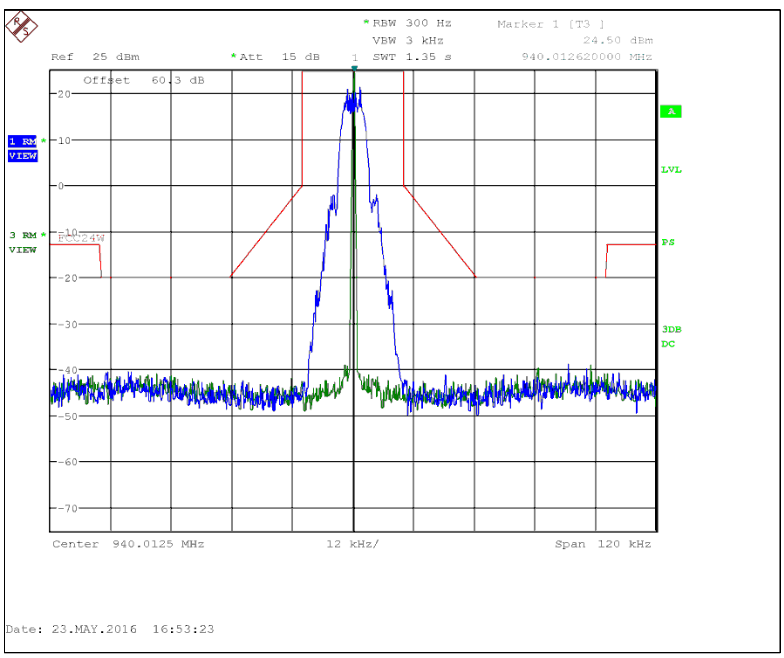

Figure 7.2.2-14: 940.0125 MHz – 25 kHz Channel Spacing – mPass 5k Mode

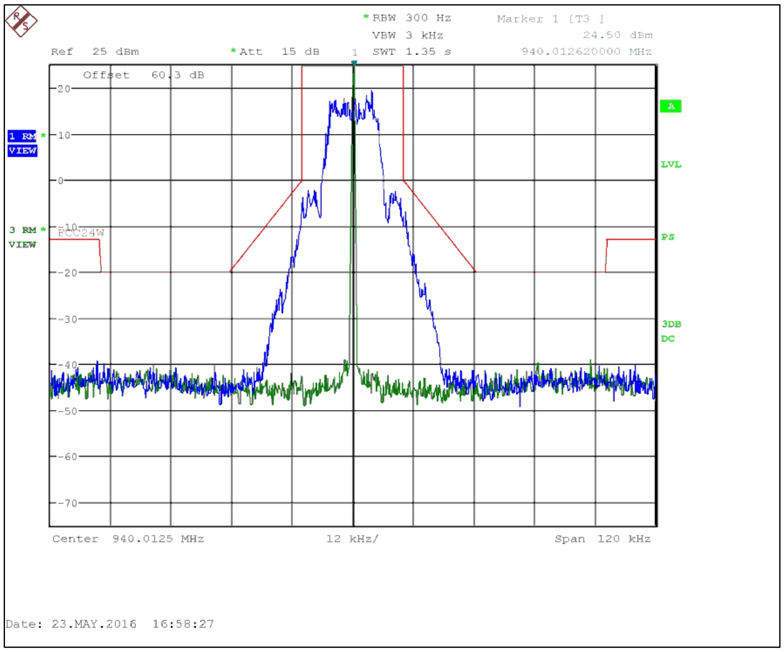

Figure 7.2.2-15: 940.0125 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

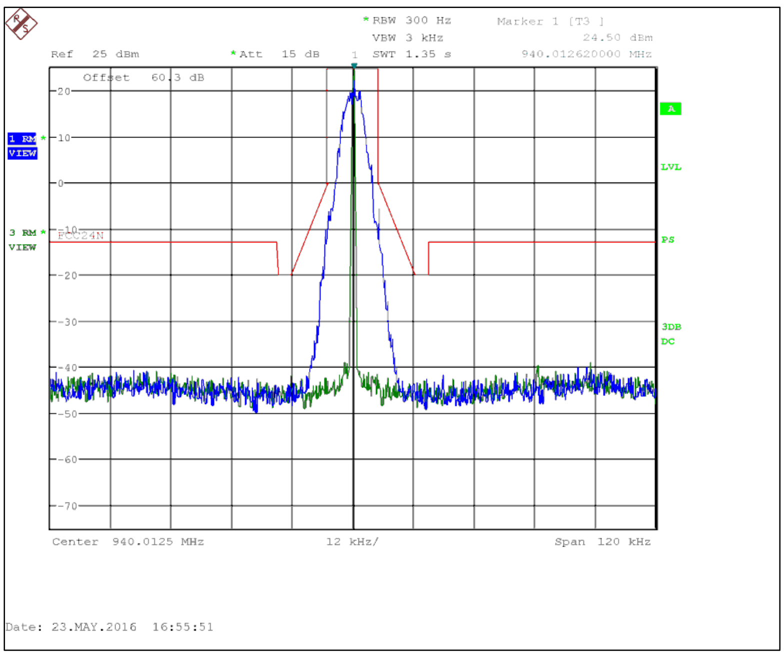

Figure 7.2.2-16: 940.0125 MHz – 12.5 kHz Channel Spacing – mPass4 10k Mode

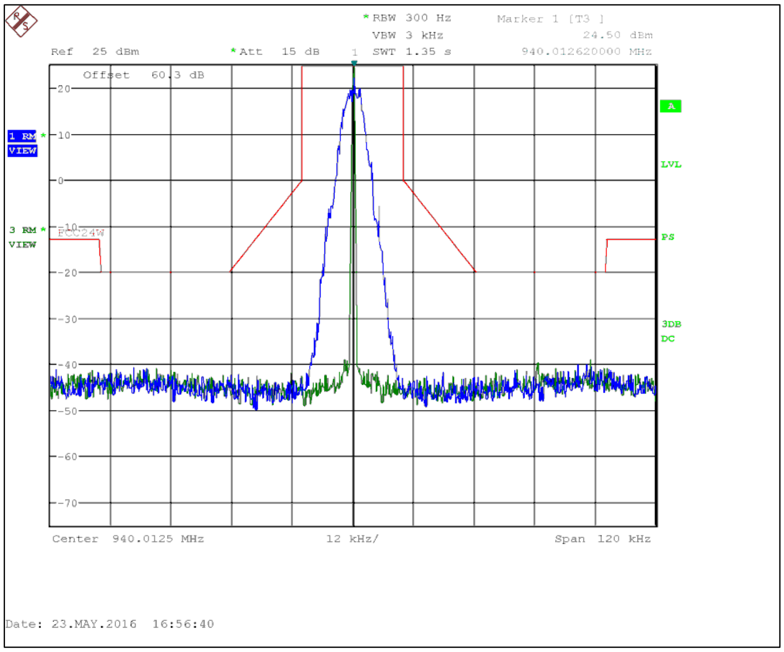

Figure 7.2.2-17: 940.0125 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

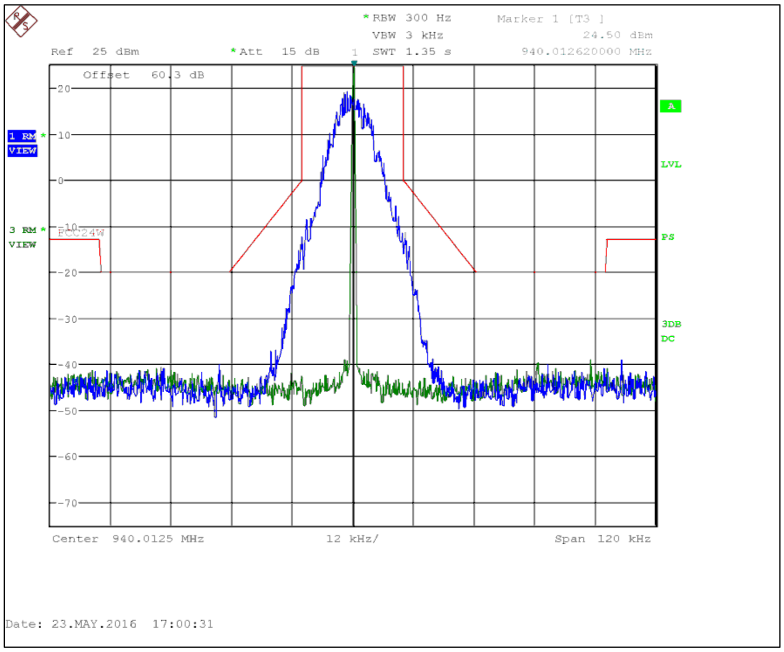

Figure 7.2.2-18: 940.0125 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

High Power

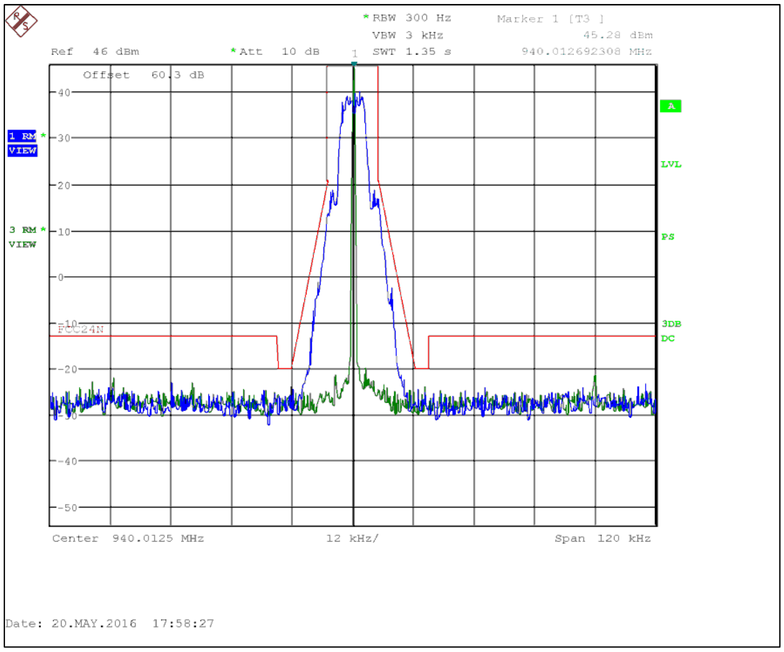

Figure 7.2.2-19: 940.0125 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

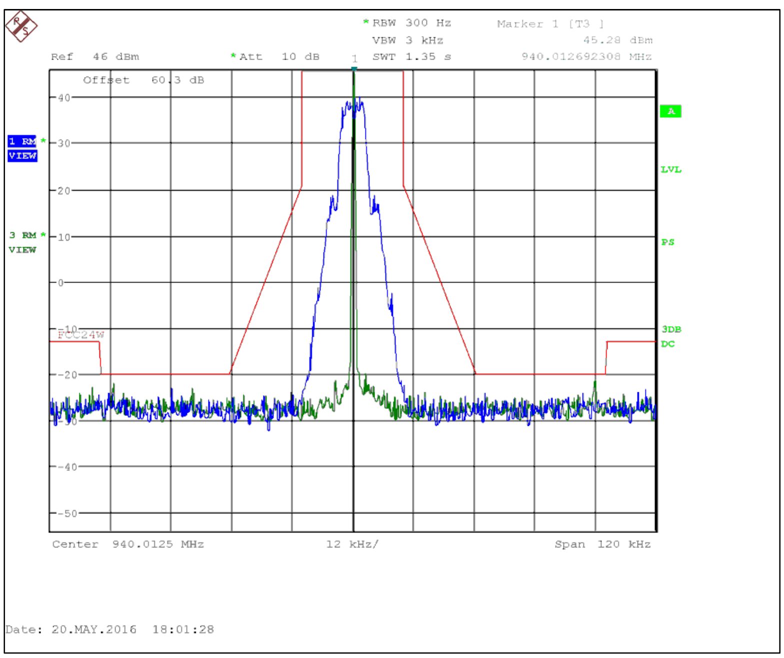

Figure 7.2.2-20: 940.0125 MHz – 25 kHz Channel Spacing – mPass 5k Mode

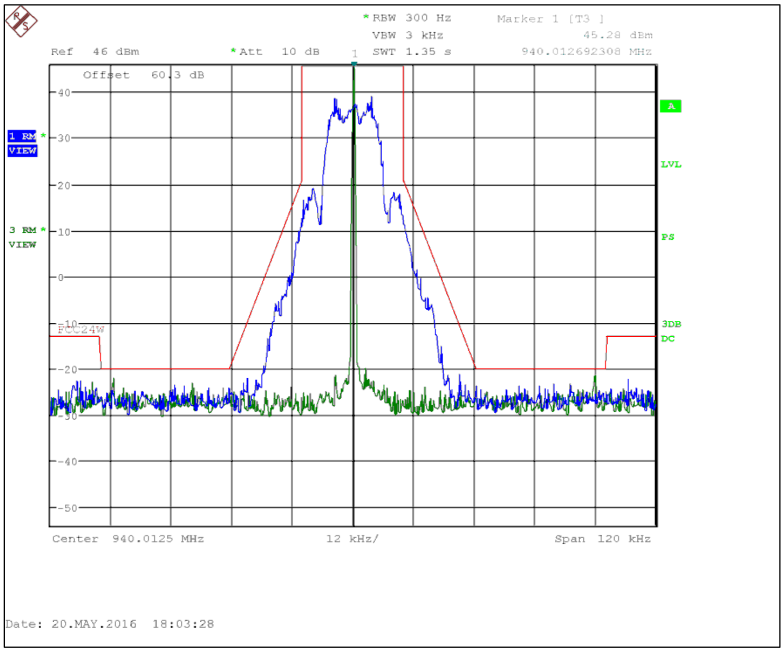

Figure 7.2.2-21: 940.0125 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

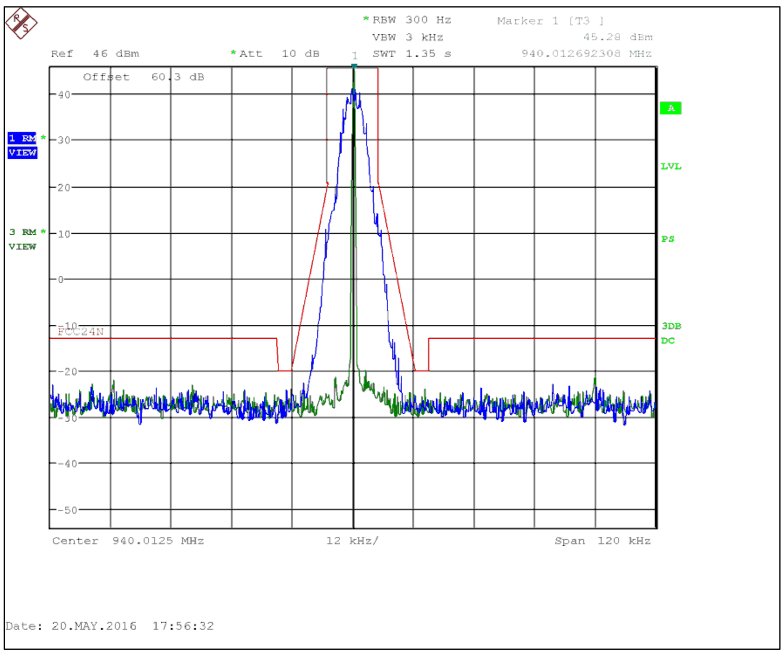

Figure 7.2.2-22: 940.0125 MHz – 12.5 kHz Channel Spacing – mPass4 10k Mode

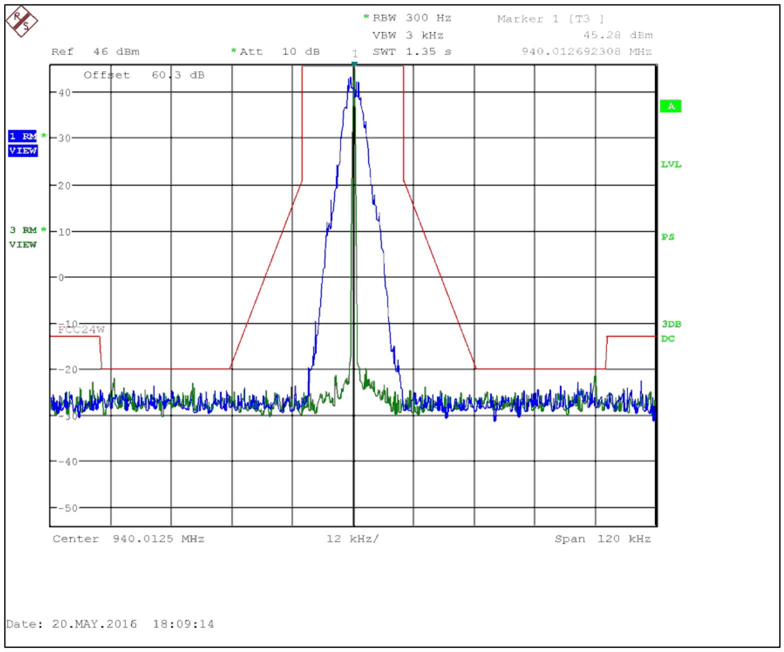

Figure 7.2.2-23: 940.0125 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

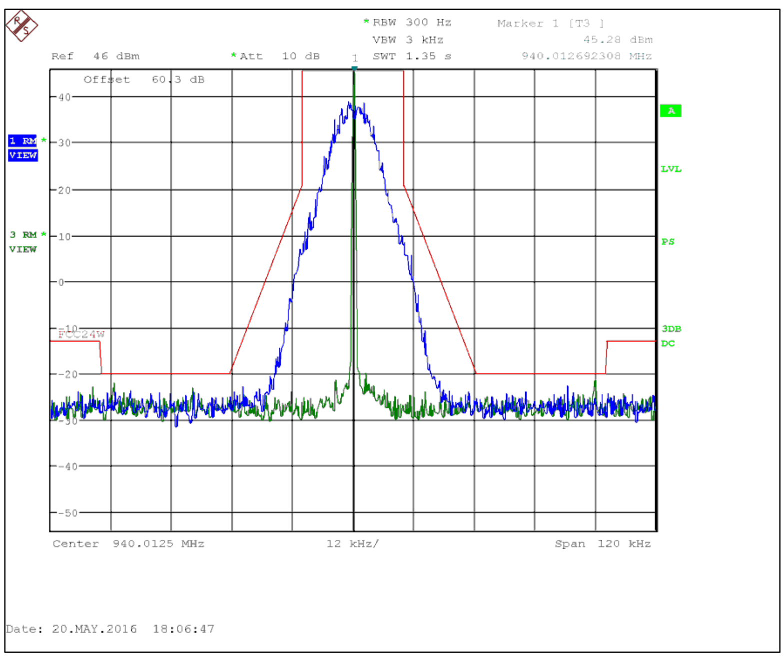

Figure 7.2.2-24: 940.0125 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

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

Low Power

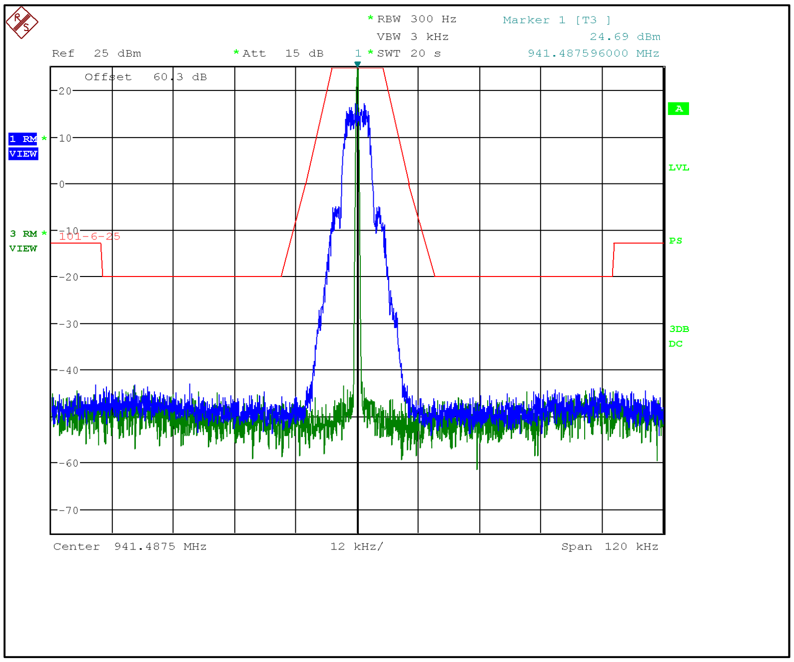

Figure 7.2.2-25: 941.4875 MHz – 25 kHz Channel Spacing – mPass 5k Mode

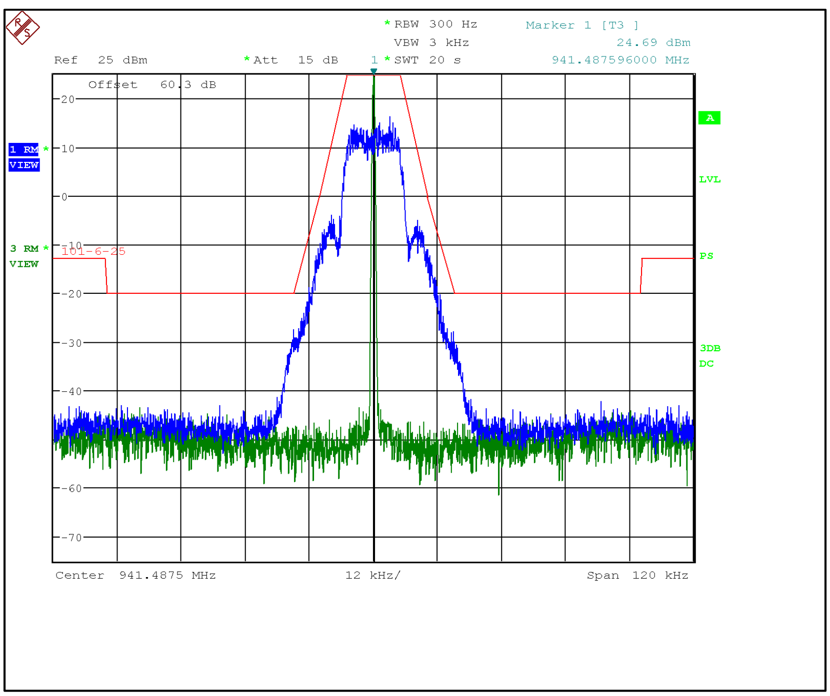

Figure 7.2.2-26: 941.4875 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

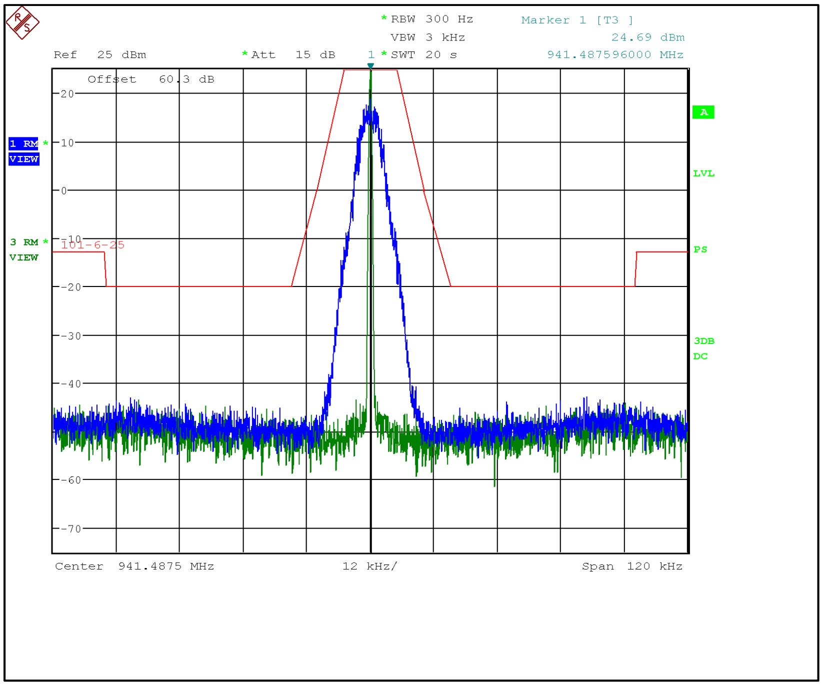

Figure 7.2.2-27: 941.4875 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

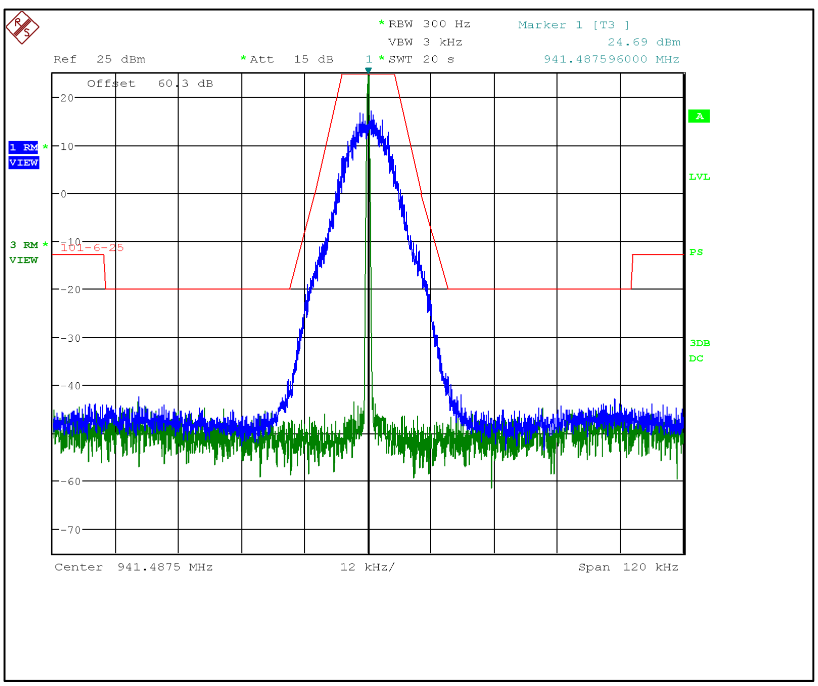

Figure 7.2.2-28: 941.4875 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

High Power

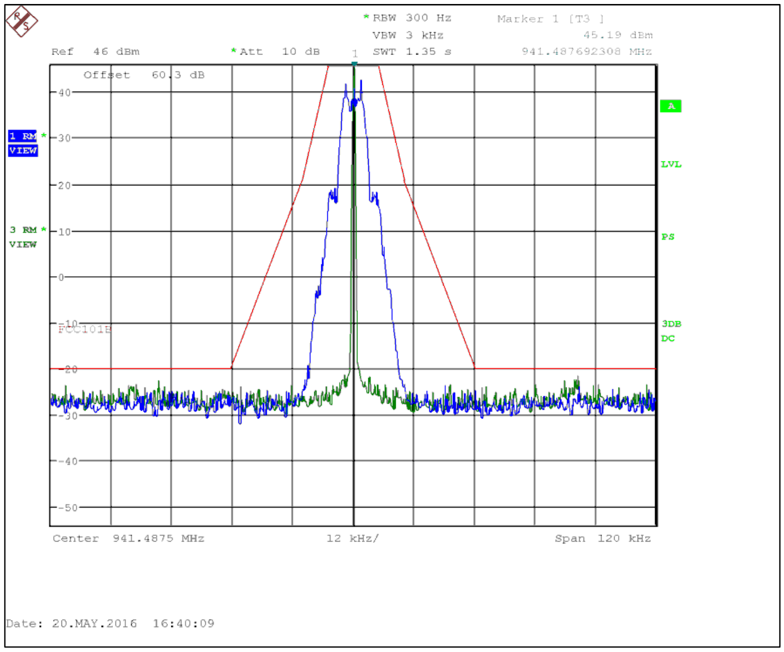

Figure 7.2.2-29: 941.4875 MHz – 25 kHz Channel Spacing – mPass 5k Mode

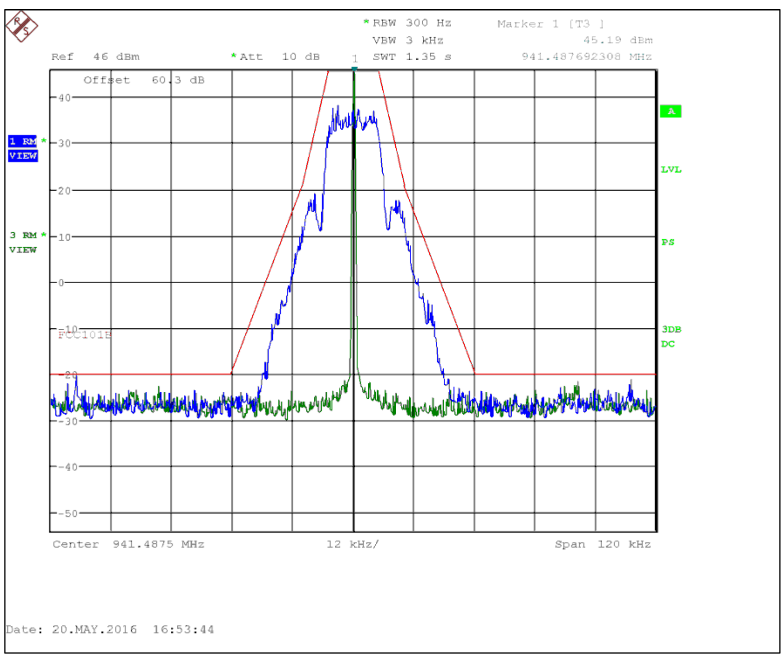

Figure 7.2.2-30: 941.4875 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

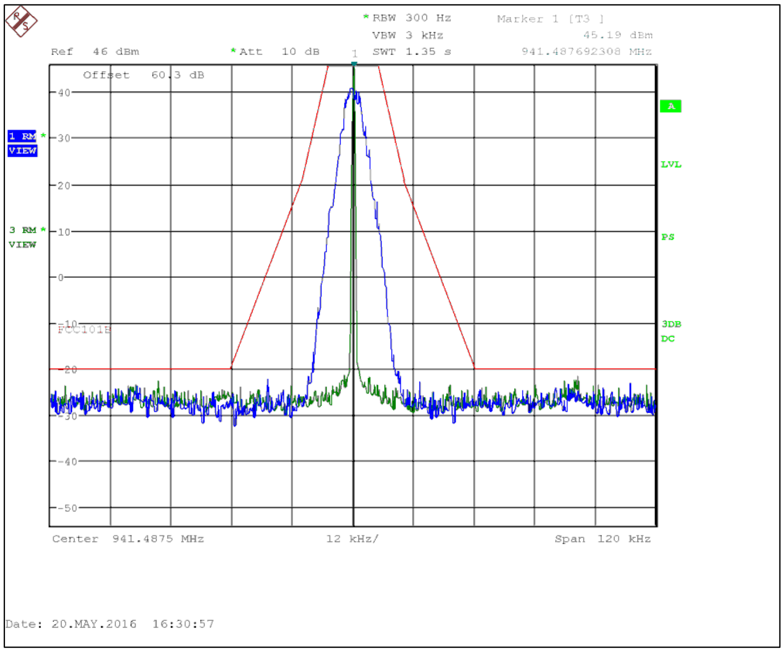

Figure 7.2.2-31: 941.4875 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

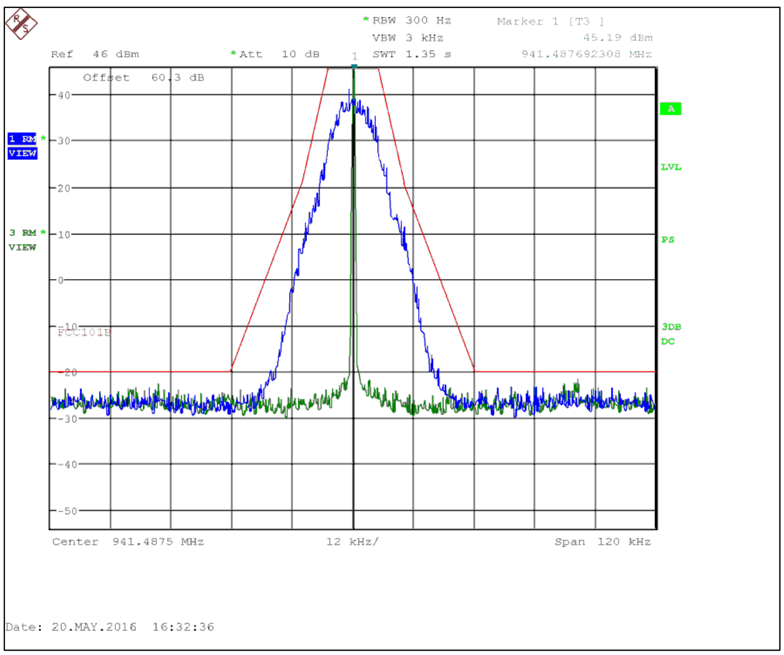

Figure 7.2.2-32: 941.4875 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

Low Power

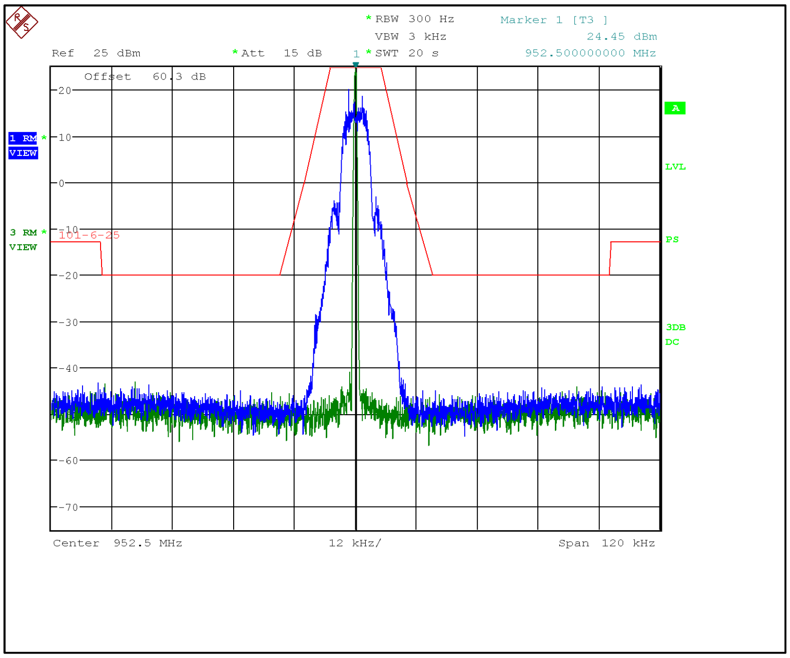

Figure 7.2.2-33: 952.5 MHz – 25 kHz Channel Spacing – mPass 5k Mode

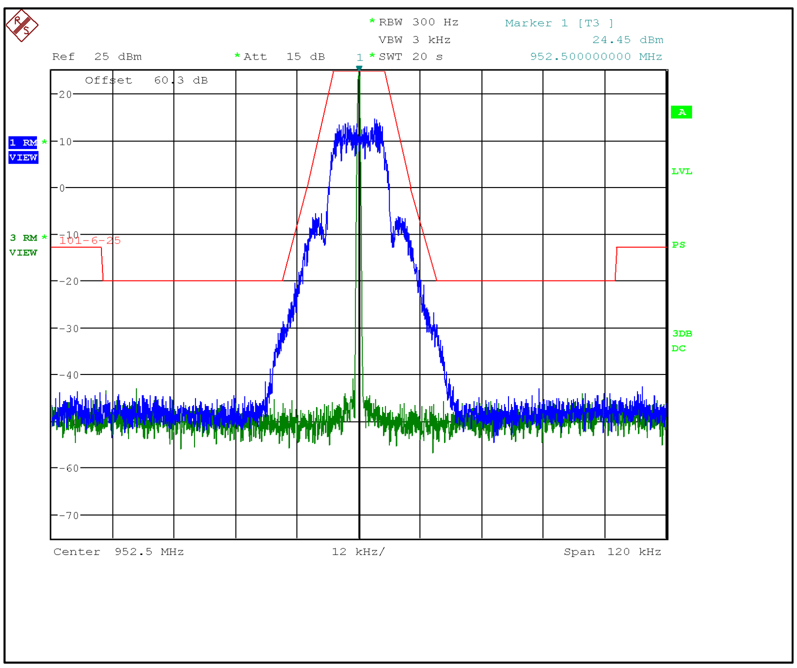

Figure 7.2.2-34: 952.5 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

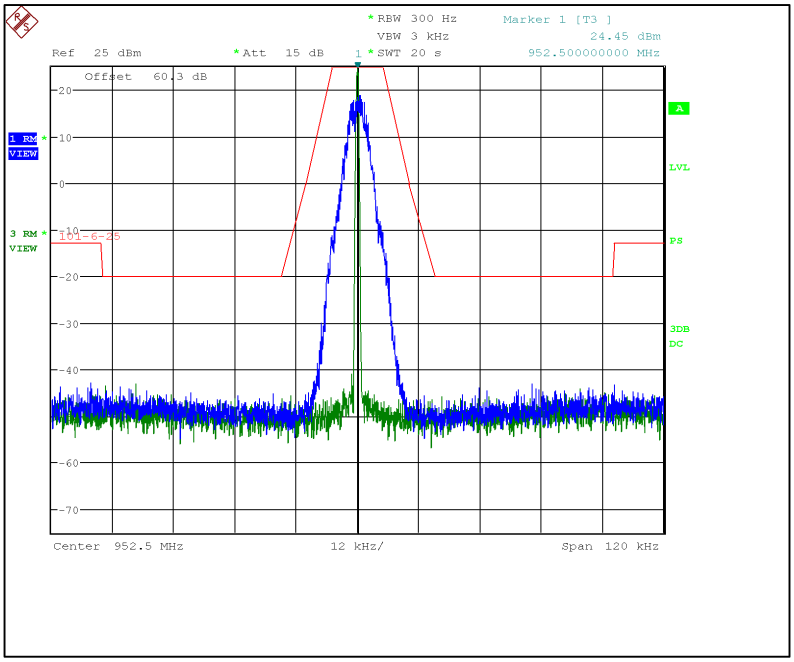

Figure 7.2.2-35: 952.5 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

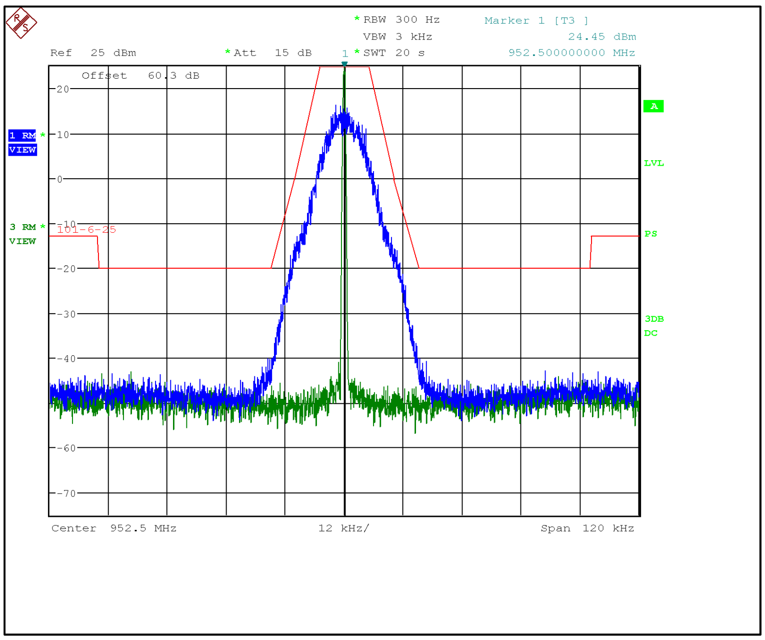

Figure 7.2.2-36: 952.5 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

High Power

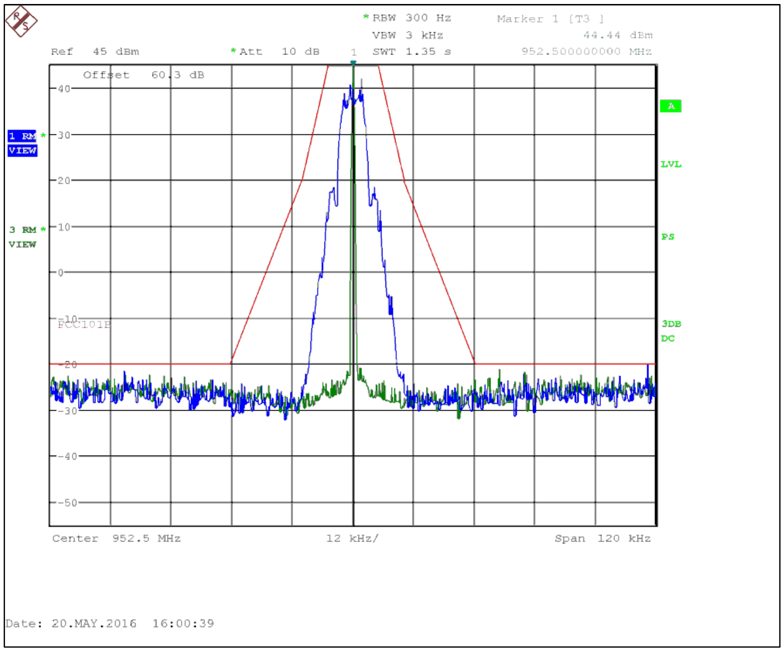

Figure 7.2.2-37: 952.5 MHz – 25 kHz Channel Spacing – mPass 5k Mode

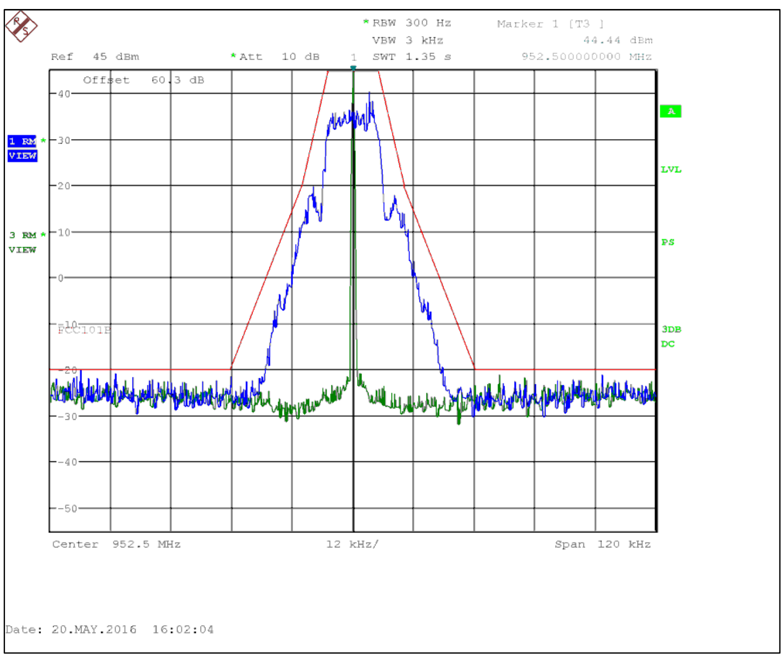

Figure 7.2.2-38: 952.5 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

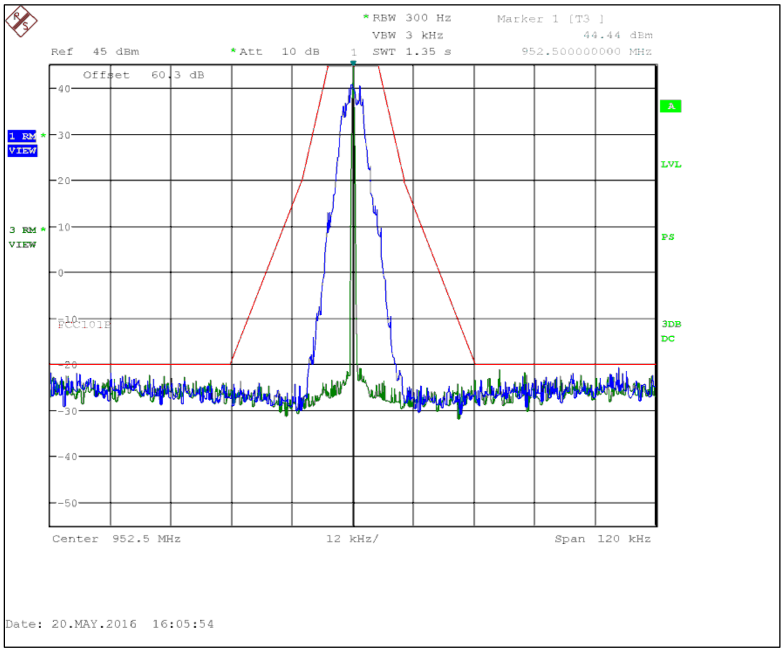

Figure 7.2.2-39: 952.5 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

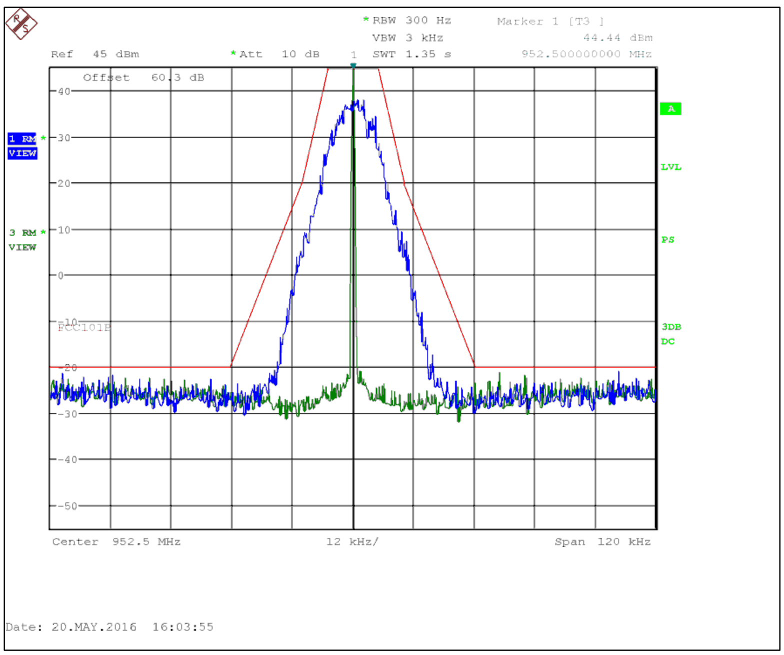

Figure 7.2.2-40: 952.5 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

Low Power

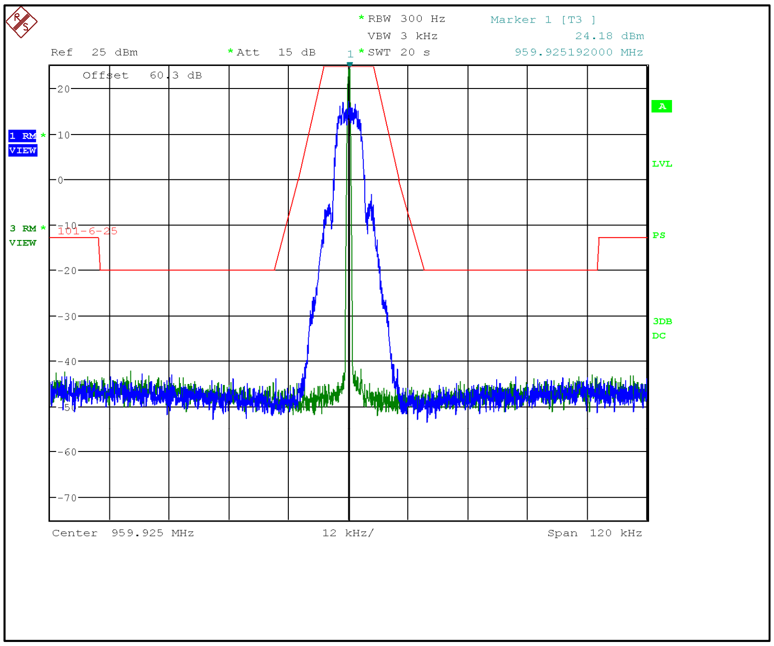

Figure 7.2.2-41: 959.925 MHz – 25 kHz Channel Spacing – mPass 5k Mode

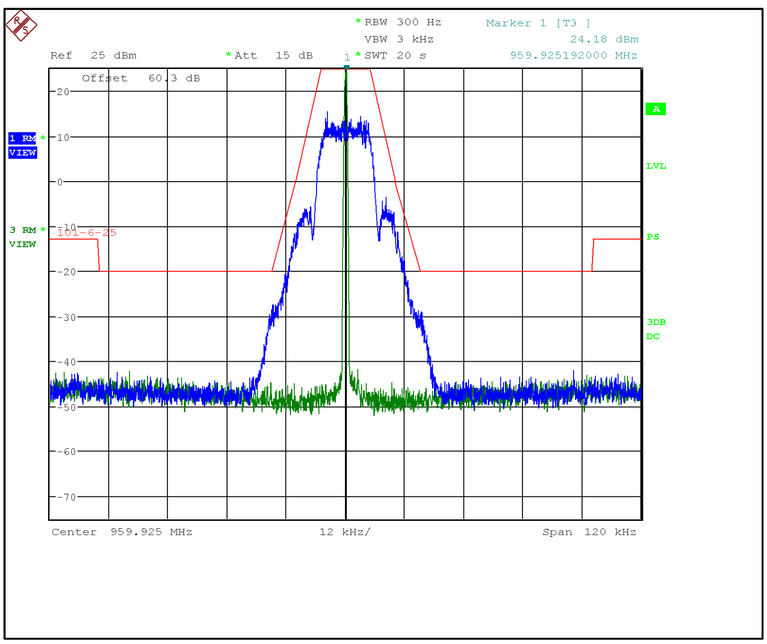

Figure 7.2.2-42: 959.925 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

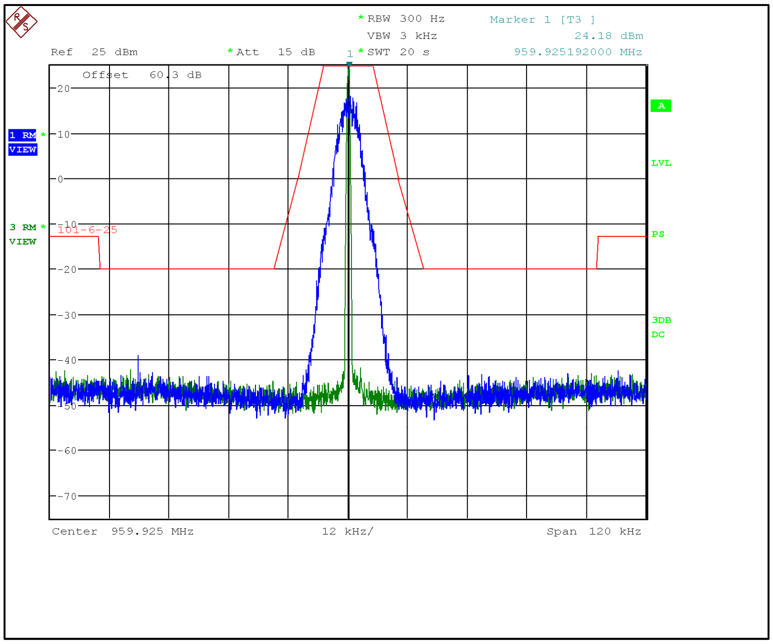

Figure 7.2.2-43: 959.925 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

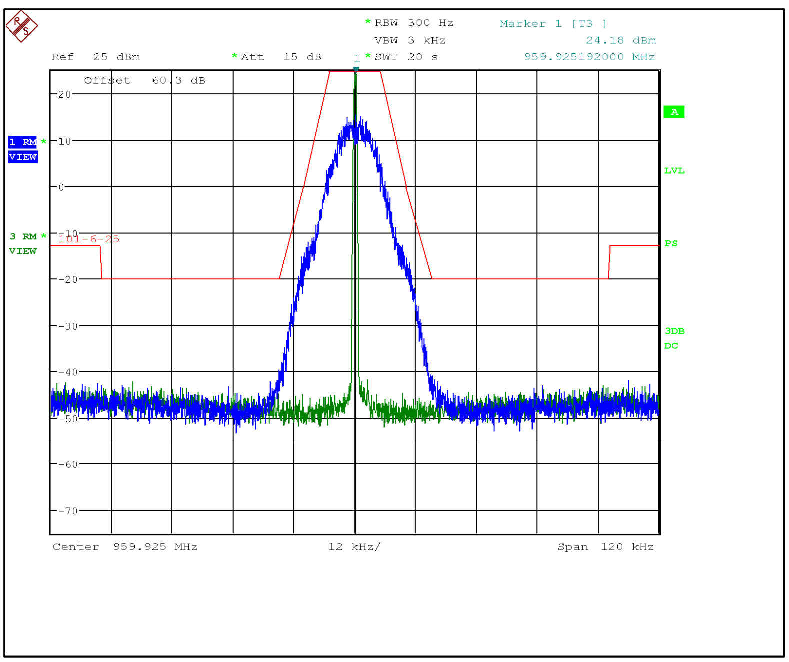

Figure 7.2.2-44: 959.925 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

High Power

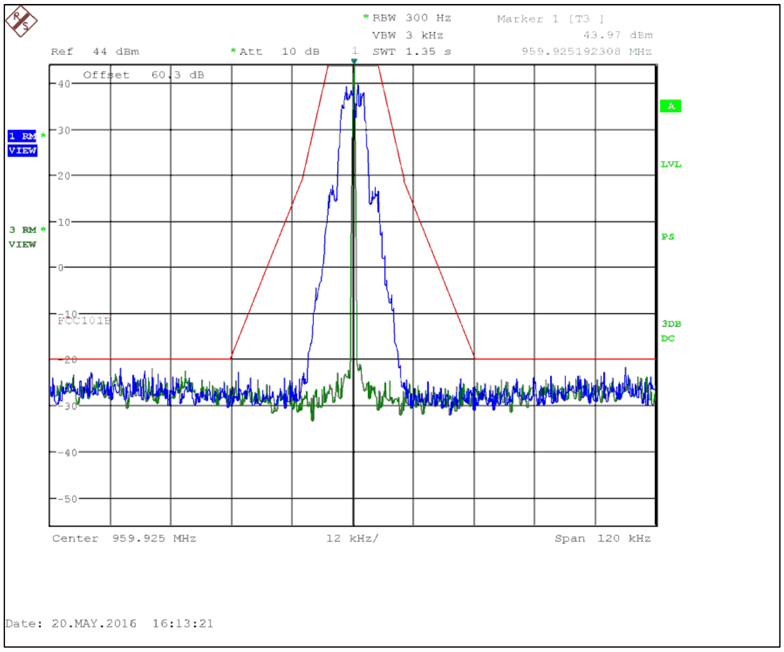

Figure 7.2.2-45: 959.925 MHz – 25 kHz Channel Spacing – mPass 5k Mode

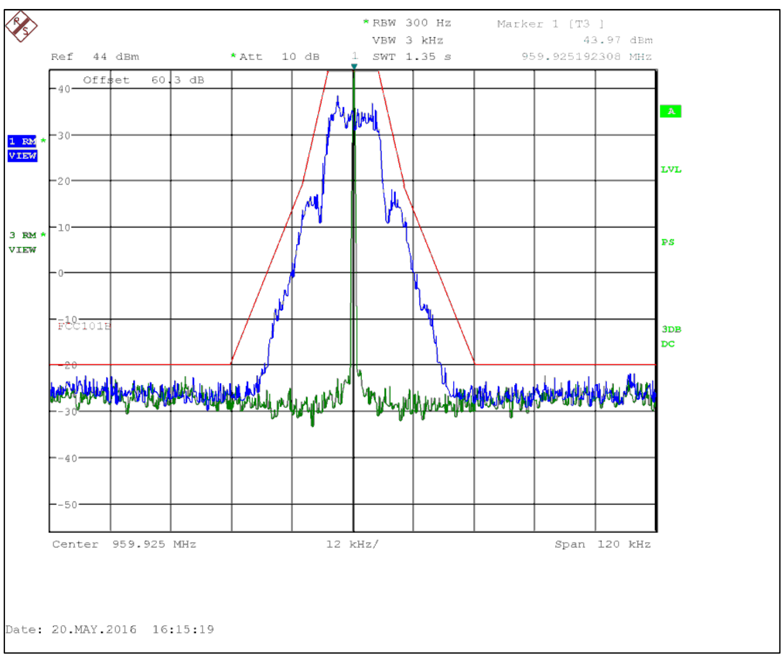

Figure 7.2.2-46: 959.925 MHz – 25 kHz Channel Spacing – mPass2 10k Mode

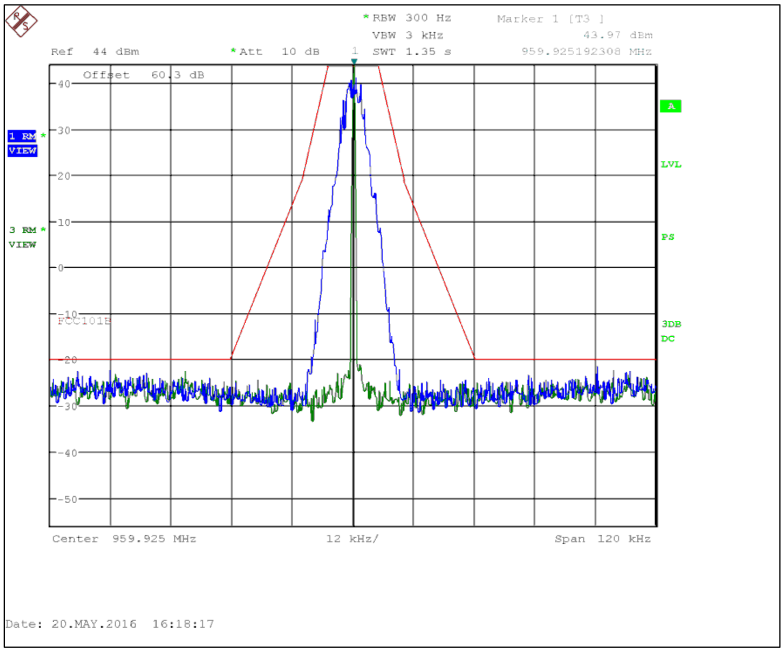

Figure 7.2.2-47: 959.925 MHz – 25 kHz Channel Spacing – mPass4 10k Mode

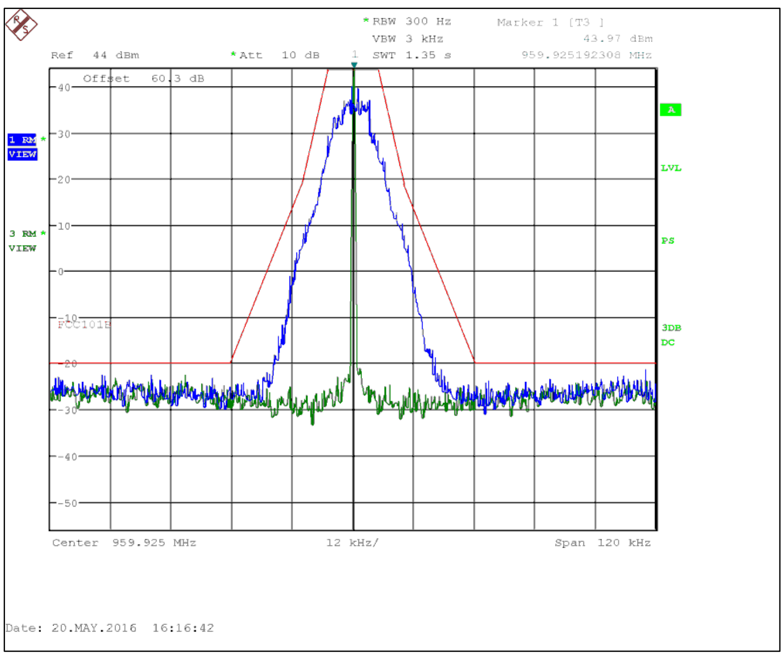

Figure 7.2.2-48: 959.925 MHz – 25 kHz Channel Spacing – mPass4 20k Mode

7.2.3 Measurement Results – 99% Bandwidth

The bandwidth was measured in accordance with RSS-Gen 6.6. The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set to 1% to 5% of the occupied bandwidth. The video bandwidth was set to 3 times the resolution bandwidth.

Frequency (MHz)	ISED Canada Rule Part	Mode of Operation	99% Bandwidth (kHz)
930.5000	RSS-134	mPass 5k	5.840
930.5000	RSS-134	mPass2 10k	11.900
930.5000	RSS-134	mPass4 10k	6.080
930.5000	RSS-134	mPass4 20k	12.250
940.0125	RSS-134	mPass 5k	5.840
940.0125	RSS-134	mPass2 10k	11.950
940.0125	RSS-134	mPass4 10k	6.000
940.0125	RSS-134	mPass4 20k	12.150
941.4875	RSS-119	mPass 5k	5.880
941.4875	RSS-119	mPass2 10k	12.000
941.4875	RSS-119	mPass4 10k	6.000
941.4875	RSS-119	mPass4 20k	11.900
952.5000	RSS-119	mPass 5k	5.720
952.5000	RSS-119	mPass2 10k	11.900
952.5000	RSS-119	mPass4 10k	6.140
952.5000	RSS-119	mPass4 20k	12.250

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

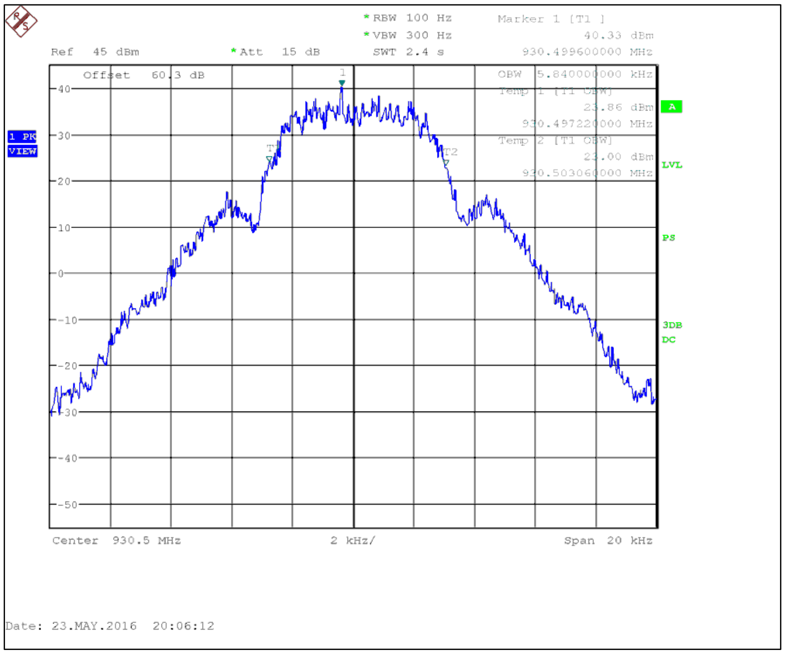

Figure 7.2.3-1: 930.5 MHz – mPass 5k

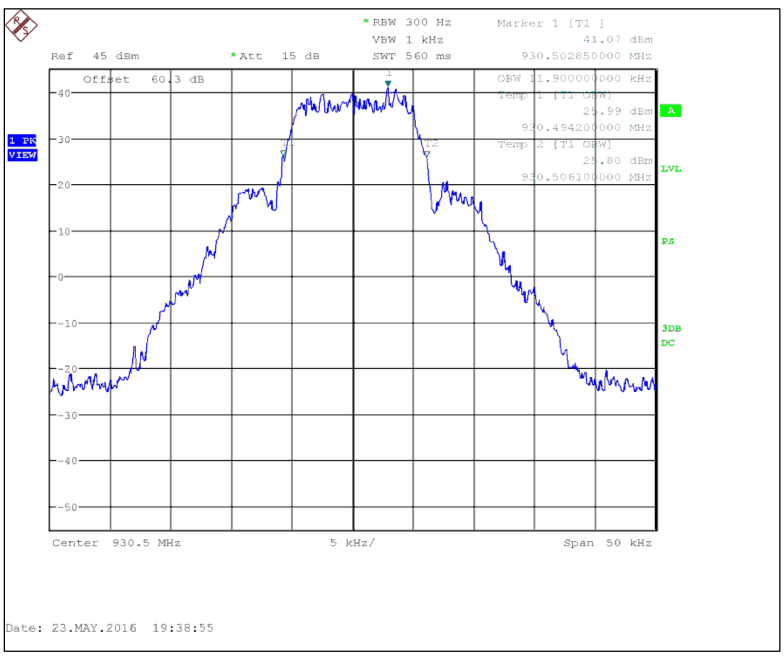

Figure 7.2.3-2: 930.5 MHz – mPass2 10k

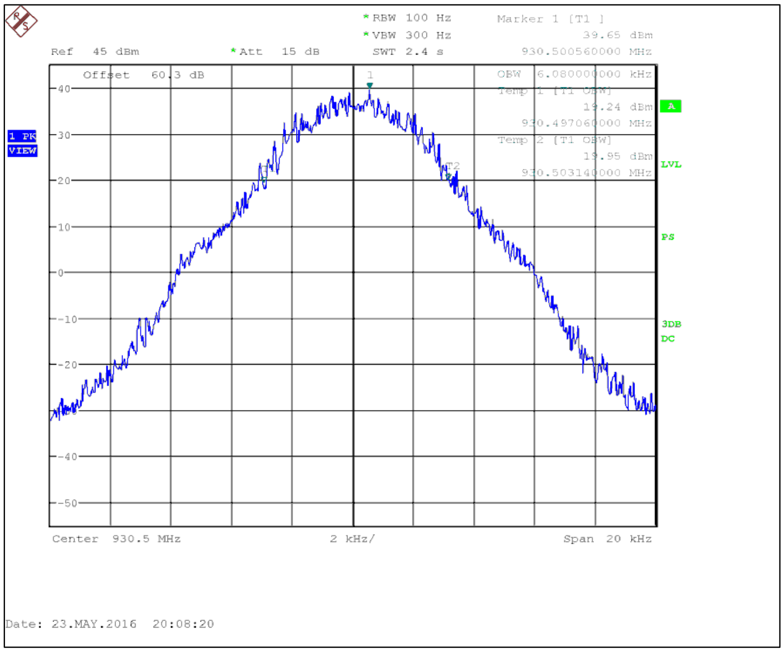

Figure 7.2.3-3: 930.5 MHz – mPass4 10k

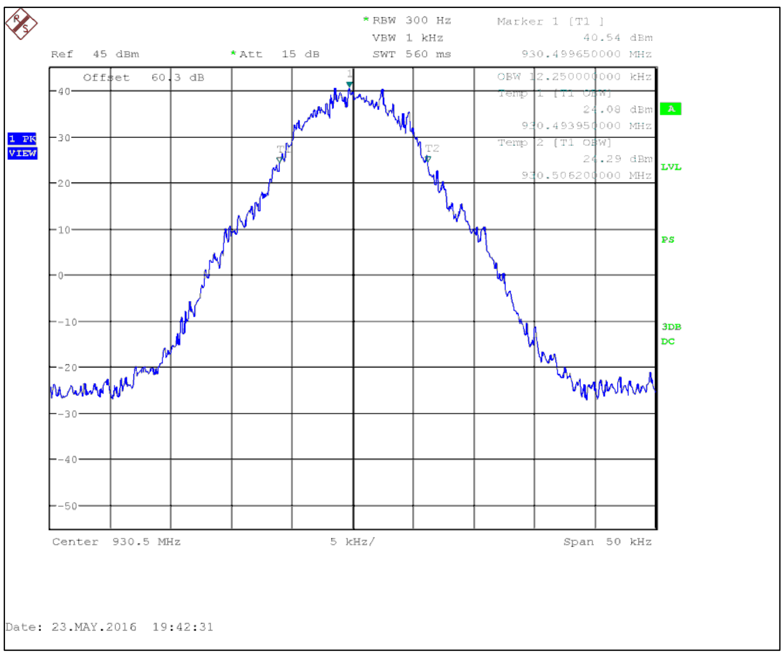

Figure 7.2.3-4: 930.5 MHz – mPass4 20k

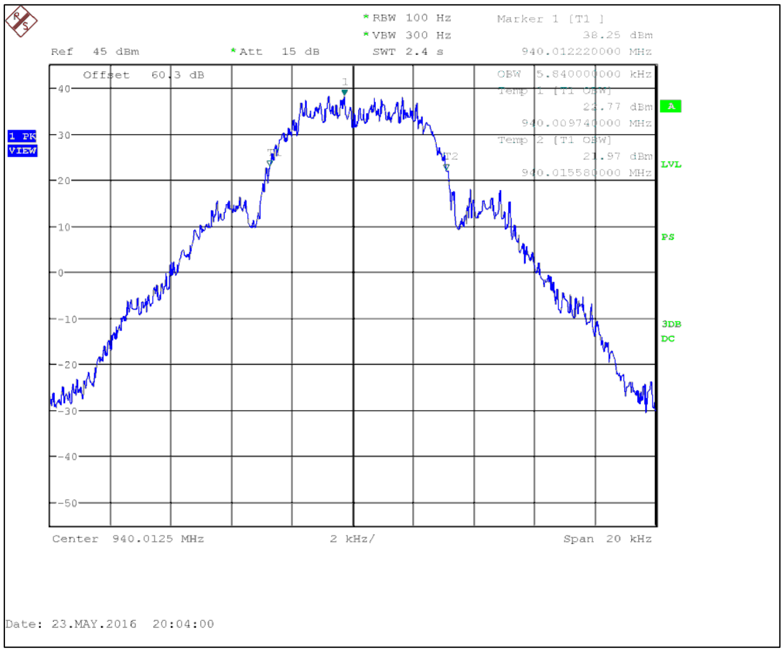

Figure 7.2.3-5: 940.0125 MHz – mPass 5k

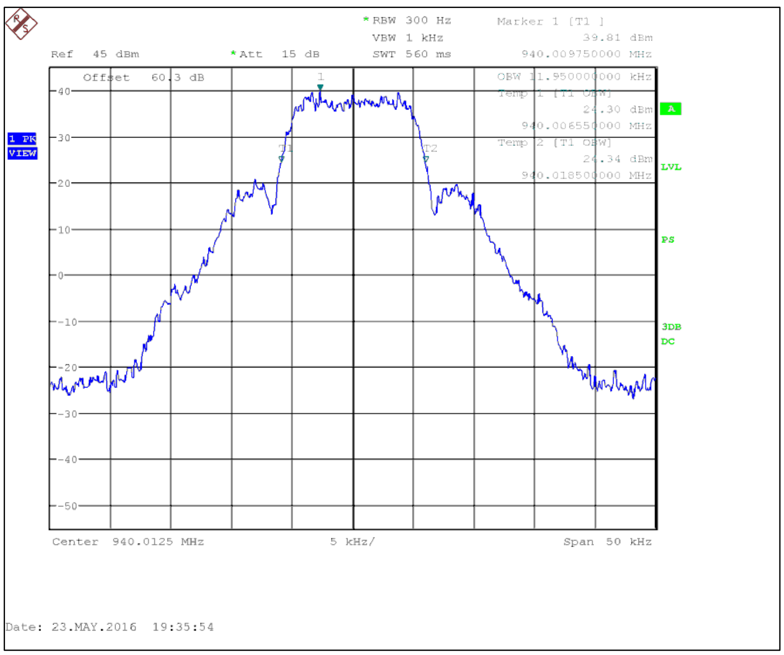

Figure 7.2.3-6: 940.0125 MHz – mPass2 10k

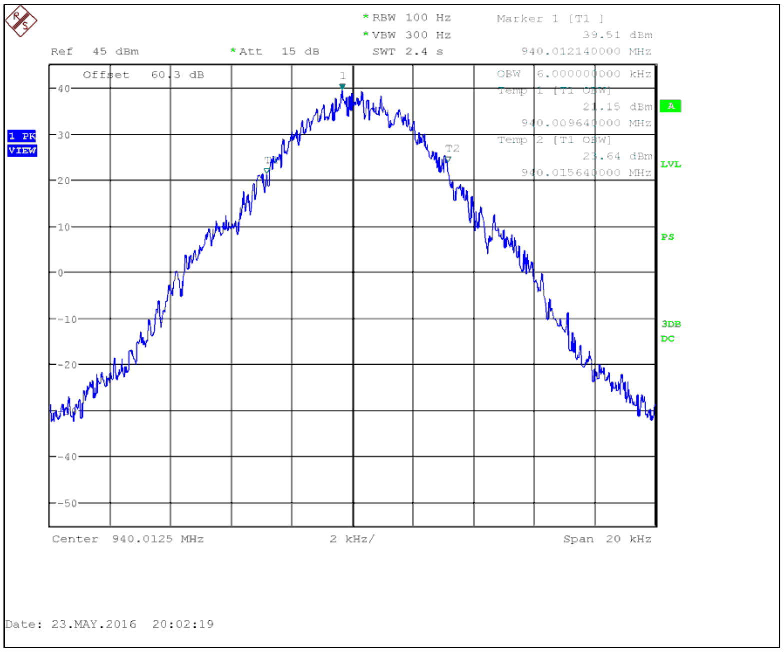

Figure 7.2.3-7: 940.0125 MHz – mPass4 10k

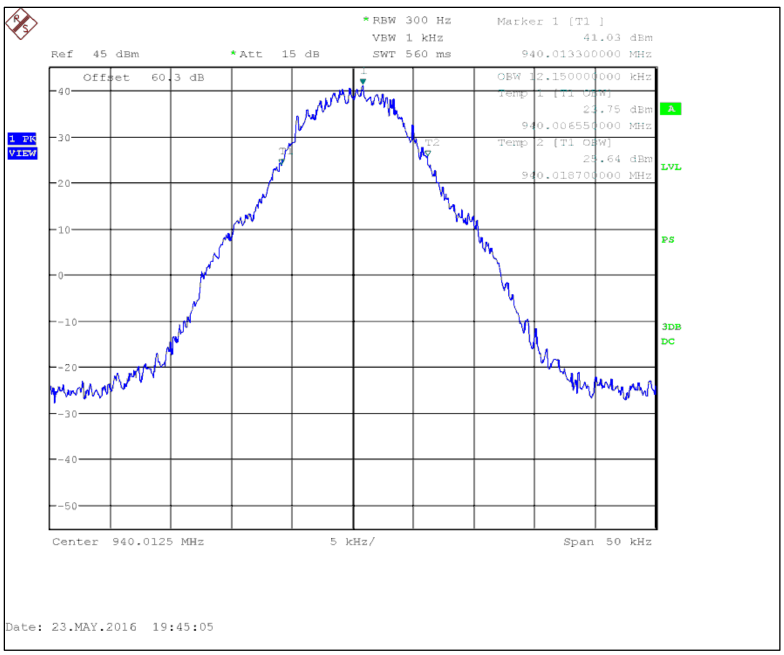

Figure 7.2.3-8: 940.0125 MHz – mPass4 20k

RSS-Gen 6.6, RSS-119

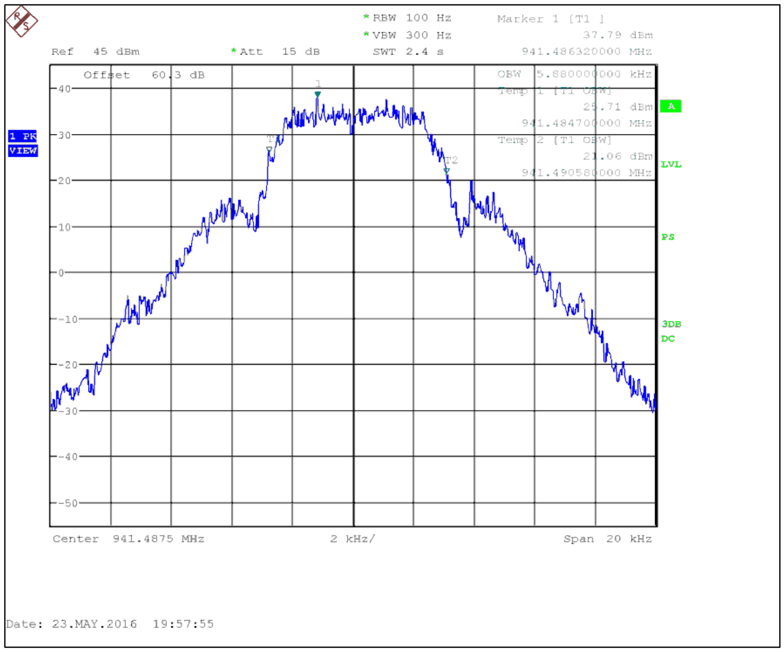

Figure 7.2.3-9: 941.4875 MHz – mPass 5k

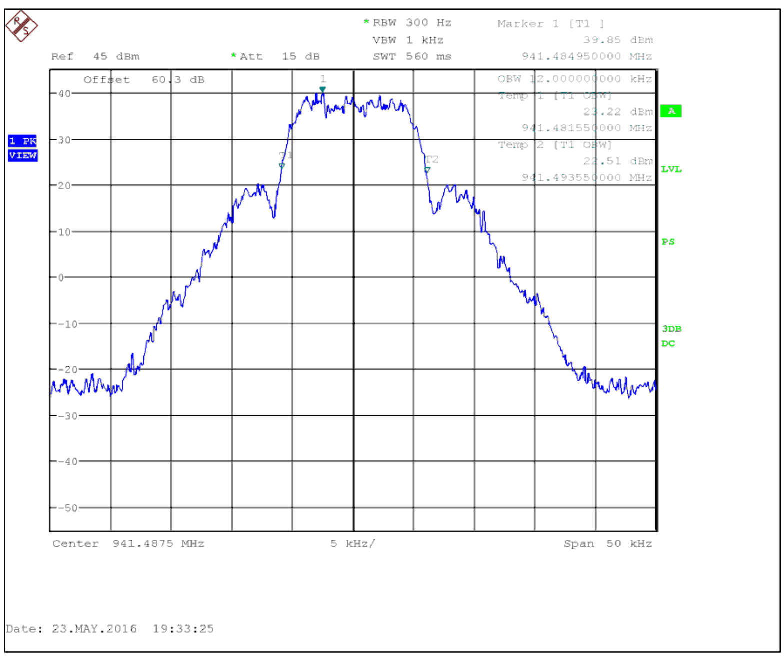

Figure 7.2.3-10: 941.4875 MHz – mPass2 10k

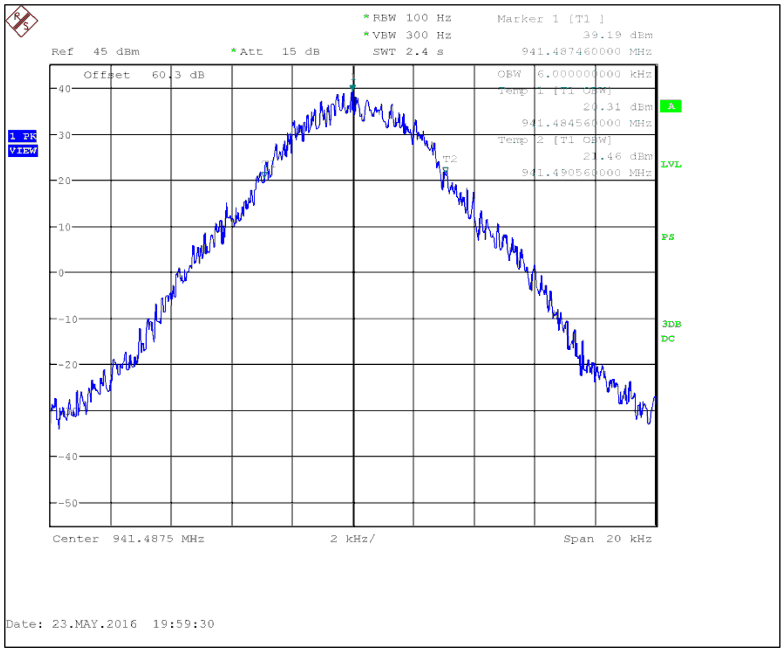

Figure 7.2.3-11: 941.4875 MHz – mPass4 10k

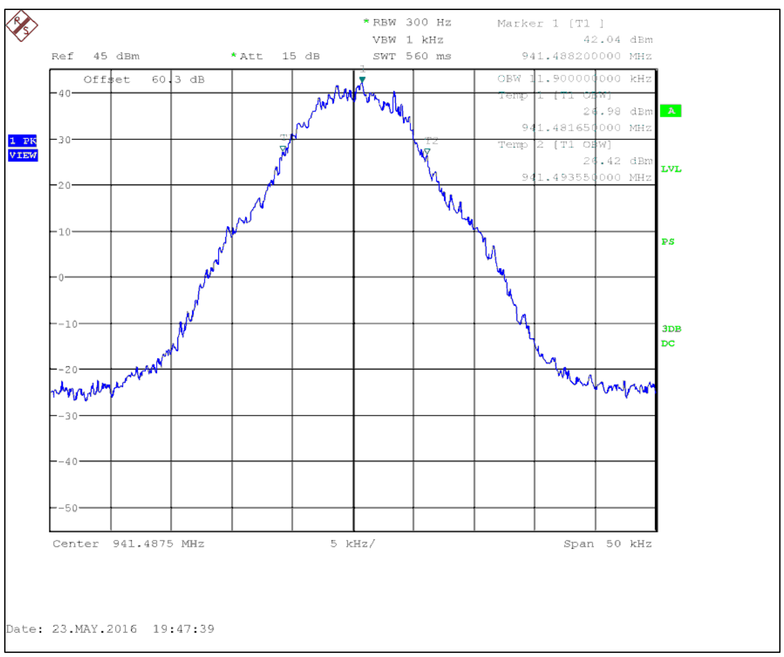

Figure 7.2.3-12: 941.4875 MHz – mPass4 20k

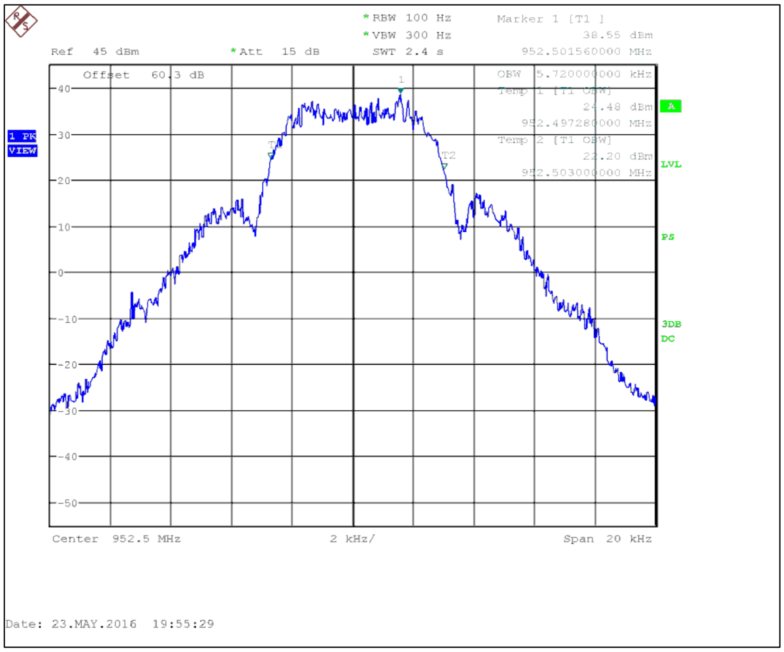

Figure 7.2.3-13: 952.5 MHz – mPass 5k

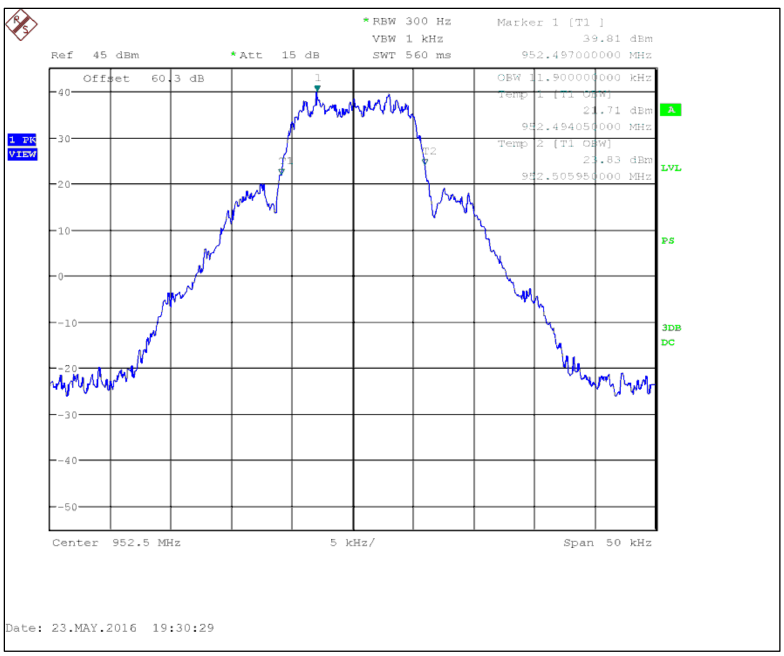

Figure 7.2.3-14: 952.5 MHz – mPass2 10k

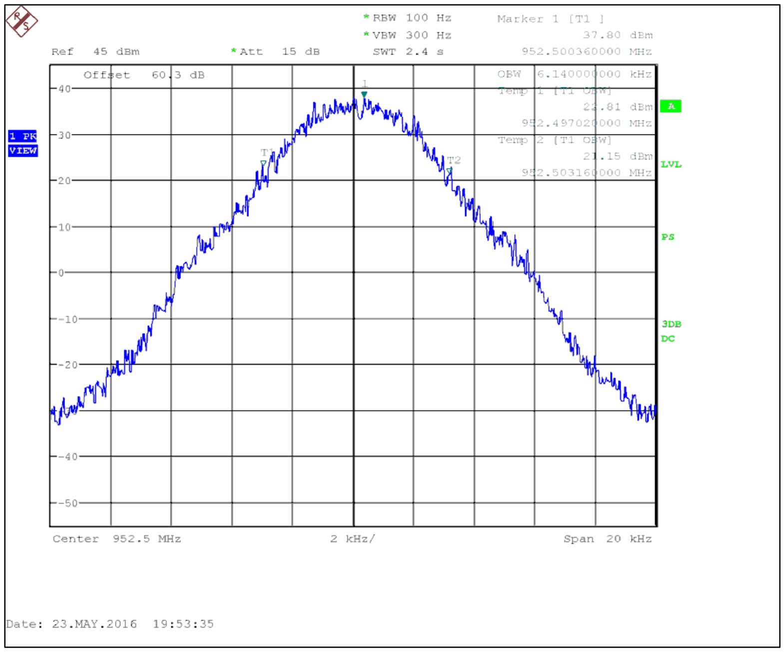

Figure 7.2.3-15: 952.5 MHz – mPass4 10k

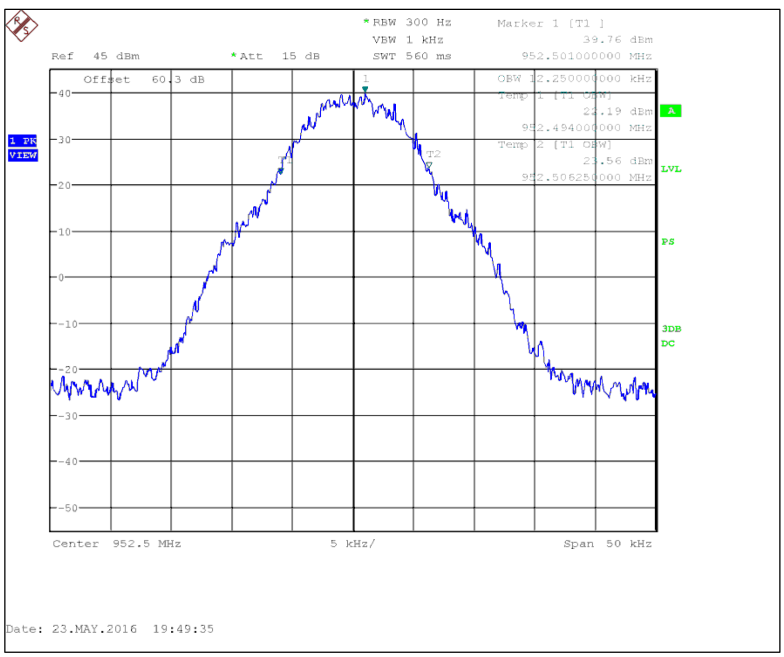

Figure 7.2.3-16: 952.5 MHz – mPass4 20k

7.3 Spurious Emissions at Antenna Terminals

7.3.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the spectrum analyzer through 50.3 dB of passive attenuation. The spectrum analyzer resolution bandwidth was set to 100 kHz and the VBW>RBW. 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. Results are shown below.

7.3.2 Measurement Results

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

Low Power

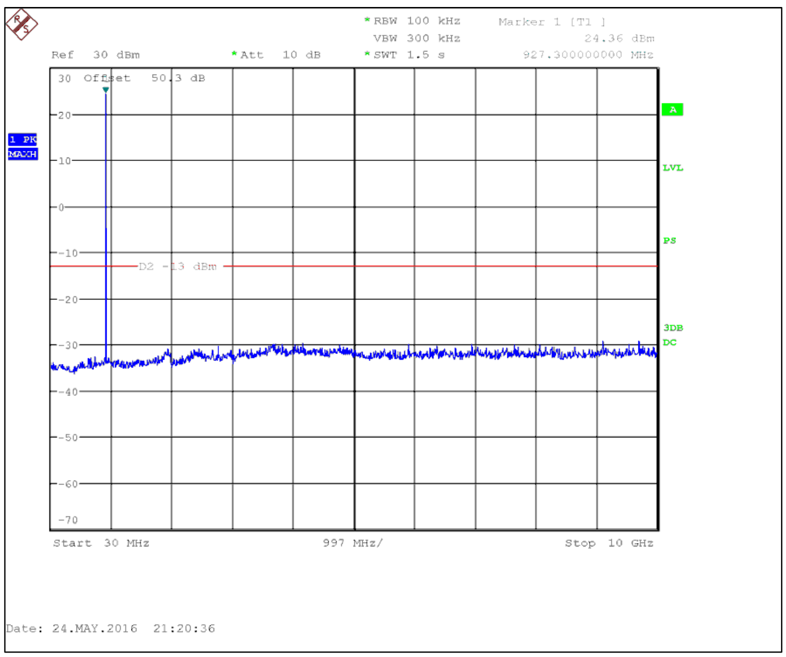

Figure 7.3.2-1: 930.5 MHz – 30 MHz to 10 GHz – mPass 5k

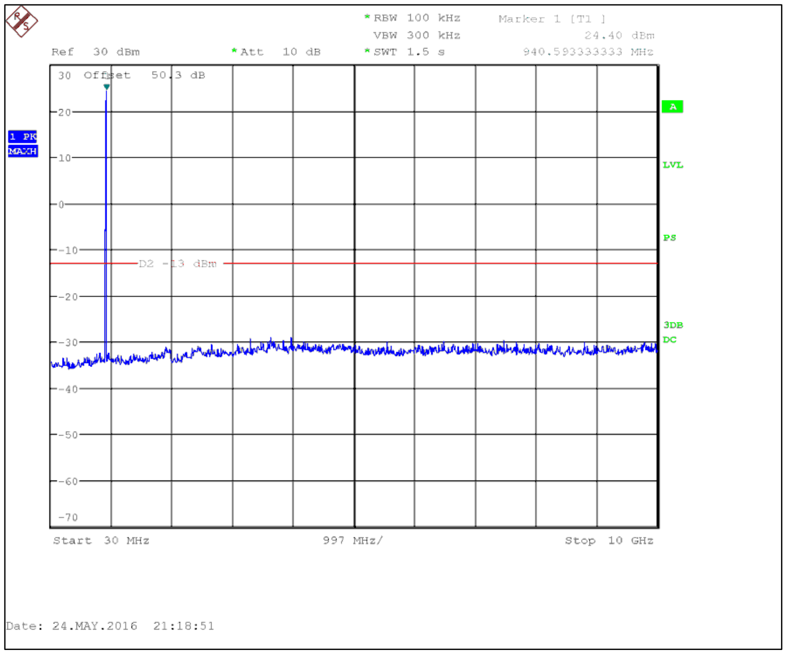

Figure 7.3.2-2: 940.0125 MHz – 30 MHz to 10 GHz – mPass 5k

High Power

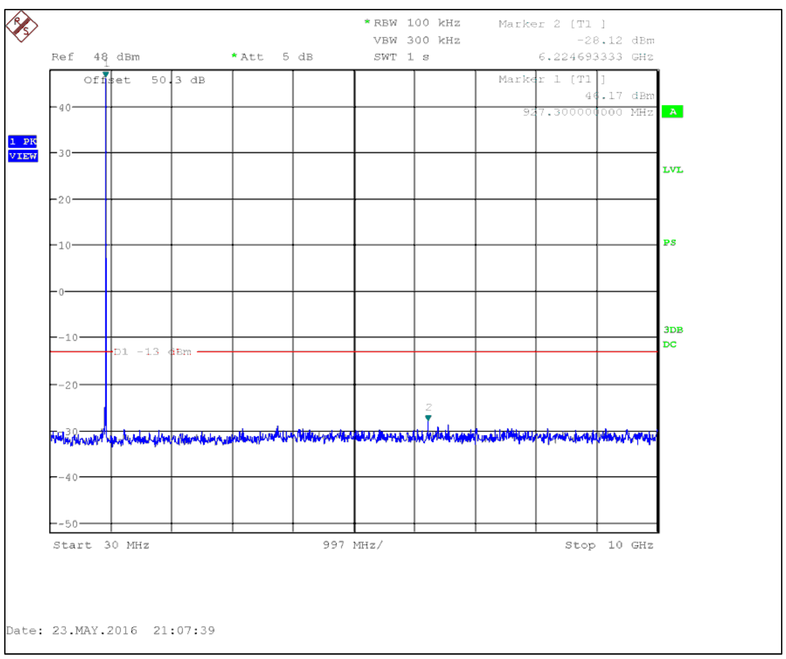

Figure 7.3.2-3: 930.5 MHz – 30 MHz to 10 GHz – mPass 5k

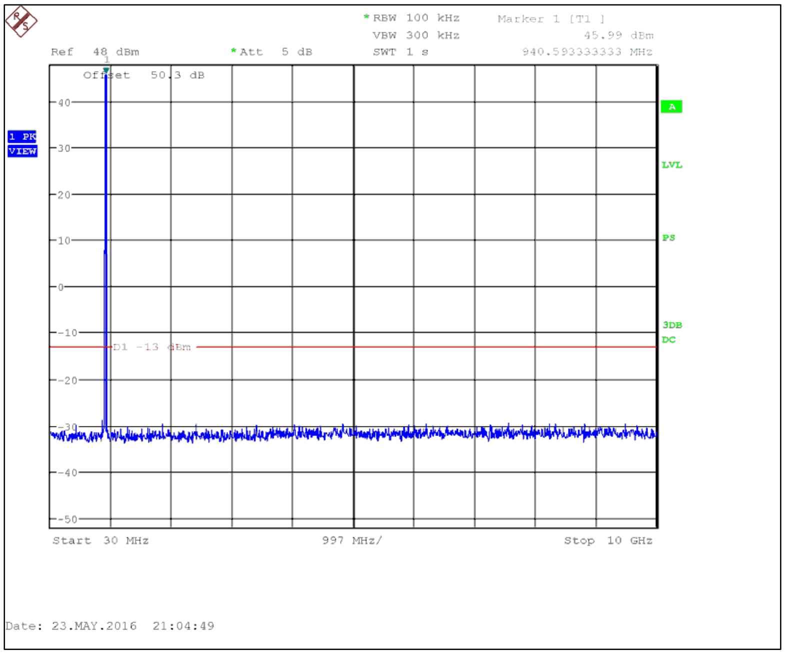

Figure 7.3.2-4: 940.0125 MHz – 30 MHz to 10 GHz – mPass 5k

Part 101.111 a(6), RSS-119 5.8.6

Low Power

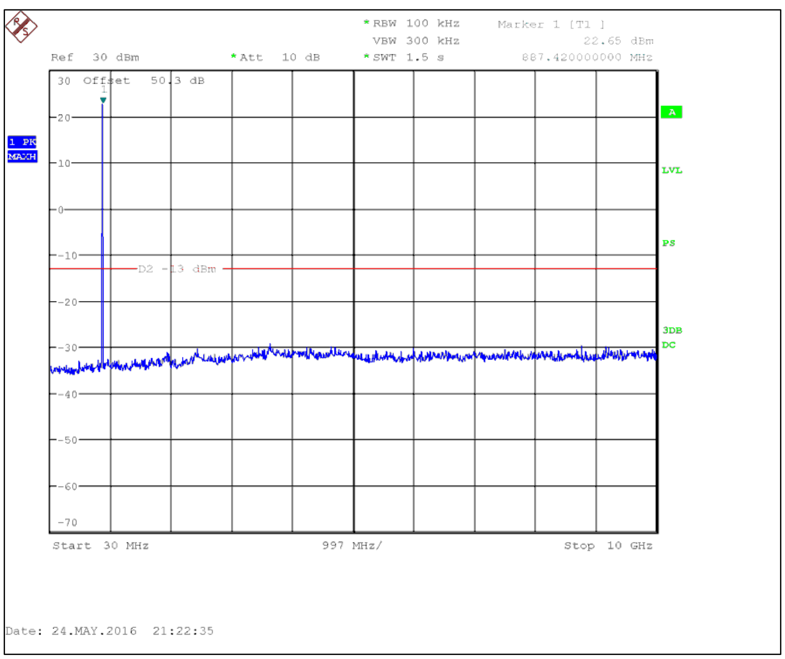

Figure 7.3.2-5: 941.4875 MHz – 30 MHz to 10 GHz – mPass 5k

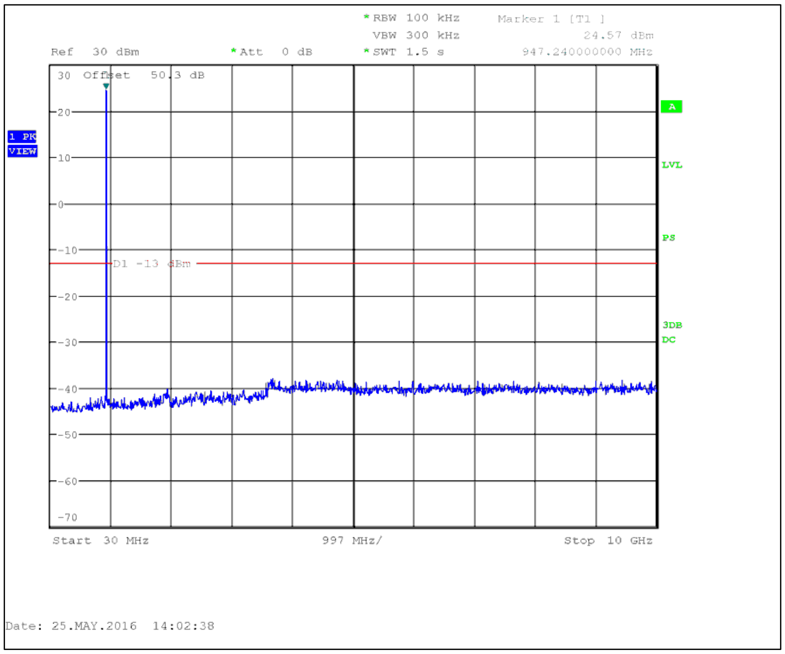

Figure 7.3.2-6: 952.5 MHz – 30 MHz to 10 GHz – mPass 5k

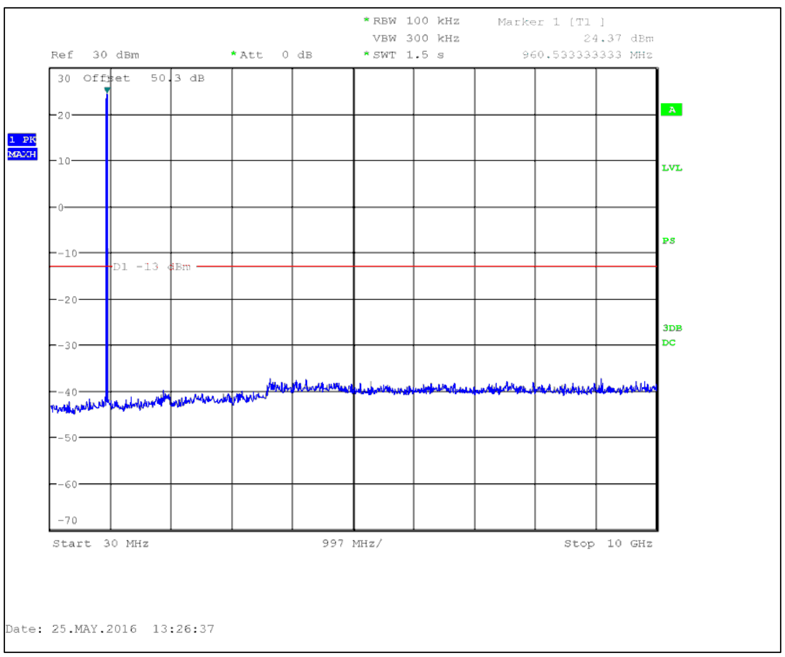

Figure 7.3.2-7: 959.925 MHz – 30 MHz to 10 GHz – mPass 5k

High Power

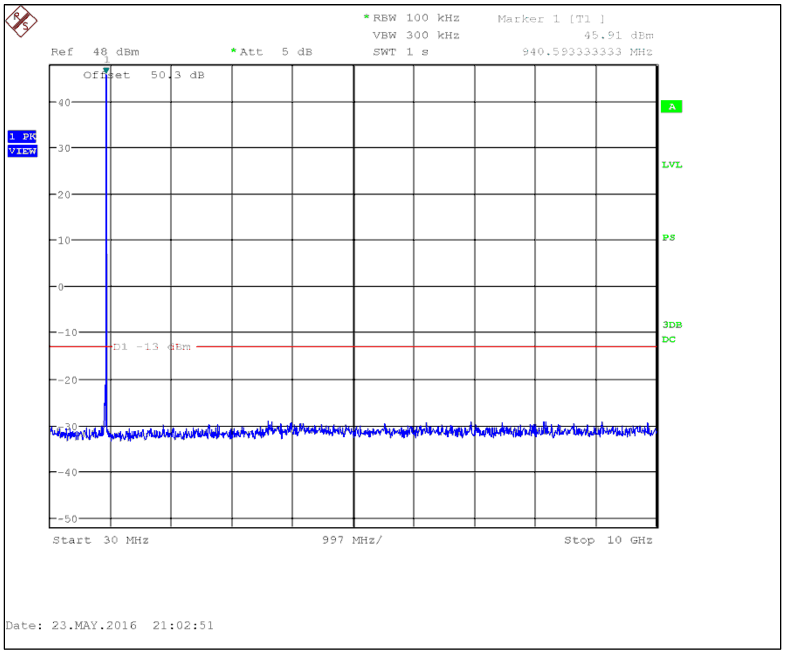

Figure 7.3.2-8: 941.4875 MHz – 30 MHz to 10 GHz – mPass 5k

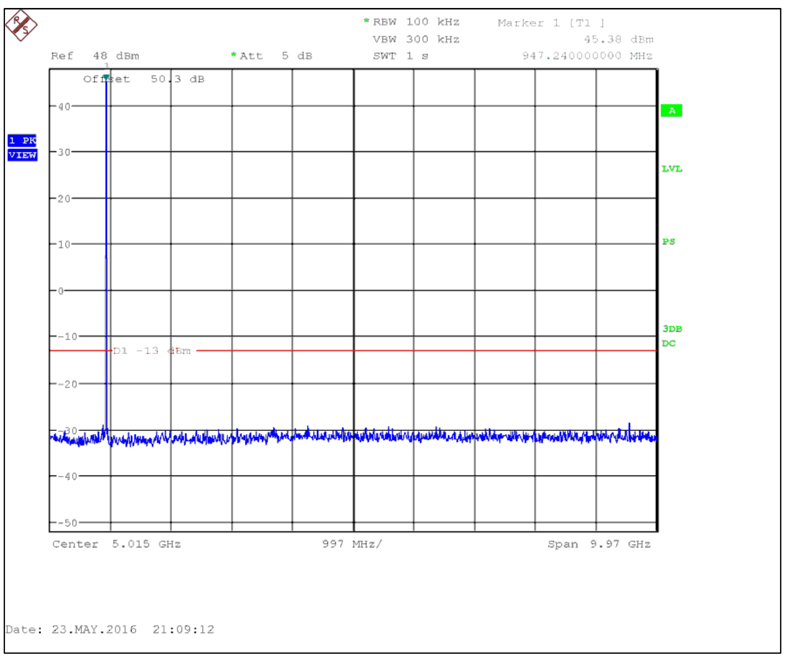

Figure 7.3.2-9: 952.5 MHz – 30 MHz to 10 GHz – mPass 5k

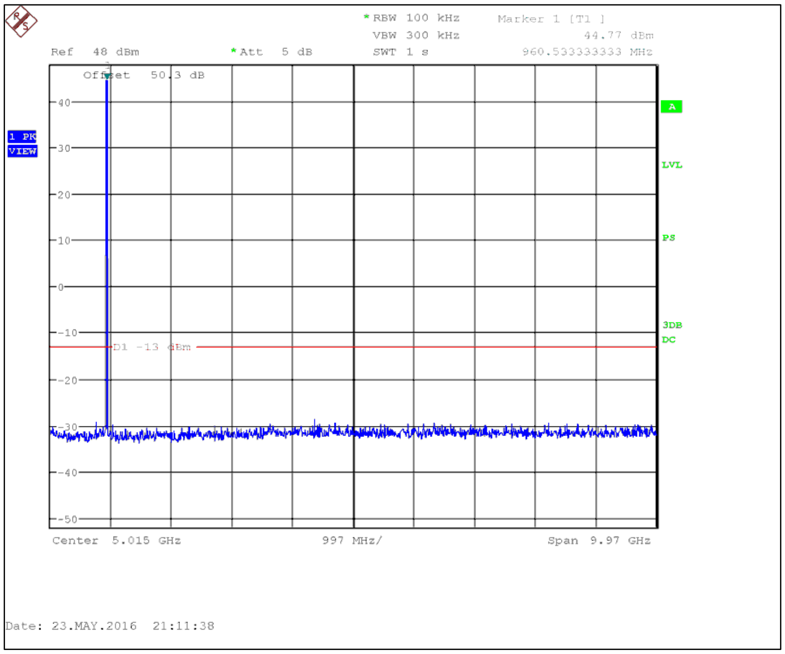

Figure 7.3.2-10: 959.925 MHz – 30 MHz to 10 GHz – mPass 5k

7.4 Field Strength of Spurious Emissions

7.4.1 Measurement Procedure

The equipment under test is placed in the Semi-Anechoic Chamber (described in section 2.3.1) on a table at the turntable center. 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.

7.4.2 Measurement Results

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

Low Power

Table 7.4.2-1: Field Strength of Spurious Emissions –930.5 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1861	55.10	H	-50.08	-13.00	37.08
1861	52.8	V	-51.78	-13.00	38.78
2791.5	64.3	H	-37.75	-13.00	24.75
2791.5	59.3	V	-42.15	-13.00	29.15
3722	52.3	V	-47.12	-13.00	34.12
5583	61.3	H	-31.07	-13.00	18.07
5583	64.7	V	-31.67	-13.00	18.67

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

Table 7.4.2-2: Field Strength of Spurious Emissions –940.0125 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1880.025	63.30	H	-39.78	-13.00	26.78
1880.025	61.9	V	-42.58	-13.00	29.58
2820.0375	62.8	H	-38.24	-13.00	25.24
2820.0375	58.3	V	-43.44	-13.00	30.44
4700.0625	51	H	-40.61	-13.00	27.61
5640.075	60.1	H	-31.53	-13.00	18.53
5640.075	63.7	V	-32.53	-13.00	19.53

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

High Power

Table 7.4.2-3: Field Strength of Spurious Emissions –930.5 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1861	78.70	H	-25.18	-13.00	12.18
1861	78.6	V	-25.28	-13.00	12.28
2791.5	83	H	-18.65	-13.00	5.65
2791.5	79.7	V	-21.15	-13.00	8.15
3722	63.9	H	-31.02	-13.00	18.02
3722	66.1	V	-32.12	-13.00	19.12
4652.5	54.5	V	-43.44	-13.00	30.44
5583	64.9	H	-26.97	-13.00	13.97
5583	70.8	V	-25.47	-13.00	12.47

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

Table 7.4.2-4: Field Strength of Spurious Emissions –940.0125 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1880.025	81.70	H	-21.18	-13.00	8.18
1880.025	81.5	V	-22.58	-13.00	9.58
2820.0375	80.7	H	-20.04	-13.00	7.04
2820.0375	75.8	V	-25.34	-13.00	12.34
3760.05	56.6	V	-41.30	-13.00	28.30
5640.075	61.5	H	-30.03	-13.00	17.03
5640.075	66.6	V	-29.43	-13.00	16.43

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

Part 101.111 a(6), RSS-119 5.8.6

Low Power

Table 7.4.2-5: Field Strength of Spurious Emissions –941.4875 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1882.975	60.80	H	-42.38	-13.00	29.38
1882.975	64.7	V	-39.38	-13.00	26.38
2824.4625	63.2	H	-37.53	-13.00	24.53
2824.4625	56.9	V	-45.03	-13.00	32.03
4707.4375	50.1	H	-41.12	-13.00	28.12
4707.4375	49.2	V	-48.32	-13.00	35.32

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

Table 7.4.2-6: Field Strength of Spurious Emissions –952.5 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1905	48.80	H	-53.58	-13.00	40.58
1905	48.8	V	-53.48	-13.00	40.48
2857.5	63.7	H	-36.82	-13.00	23.82
2857.5	60.8	V	-39.82	-13.00	26.82
3810	57.4	H	-35.77	-13.00	22.77
3810	57.7	V	-37.37	-13.00	24.37
5715	51.4	H	-33.65	-13.00	20.65
5715	61.3	V	-30.35	-13.00	17.35
6667.5	53.7	H	-31.45	-13.00	18.45
6667.5	53.3	V	-33.45	-13.00	20.45

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

Table 7.4.2-7: Field Strength of Spurious Emissions –959.925 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1919.85	53.50	H	-47.67	-13.00	34.67
1919.85	52.1	V	-53.27	-13.00	40.27
2879.775	63.8	H	-36.90	-13.00	23.90
2879.775	59.1	V	-42.80	-13.00	29.80
5759.55	53.4	H	-37.15	-13.00	24.15
5759.55	55.1	V	-41.15	-13.00	28.15

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

High Power

Table 7.4.2-8: Field Strength of Spurious Emissions –941.4875 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1882.975	84.40	H	-18.28	-13.00	5.28
1882.975	81.7	V	-22.08	-13.00	9.08
2824.4625	78.4	H	-22.03	-13.00	9.03
2824.4625	73.6	V	-27.63	-13.00	14.63
3765.95	59.7	V	-38.50	-13.00	25.50
4707.4375	53.2	H	-37.52	-13.00	24.52
5648.925	61.7	H	-29.51	-13.00	16.51
5648.925	65.8	V	-30.31	-13.00	17.31

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

Table 7.4.2-9: Field Strength of Spurious Emissions –952.5 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1905	87.00	H	-15.38	-13.00	2.38
1905	81.7	V	-20.68	-13.00	7.68
2857.5	68.9	H	-31.62	-13.00	18.62
2857.5	68.6	V	-32.02	-13.00	19.02
3810	63.2	H	-29.87	-13.00	16.87
3810	63.5	V	-31.77	-13.00	18.77
5715	62.6	H	-22.75	-13.00	9.75
5715	69.2	V	-22.55	-13.00	9.55

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

Table 7.4.2-10: Field Strength of Spurious Emissions –959.925 MHz – mPass 5k Mode

Frequency (MHz)	Spectrum Analyzer Level (dBµV/m)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1919.85	85.60	H	-16.77	-13.00	3.77
1919.85	86.5	V	-17.57	-13.00	4.57
2879.775	75	H	-25.40	-13.00	12.40
2879.775	68.9	V	-32.60	-13.00	19.60
5759.55	60.3	H	-29.55	-13.00	16.55
5759.55	64.8	V	-30.85	-13.00	17.85

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

7.5 Frequency Stability

7.5.1 Measurement Procedure

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

Frequency measurements were made at intervals of 10º C over the temperature range of -30º C to +50º C at the normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each temperature step. The equipment operates at 24 Vdc. At 20ºC two additional measurements were performed at +/- 15% of 24Vdc. The maximum variation of frequency over temperature and voltage was recorded.

The results of the test are shown below:

7.5.2 Measurement Results

Part 24.135, RSS-134 (4.5)

Frequency Stability

Frequency (MHz): 930.5

Deviation Limit (PPM): 1.0ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**930.500100**	**0.107**	100%	24.00
-20 C	**930.500170**	**0.183**	100%	24.00
-10 C	**930.500235**	**0.253**	100%	24.00
0 C	**930.500243**	**0.261**	100%	24.00
10 C	**930.500173**	**0.186**	100%	24.00
20 C	**930.500069**	**0.074**	100%	24.00
30 C	**930.500052**	**0.056**	100%	24.00
40 C	**930.500115**	**0.124**	100%	24.00
50 C	**930.500072**	**0.077**	100%	24.00
20 C	**930.500073**	**0.078**	85%	20.40
20 C	**930.500078**	**0.084**	115%	27.60

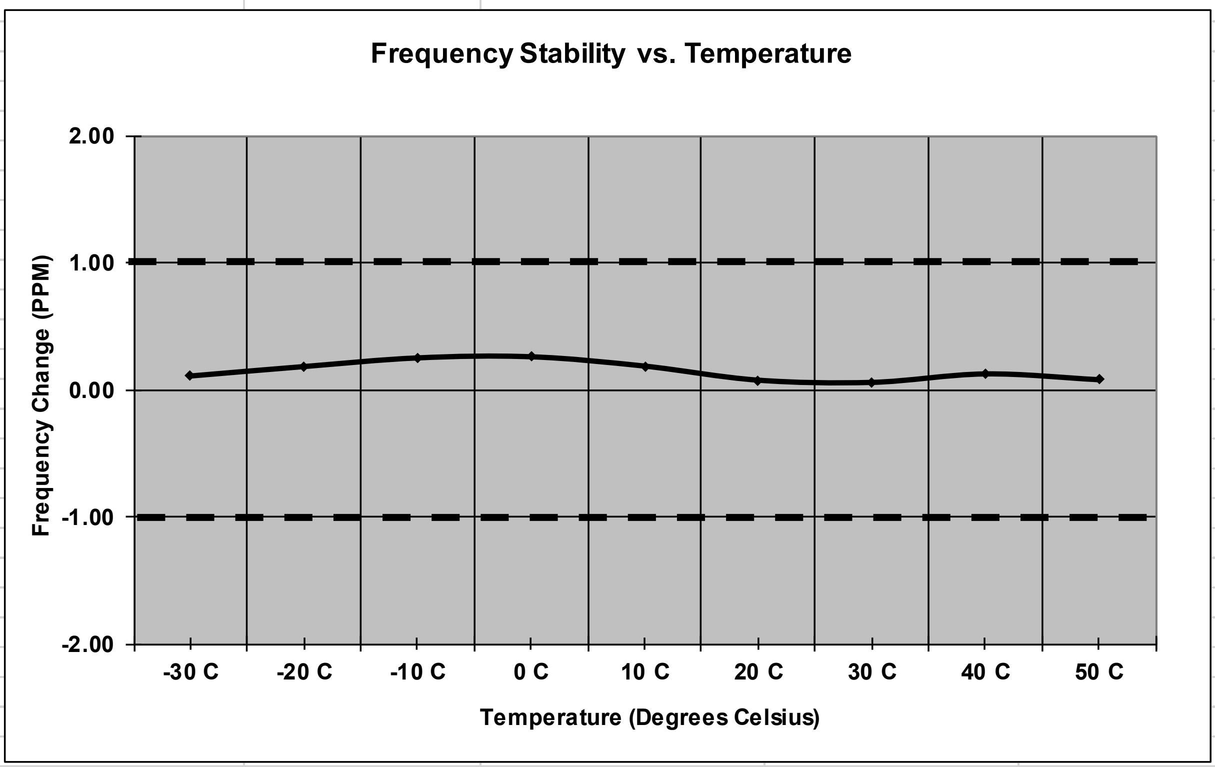

Figure 7.5.2-1: Frequency Stability – 930.5 MHz

Part 101.107, RSS-119 5.3

Frequency Stability

Frequency (MHz): 941.4875

Deviation Limit (PPM): 1.0ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	941.487606	0.113	100%	24.00
-20 C	941.487646	0.155	100%	24.00
-10 C	941.487750	0.266	100%	24.00
0 C	941.487768	0.285	100%	24.00
10 C	941.487678	0.189	100%	24.00
20 C	941.487560	0.064	100%	24.00
30 C	941.487528	0.030	100%	24.00
40 C	941.487630	0.138	100%	24.00
50 C	941.487570	0.074	100%	24.00
20 C	941.487568	0.072	85%	20.40
20 C	941.487570	0.074	115%	27.60

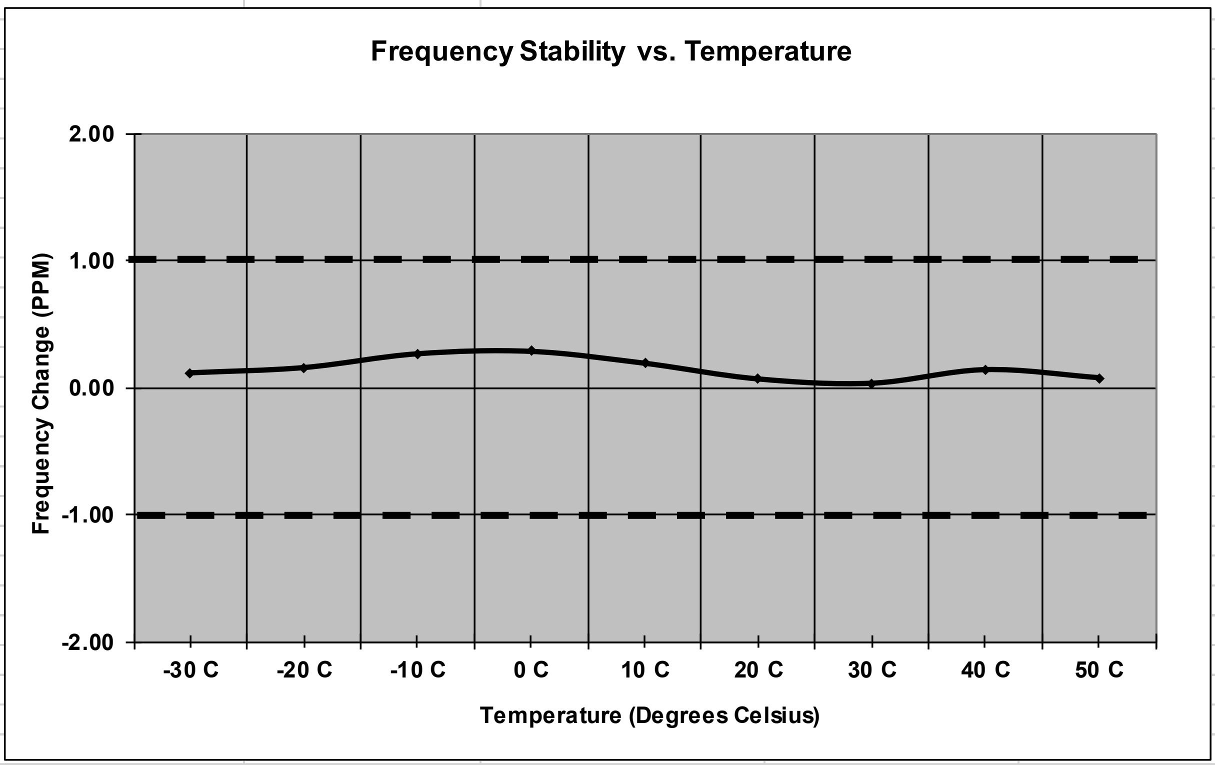

Figure 7.5.2-2: Frequency Stability – 941.4875 MHz

Frequency Stability

Frequency (MHz): 959.925

Deviation Limit (PPM): 1.0ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	**959.925109**	**0.114**	100%	24.00
-20 C	**959.925117**	**0.122**	100%	24.00
-10 C	**959.925220**	**0.229**	100%	24.00
0 C	**959.925263**	**0.274**	100%	24.00
10 C	**959.925210**	**0.219**	100%	24.00
20 C	**959.925080**	**0.083**	100%	24.00
30 C	**959.925030**	**0.031**	100%	24.00
40 C	**959.925130**	**0.135**	100%	24.00
50 C	**959.925067**	**0.070**	100%	24.00
20 C	**959.925082**	**0.085**	85%	20.40
20 C	**959.925084**	**0.088**	115%	27.60

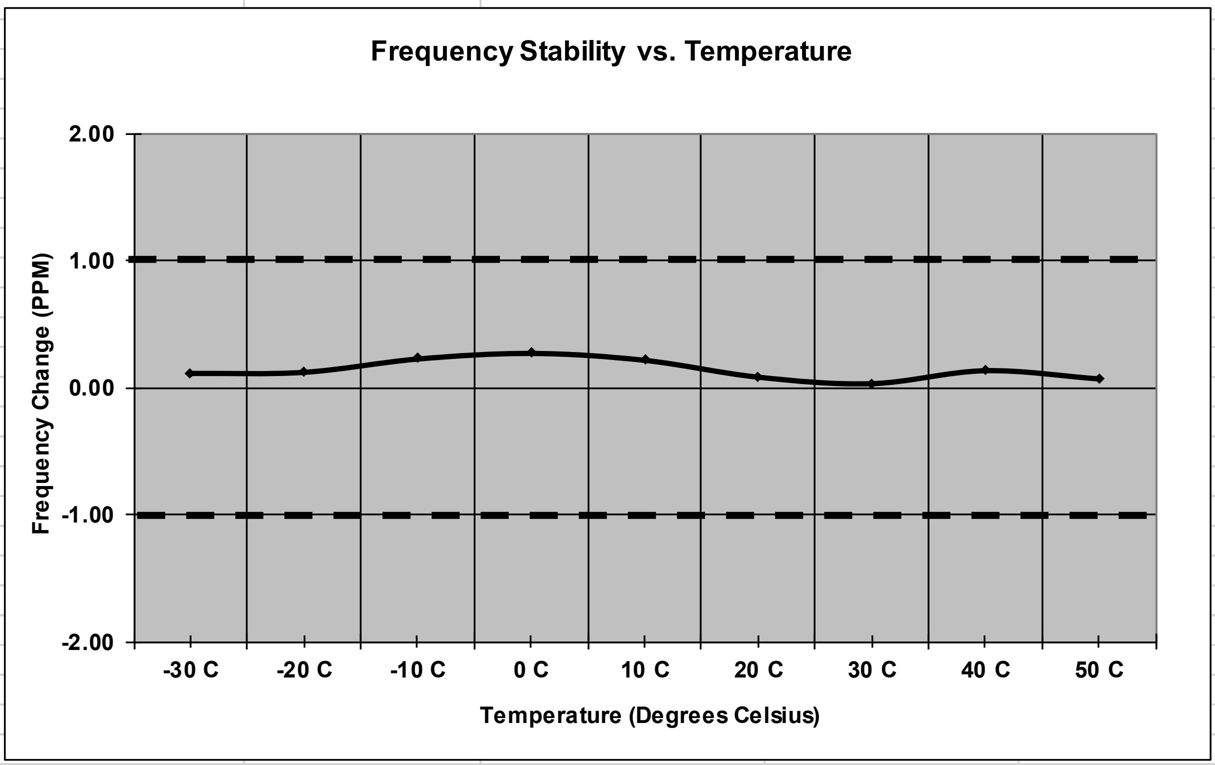

Figure 7.5.2-3: Frequency Stability – 959.925 MHz

8.0 CONCLUSION

In the opinion of ACS, Inc. the model M400G2900, manufactured by Sensus Metering Systems, Inc., meets all the requirements of Part 2 Subpart J, Part 24 Subpart D and Part 101 Subpart C of the FCC's Code of Federal Regulations, and Innovation, Science and Economic Development, Canada's Radio Standards Specifications RSS-119 and RSS-134 where applicable.

End of Report