

Certification Test Report

FCC ID: SDBTGB001HP
IC: 2220A-TGB001

FCC Rule Part: CFR 47 Part 24 Subpart D, Part 101 Subpart C
IC Radio Standards Specification: RSS 119, RSS 134

ACS Report Number: 12-2044.W06.1A

Applicant: Sensus Metering Systems, Inc.
Model: TGB001HP

Test Begin Date: April 17, 2012
Test End Date: September 11, 2012

Report Issue Date: September 12, 2012




For The Scope of Accreditation Under Certificate Number AT-1533



For The Scope of Accreditation Under Lab Code 200612-0

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Advanced Compliance Solutions, Inc.

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This report contains 41 pages

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1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with the specific test requirements of Part 2 Subpart J, Part 24 Subpart D and Part 101 Subpart C of the FCC’s Code of Federal Regulations, and Industry Canada Radio Standards Specifications RSS-119 and RSS-134 for a Class II permissive change.

The purpose of this Class II Permissive Change is to include additional frequency bands of operation under Part 101, additional emission designators and to show compliance under low power operation.

Separate test reports are provided for both low and high power operations. This report applies to high power operation only.

1.2 Product Description

The TGB001HP is the base station component of the Sensus Automated Meter Reading (AMR) and Telemetry System. The device receives telemetry transmissions from multiple system end point units. These units are mostly utilized for utility metering, but in some cases may send other types of information such as that used for inventory and industrial control applications.

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

Test Sample Serial Numbers: 2612

Test Sample Condition: The unit was in good operating conditions with no physical damages.

1.3 Test Methodology

1.3.1 Configurations and Justification

The TGB001HP was configured using the Sensus VGB Utility v1.3.1.0 with the "TX Atten" set to 18 dB. The TGB001HP was evaluated for high power operation for the mPass 5k and new mPass 10k modes across the range of operation which includes additional frequency bands listed in the table below.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)
101	928.85 - 929.0
101	932.0 - 932.5
101	952.0 – 953.0

The TGB001HP was evaluated at the antenna port for mPass 5K and new mPass 10k modulation, across the entire range of operation. The RF conducted measurements were performed through the PA Out port of the unit using suitable attenuation.

The radiated emissions investigation was performed up to the 10th harmonic with the EUT terminated with a 50 ohm load at the antenna port. The evaluation was performed on the mode of operation leading to the highest emissions.

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

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	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.
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 TGB001HP transmitter produces 2 distinct modulation formats. The emissions designators for the modulation types used by the TGB001HP transmitter are as follows:

EMISSIONS DESIGNATORS:

- mPass Mode (5 kbps): 5K90F1D (2-GFSK)
- mPass Mode (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:

Site 1

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

Site 2

Advanced Compliance Solutions, Inc.
5015 B.U. Bowman Drive
Buford GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598
www.acstestlab.com

2.2 Laboratory Accreditations/Recognitions/Certifications

Site 1

ACS, Boca Raton, Florida, is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ACLASS program and has been issued certificate number AT-1533 in recognition of this accreditation.

Site 2

ACS, Buford, GA is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP).

Unless otherwise specified, all test methods described within this report are covered under the respective test site ISO/IEC 17025 scope of accreditation.

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl floor.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flushed with the chamber floor which it is connected to, around its circumference, with metallic loaded springs. An EMCO Model 1051 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

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

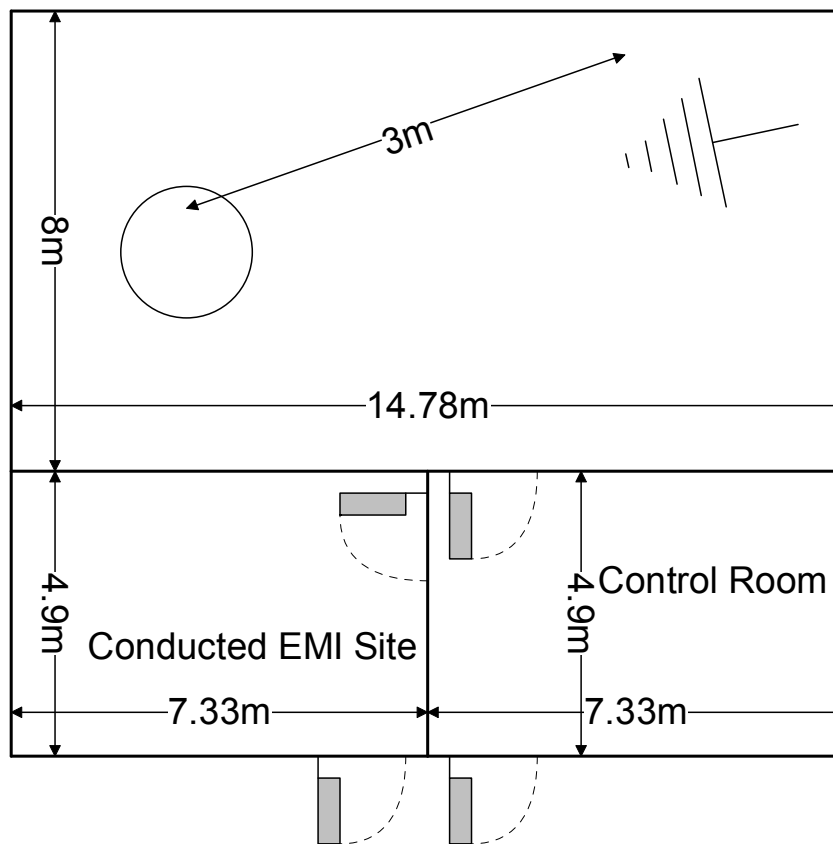


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m³. As per ANSI C63.4 2003 requirements, the data were taken using two LISNs; a Solar Model 8028-50 50 Ω/50 μH and an EMCO Model 3825, which are installed as shown in Photograph 3. For 220 V, 50 Hz, a Polarad LISN (S/N 879341/048) is used in conjunction with a 1 kVA, 50 Hz/220 V EDGAR variable frequency generator, Model 1001B, to filter conducted noise from the generator.

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

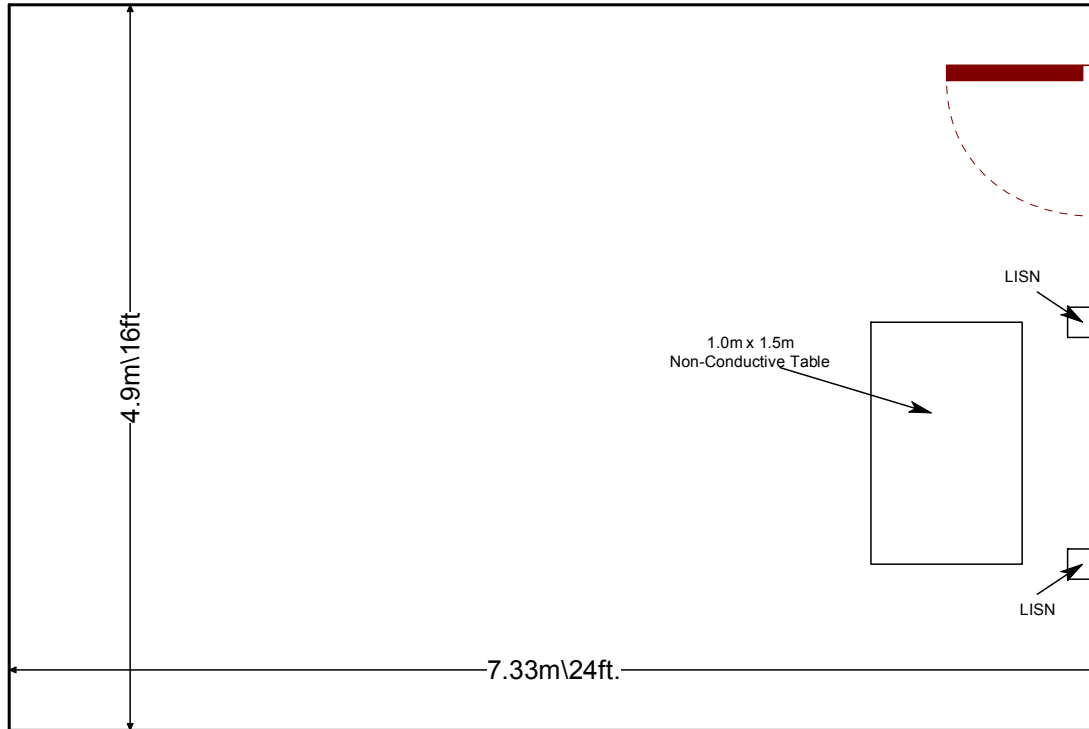


Figure 2.3.2-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- 1 - ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40GHz - 2003
- 2 - US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures - 2012
- 3 - US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communications Services – 2012
- 4 - US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services - 2012
- 5 – TIA-603-C: Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards – 2004
- 6 – Industry 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 11, June 2011
- 7 – Industry Canada Radio Standards Specification: RSS-134 - 900 MHz Narrow Band Personal Communication Service, Issue 1, March 2000

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
270	Associated Research Inc	510L	Safety Tester	9131061	12/10/2010	12/10/2012
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	8/26/2011	8/26/2012
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	8/1/2012	8/1/2013
426	Thermotron	S-8 Mini Max	Environmental Chamber	25-2888-10	8/29/2011	8/29/2012
426	Thermotron	S-8 Mini Max	Environmental Chamber	25-2888-10	8/2/2012	8/2/2013
523	Agilent	E7405	Spectrum Analyzers	MY45103293	1/5/2011	1/5/2013
524	Chase	CBL6111	Antennas	1138	1/7/2011	1/7/2013
1265	Weinschel	48-10-33	Attenuators	BX7204	12/30/2011	12/30/2012
2002	EMCO	3108	Antennas	2147	11/30/2011	11/30/2013
2004	EMCO	3146	Antennas	1385	11/30/2011	11/30/2013
2006	EMCO	3115	Antennas	2573	3/2/2011	3/2/2013
2007	EMCO	3115	Antennas	2419	1/18/2012	1/18/2014
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	1/2/2012	1/2/2013
2037	ACS Boca	Chamber EMI Cable Set	Cable Set	2037	1/2/2012	1/2/2013
2075	Hewlett Packard	8495B	Attenuators	2626A11012	1/2/2012	1/2/2013
2076	Hewlett Packard	HP5061-5458	Cables	2076	1/2/2012	1/2/2013
2082	Teledyne Storm Products	90-010-048	Cables	2082	6/6/2011	6/6/2012
2082	Teledyne Storm Products	90-010-048	Cables	2082	5/31/2012	5/31/2013
2091	Agilent Technologies, Inc.	8573A	Spectrum Analyzers	2407A03233	12/12/2011	12/12/2013
RE571	Narda	26298	Attenuators	A500	6/21/2011	6/21/2012
RE571	Narda	26298	Attenuators	A500	6/29/2012	6/29/2013
RE586	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00168	9/23/2011	9/23/2012
RE587	Fairview Microwave Inc.	SA3N511-15	Attenuators	RE587	4/18/2012	4/18/2013

NCR=No Calibration Required

*Note: Assets RE571 and RE587 were only utilized during their active calibration cycles.

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Sensus Metering Systems, Inc.	TGB001HP	2612
2	24 VDC Power Supply	Lineage Power	J2007003 L102	10KZ47016361
3	Antenna	LAIRD	FG8963	39965
4	Ethernet Switch	NetGear	FS105	FS15A09005405
5	Power Supply	NetGear	YP-040	N/A
6	10 dB Attenuator	Weinschel	48-10-33	BX7204
7	15 dB Attenuator	Fairview Microwave Inc.	SA3N511-15	RE587
8	50 Ohm Termination	Narda	376BNF	9401

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Coaxial Cable	0.6m	Yes	EUT to 50 Ω Termination
B	Serial Alarm Cable	0.9m	No	None
C	RS232 Cable	1.83m	No	None
D	POTS Cable	2.2m	No	None
E	Coaxial Cable RG-214	10.0 m	Yes	EUT to Antenna
F	CAT5 Cable	2.0m	Yes	EUT to Ethernet Switch
G	Power Cord	1.87m	No	Power Supply to Ethernet Switch
H	Coaxial Cable	1.28m	Yes	EUT to 50 Ω Termination
I	Power Cable	1.2 m	No	Power Supply to EUT
J	Power Cord	2.2m	No	Power Supply to AC Mains

6.0 EQUIPMENT UNDER TEST SETUP AND BLOCK DIAGRAM

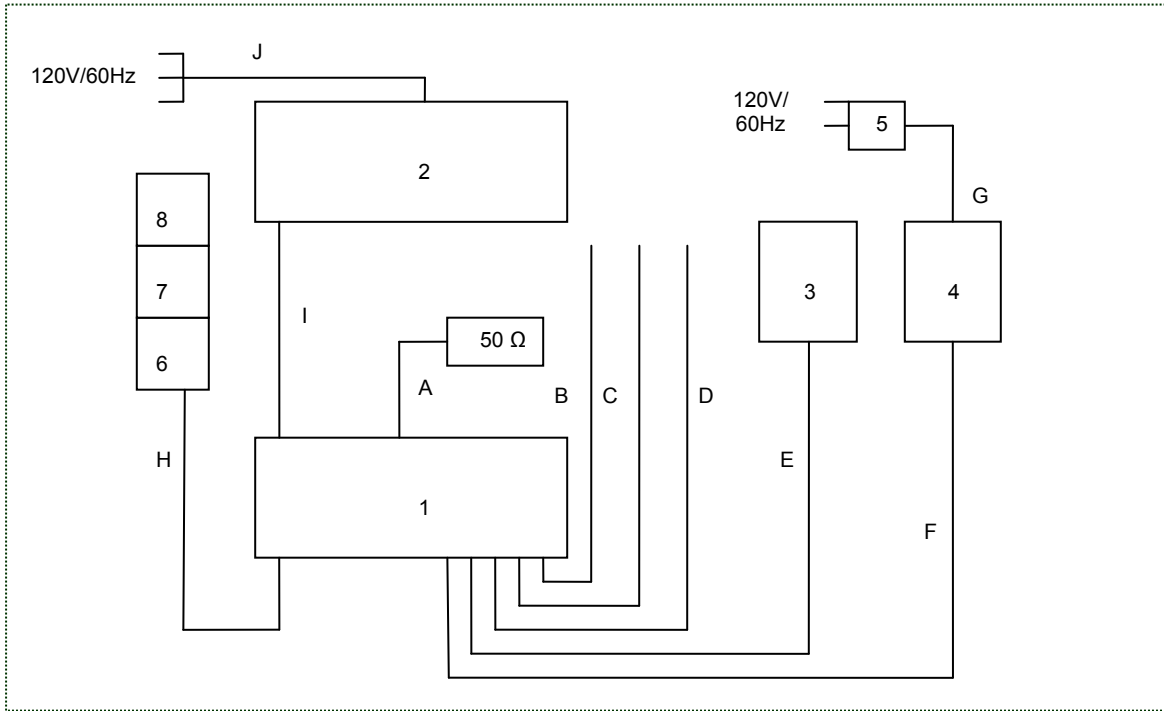


Figure 6-1: EUT Test Setup

* Note: The EUT and port terminations were configured per the customer setup instructions.

7.0 SUMMARY OF TESTS

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

Table 7-1: Test Results Summary

Test Parameter	Test Site	Test Summary
RF Power Output	1	Pass
Occupied Bandwidth (Emissions Limits)	1	Pass
Spurious Emissions at Antenna Terminals	1	Pass
Field Strength of Spurious Emissions	1	Pass
Frequency Stability	2	Pass

7.1 RF Power Output

7.1.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 45 dB of passive attenuation. The resolution and video bandwidths of the spectrum analyzer were set at sufficient levels, >> signal bandwidth, to produce accurate results. The internal correction factors of the spectrum analyzer were employed to correct for any cable or attenuator losses. Results are shown below.

7.1.2 Measurement Results

Table 7.1.2-1: Peak Output Power

Frequency (MHz)	FCC Rule Part	Output Power (dBm)
930.5000	24D	45.0
940.0125	24D	45.08
928.9250	101	44.97
932.2500	101	44.98
941.4875	101	45.08
952.5000	101	44.57
959.9250	101	44.09

Part 24.132 / RSS-134 5.4(a)

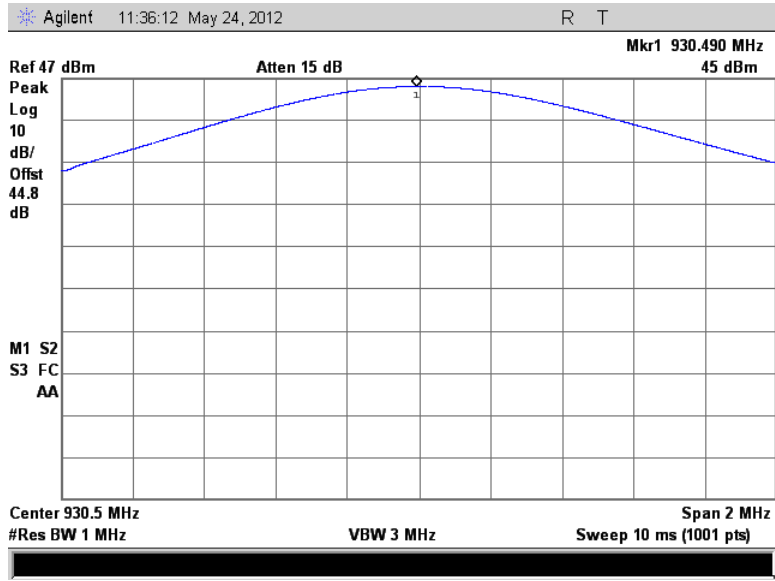


Figure 7.1.2-1: Peak Output Power - 930.5 MHz

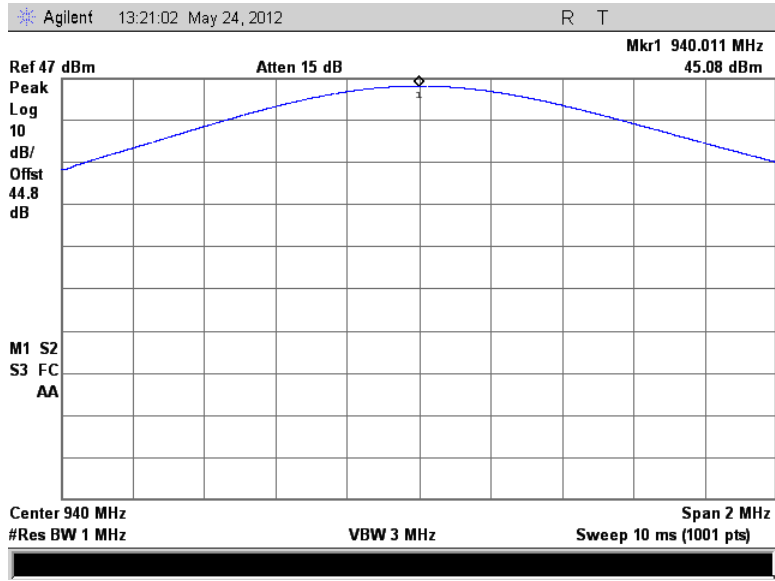


Figure 7.1.2-2: Peak Output Power – 940.0125 MHz

Part 101.113(a) / RSS-119 5.4.1

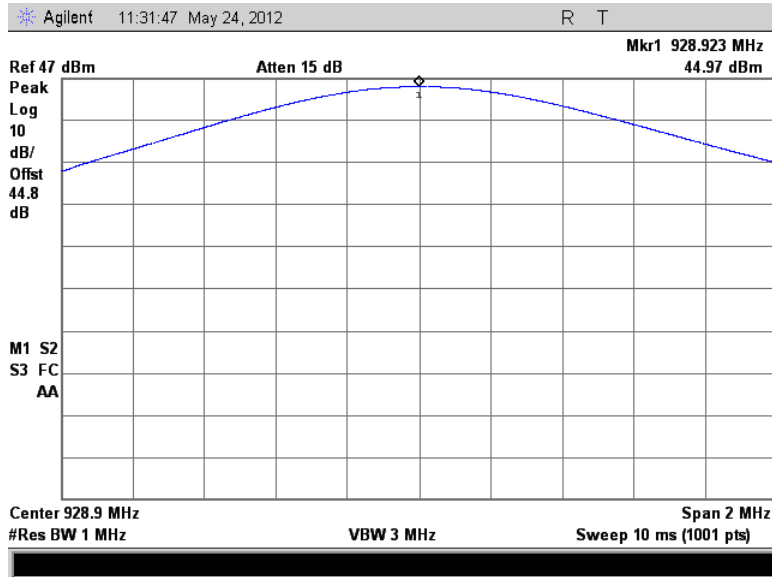


Figure 7.1.2-3: Peak Output Power - 928.925 MHz

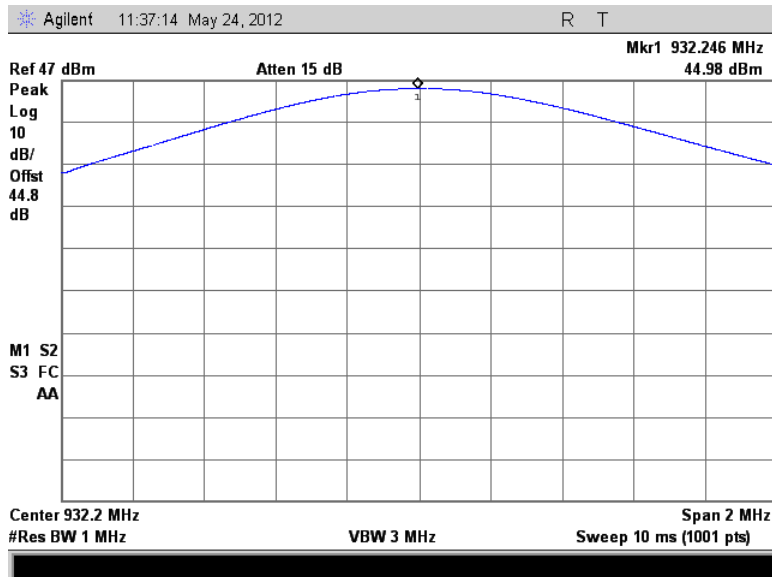


Figure 7.1.2-4: Peak Output Power - 932.25 MHz

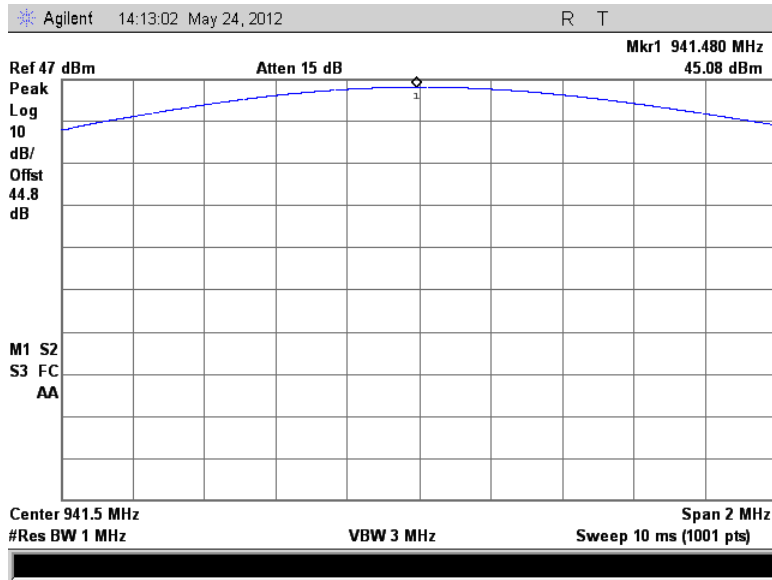


Figure 7.1.2-5: Peak Output Power - 941.4875 MHz

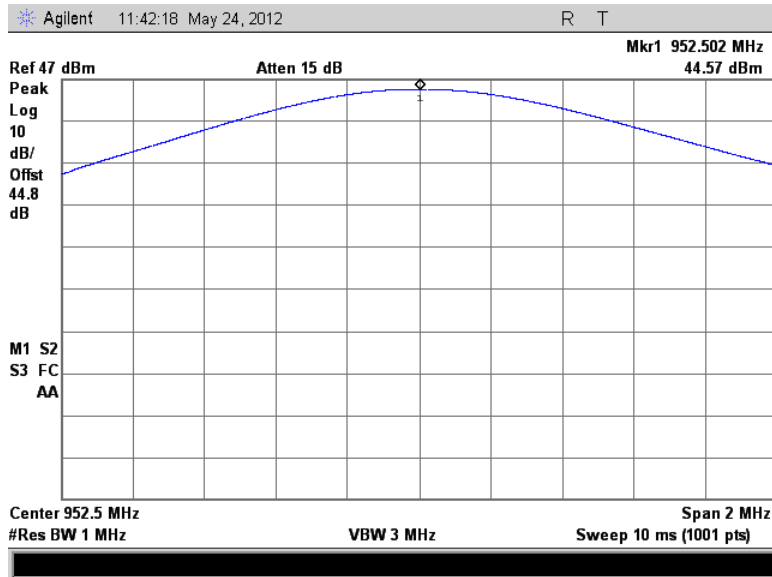


Figure 7.1.2-6: Peak Output Power - 952.5 MHz

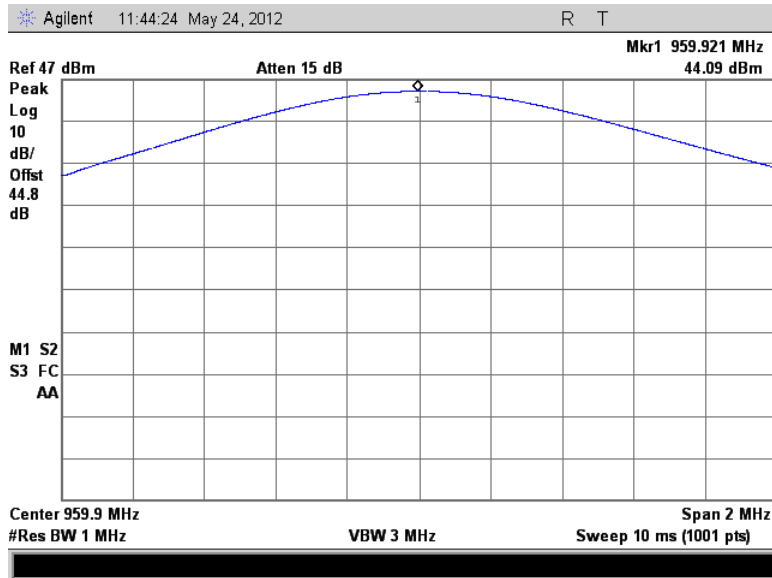


Figure 7.1.2-7: Peak Output Power - 959.925 MHz

7.2 Occupied Bandwidth (Emission Limits)

7.2.1 Measurement Procedure

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 45 dB 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

Part 24.133 a(1), a(2), IC RSS-134 6.3(i), (ii)

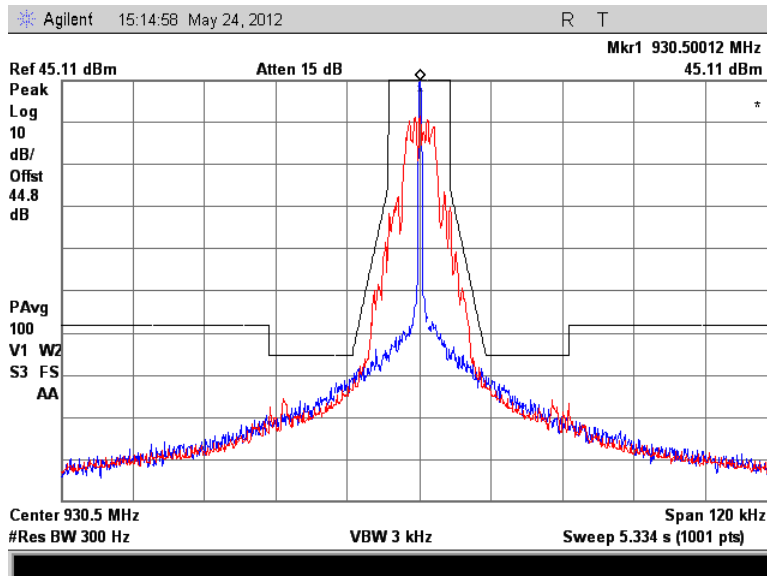


Figure 7.2.2-1: 930.5 MHz – 12.5 kHz Channel Spacing – MPass 5k Mode

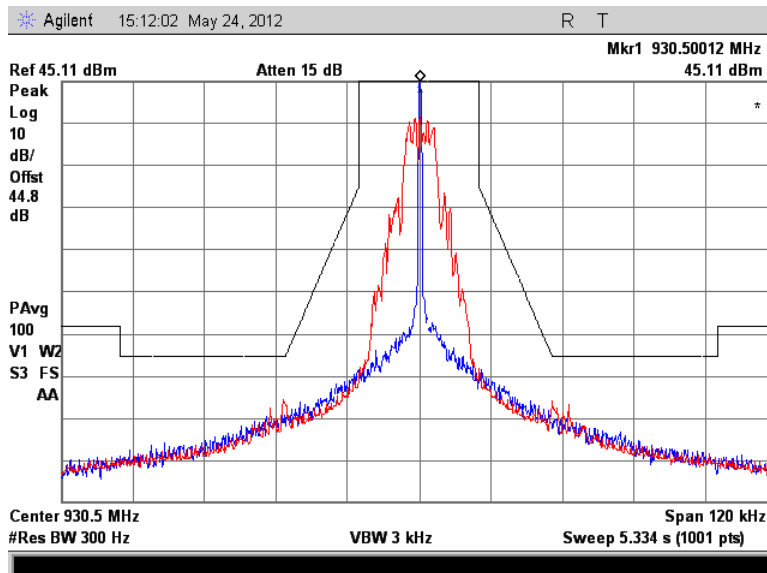


Figure 7.2.2-2: 930.5 MHz – 25 kHz Channel Spacing – MPass 5k Mode

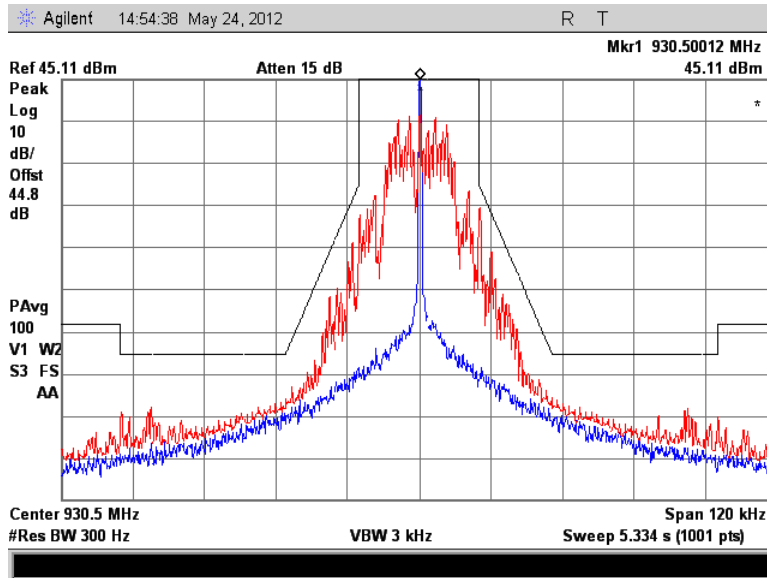


Figure 7.2.2-3: 930.5 MHz – 25 kHz Channel Spacing – MPass 10k Mode

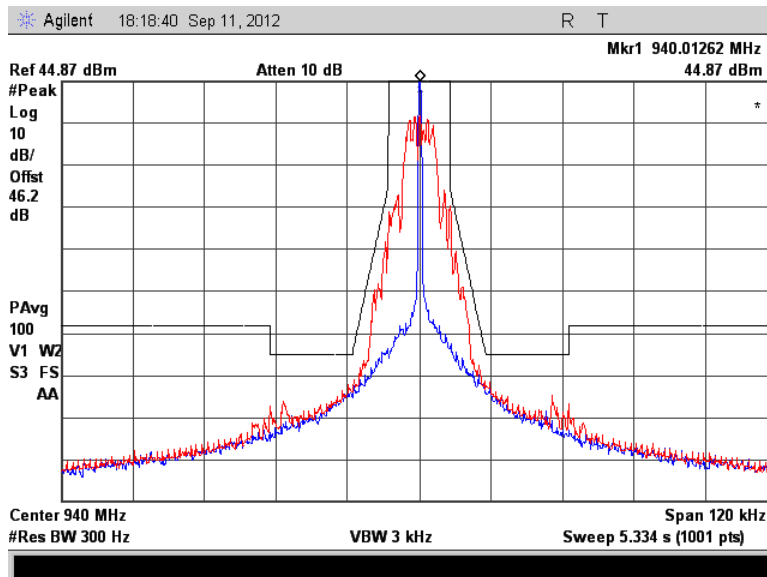


Figure 7.2.2-4: 940.0125 MHz – 12.5 kHz Channel Spacing – MPass 5k Mode

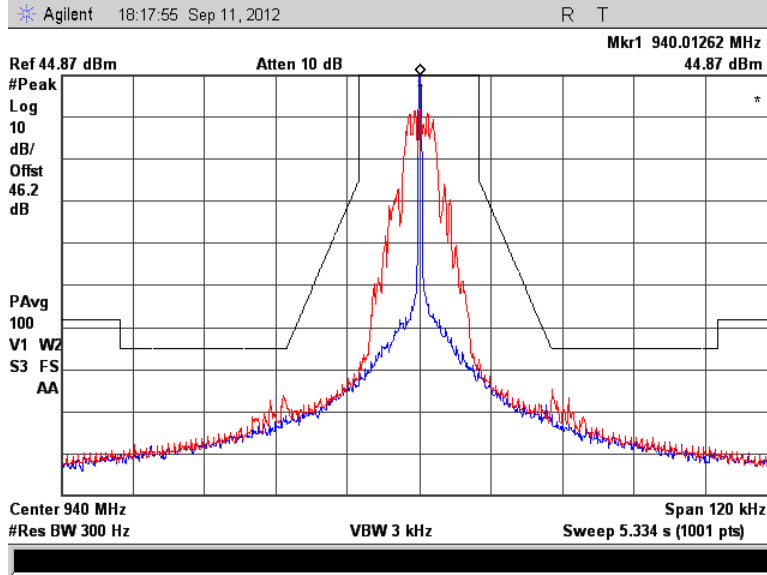


Figure 7.2.2-5: 940.0125MHz – 25 kHz Channel Spacing – MPass 5k Mode

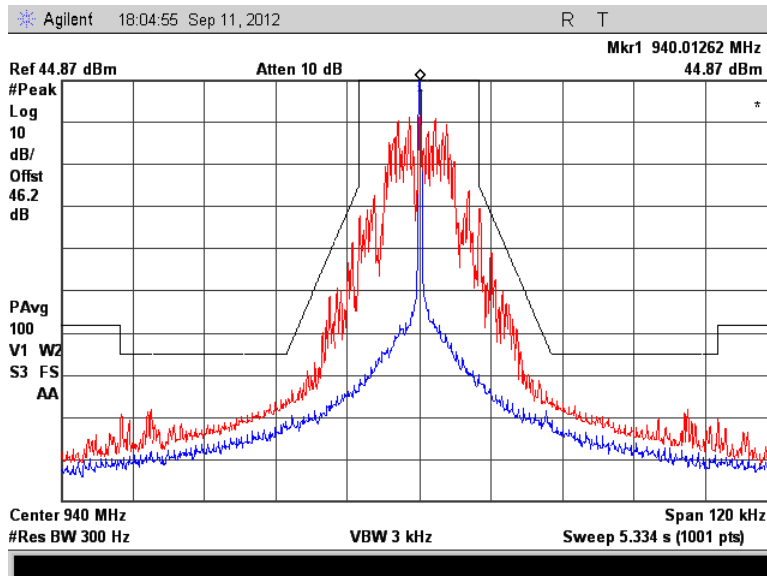


Figure 7.2.2-6: 940.0125 MHz – 25 kHz Channel Spacing – MPass 10k Mode

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

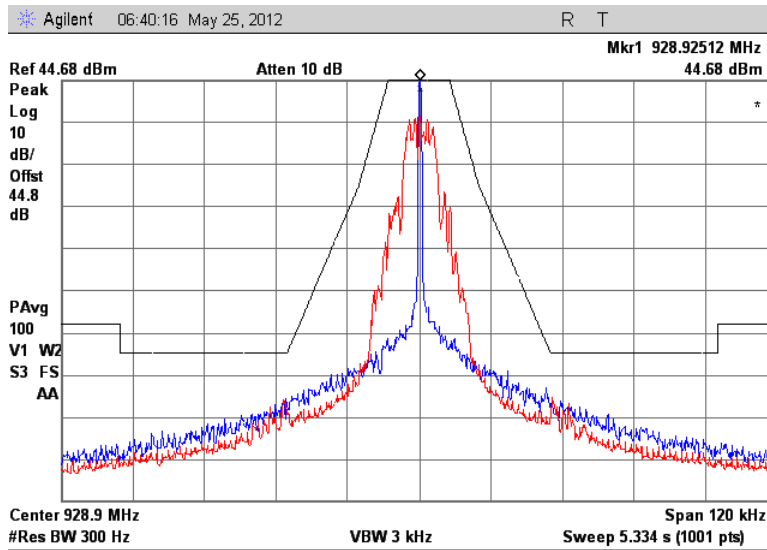


Figure 7.2.2-7: 928.925 MHz – MPass 5k Mode

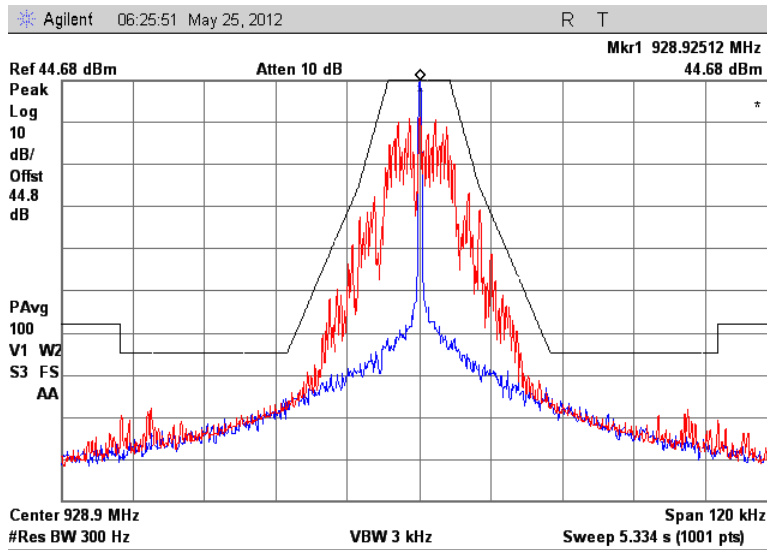


Figure 7.2.2-8: 928.925 MHz –MPass 10k Mode

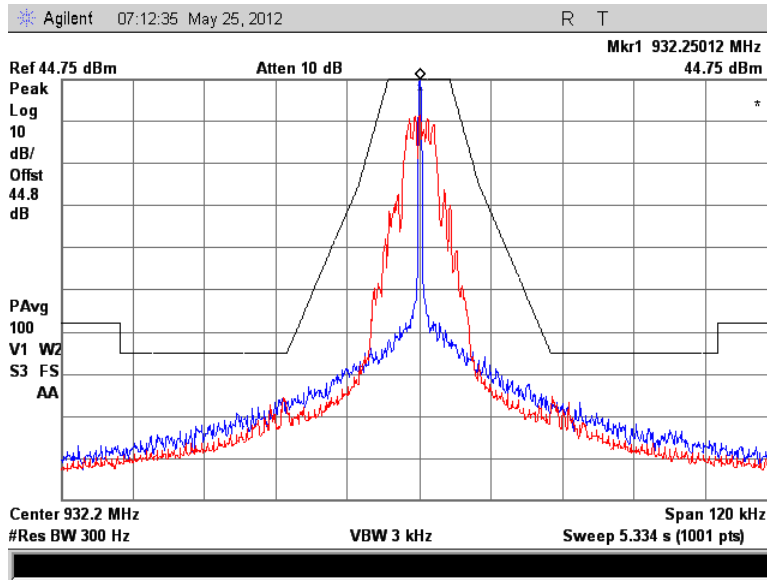


Figure 7.2.2-9: 932.25 MHz – MPass 5k Mode

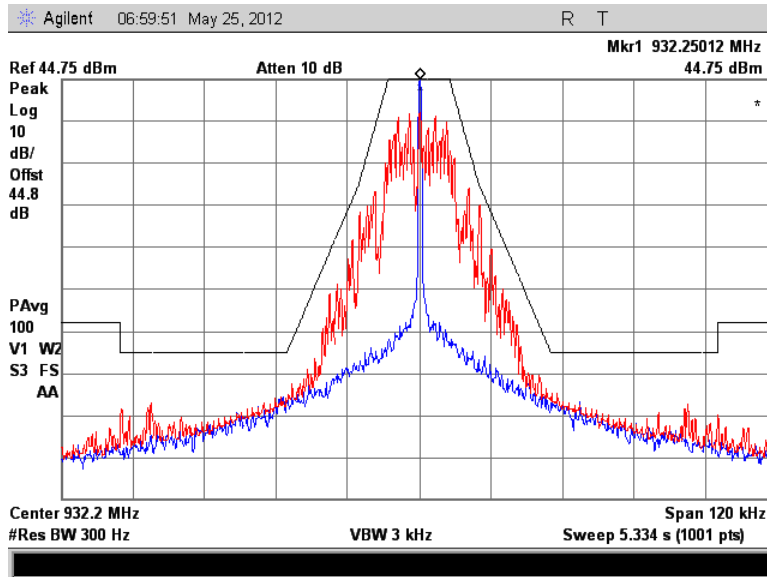


Figure 7.2.2-10: 932.25 MHz – MPass 10k Mode

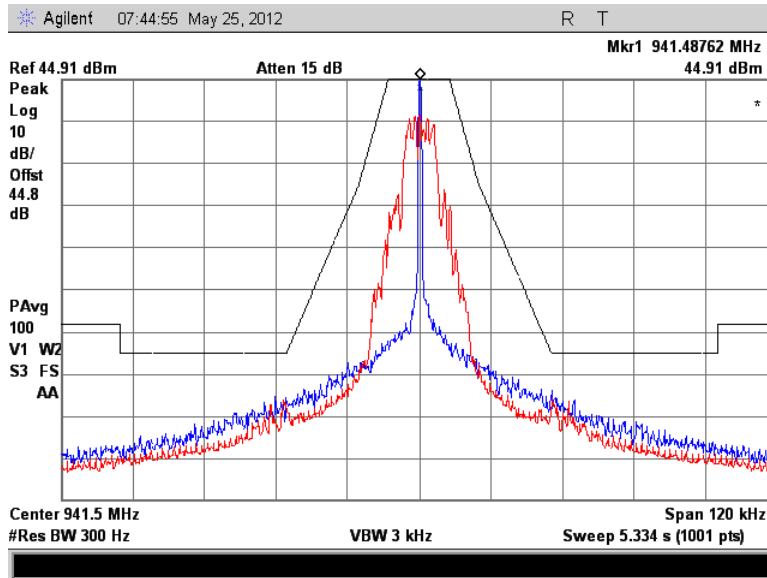


Figure 7.2.2-11: 941.4875 MHz – MPass 5k Mode

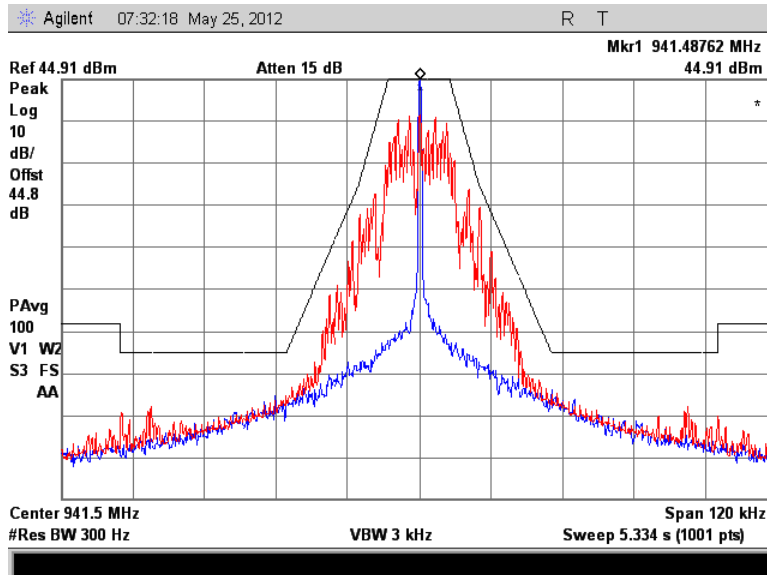


Figure 7.2.2-12: 941.4875 MHz – MPass 10k Mode

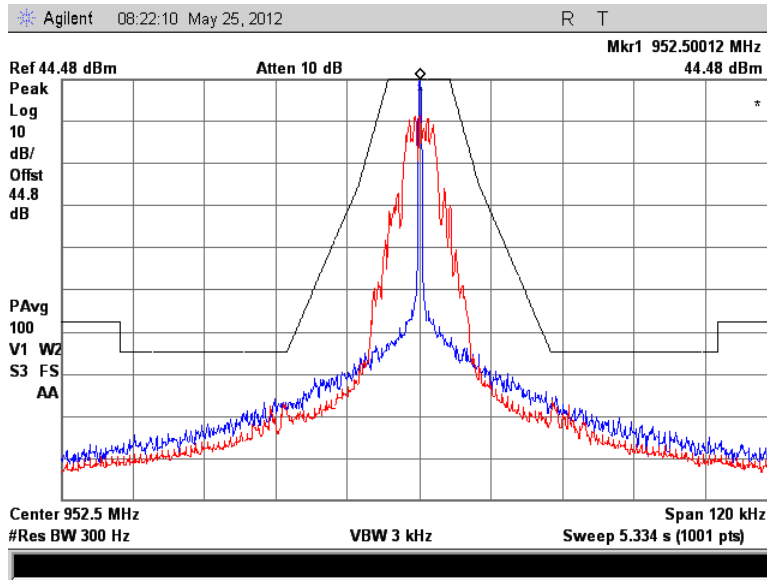


Figure 7.2.2-13: 952.5 MHz – MPass 5k Mode

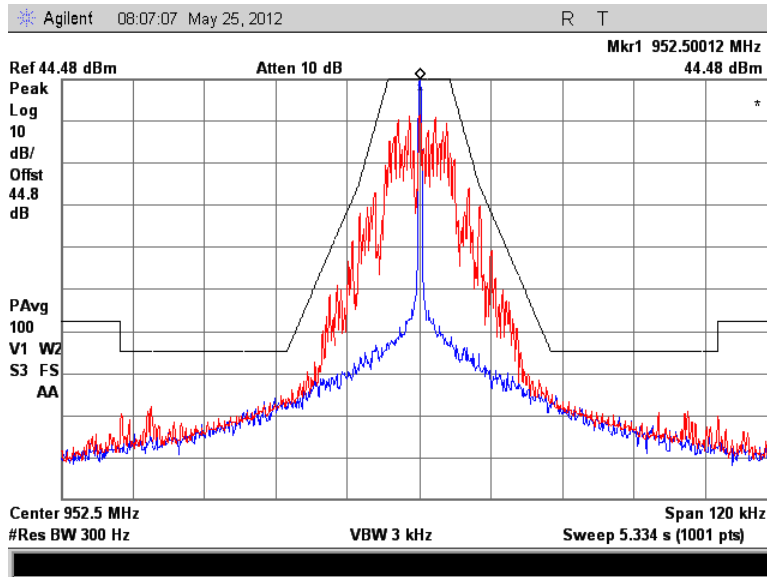


Figure 7.2.2-14: 952.5 MHz – MPass 10k Mode

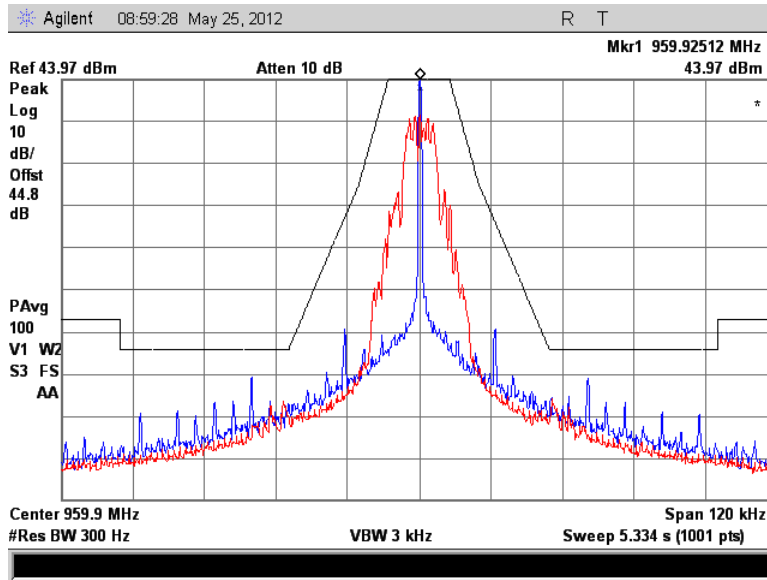


Figure 7.2.2-15: 959.925 MHz – MPass 5k Mode

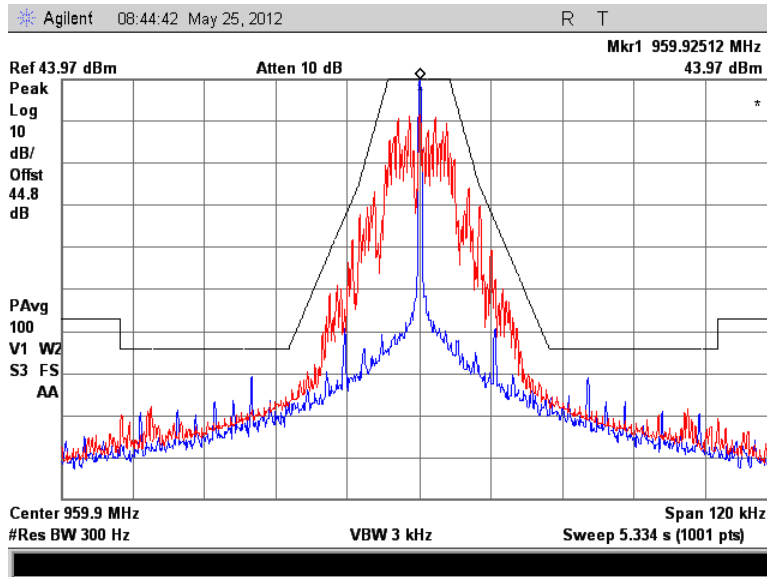


Figure 7.2.2-16: 959.925 MHz –MPass 10k Mode

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 45 dB 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. Results are shown below.

7.3.2 Measurement Results

Part 24.133 a(1), a(2), IC RSS-134 6.3(i), (ii)

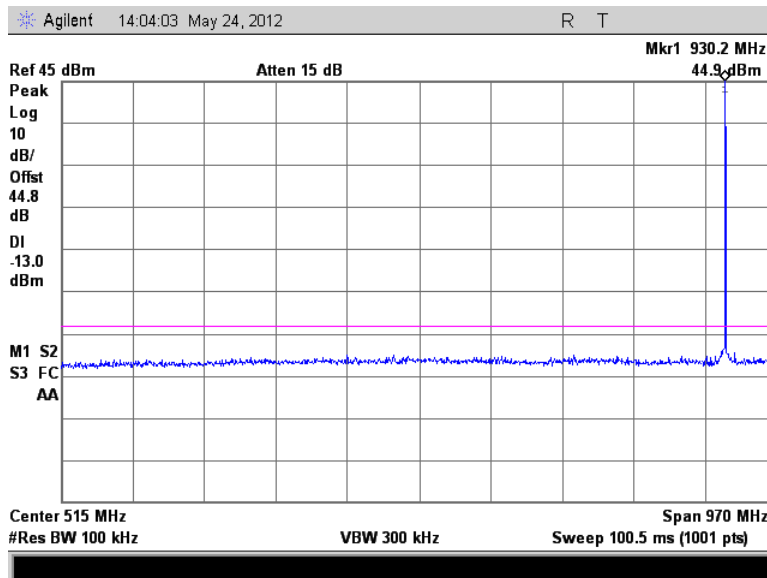


Figure 7.3.2-1: 930.5 MHz – 30MHz to 1GHz

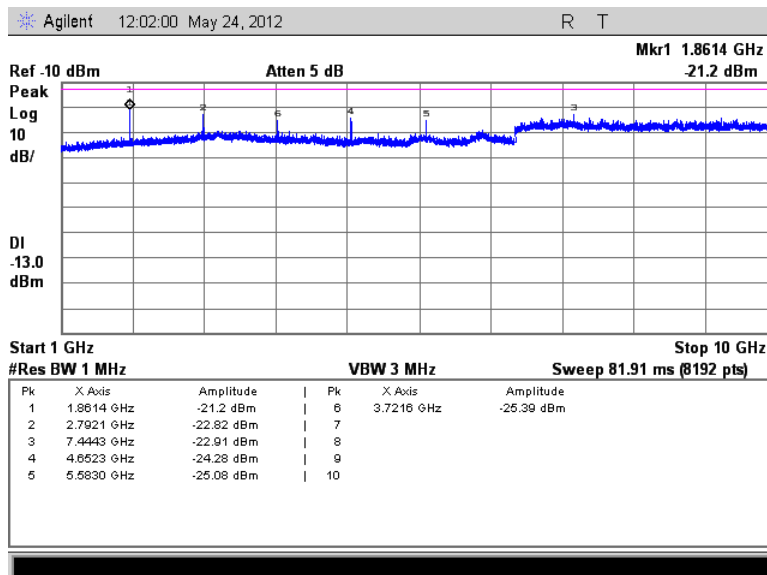


Figure 7.3.2-2: 930.5 MHz – 1GHz to 10GHz

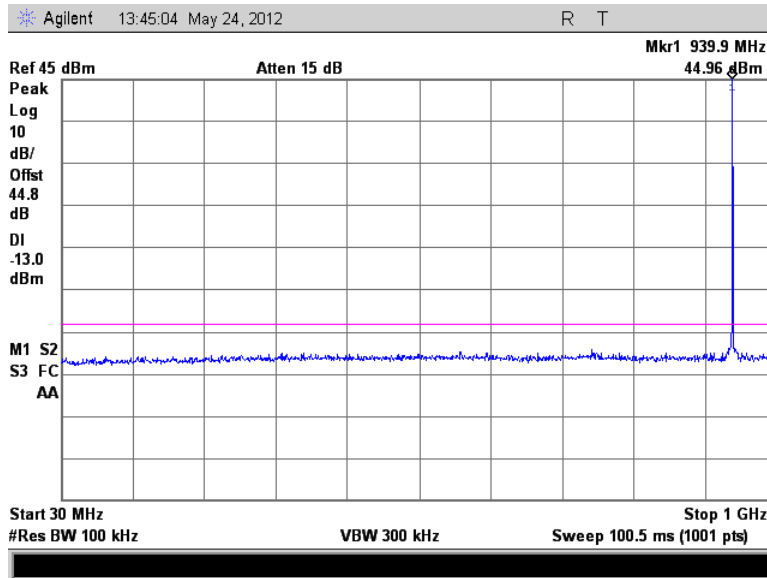


Figure 7.3.2-3: 940.0125 MHz – 30MHz to 1GHz

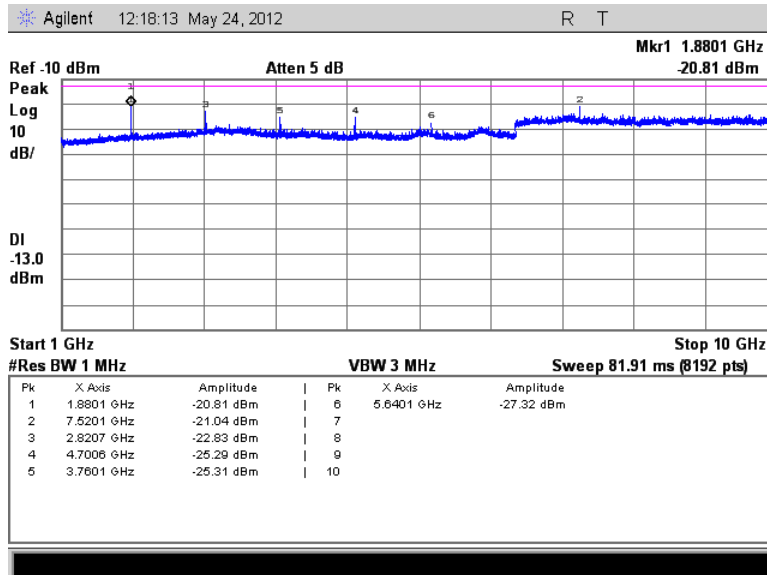


Figure 7.3.2-4: 940.0125 MHz – 1GHz to 10GHz

Part 101.111 a(6), RSS-119 5.8.6

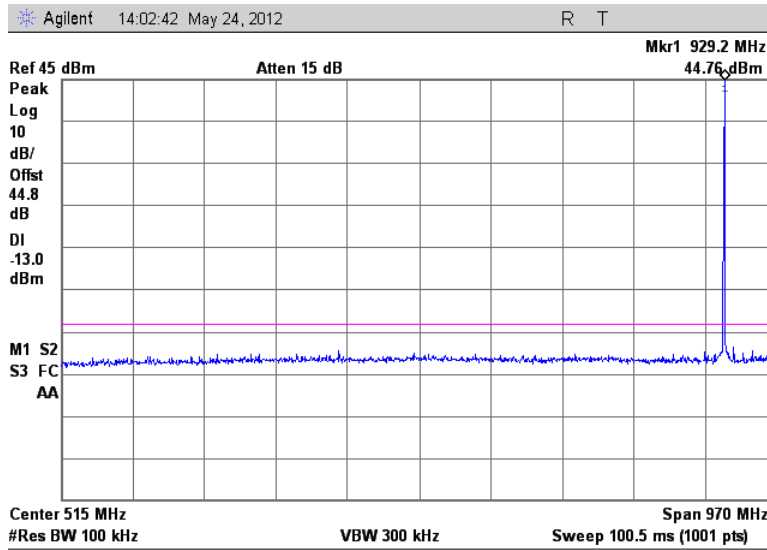


Figure 7.3.2-5: 928.925 MHz – 30MHz to 1GHz

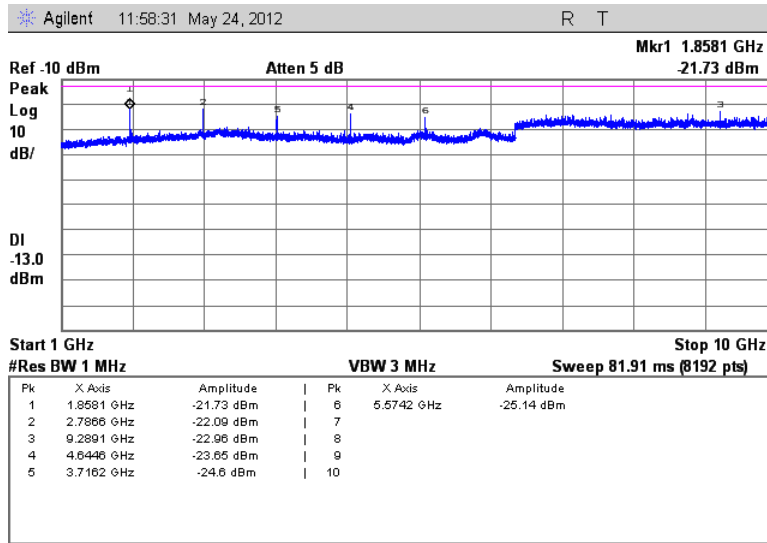


Figure 7.3.2-6: 928.925 MHz – 1GHz to 10GHz

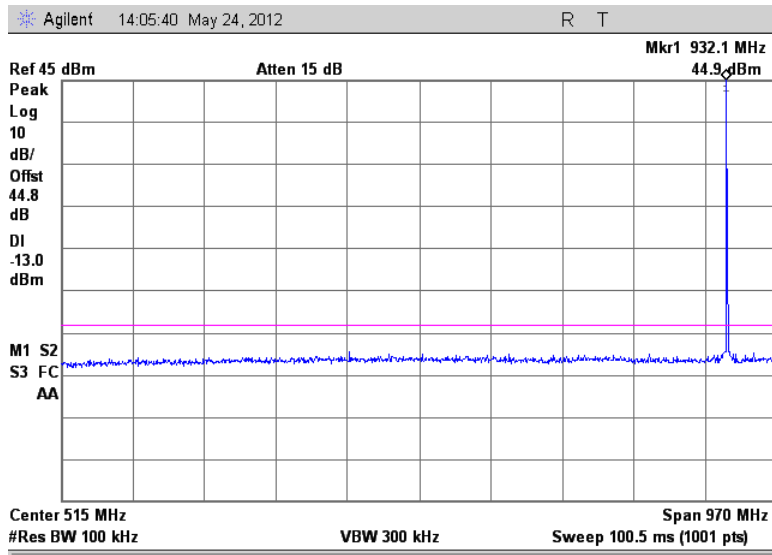


Figure 7.3.2-7: 932.25 MHz – 30MHz to 1GHz

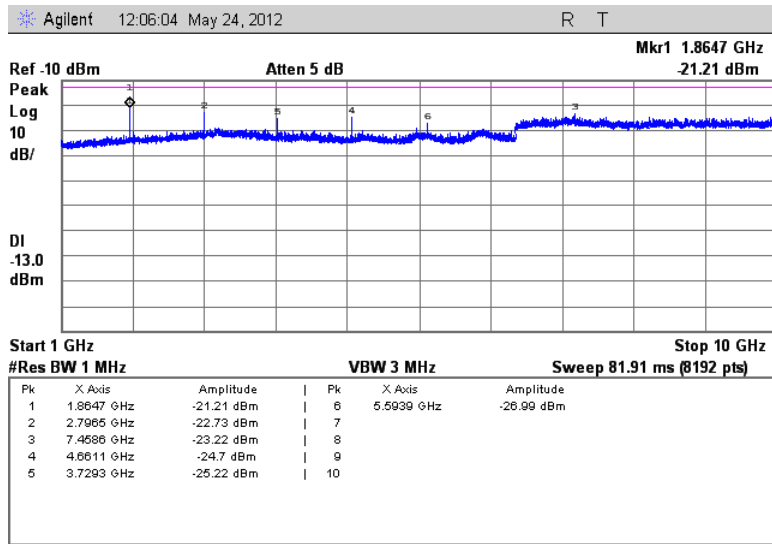


Figure 7.3.2-8: 932.25 MHz – 1GHz to 10GHz

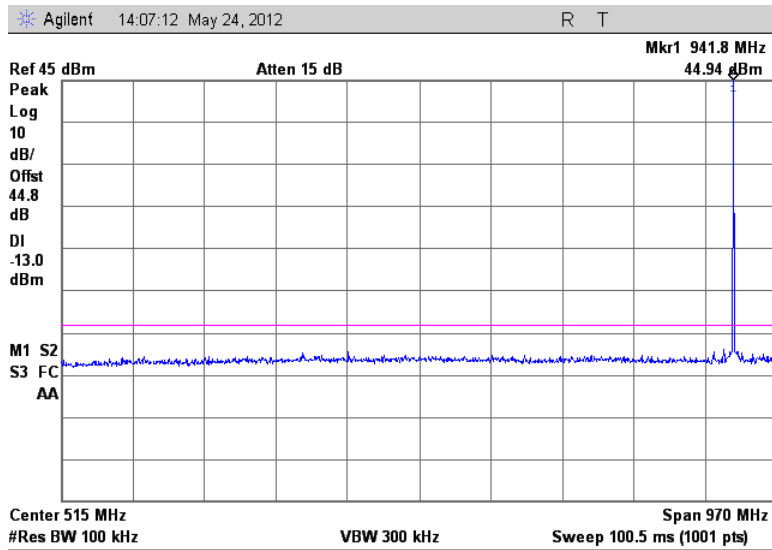


Figure 7.3.2-9: 941.4875 MHz – 30MHz to 1GHz

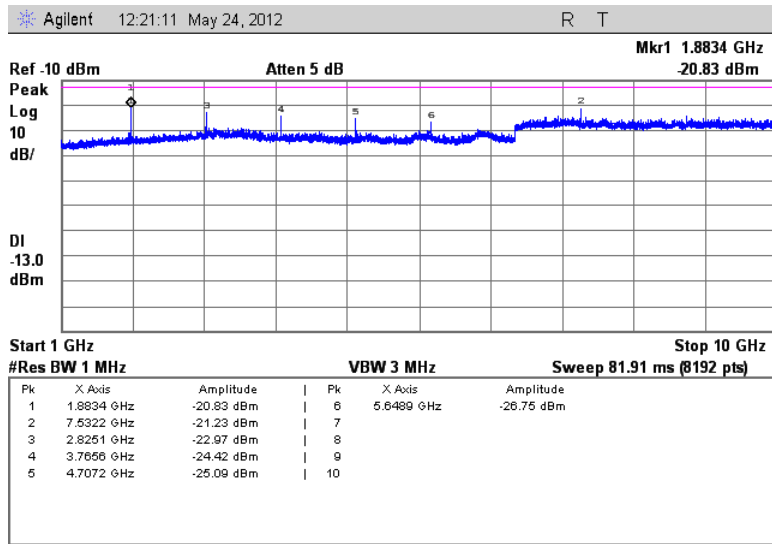


Figure 7.3.2-10: 941.4875 MHz – 1GHz to 10GHz

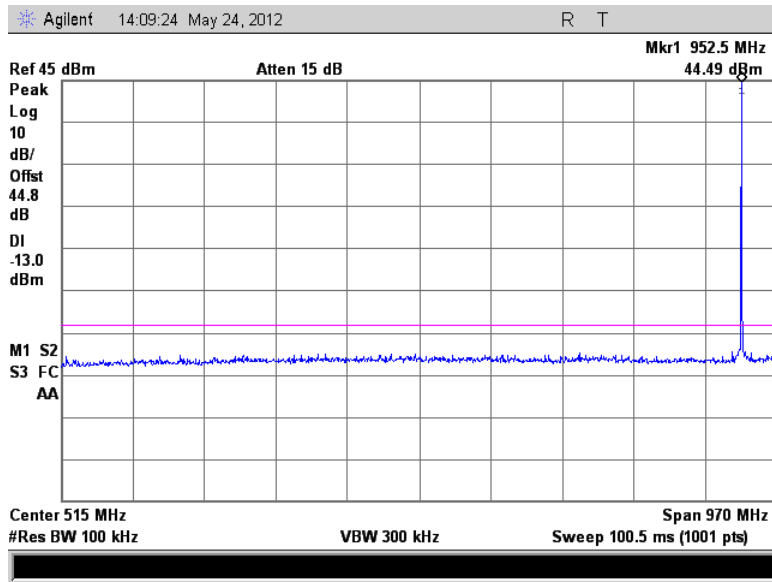


Figure 7.3.2-11: 952.5 MHz – 30MHz to 1GHz

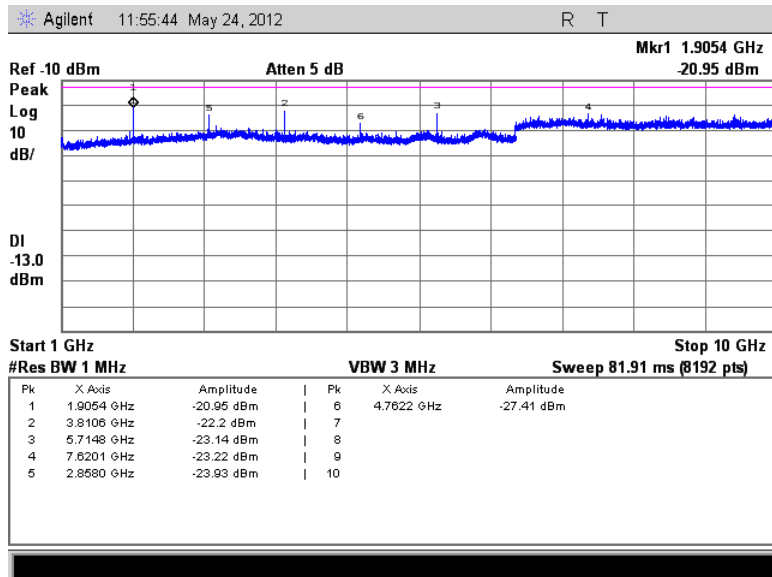


Figure 7.3.2-12: 952.5 MHz – 1GHz to 10GHz

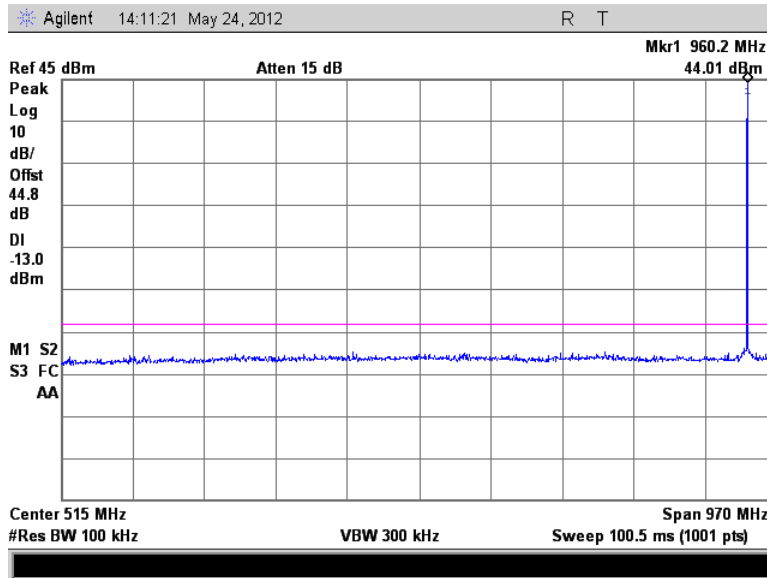


Figure 7.3.2-13: 959.925 MHz – 30MHz to 1GHz

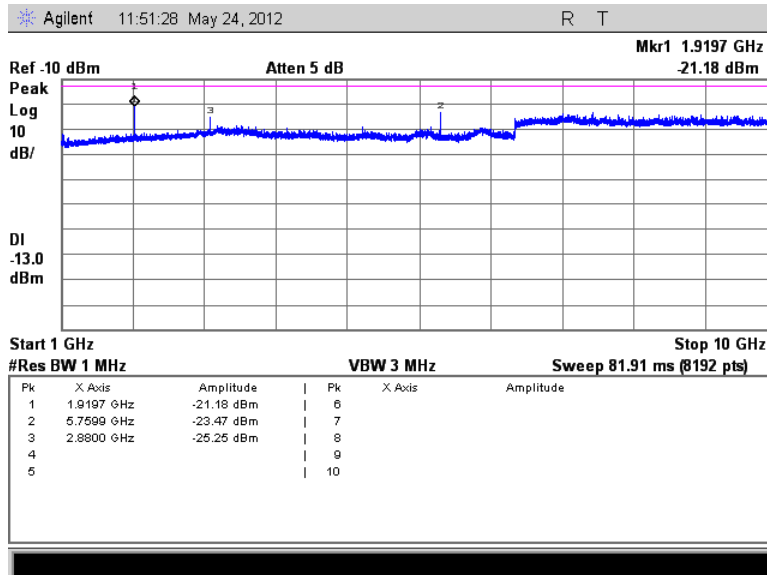


Figure 7.3.2-14: 959.925 MHz – 1GHz to 10GHz

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 wooden 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 360° 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.

7.4.2 Measurement Results

Part 24.133 a(1), a(2), RSS-134 6.3(i), (ii)

Table 7.4.2-1: Field Strength of Spurious Emissions – 930.5 MHz

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1861	-41.10	H	-40.12	-13.00	27.12
2791.5	-25.55	H	-21.47	-13.00	8.47
3722	-30.05	H	-30.09	-13.00	17.09
4652.5	-43.55	H	-29.66	-13.00	16.66
5583	-54.10	H	-40.83	-13.00	27.83
6513.5	-55.80	H	-41.93	-13.00	28.93
8374.5	-56.05	H	-40.66	-13.00	27.66
1861	-39.55	V	-38.72	-13.00	25.72
2791.5	-25.60	V	-19.87	-13.00	6.87
3722	-31.55	V	-20.24	-13.00	7.24
4652.5	-44.00	V	-30.51	-13.00	17.51
5583	-53.35	V	-40.93	-13.00	27.93
6513.5	-55.20	V	-40.73	-13.00	27.73
8374.5	-55.60	V	-40.36	-13.00	27.36

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

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1880.025	-41.20	H	-40.67	-13.00	27.67
2820.0375	-27.35	H	-22.59	-13.00	9.59
3760.05	-35.20	H	-25.14	-13.00	12.14
4700.0625	-45.25	H	-32.12	-13.00	19.12
5640.075	-57.10	H	-48.43	-13.00	35.43
6580.0875	-55.90	H	-47.23	-13.00	34.23
1880.025	-39.40	V	-39.42	-13.00	26.42
2820.0375	-27.20	V	-21.34	-13.00	8.34
3760.05	-34.05	V	-22.54	-13.00	9.54
4700.0625	-48.90	V	-36.67	-13.00	23.67
5640.075	-55.10	V	-43.63	-13.00	30.63
6580.0875	-55.20	V	-44.33	-13.00	31.33

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

Part 101.111 a(6), RSS-119 5.8.6**Table 7.4.2-3: Field Strength of Spurious Emissions – 928.925 MHz**

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1857.85	-41.35	H	-40.07	-13.00	27.07
2786.775	-25.60	H	-20.32	-13.00	7.32
3715.7	-29.70	H	-19.84	-13.00	6.84
4644.625	-42.85	H	-29.06	-13.00	16.06
5573.55	-53.10	H	-40.43	-13.00	27.43
8360.325	-56.55	H	-41.81	-13.00	28.81
1857.85	-39.55	V	-38.92	-13.00	25.92
2786.775	-26.50	V	-19.72	-13.00	6.72
3715.7	-30.80	V	-19.39	-13.00	6.39
4644.625	-43.40	V	-29.96	-13.00	16.96
5573.55	-53.50	V	-41.58	-13.00	28.58
8360.325	-56.45	V	-44.41	-13.00	31.41

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

Table 7.4.2-4: Field Strength of Spurious Emissions – 932.25 MHz

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1864.5	-40.90	H	-39.77	-13.00	26.77
2796.75	-26.30	H	-21.42	-13.00	8.42
3729	-32.40	H	-22.64	-13.00	9.64
4661.25	-45.95	H	-32.66	-13.00	19.66
5593.5	-55.80	H	-43.38	-13.00	30.38
6525.75	-55.50	H	-43.08	-13.00	30.08
8390.25	-57.05	H	-43.96	-13.00	30.96
1864.5	-39.90	V	-39.42	-13.00	26.42
2796.75	-25.15	V	-18.82	-13.00	5.82
3729	-30.35	V	-18.84	-13.00	5.84
4661.25	-44.70	V	-31.21	-13.00	18.21
5593.5	-53.10	V	-39.63	-13.00	26.63
6525.75	-55.10	V	-41.58	-13.00	28.58
8390.25	-55.20	V	-38.56	-13.00	25.56

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

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

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1882.975	-42.60	H	-42.32	-13.00	29.32
2824.4625	-28.15	H	-22.44	-13.00	9.44
3765.95	-40.25	H	-31.19	-13.00	18.19
4707.4375	-47.30	H	-34.97	-13.00	21.97
5648.925	-58.20	H	-49.58	-13.00	36.58

1882.975	-38.90	V	-38.62	-13.00	25.62
2824.4625	-28.40	V	-21.39	-13.00	8.39
3765.95	-37.95	V	-27.09	-13.00	14.09
4707.4375	-47.15	V	-35.02	-13.00	22.02
5648.925	-55.80	V	-44.13	-13.00	31.13
8473.3875	-56.00	V	-40.77	-13.00	27.77

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

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1905	-54.30	H	-54.49	-13.00	41.49
2857.5	-27.50	H	-23.44	-13.00	10.44
3810	-43.35	H	-33.83	-13.00	20.83
4762.5	-52.00	H	-39.97	-13.00	26.97
5715	-57.05	H	-46.17	-13.00	33.17

1905	-52.10	V	-56.89	-13.00	43.89
2857.5	-27.20	V	-21.34	-13.00	8.34
3810	-40.05	V	-28.43	-13.00	15.43
4762.5	-49.30	V	-37.17	-13.00	24.17
5715	-54.70	V	-41.47	-13.00	28.47

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

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
1919.85	-49.55	H	-50.74	-13.00	37.74
2879.775	-31.10	H	-27.09	-13.00	14.09
3839.7	-43.00	H	-33.43	-13.00	20.43
4799.625	-56.80	H	-48.12	-13.00	35.12
5759.55	-56.05	H	-44.22	-13.00	31.22
7679.4	-55.80	H	-42.89	-13.00	29.89
1919.85	-48.10	V	-49.14	-13.00	36.14
2879.775	-31.00	V	-24.44	-13.00	11.44
3839.7	-43.95	V	-32.58	-13.00	19.58
4799.625	-53.90	V	-43.57	-13.00	30.57
5759.55	-55.70	V	-43.32	-13.00	30.32
7679.4	-54.85	V	-40.29	-13.00	27.29

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 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 -30°C to $+50^{\circ}\text{C}$ and at intervals of 10°C at normal supply voltage. A period of time sufficient to stabilize all components of the equipment was allowed at each frequency measurement. At a temperature 20°C the measurements were performed at 85% and 115% of the EUT nominal voltage. The maximum variation of frequency was recorded.

Since the EUT falls under multiple rule parts, the most stringent ppm limit from the different rule parts was applied for the measurements. The results of the tests are shown below.

7.5.2 Measurement Results

Part 24.135, RSS-134 (7)

Frequency Stability

Frequency (MHz): 940.0125
 Deviation Limit (PPM): 0.1ppm

Temperature C	Frequency MHz	Frequency Error (PPM)	Voltage (%)	Voltage (VDC)
-30 C	940.012529	0.031	100%	24.00
-20 C	940.012529	0.031	100%	24.00
-10 C	940.012530	0.032	100%	24.00
0 C	940.012530	0.032	100%	24.00
10 C	940.012529	0.031	100%	24.00
20 C	940.012522	0.023	100%	24.00
30 C	940.012526	0.028	100%	24.00
40 C	940.012524	0.026	100%	24.00
50 C	940.012524	0.026	100%	24.00
20 C	940.012522	0.023	85%	20.40
20 C	940.012522	0.023	115%	27.60

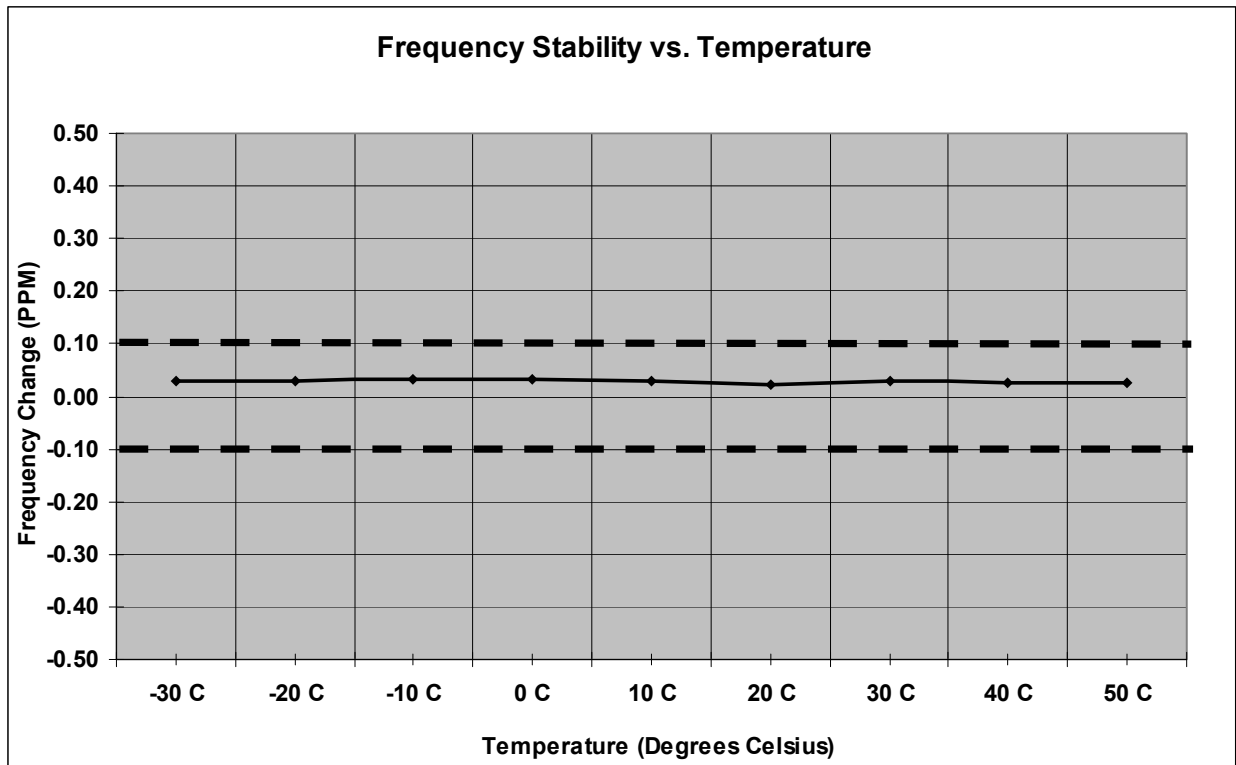


Figure 7.5.2-1: Frequency Stability – 940.0125 MHz

Part 101.107, RSS-119 5.3

Frequency Stability

Frequency (MHz): 928.925

Deviation Limit (PPM): 0.1ppm

Temperature C	Frequency MHz	Frequency Error (PPM)	Voltage (%)	Voltage (VDC)
-30 C	928.925026	0.028	100%	24.00
-20 C	928.925029	0.031	100%	24.00
-10 C	928.925030	0.032	100%	24.00
0 C	928.925032	0.034	100%	24.00
10 C	928.925026	0.028	100%	24.00
20 C	928.925022	0.024	100%	24.00
30 C	928.925026	0.028	100%	24.00
40 C	928.925023	0.025	100%	24.00
50 C	928.925024	0.026	100%	24.00
20 C	928.925021	0.023	85%	20.40
20 C	928.925021	0.023	115%	27.60

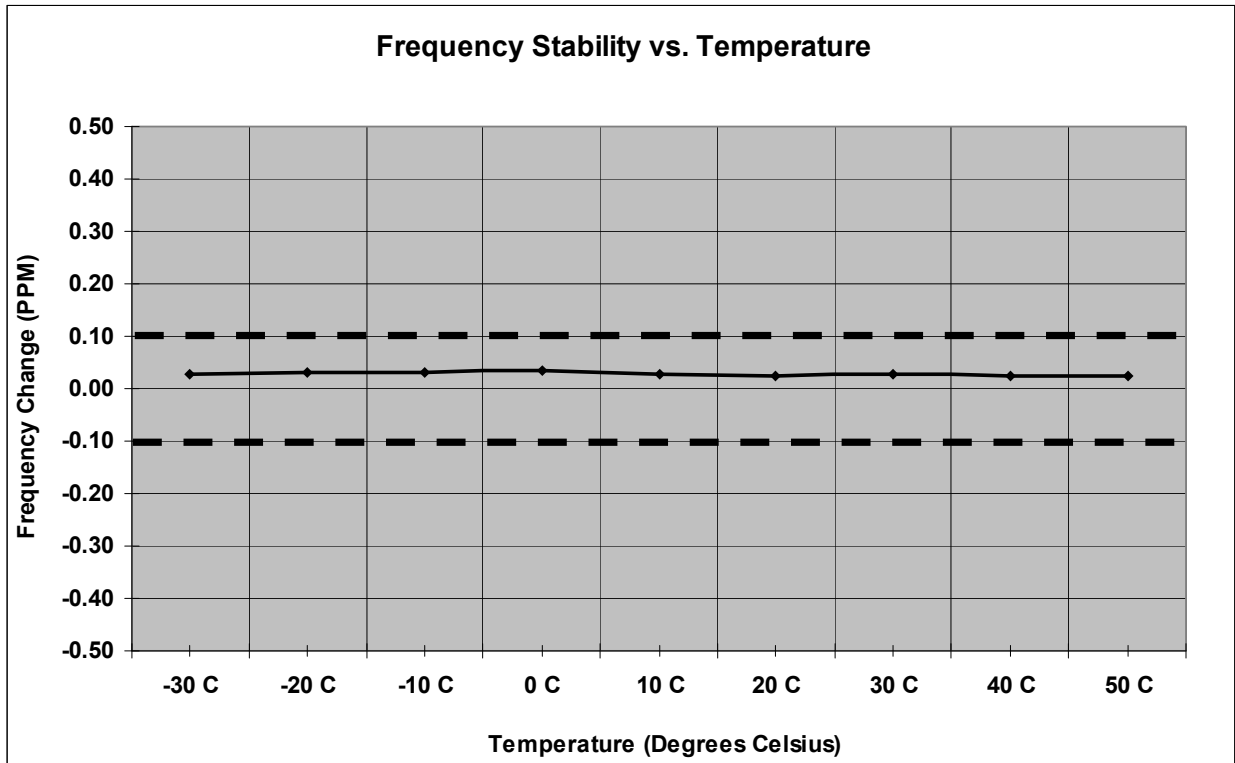


Figure 7.5.2-2: Frequency Stability – 928.925 MHz

Part 101.107, RSS-119 5.3

Frequency Stability

Frequency (MHz): 959.925
 Deviation Limit (PPM): 0.1ppm

Temperature C	Frequency MHz	Frequency Error (PPM)	Voltage (%)	Voltage (VDC)
-30 C	959.925037	0.039	100%	24.00
-20 C	959.925030	0.031	100%	24.00
-10 C	959.925033	0.034	100%	24.00
0 C	959.925030	0.031	100%	24.00
10 C	959.925029	0.030	100%	24.00
20 C	959.925022	0.023	100%	24.00
30 C	959.925025	0.026	100%	24.00
40 C	959.925026	0.027	100%	24.00
50 C	959.925023	0.024	100%	24.00
20 C	959.925022	0.023	85%	20.40
20 C	959.925022	0.023	115%	27.60

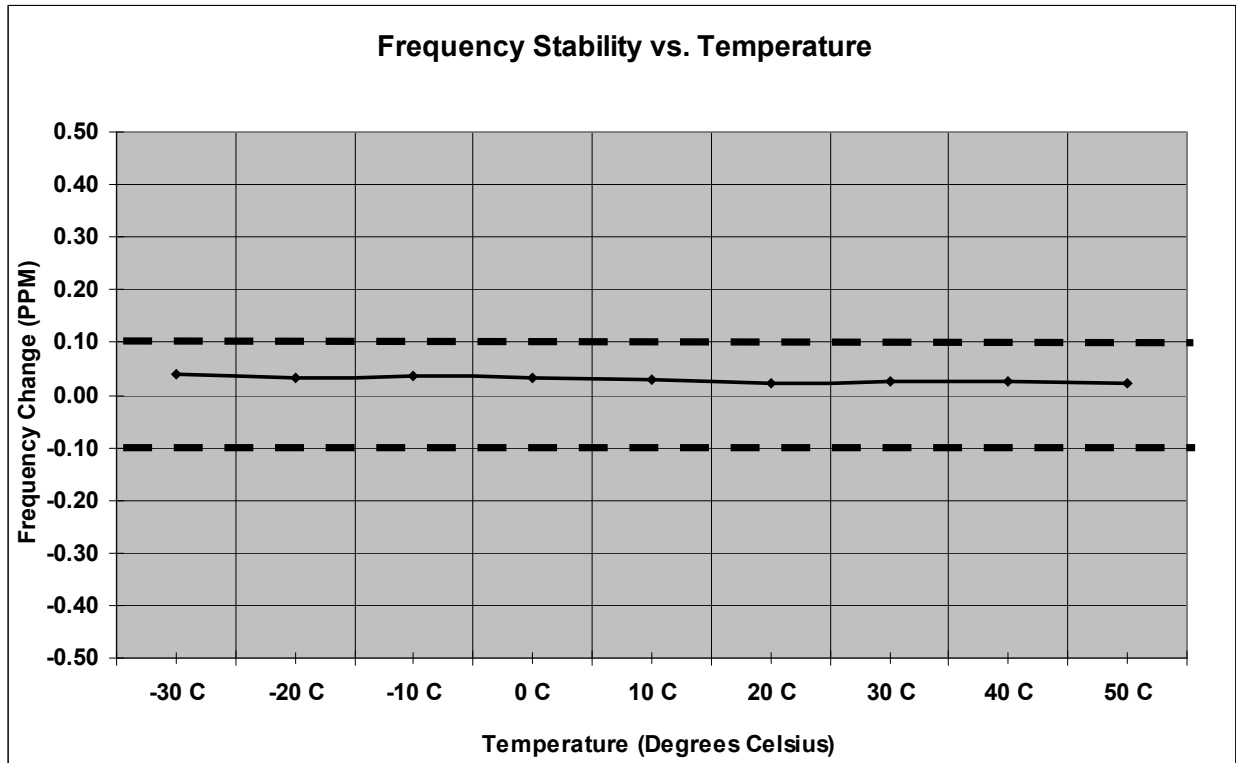


Figure 7.5.2-3: Frequency Stability – 959.925 MHz

8.0 CONCLUSION

In the opinion of ACS, Inc. the model TGB001HP, manufactured by Sensus Metering Systems, Inc., meets all the requirements of FCC Part 24D and Part 101 as well as Industry Canada RSS-119 and RSS-134 where applicable.

End Report