

Certification Test Report

**FCC ID: SDBFLEXELS
IC: 2220A-FLEXELS**

**FCC Rule Part: CFR 47 Part 24 Subpart D, Part 90 Subpart I, Part 101
Subpart C**

ACS Report Number: 13-2088.W04.1B

**Applicant: Sensus Metering Systems, Inc.
Model: FLXA2D, FLXA2E**

**Test Begin Date: June 11, 2013
Test End Date: June 28, 2013**

Report Issue Date: January 3, 2014



For The Scope of Accreditation Under Certificate Number AT-1533



For The Scope of Accreditation Under Lab Code 200612-0

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Reviewed by:



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This report contains 28 pages

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1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 2 Subpart J, Part 24 Subpart D, Part 90 Subpart I, and Part 101 Subpart C of the FCC's Code of Federal Regulations for a Class II Permissive Change.

The purpose of the permissive change is to revise the emission designators listed in the original filing. This report provides supplemental data to support compliance for all frequency bands and emission designators listed in section 1.3 and 1.4 below and not covered in test report SNUS10-U1 Rev C.

1.2 Product Description

The Sensus Metering Systems models FLXA2D and FLXA2E are 900 MHz transceiver modules which consist of a single PCB assembly containing the radio power supply, FlexNet radio, printed circuit antenna, FlexNet microprocessor, FlexNet magnetic loop interface.

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

Test Sample Serial Numbers: 210815003383207

Test Sample Condition: The units were in good operating conditions with no physical damage.

1.3 Test Methodology

1.3.1 Configurations and Justification

The unit was evaluated for RF conducted emissions for the additional emission designators in the frequency bands listed in this report. The measurements were performed on a FLXA2D sample configured with an SMA connector at the antenna port. RF output power and bandwidth measurements were collected to supplement the data in test report SNUS10-U1 Rev C. Where applicable, the data is provided for the worst case.

1.3.2 In-Band Testing Methodology

The EUT is designed to operate in multiple bands under the requirements of CFR 47 Parts 24 and 101. The following is a list of the frequency bands of operation sorted based on the FCC rule parts in which the band is associated.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)
24D	901.0 - 902.0
24D	930.0 - 931.0
24D	940.0 - 941.0
90	896.0375 – 901.0
90	935.0 – 940.0
101	928.85 - 929.0
101	932.0 - 932.5
101	941.0 - 941.5
101	959.85 - 960.0

The evaluation for the supplemental data applies to the bands listed in the table below. Based on the requirements set forth in accordance 47 CFR 2.1046-2.1057 as stated above and the channels tested in the test report SNUS10-U1 Rev C, 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.
90	896.0375 – 901.0	1 near top and 1 near bottom	896.0375
24D	901.0 - 902.0		901.9875
101	928.85 - 929.0	Middle	928.9250
24D	930.0 - 931.0	Middle	930.5000
101	932.0 - 932.5	Middle	932.2500
90	935.0 – 940.0	1 near top and 1 near bottom	935.0125
24D	940.0 - 941.0		-----
101	941.0 - 941.5		941.4875
101	959.85 – 960.0	Middle	959.9250

1.4 Emission Designators

The FLXA2D and FLXA2E transmitters produce six (6) distinct modulation formats. The emissions designators for the modulation types used by the FLXA2D and FLXA2E transmitters are as follows:

EMISSIONS DESIGNATORS:

- Normal Mode: 9K60F2D (7-FSK)
- Double Density Mode: 9K60F2D (13-FSK)
- C&I Mode (Half-Baud): 4K80F2D (7-FSK)
- Priority Mode: 4K80F2D (13-FSK)
- 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

FCC Test Firm Registration #: 475089
Industry Canada Lab Code: 4175C

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:

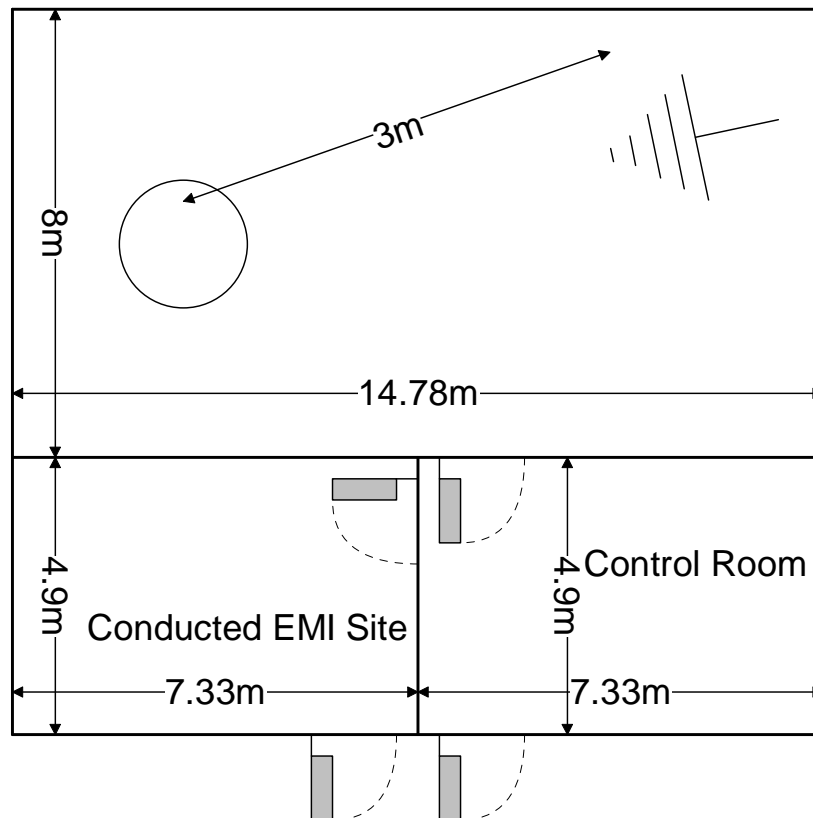


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

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:

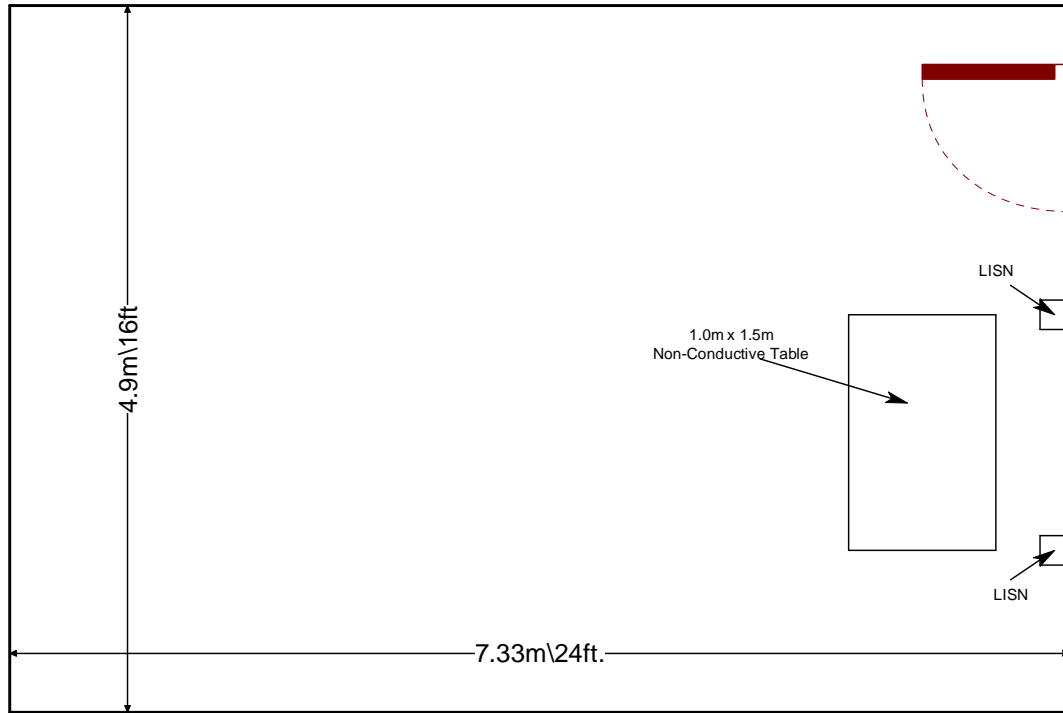


Figure 2.3.2-1: AC Mains Conducted EMI Site

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 - 2013
- 3 - US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communications Services – 2013
- 4 - US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services - 2013
- 5 – TIA-603-D: Land Mobile FM or PM - Communications Equipment - Measurement and Performance Standards – 2010

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
523	Agilent	E7405	Spectrum Analyzers	MY45103293	1/8/2013	1/8/2015
2075	Hewlett Packard	8495B	Attenuators	2626A11012	12/31/2012	12/31/2013
2082	Teledyne Storm Products	90-010-048	Cables	2082	5/31/2013	5/31/2014

NCR=No Calibration Required

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Sensus Metering Systems	FLXA2D	210815003383207
2	DC Power Supply	Lambda	LPD-422A-FM	A82600

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	20 VDC Power Lead	1.65 m	No	EUT to Power Supply
B	5.5 VDC Power Lead	1.65 m	No	EUT to Power Supply
C	Ground Lead	2.1 m	No	EUT to Power Supply
D	Power Cord	1.5 m	No	Power Supply to AC Mains

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

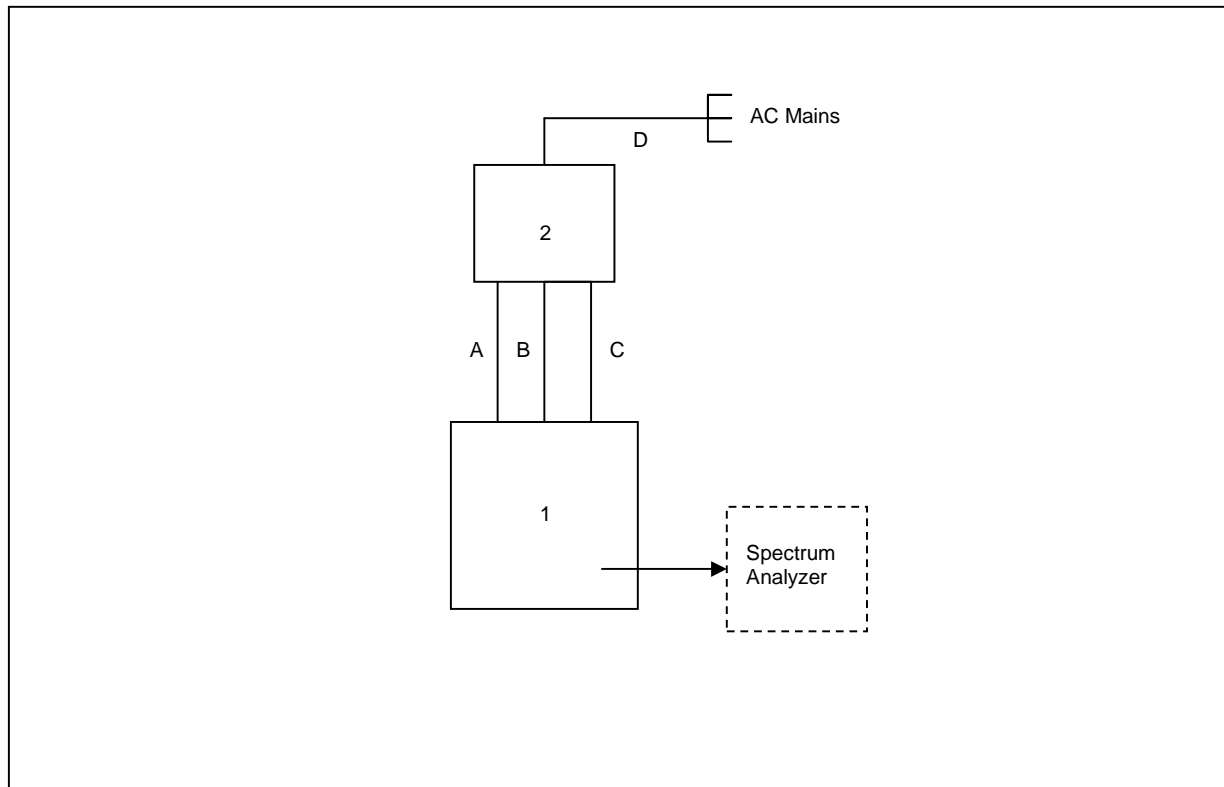


Figure 6-1: EUT Test Setup

7.0 SUMMARY OF TESTS

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

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	N/A
Field Strength of Spurious Emissions	1	N/A
Frequency Stability	2	N/A

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 30 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.

7.1.2 Measurement Results**Table 7.1.2-1: Peak Output Power**

Frequency (MHz)	FCC Rule Part	Output Power (dBm)	Mode of Operation
896.0375	90	28.95	Priority
901.9875	24D	28.97	Mpass10k
901.9875	24D	28.98	Priority
930.5000	24D	29.21	Mpass10k
930.5000	24D	29.22	Priority
928.9250	101	29.22	Mpass10k
928.9250	101	29.13	Priority
932.2500	101	29.20	Mpass10k
932.2500	101	29.19	Priority
935.0125	90	29.22	Priority
941.4875	101	29.34	Mpass10k
941.4875	101	29.39	Priority
959.9250	101	29.47	mPass 10k
959.9250	101	29.43	Priority

Part 24.132 / RSS-134 5.4(a)

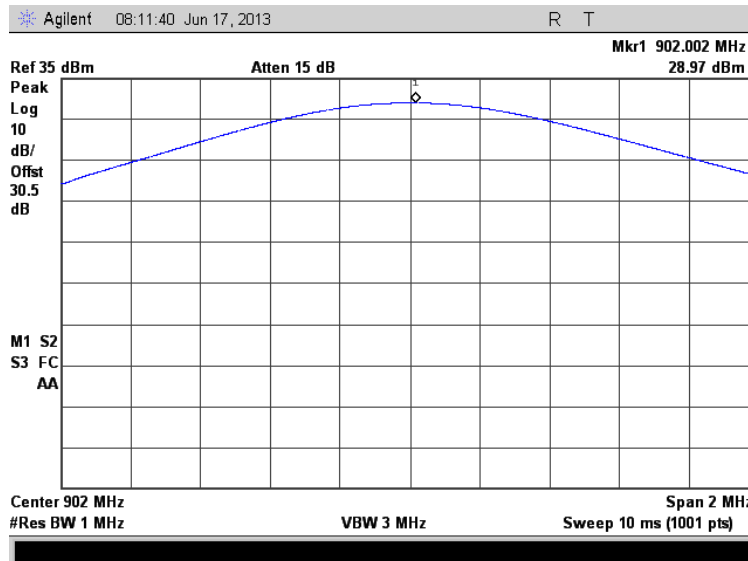


Figure 7.1.2-1: Peak Output Power 901.9875 MHz – mPass 10k Mode

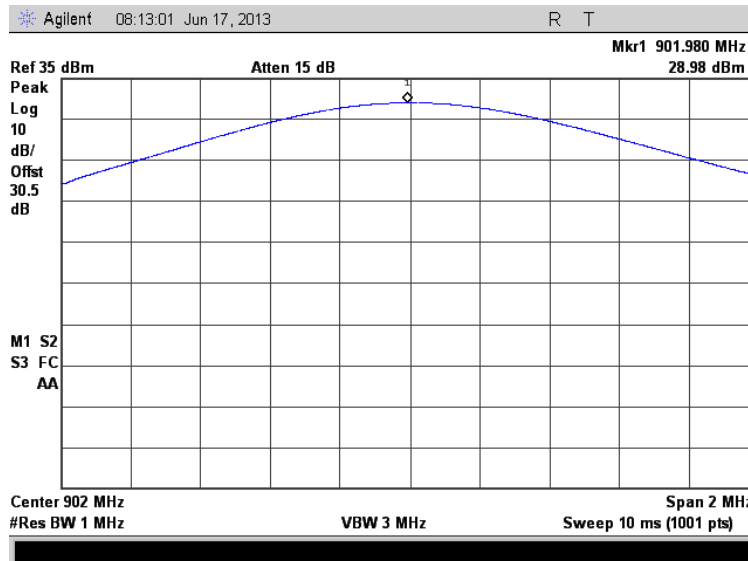


Figure 7.1.2-2: Peak Output Power 901.9875 MHz – Priority Mode

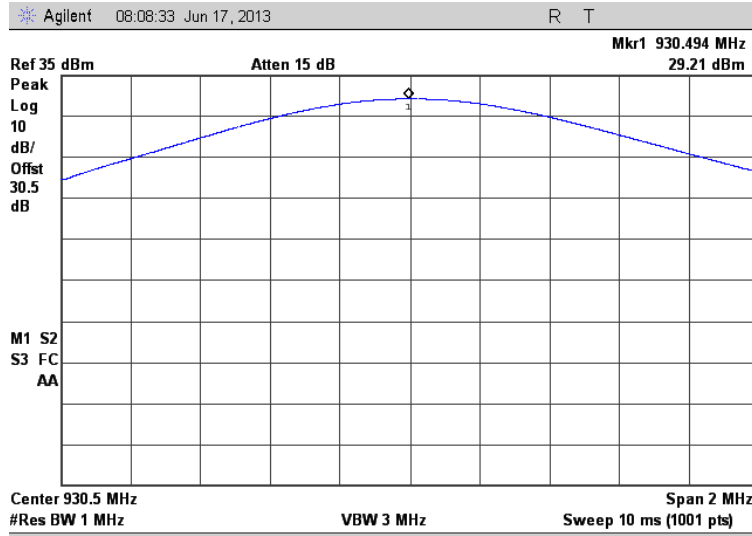


Figure 7.1.2-3: Peak Output Power 930.5 MHz – mPass 10k Mode

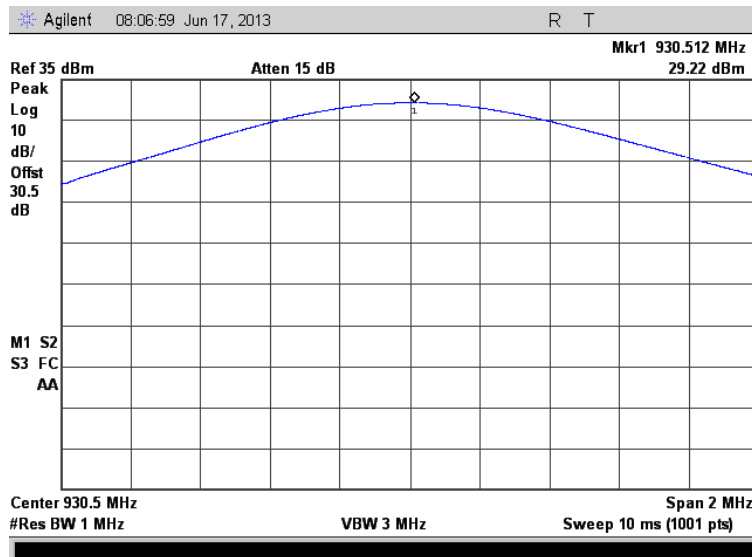


Figure 7.1.2-4: Peak Output Power 930.5 MHz – Priority Mode

Part 90 / RSS-119 5.41

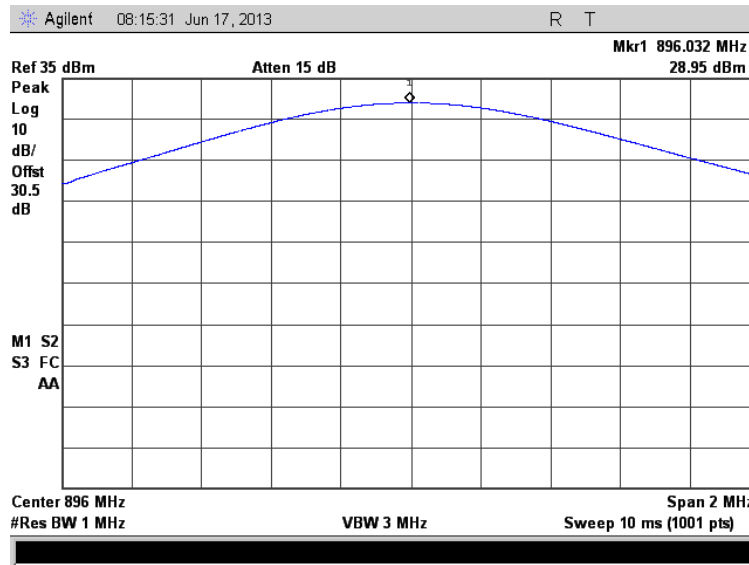


Figure 7.1.2-5: Peak Output Power 896.0375 MHz – Priority Mode

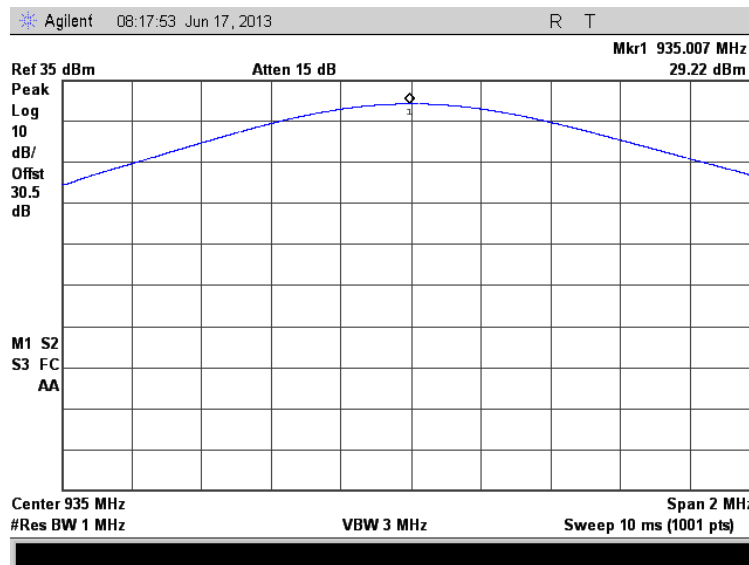


Figure 7.1.2-6: Peak Output Power 935.0125 MHz – Priority Mode

Part 101.113(a) / RSS-119 5.41

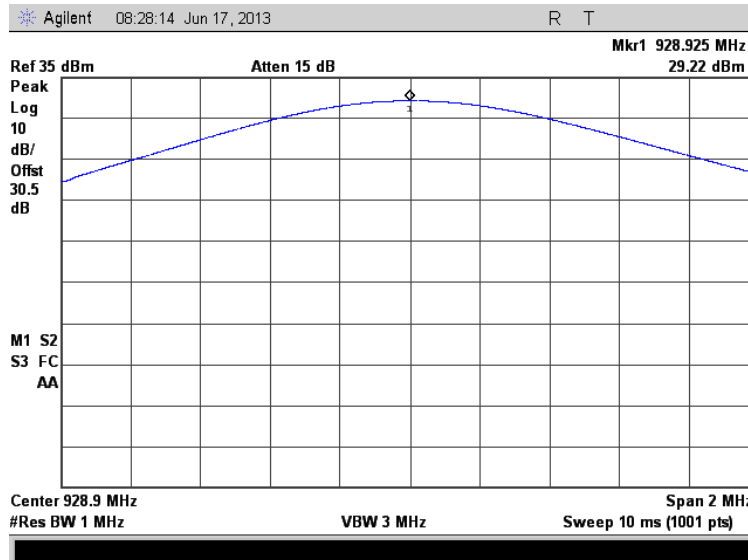


Figure 7.1.2-7: Peak Output Power 928.925 MHz – mPass 10k Mode

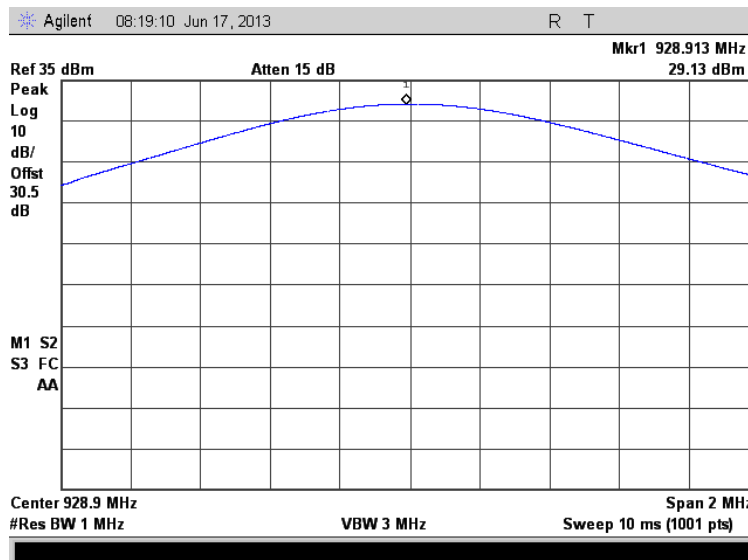


Figure 7.1.2-8: Peak Output Power 928.925 MHz – Priority Mode

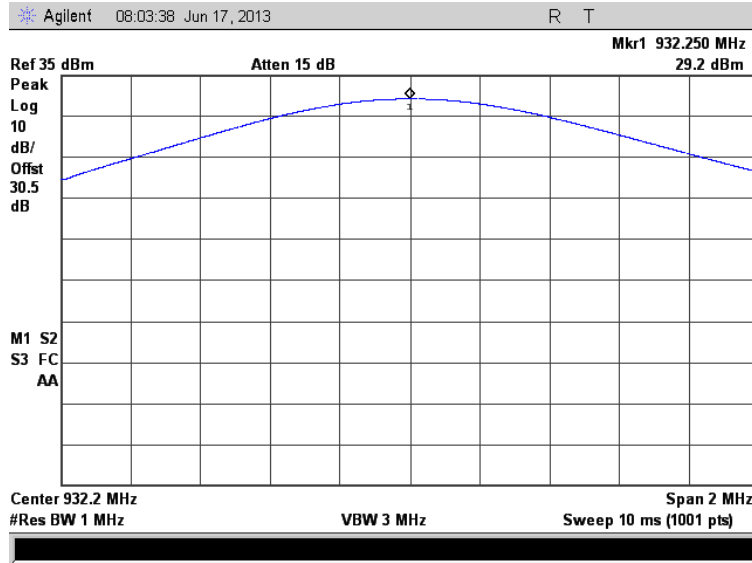


Figure 7.1.2-9: Peak Output Power 932.25 MHz – mPass 10k Mode

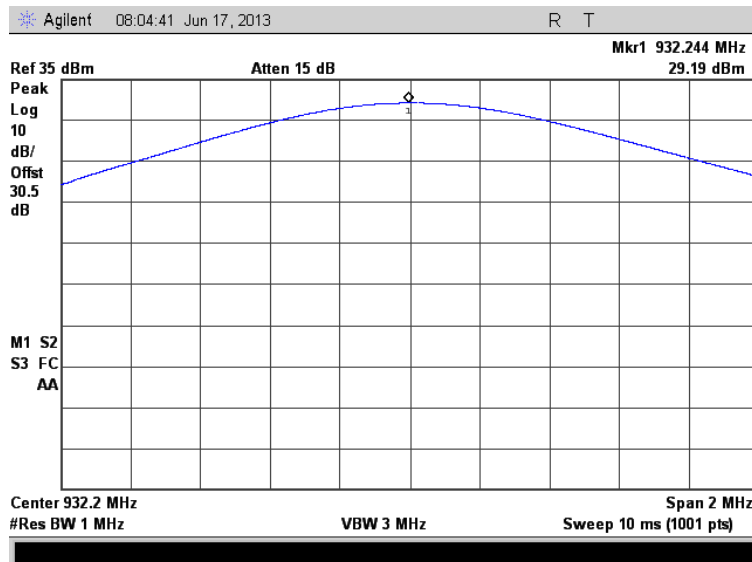


Figure 7.1.2-10: Peak Output Power 932.25 MHz – Priority Mode

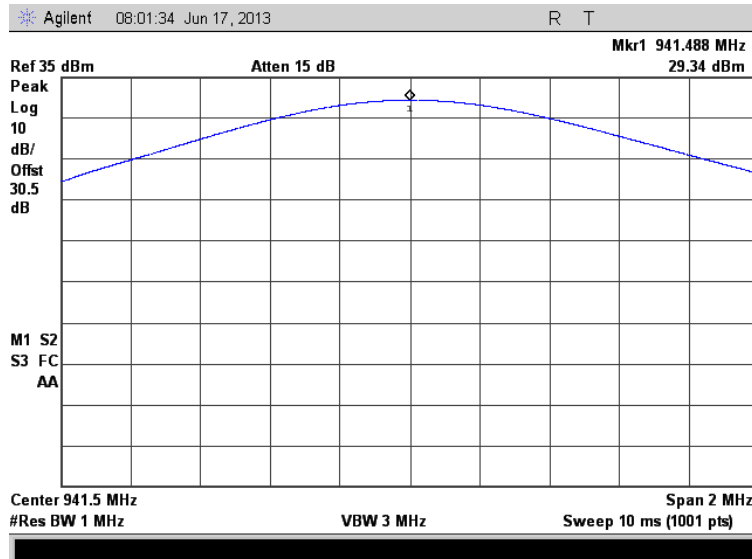


Figure 7.1.2-11: Peak Output Power 941.4875 MHz – mPass 10k Mode

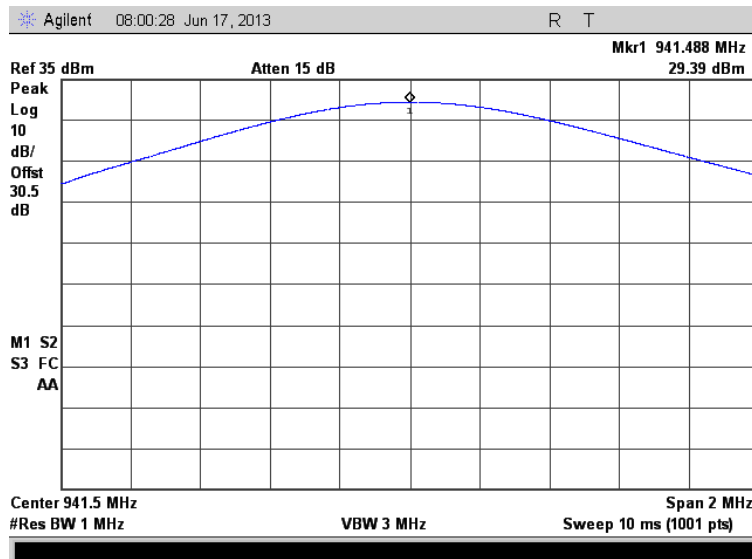


Figure 7.1.2-12: Peak Output Power 941.4875 MHz – Priority Mode

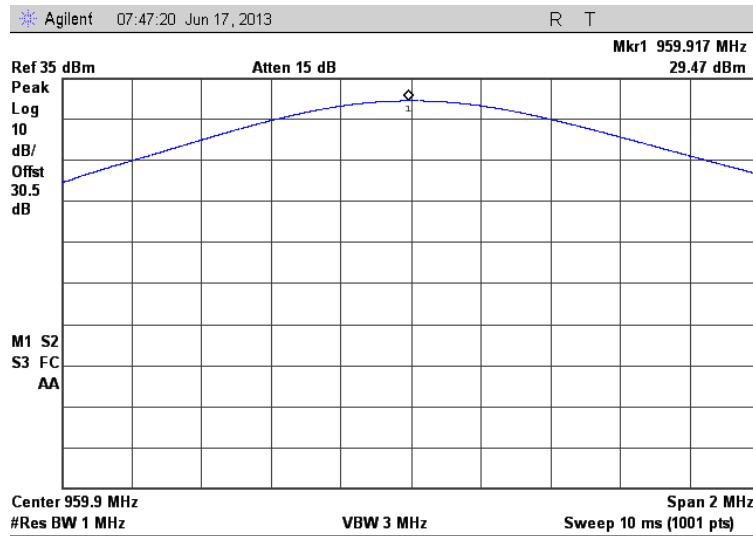


Figure 7.1.2-13: Peak Output Power 959.925 MHz – mPass 10k Mode

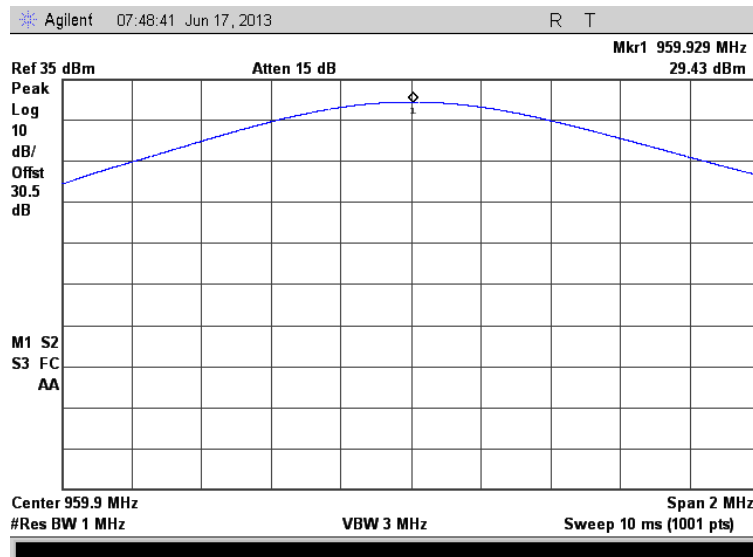


Figure 7.1.2-14: Peak Output Power 959.925 MHz – Priority Mode

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 30 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.

7.2.2 Measurement Results

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

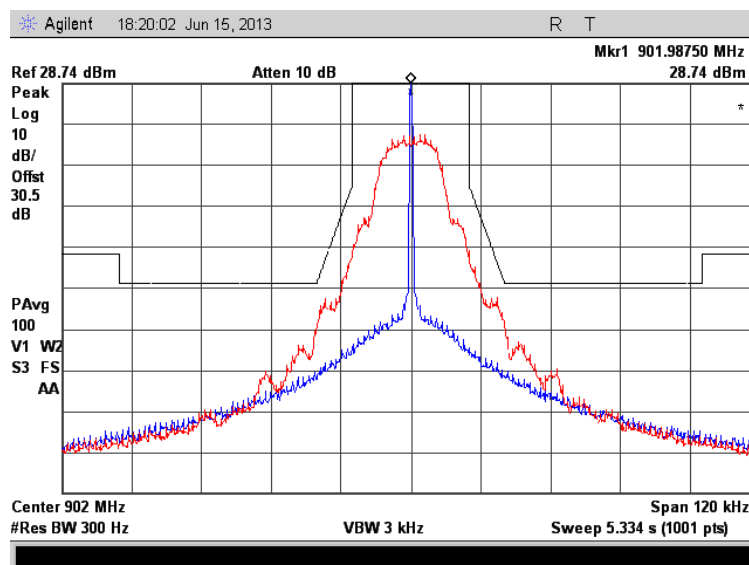


Figure 7.2.2-1: 901.9875 MHz – 25 kHz Channel Spacing – mPass 10k Mode

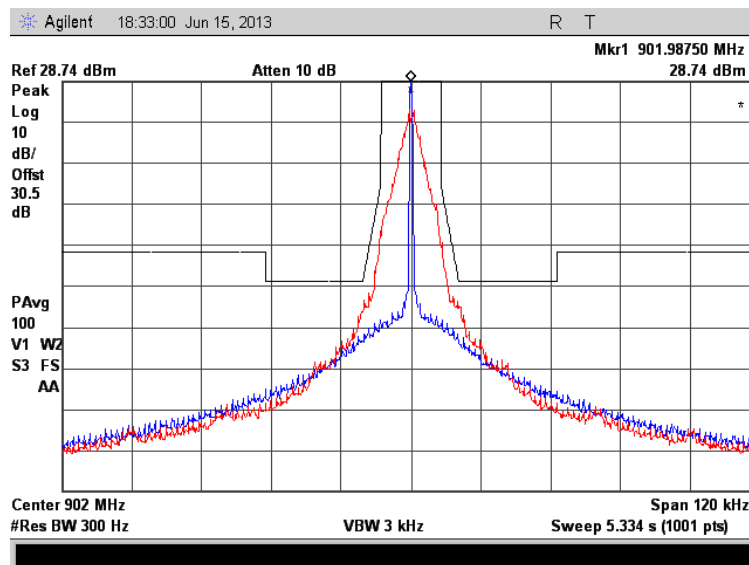


Figure 7.2.2-2: 901.9875 MHz – 12.5 kHz Channel Spacing – Priority Mode

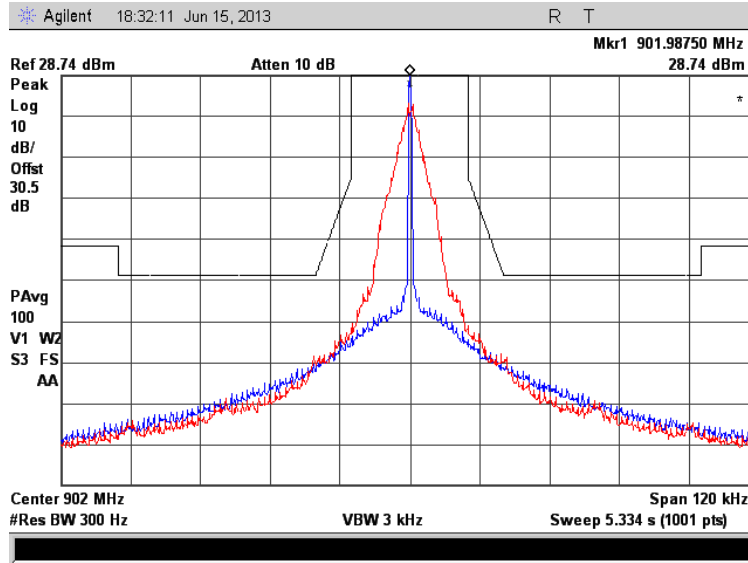


Figure 7.2.2-3: 901.9875 MHz – 25 kHz Channel Spacing – Priority Mode

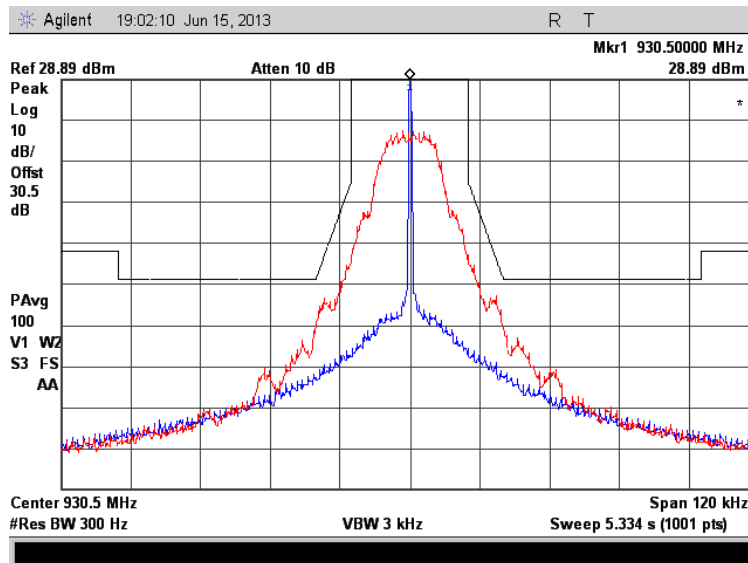


Figure 7.2.2-4: 930.5 MHz – 25 kHz Channel Spacing – mPass 10k Mode

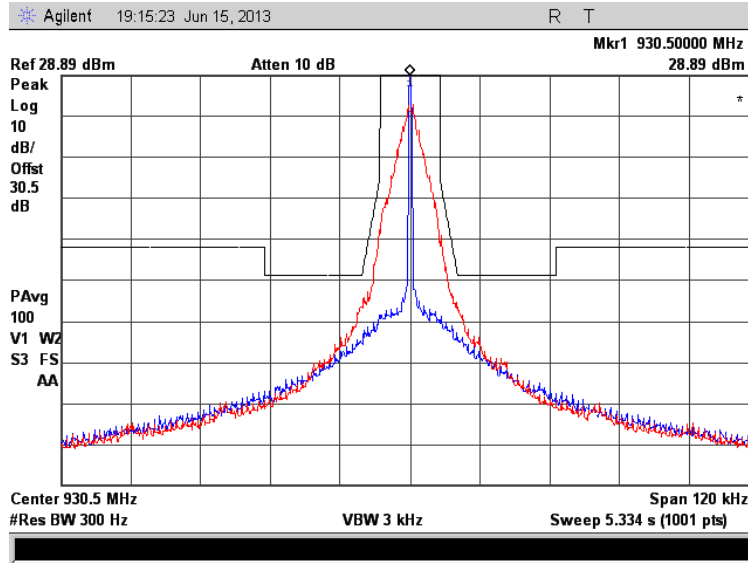


Figure 7.2.2-5: 930.5 MHz – 12.5 kHz Channel Spacing – Priority Mode

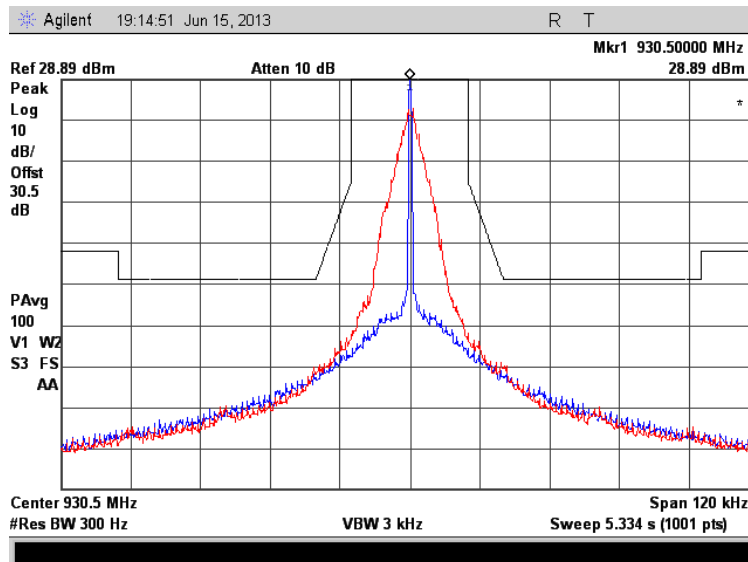


Figure 7.2.2-6: 930.5 MHz – 25 kHz Channel Spacing – Priority Mode

Part 90.210(j), RSS-119 5.8.6 (FCC Part 90.210(j) provides worst case)

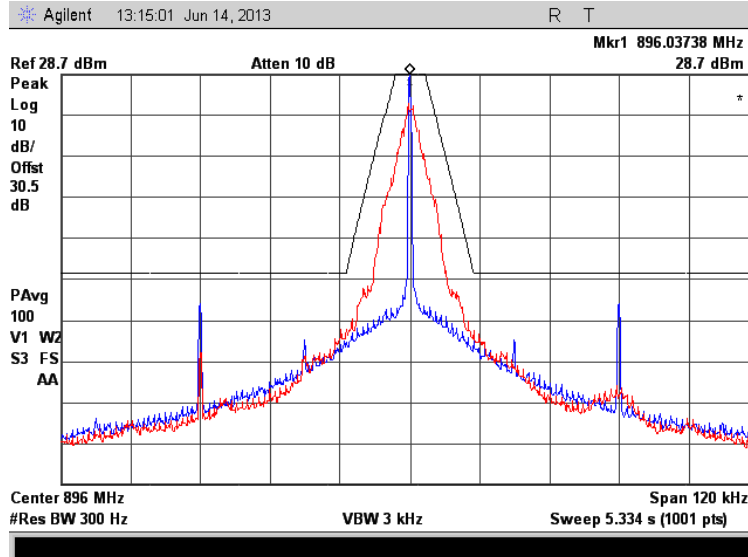


Figure 7.2.2-7: 896.0375 MHz – Priority Mode

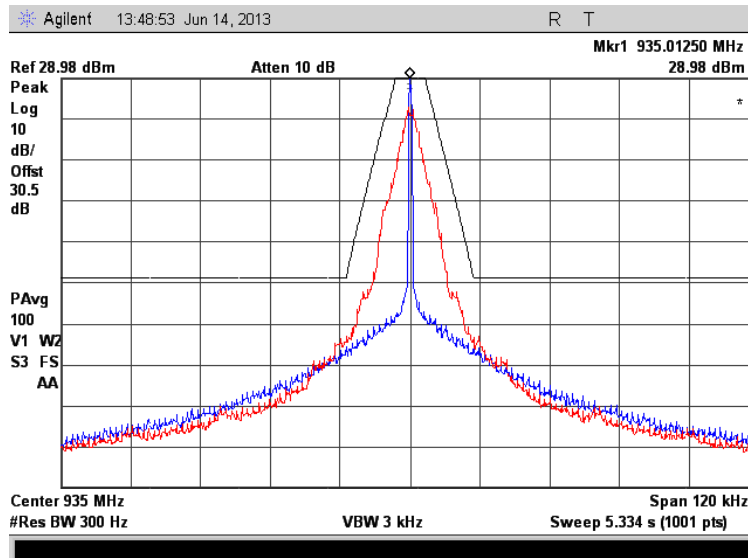


Figure 7.2.2-8: 935.0125 MHz – Priority Mode

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

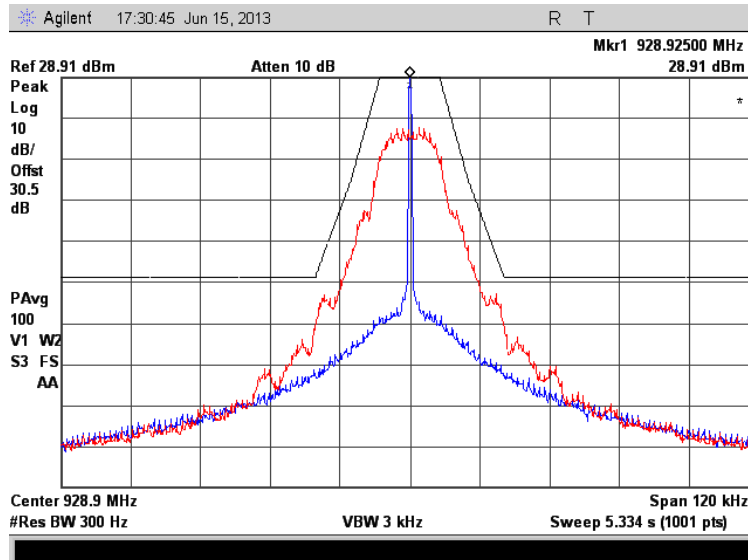


Figure 7.2.2-9: 928.925 MHz – mPass 10k Mode

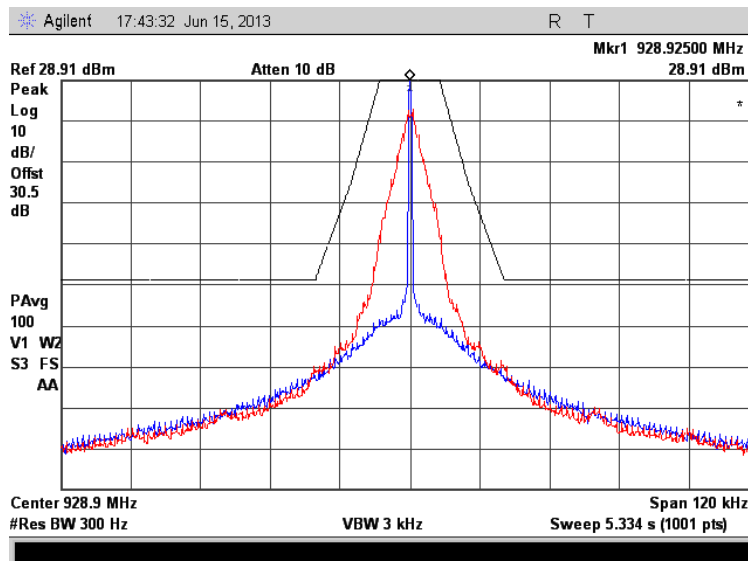


Figure 7.2.2-10: 928.925 MHz – Priority Mode

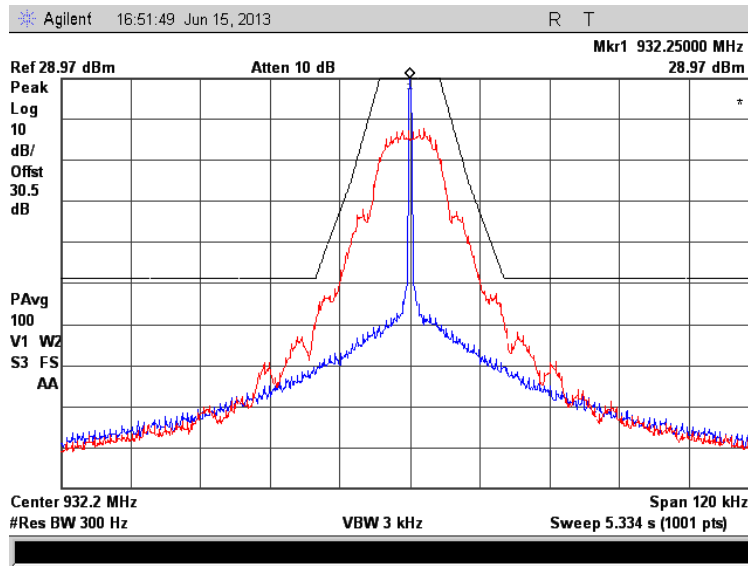


Figure 7.2.2-11: 932.25 MHz – mPass 10k Mode

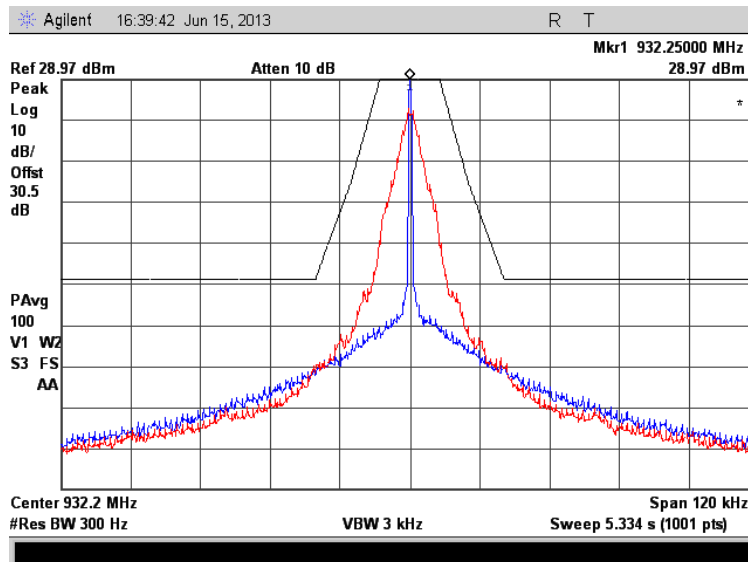


Figure 7.2.2-12: 932.25 MHz – Priority Mode

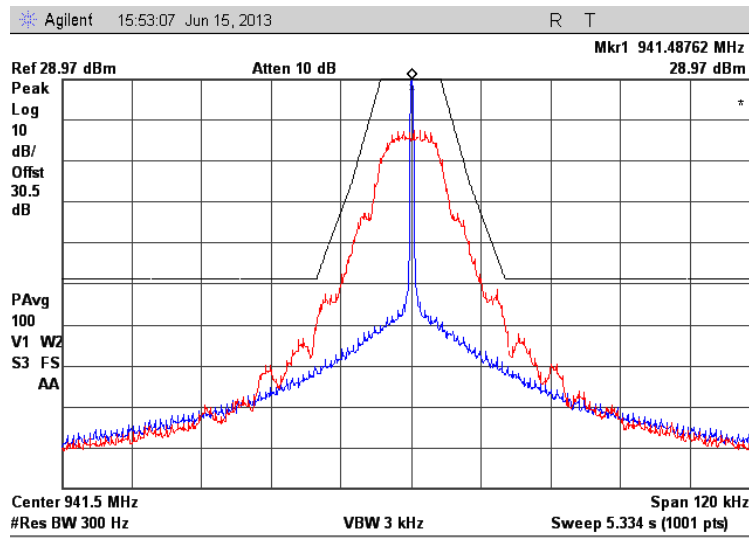


Figure 7.2.2-13: 941.4875 MHz – mPass 10k Mode

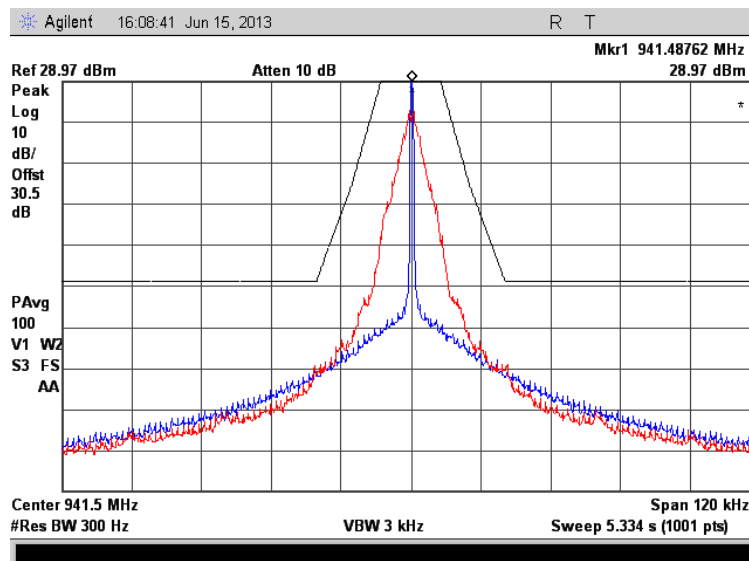


Figure 7.2.2-14: 941.4875 MHz – Priority Mode

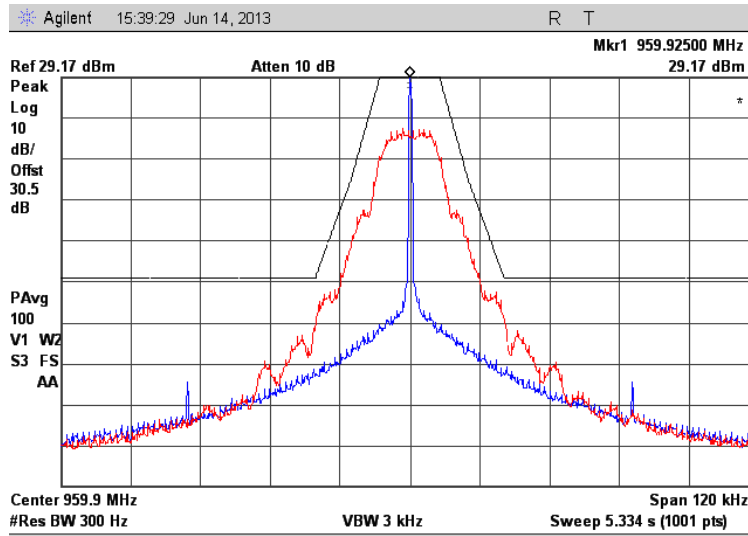


Figure 7.2.2-15: 959.925 MHz – mPass 10k Mode

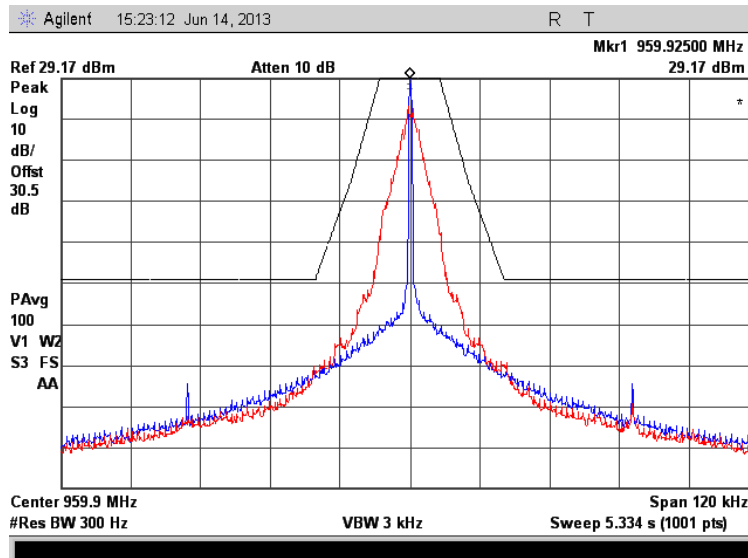


Figure 7.2.2-16: 959.925 MHz – Priority Mode

8.0 CONCLUSION

In the opinion of ACS, Inc. the models FLXA2D and FLXA2E, manufactured by Sensus Metering Systems, Inc., meet the requirements of FCC Part 24D, Part 90 and Part 101 for the tests reported herein where applicable.

End Report