Excellence in Compliance Testing

Certification Test Report

FCC ID: SDBTGB20

FCC Rule Part: CFR 47 Part 24 Subpart D, Part 101 Subpart C

ACS Report Number: 11-2071.W03.11.A

This report contains data that is not covered by the scope of accreditation

Applicant: Sensus Metering Systems, Inc.
Model: TGB20

Test Begin Date: August 15, 2011
Test End Date: August 26, 2011

Report Issue Date: September 14, 2011

ACLASS ACCREDITED TESTING

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

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

Project Manager:

Thierry Jean-Charles
EMC Engineer
Advanced Compliance Solutions, Inc.

Reviewed by:

Kirby Munroe
Director, Wireless Certifications
Advanced Compliance Solutions, Inc.

This report contains 27 pages

Table of Content

1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 2 Subpart J, Part 24 Subpart D and Part 101 Subpart C of the FCC's Code of Federal Regulations.

1.2 Product Description

The TGB20 is a base station for the Sensus Metering Systems meters. The device receives telemetry transmission from multiple system end point units used mostly for utility metering. The TGB20 sends also command information to the end point units.

The TGB20 transceiver is housed in a rack mountable enclosure and is powered by 24 VDC.

Manufacturer Information:
Sensus Metering Systems, Inc.
400 Perimeter Park Drive, Suite K
Morrisville, NC 27560

Test Sample Serial Numbers: 2078

Test Sample Condition: TheTGB20 was in good physical condition with no noticeable damages.

1.3 Test Methodology

1.3.1 Configurations and Justification

The TGB20 was evaluated for compliance to the radiated and RF conducted emissions requirements. The radiated spurious emissions were evaluated up to the 10th harmonic. The EUT was tested in the MPass (5k) mode.

Compliance to the radiated and power line conducted emissions requirements are 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	941.0 - 941.5
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	930.0 - 931.0	Middle	930.5
24D	940.0 - 941.0	1 near top and 1 near bottom	940.0125
101	941.0 - 941.5		941.4875
101	959.85 - 960.0	Middle	959.925

1.4 Emission Designators

The TGB20 transmitter produces 1 distinct modulation format. The emissions designators for the modulation types used by the TGB20 transmitter are as follows:

EMISSIONS DESIGNATORS:

MPass Mode (5K): 5K90F1D

2.0 TEST FACILITIES

2.1 Location

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

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

FCC Test Firm Registration #: 587595
Industry Canada Lab Code: 4175C

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS 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. Unless otherwise specified, all test 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 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:

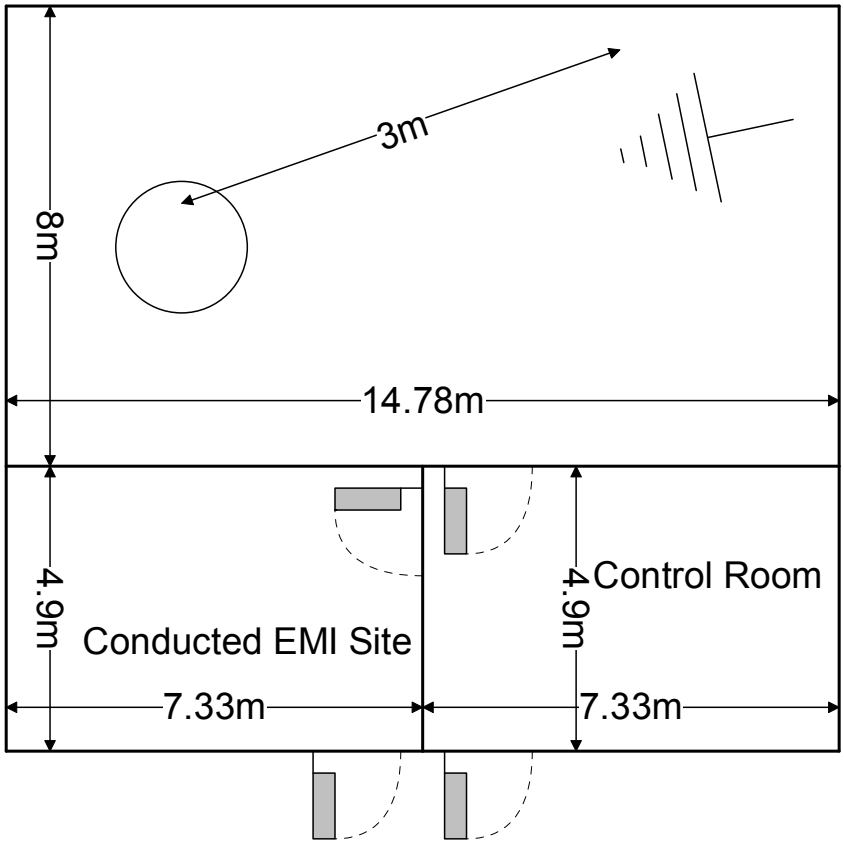

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m^3. 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:

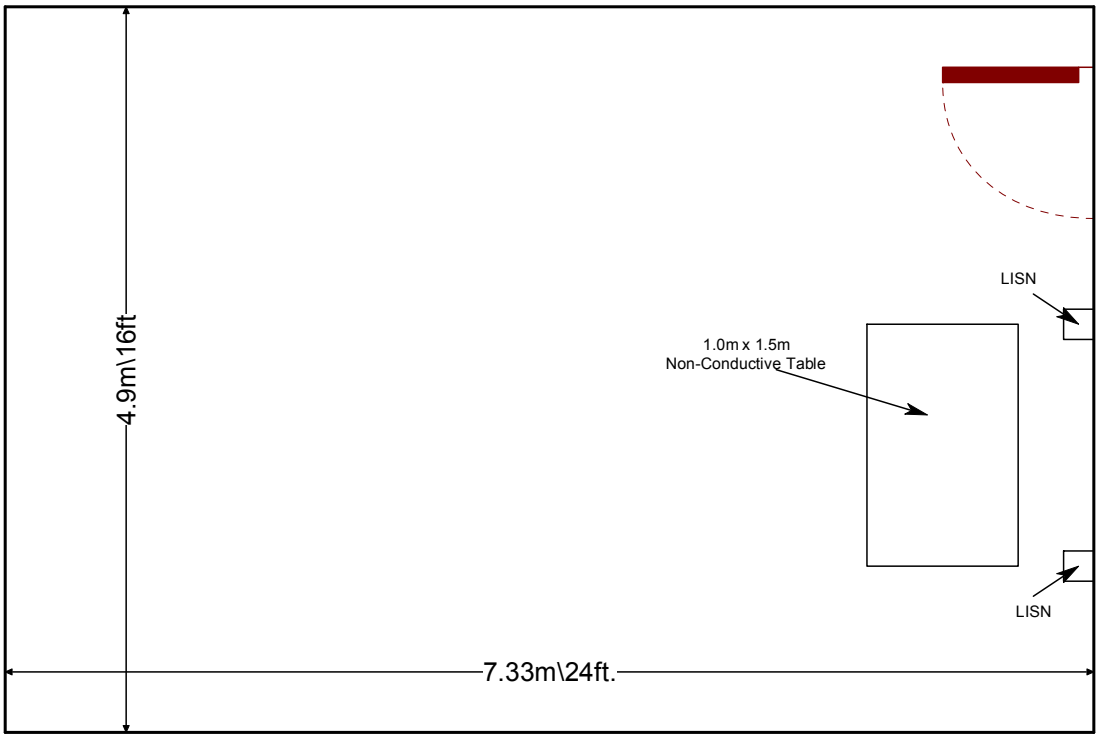

Figure 2.3.2-1: AC Mains Conducted EMI Site

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 - 2010
3 - US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communications Services – 2010
4 - US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services - 2010
5 – TIA-603-C: Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards – 2004

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
2006	EMCO	3115	Antennas	2573	3/2/2011	3/2/2013
2007	EMCO	3115	Antennas	2419	1/12/2010	1/12/2012
2012	Hewlett-Packard	HP83017A	Amplifiers	3123A00324	2/25/2011	2/25/2012
2013	Hewlett Packard	HP8566B	Spectrum Analyzers	2407A03233	8/5/2010	8/5/2012
2014	Hewlett Packard	HP 85650A	Quasi Peak Adapter	2430A00559	8/5/2010	8/5/2012
2037	ACS Boca	Chamber EMI Cable Set	Cable Set	2037	1/7/2011	1/7/2012
2071	Trilithic, Inc.	4HC1400-1-KK	Filter	9643263	2/3/2011	2/3/2012
2078	ACS Boca	Substitution Cable Set	Cable Set	2078	2/2/2011	2/2/2012
RE563	Hewlett Packard	8673D	Signal Generators	3034A01078	2/22/2011	2/22/2013
523	Agilent	E7405	Spectrum Analyzers	MY45103293	1/5/2011	1/5/2013
2066	Hewlett Packard	11170B	Cables	2066	7/4/2011	7/4/2012
2069	Trilithic, Inc.	7NM867/122-X1-AA	Notch Filter	200315126	2/3/2011	2/3/2012
2075	Hewlett Packard	8495B	Attenuators	2626A11012	12/10/2010	12/10/2011
2082	Teledyne Storm Products	90-010-048	Cables	2082	6/6/2011	6/6/2012
RE571	Narda	26298	Attenuators	A500	6/21/2011	6/21/2012
524	Chase	CBL6111	Antennas	1138	1/7/2011	1/7/2013
2005	FAU EMI R&D Lab	Lazarus	Antennas	EM001	1/19/2010	1/19/2012
2003	EMCO	3108	Antennas	2148	1/19/2010	1/19/2012
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	8/26/2011	8/26/2012
426	Thermotron	S-8 Mini Max	Environmental Chamber	25-2888-10	8/30/2010	8/30/2011
339	Aeroflex/Weinschel	AS-18	Attenuators	7142	6/6/2011	6/10/2012
215	Sorensen	DCS60-50	Power Supplies	0024B1130	NCR	NCR

NCR=No Calibration Required

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Diagram #	Manufacturer	Equipment Type	Model Number	Serial Number	FCC ID
1	Sensus Metering Systems	EUT	TGB20	2078	SDBTGB20
2	24 VDC Power Supply	Lineage Power	J2007003L102	10KZ47016361	N/A
3	Ethernet Switch	NetGear	FS105	FS105A09005405	N/A
4	Power Supply	NetGear	YP-040	N/A	N/A
5	15 dB Attenuator	Fairview Microwave, Inc.	SA3N511-15	N/A	N/A

6.0 EQUIPMENT UNDER TEST SETUP AND BLOCK DIAGRAM

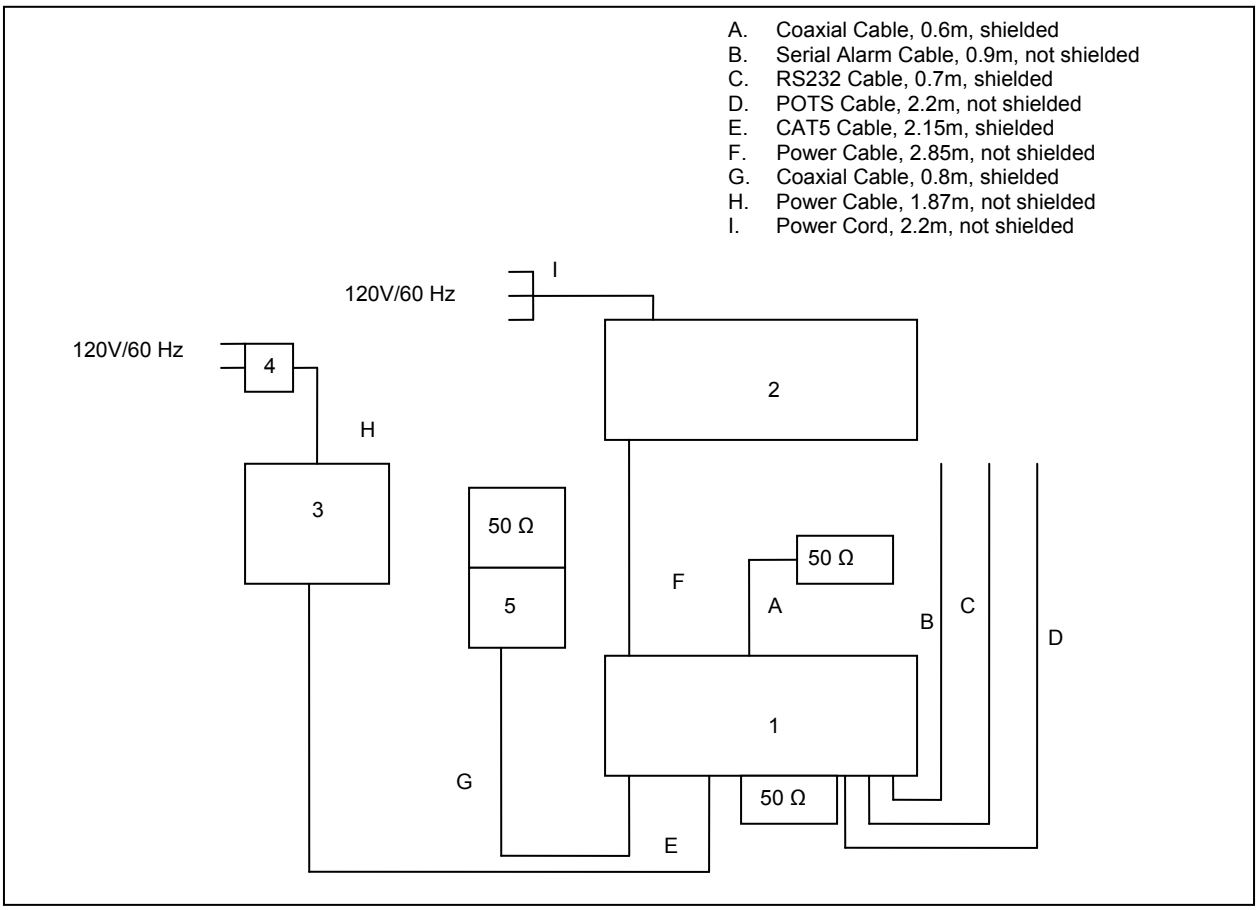

Figure 6-1: EUT Test Setup

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 of the equipment under test was directly connected to the input of the Spectrum Analyzer through a 40 dB passive attenuator. 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 in Table 7.1.2-1 and Figure 7.1.2-1 through 7.1.2-4.

7.1.2 Measurement Results

Table 7.1.2-1: Peak Output Power

Frequency (MHz)	FCC Rule Part	Output Power (dBm)
930.5	24D	46.52
940.0125	24D	46.27
941.4875	101	46.16
959.925	101	45.10

Part 24.132

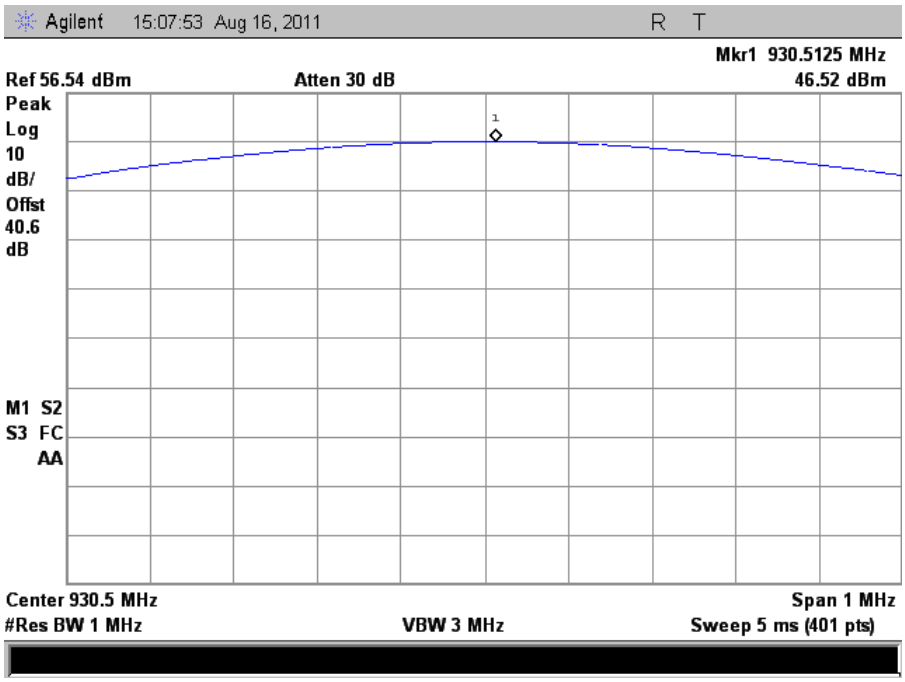

Figure 7.1.2-1: Peak Output Power 930.5 MHz

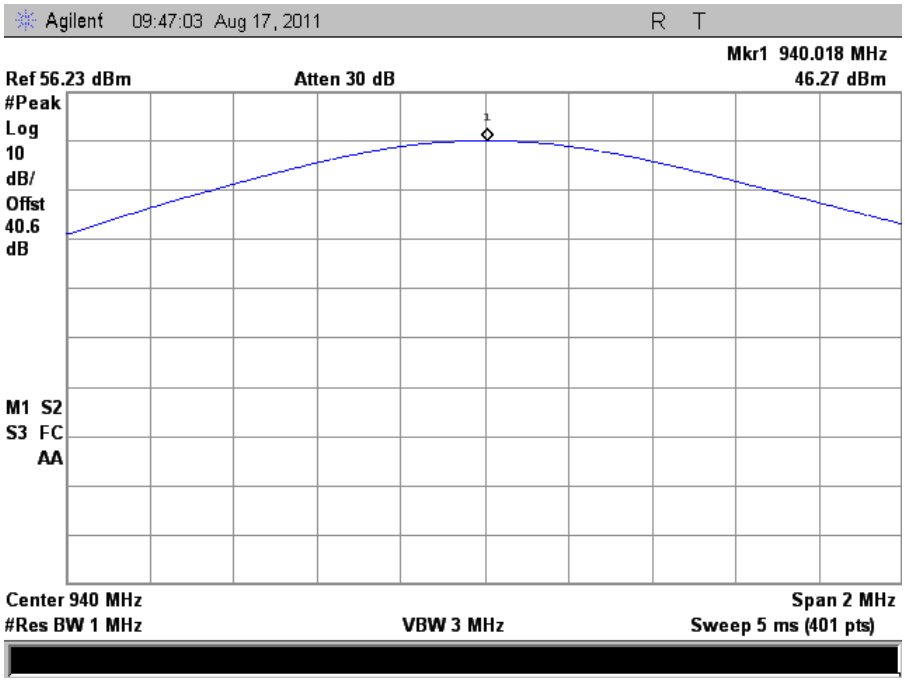

Figure 7.1.2-2: Peak Output Power 940.0125 MHz

Part 101.113(a)

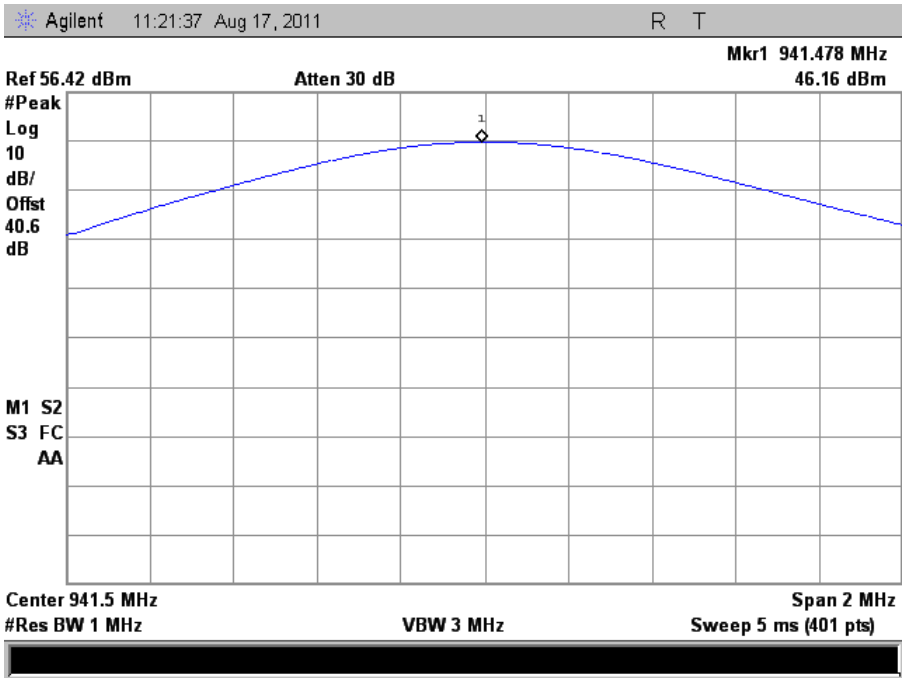

Figure 7.1.2-3: Peak Output Power 941.4875 MHz

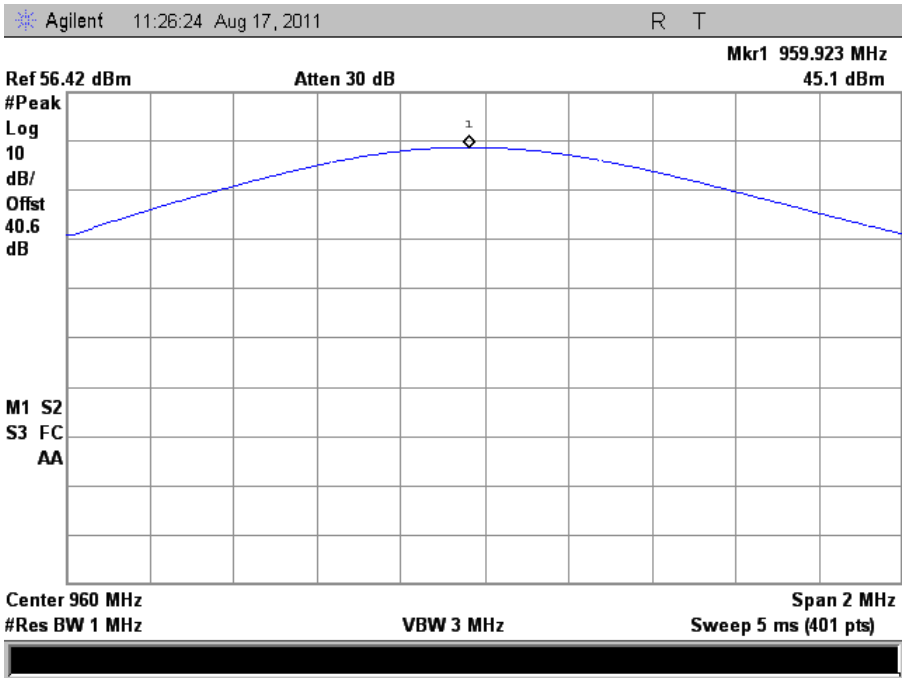

Figure 7.1.2-4: Peak Output Power 959.925 MHz

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 a 40 dB passive attenuator. 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. Results are shown below in Figures 7.2.2-1 through 7.2.2-6.

7.2.2 Measurement Results

Part 24.133 a(1), a(2)

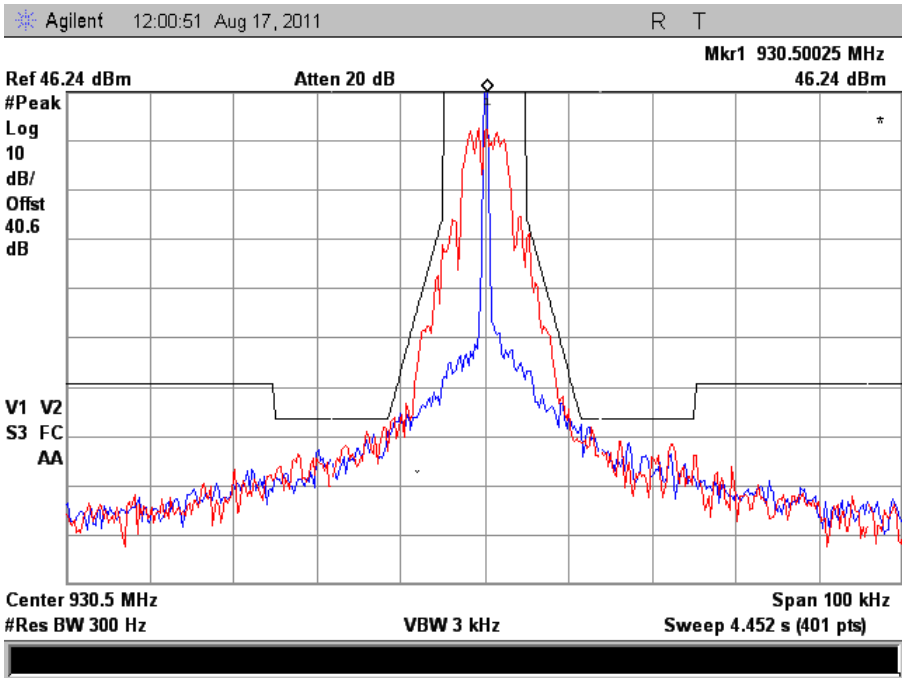

Figure 7.2.2-1: 930.5 MHz – 12.5 kHz Channel Spacing

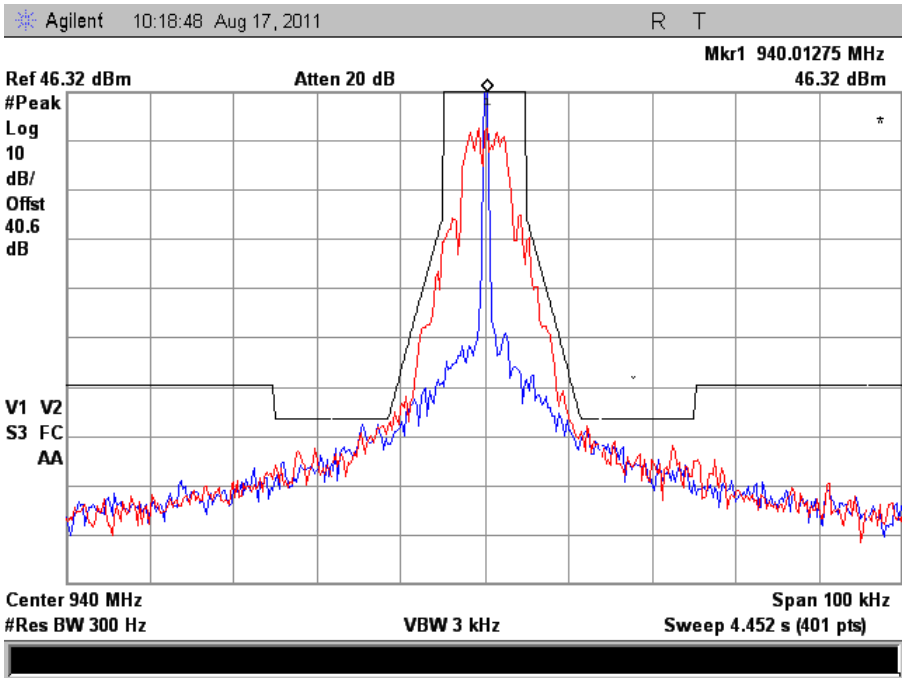

Figure 7.2.2-2: 940.0125 MHz – 12.5 kHz Channel Spacing

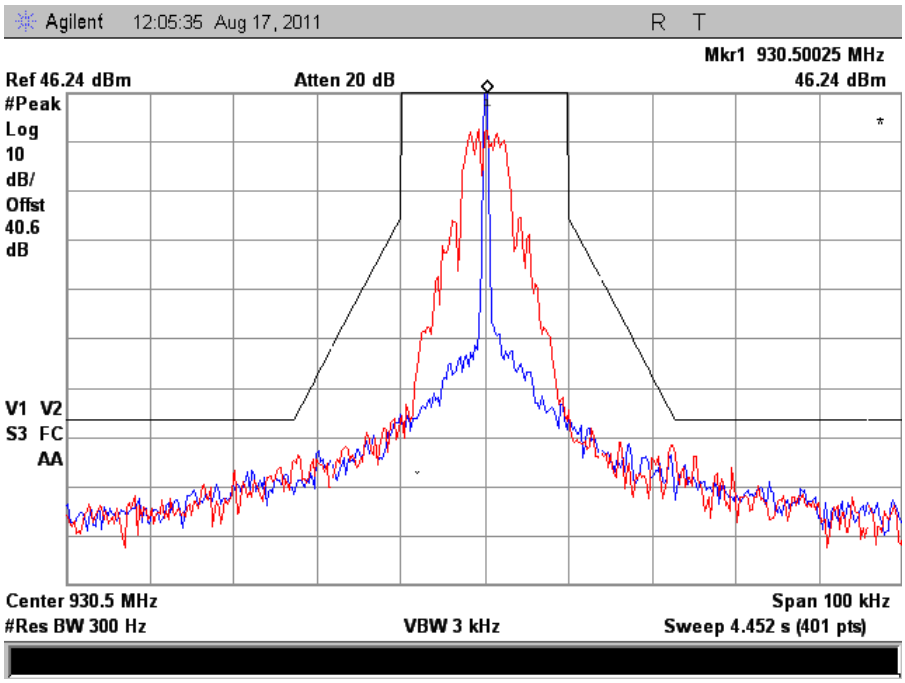

Figure 7.2.2-3: 930.5 MHz – 25 kHz Channel Spacing

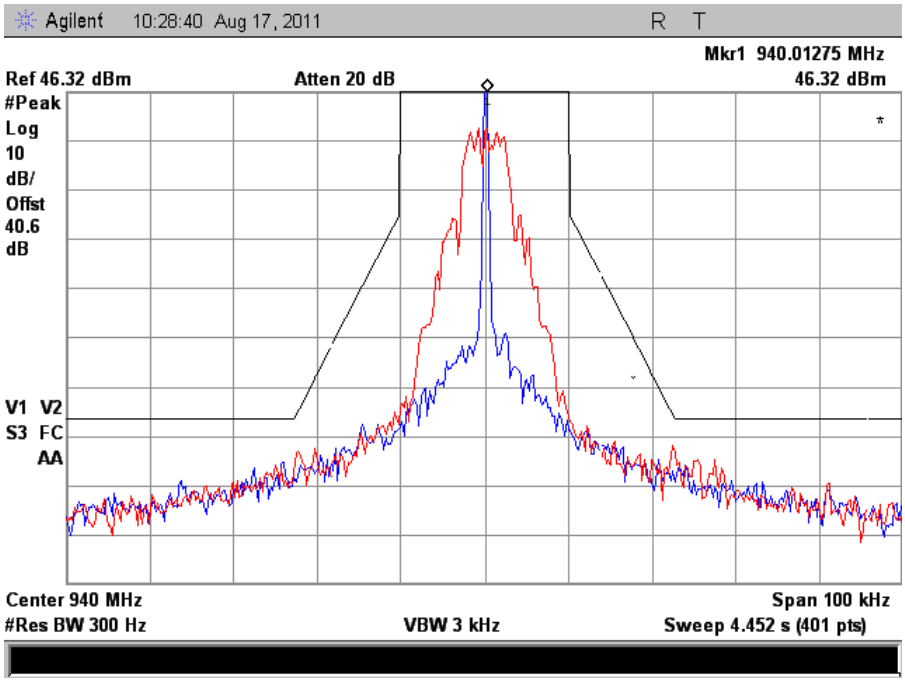

Figure 7.2.2-4: 940.0125 MHz – 25 kHz Channel Spacing

Part 101.111 a(6)

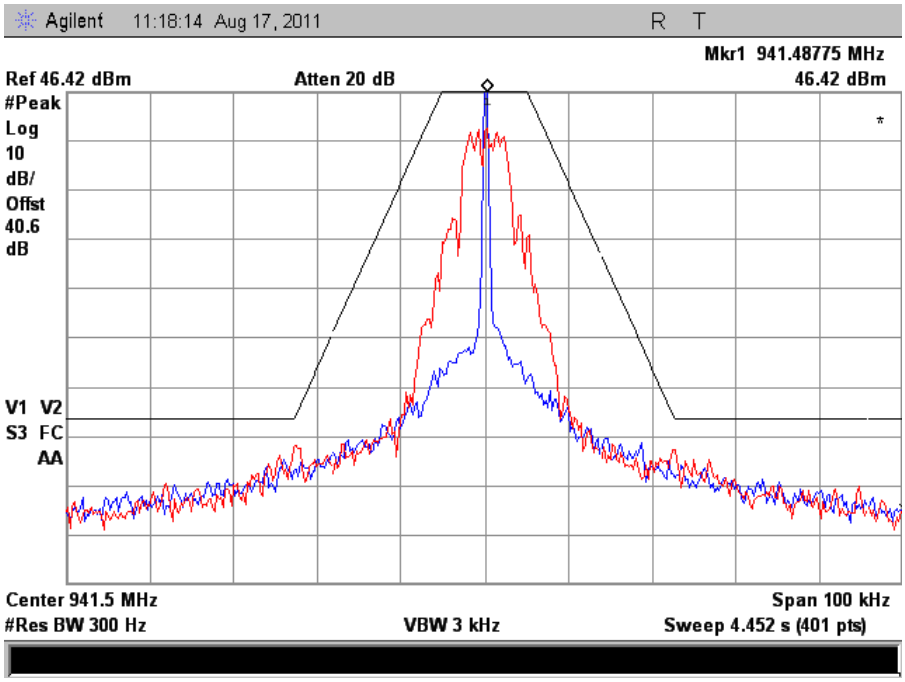

Figure 7.2.2-5: 941.4875 MHz

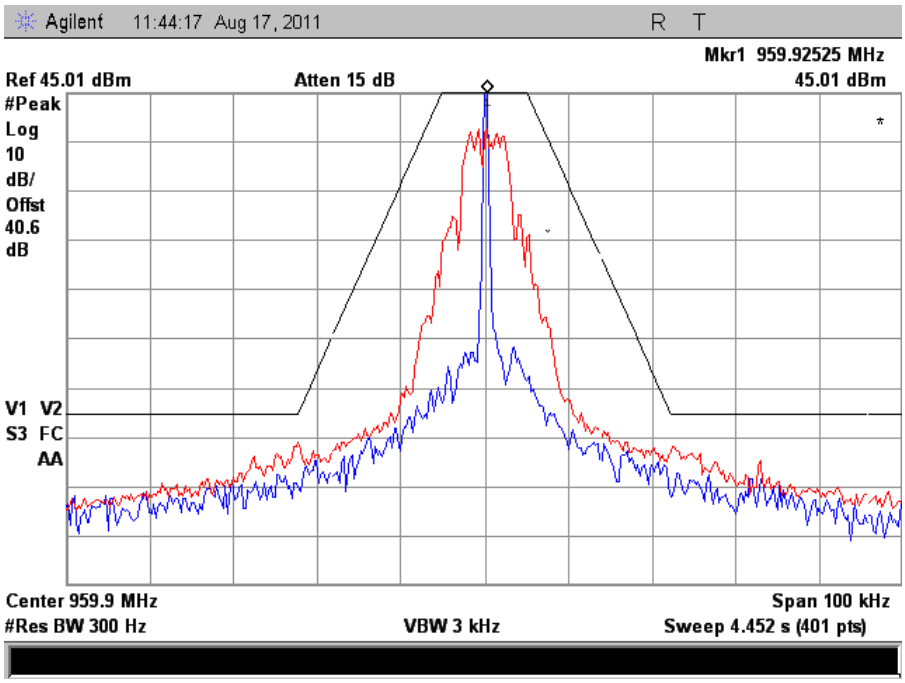

Figure 7.2.2-6: 959.925 MHz

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 a 20 dB passive attenuator used in series with a notch filter for the emissions below 1000 MHz and a high pass filter for the emissions above 1000 MHz. 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 in Figures 7.3.2-1 through 7.3.2-8.

7.3.2 Measurement Results

Part 24.133 a(1), a(2)

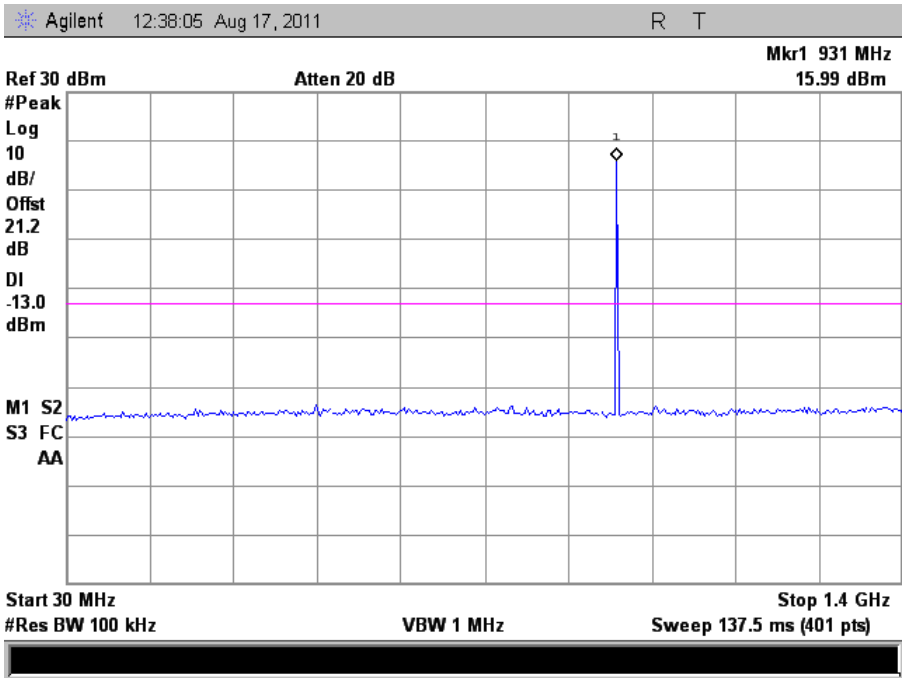

Figure 7.3.2-1: 930.5 MHz – 30MHz to 1GHz

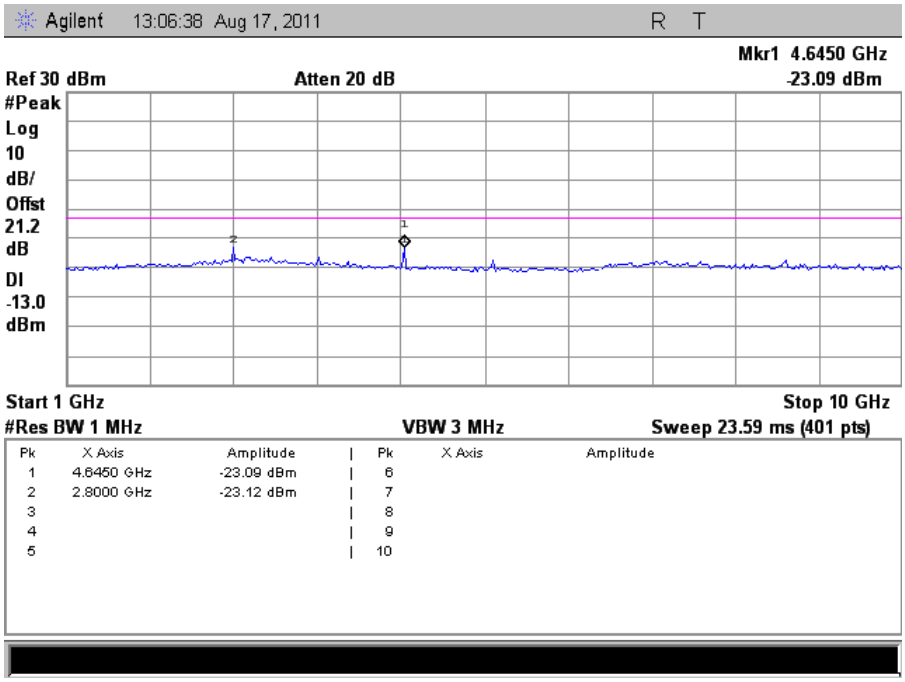

Figure 7.3.2-2: 930.5 MHz – 1GHz to 10GHz

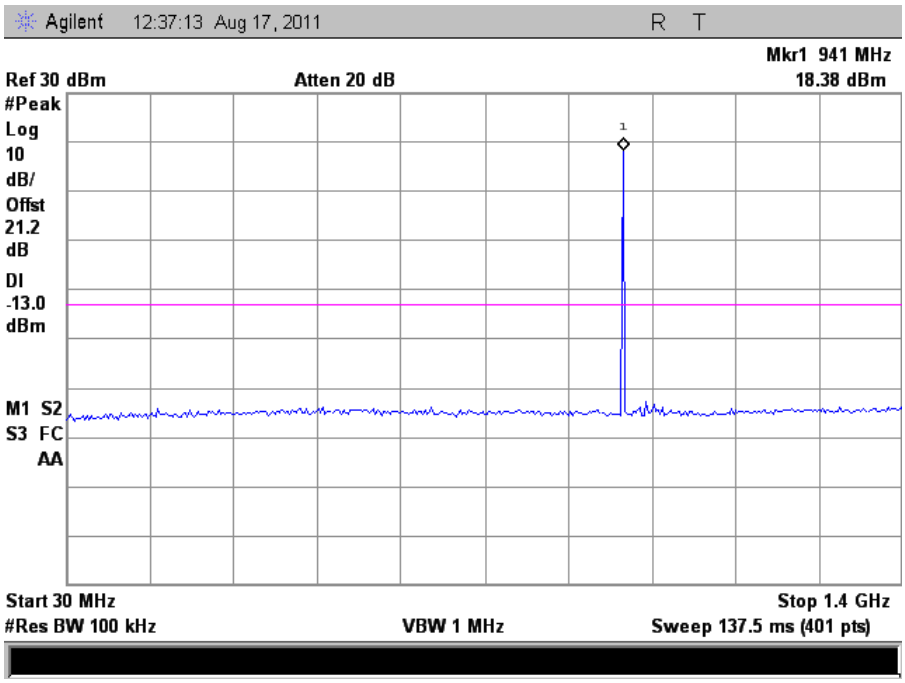

Figure 7.3.2-3: 940.0125 MHz – 30MHz to 1GHz

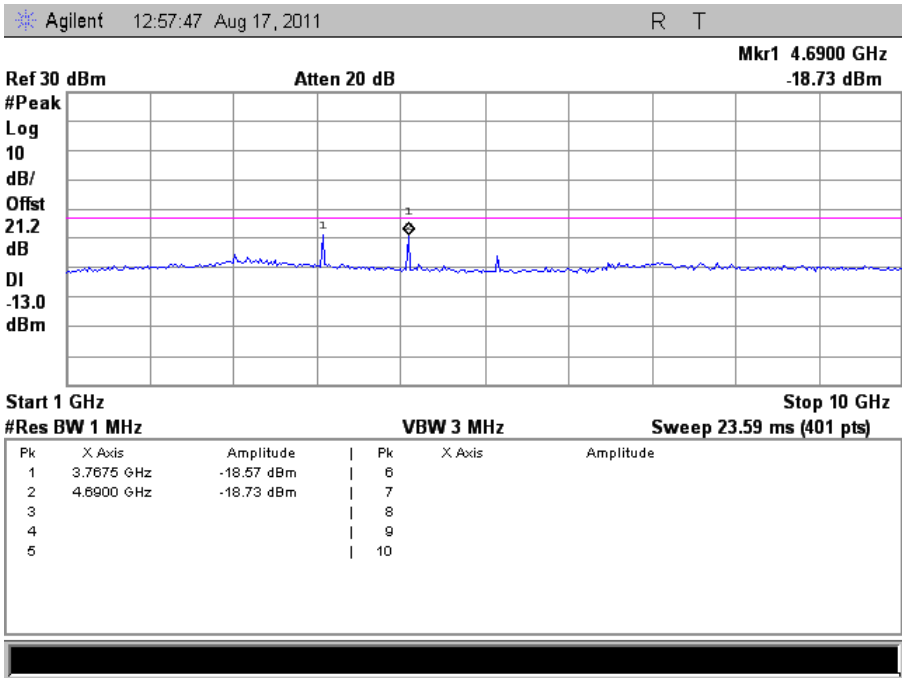

Figure 7.3.2-4: 940.0125 MHz – 1GHz to 10GHz

Part 101.111 a(6)

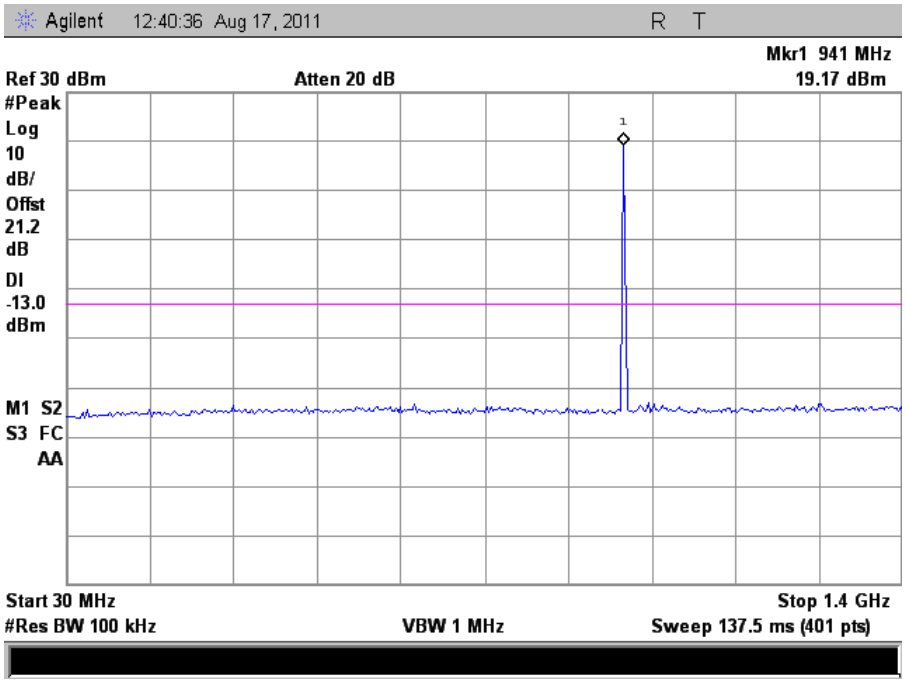

Figure 7.3.2-5: 941.4875 MHz – 30MHz to 1GHz

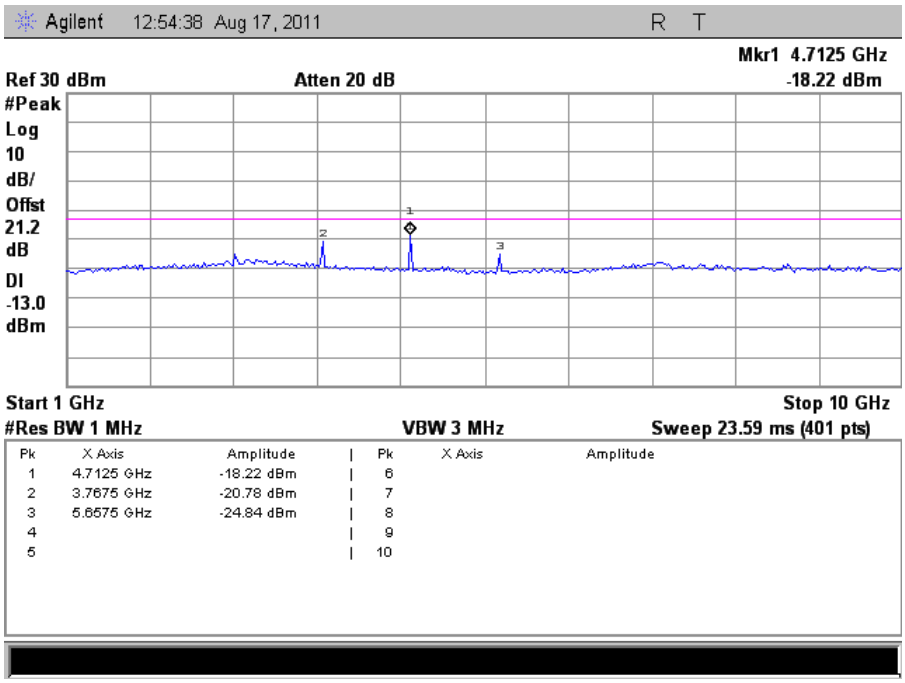

Figure 7.3.2-6: 941.4875 MHz – 1GHz to 10GHz

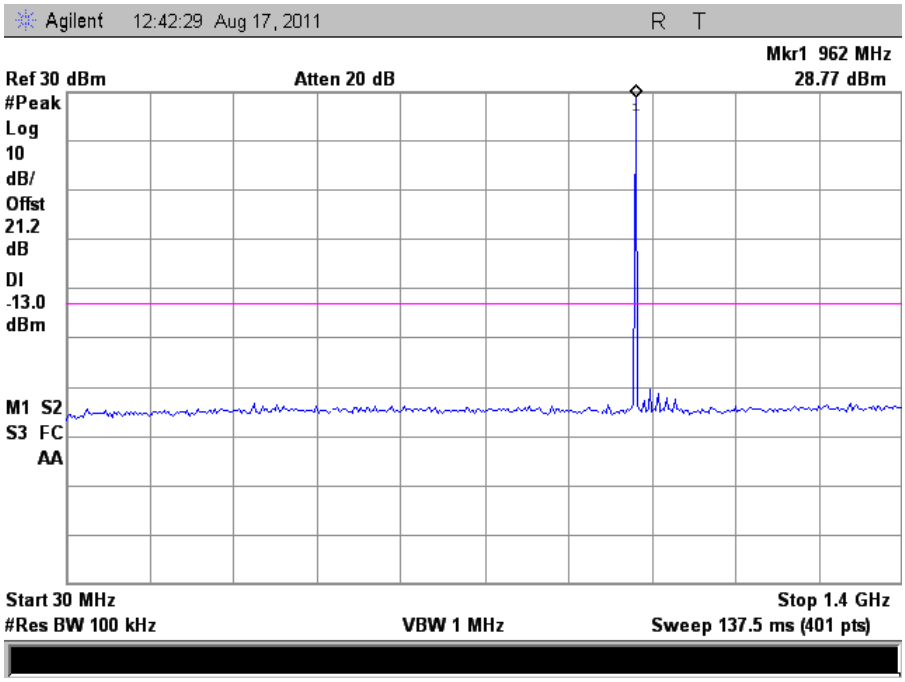

Figure 7.3.2-7: 959.925 MHz – 30MHz to 1GHz

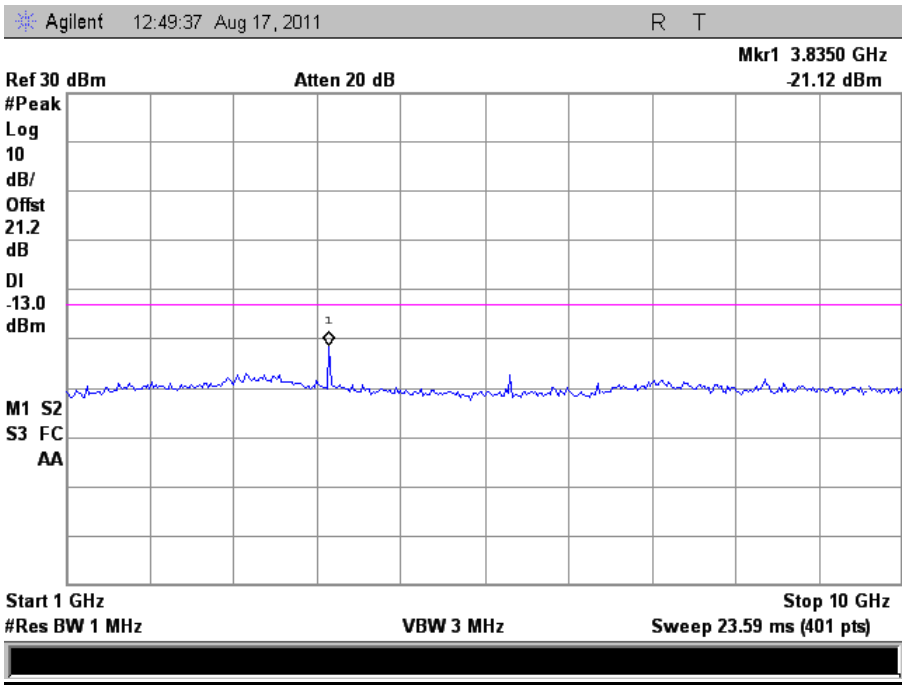

Figure 7.3.2-8: 959.925 MHz – 1GHz to 10GHz

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 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 in Figures 7.4.2-1 through 7.4.2-4.

7.4.2 Measurement Results

Part 24.133 a(1), a(2)

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

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
2791.5	-52.00	H	-43.22	-13.00	30.22
3722	-57.50	H	-44.55	-13.00	31.55
4652.5	-61.05	H	-42.37	-13.00	29.37
5583	-61.05	H	-41.89	-13.00	28.89
2791.5	-51.65	V	-41.82	-13.00	28.82
3722	-57.95	V	-43.90	-13.00	30.90
4652.5	-64.35	V	-47.47	-13.00	34.47
5583	-61.85	V	-44.19	-13.00	31.19

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 (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
2820.038	-54.75	H	-46.70	-13.00	33.70
3760.05	-56.55	H	-43.09	-13.00	30.09
4700.063	-59.90	H	-43.41	-13.00	30.41
2820.038	-52.05	V	-42.50	-13.00	29.50
3760.05	-59.05	V	-45.54	-13.00	32.54
4700.063	-60.45	V	-44.51	-13.00	31.51

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

Table 7.4.2-3: Field Strength of Spurious Emissions – 941.4875 MHz – MPass (5k) Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
2824.463	-53.65	H	-44.35	-13.00	31.35
3765.95	-58.55	H	-45.99	-13.00	32.99
4707.438	-59.50	H	-42.81	-13.00	29.81
2824.463	-53.00	V	-42.55	-13.00	29.55
3765.95	-60.90	V	-48.04	-13.00	35.04
4707.438	-60.95	V	-44.46	-13.00	31.46

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

Table 7.4.2-4: Field Strength of Spurious Emissions – 959.925 MHz – MPass (5k) Mode

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
2879.775	-55.10	H	-47.10	-13.00	34.10
3839.7	-62.65	H	-53.02	-13.00	40.02
2879.775	-55.60	V	-47.25	-13.00	34.25
3839.7	-60.40	V	-46.12	-13.00	33.12
5759.55	-64.70	V	-49.20	-13.00	36.20

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 -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. At a temperature 20º C the supply voltage was varied from 85% to 115% from the normal. The maximum variation of frequency was recorded.

Results of the test are shown below in Figures 7.5.2-1 to 7.5.2-3.

7.5.2 Measurement Results

Part 24.135(a)

Frequency Stability

Frequency (MHz): 930.5
Deviation Limit (PPM): 1ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VAC)
-30 C	**930.499995**	**-0.005**	100%	24.00
-20 C	**930.500003**	**0.003**	100%	24.00
-10 C	**930.500006**	**0.006**	100%	24.00
0 C	**930.500002**	**0.002**	100%	24.00
10 C	**930.499999**	**-0.001**	100%	24.00
20 C	**930.499998**	**-0.002**	100%	24.00
30 C	**930.499995**	**-0.005**	100%	24.00
40 C	**930.499993**	**-0.008**	100%	24.00
50 C	**930.499992**	**-0.009**	100%	24.00
20 C	**930.499998**	**-0.002**	85%	20.400
20 C	**930.499998**	**-0.002**	115%	27.600

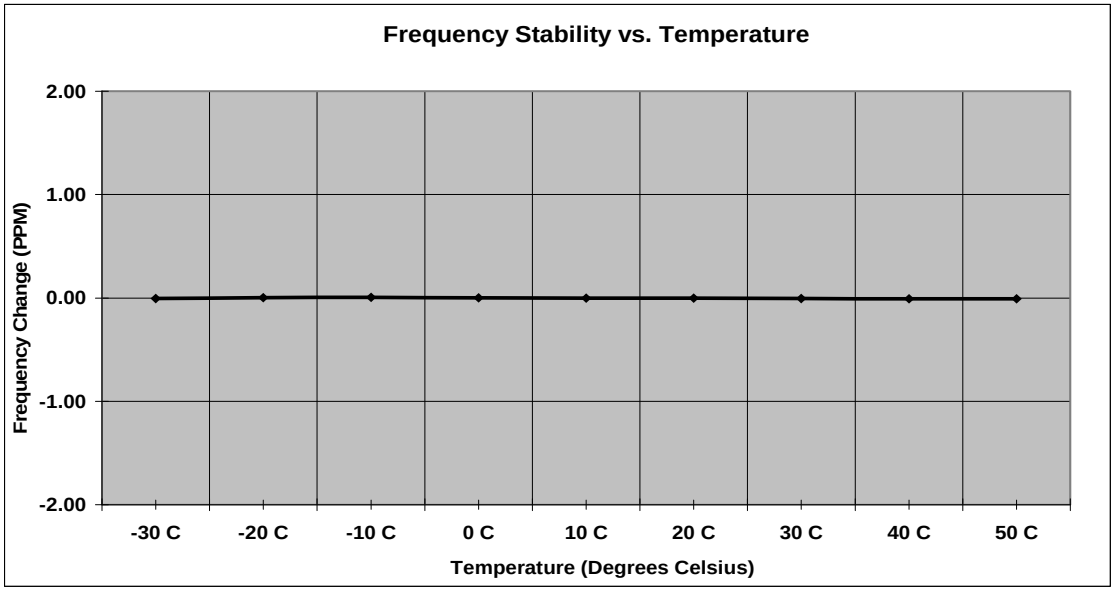

Figure 7.5.2-1: Frequency Stability – 930.5 MHz[1]

[1] The frequency stability data is not covered by the scope of accreditation.

Part 101.107 (a)

Frequency Stability

Frequency (MHz): 941.4875
Deviation Limit (PPM): 1ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VAC)
-30 C	**941.487495**	**-0.005**	100%	24.00
-20 C	**941.487505**	**0.005**	100%	24.00
-10 C	**941.487505**	**0.005**	100%	24.00
0 C	**941.487504**	**0.004**	100%	24.00
10 C	**941.487500**	**0.000**	100%	24.00
20 C	**941.487499**	**-0.001**	100%	24.00
30 C	**941.487496**	**-0.004**	100%	24.00
40 C	**941.487494**	**-0.006**	100%	24.00
50 C	**941.487493**	**-0.007**	100%	24.00
20 C	**941.487499**	**-0.001**	85%	20.400
20 C	**941.487499**	**-0.001**	115%	27.600

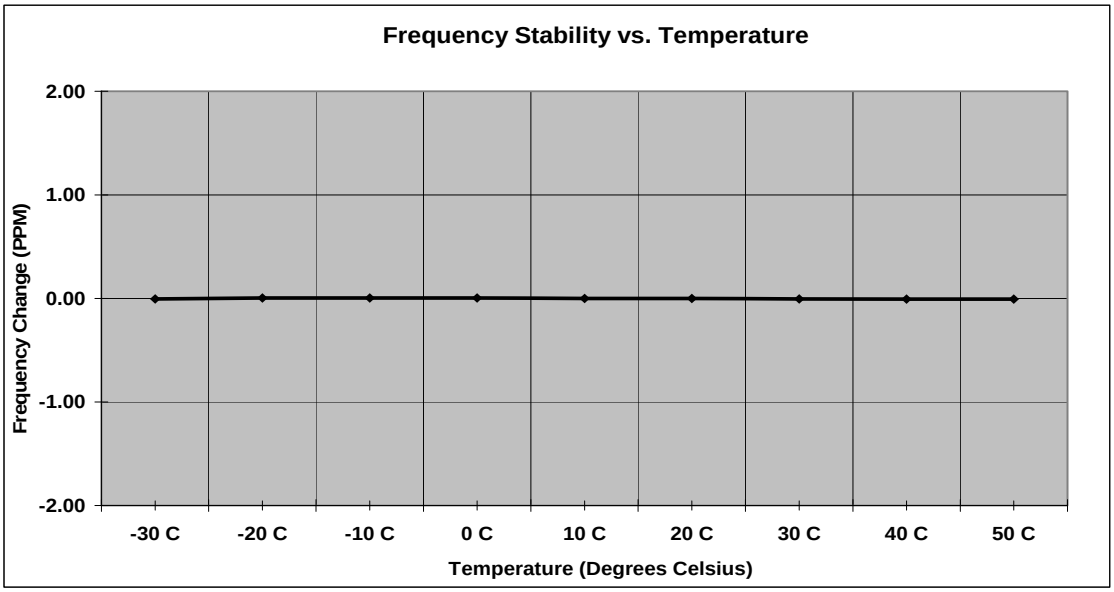

Figure 7.5.2-2: Frequency Stability – 941.4875 MHz[2]

[2] The frequency stability data is not covered by the scope of accreditation.

Part 101.107 (a)

Frequency Stability

Frequency (MHz): 959.925
Deviation Limit (PPM): 1ppm

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VAC)
-30 C	**959.924996**	**-0.004**	100%	24.00
-20 C	**959.925008**	**0.008**	100%	24.00
-10 C	**959.925006**	**0.006**	100%	24.00
0 C	**959.925008**	**0.008**	100%	24.00
10 C	**959.925002**	**0.002**	100%	24.00
20 C	**959.925001**	**0.001**	100%	24.00
30 C	**959.924998**	**-0.002**	100%	24.00
40 C	**959.924996**	**-0.004**	100%	24.00
50 C	**959.924995**	**-0.005**	100%	24.00
20 C	**959.925001**	**0.001**	85%	20.400
20 C	**959.925001**	**0.001**	115%	27.600

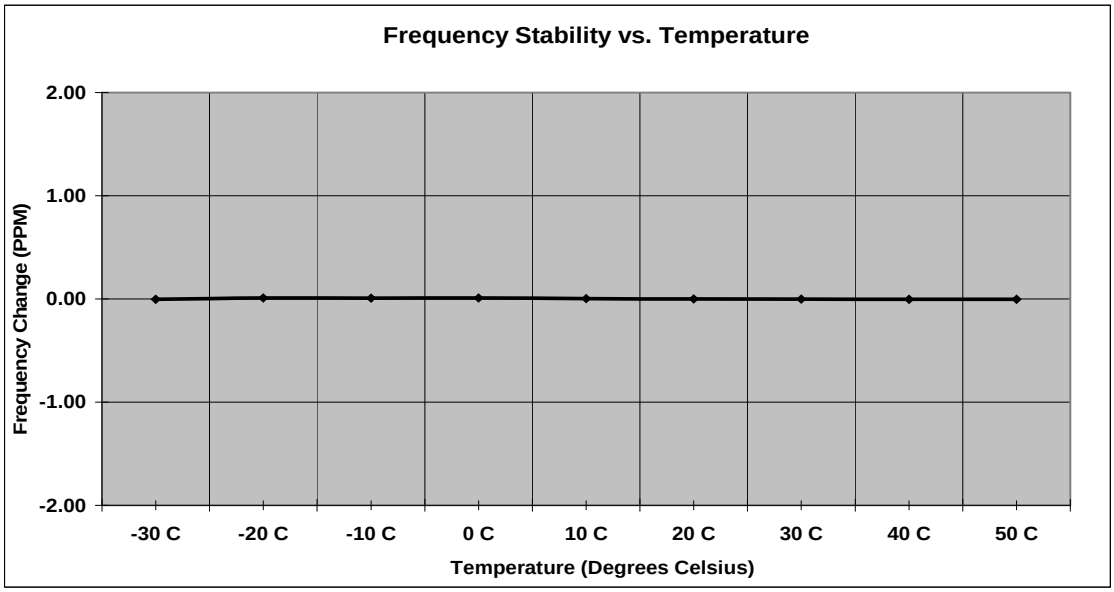

Figure 7.5.2-3: Frequency Stability – 959.925 MHz[3]

[3] The frequency stability data is not covered by the scope of accreditation.

8.0 CONCLUSION

In the opinion of ACS, Inc. the model TGB20, manufactured by Sensus Metering Systems, Inc., meets all the requirements of FCC of Part 24D and Part 101 were applicable.

End Report