

Certification Test Report

FCC ID: SDBS100QZ

FCC Rule Part: Part 90 Subpart I

ACS Report Number: 12-2077.W03.1A

**Applicant: Sensus Metering Systems, Inc.
Model: S100QZ**

**Test Begin Date: June 26, 2012
Test End Date: June 28, 2012**

Report Issue Date: July 10, 2012



For The Scope of Accreditation Under Certificate Number AT-1533



For The Scope of Accreditation Under Lab Code 200612-0

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

Project Manager:

A handwritten signature in blue ink, appearing to read "Thierry Jean-Charles".

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

Reviewed by:

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

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This report contains 23 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, and Part 90 Subpart I of the FCC's Code of Federal Regulations.

1.2 Product Description

The S100QZ transceiver is a multi-channel, high-performance burst data radio system configured to receive three distinct modulation schemes on three adjacent frequencies in the 450 to 470 MHz frequency range.

The Transceiver RF Transmitter operates on a single configurable channel in the 461 to 464 MHz frequency ranges. The transmitter utilizes yet another type of modulation scheme, different from the ones utilized by the receiver.

The Transceiver assembles the received messages and forwards them to the RNI Network Controller via a high-speed link (ISDN, T1, etc.). The Network Controller (NC) eliminates redundant messages (i.e., messages from endpoints that were received by more than one Base Station) before forwarding them to the database server. The Transceiver also notifies the RNI of any alarm indications, such as low battery, power failure, open door, or low AC power.

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

Test Sample Serial Numbers: 3143

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 S100QZ was tested in accordance to WT Docket No. 11-56, DA 11-1316 which waives 47 CFR 90.203(j) to the test requirements.

For the radiated emissions, the EUT was evaluated in the orientation of typical installation. The S100QZ provides multiple modulations formats/modes all of which were evaluated and the worst case data are presented were applicable.

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

1.3.2 In-Band Testing Methodology

The EUT band of operation is provided in the table below.

CFR Title 47 Rule Part	Frequency Band of Operation (MHz)
90	461.5625 – 463.7875

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.
90	461.5625 – 463.7875	1 near top and 1 near bottom	461.5625
			463.7875

1.4 Emission Designators

The S100QZ transmitter produces two distinct modulation formats. The emissions designators for the modulation types used by the S100QZ transmitter are as follows:

EMISSIONS DESIGNATORS:

MPass Mode (5 kbps): 5K90F1D

MPass Mode (10 kbps): 11K8F1D

2.0 TEST FACILITIES

2.1 Location

Unless noted otherwise, the radiated and conducted emissions test sites are located at the following addresses

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 EMC 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 EMC 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:

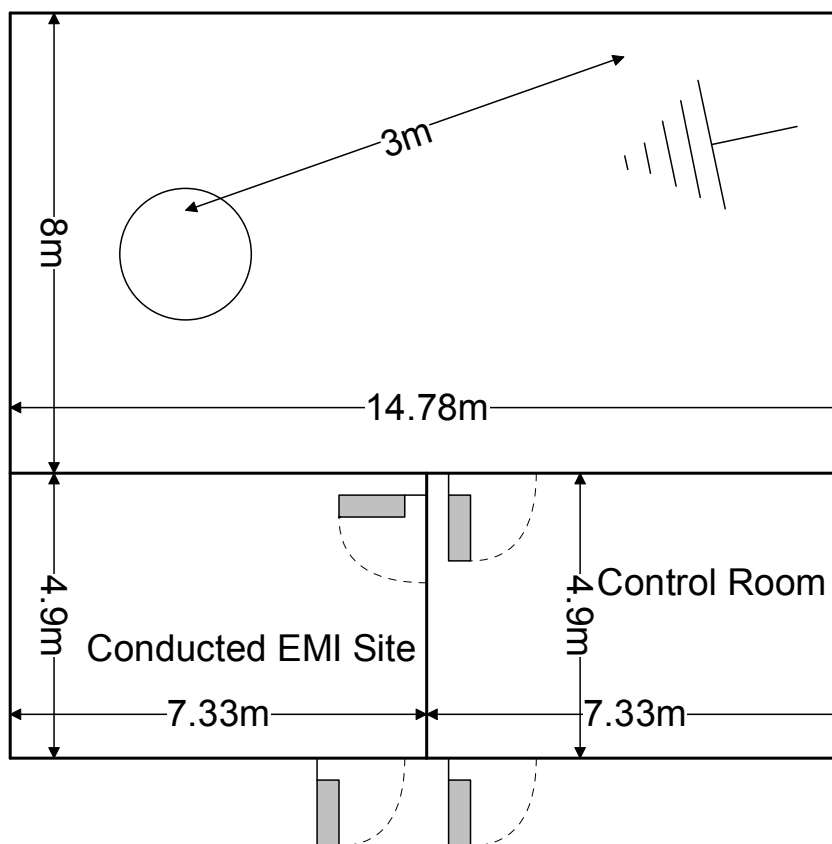


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

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 μ H 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:

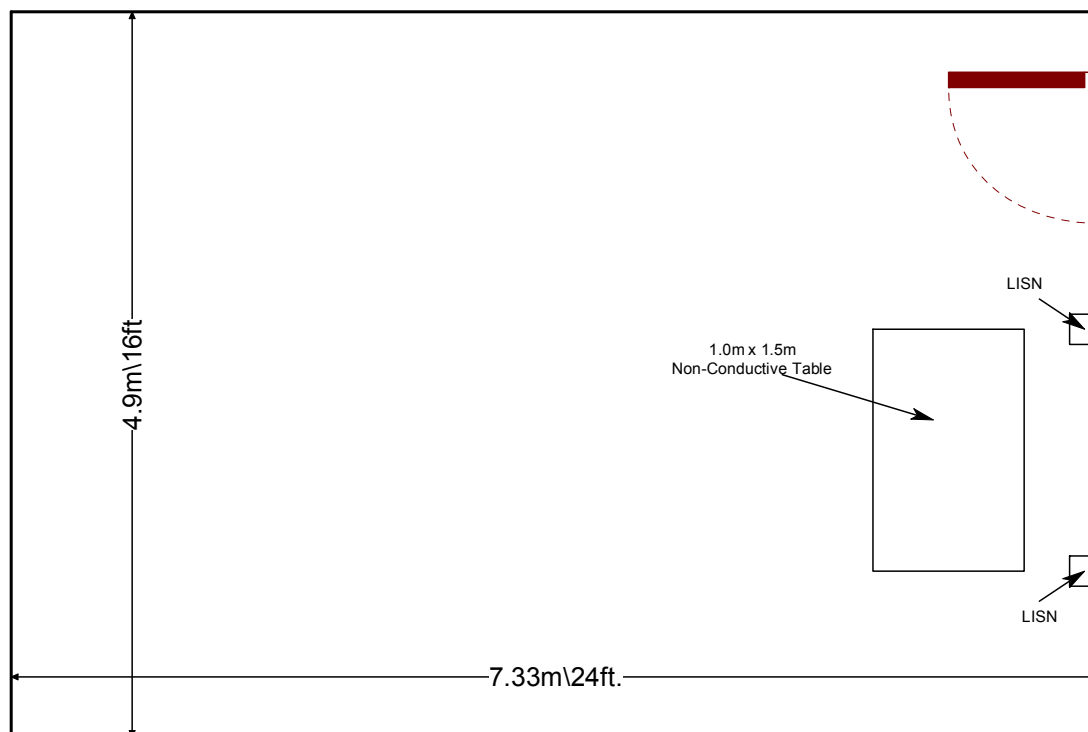


Figure 2.3.2-1: AC Mains Conducted EMI Site

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 90, Subpart I: Private Land Mobile Radio Services - 2012
- 4 - 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: ACS Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	8/26/2011	8/26/2012
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	8/29/2011	8/29/2012
426	Thermotron	S-8 Mini Max	Environmental Chamber	25-2888-10	8/29/2011	8/29/2012
523	Agilent	E7405	Spectrum Analyzers	MY45103293	1/5/2011	1/5/2013
524	Chase	CBL6111	Antennas	1138	1/7/2011	1/7/2013
562	United Microwave Products, Inc.	AA-190-00.48.0	Cables	562	8/11/2011	8/11/2012
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	5/31/2012	5/31/2013
2091	Agilent Technologies, Inc.	8573A	Spectrum Analyzers	2407A03233	12/12/2011	12/12/2013
RE563	Hewlett Packard	8673D	Signal Generators	3034A01078	2/22/2011	2/22/2013
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

Table 4-2: Transient Frequency Behavior Equipment

Manufacturer	Model	Equipment Type	Serial Number	Due Date
LeCroy	LT364	Oscilloscope	00414	9/8/2013
IFR/ Aeroflex	IFR500A	Service Monitor Receiver	5182	6/14/2013
Agilent	6286A	Power supply	1744A03842	12/29/2012
Agilent	8648C	Signal generator	3847A04696	6/12/2013
Agilent	8471D	Detector	29612	12/31/2013

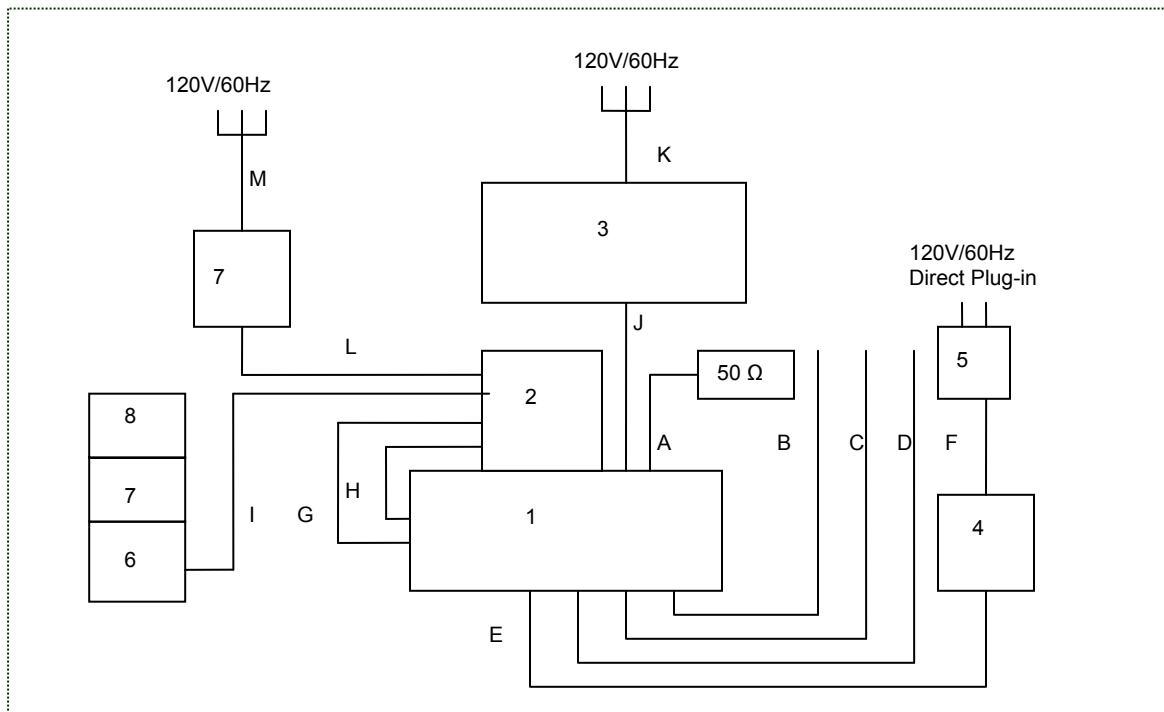
5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Sensus Metering Systems, Inc.	S100QZ	3143
2	Duplexer	Sensus Metering Systems, Inc.	CMD862	101
3	27 VDC Power Supply	Lineage Power	J2007003 L102	10KZ47016361
4	10 dB Attenuator	Weinschel	48-10-33	BX7204
5	Ethernet Switch	NetGear	FS105	FS15A09005405
6	Power Supply	NetGear	YP-040	N/A
7	DC Power Supply	MPJA	HY5003	003700278
8	15 dB Attenuator	Fairview Microwave Inc.	SA3N511-15	RE587
9	50 Ohm Termination	Narda	376BNF	9401

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Coaxial Cable	0.6 m	Yes	EUT to 50 Ω Termination
B	Serial Alarm Cable	0.9 m	No	None
C	RS232 Cable	1.83 m	No	None
D	POTS Cable	2.2 m	No	None
E	CAT5 Cable	2.0 m	Yes	EUT to Ethernet Switch
F	Power Cord	1.87 m	No	Power Supply to Ethernet Switch
G	Coaxial Cable SF-1426	1.28 m	Yes	EUT to Duplexer
H	Coaxial Cable RG-214	0.92 m	Yes	EUT to Antenna
I	Coaxial Cable RG-214	10.0 m	Yes	EUT to Antenna
J	Power Cable	1.2 m	No	Power Supply to EUT
K	Power Cord	2.2 m	No	Power Supply to AC Mains
L	Twisted Pair	1.32 m	No	Duplexer to Power Supply
M	Power Cord	1.8 m	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
Transient Frequency Behavior ¹	N/A	Pass

7.1 RF Power Output

7.1.1 Measurement Procedure

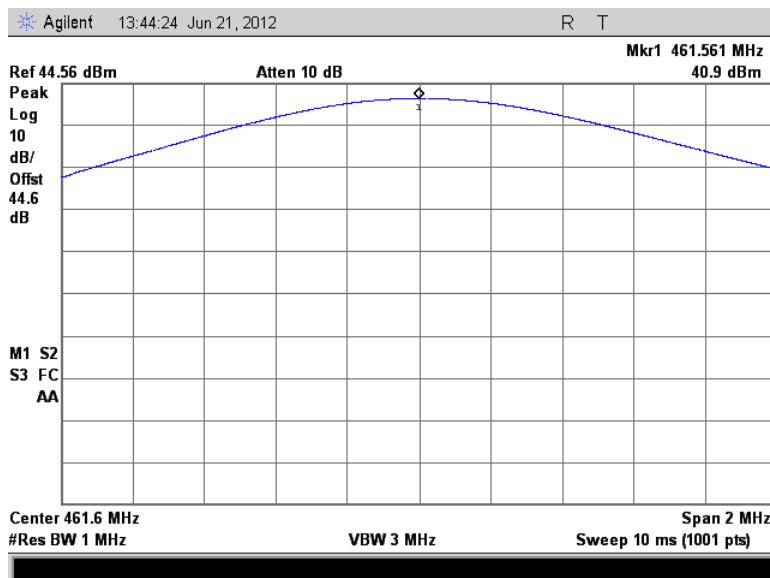
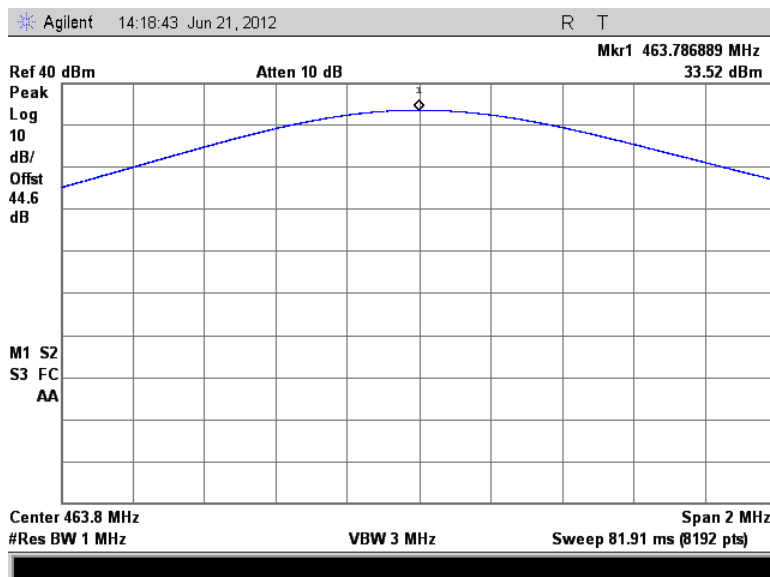
The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 45 dB of passive attenuation. The resolution and video bandwidths of the spectrum analyzer were set at sufficient levels, >> signal bandwidth, to produce accurate results. The internal correction 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)
461.5625	90	40.90
463.7875	90	33.52

¹ The transient Frequency Behavior evaluation was performed at Timco Engineering, Inc. which is accredited to ISO/IEC 17025 by American Association for Laboratory Accreditation (A2LA) and was issued a certificate number 0955.01.

Part 90.205**Figure 7.1.2-1: Peak Output Power – 461.5625 MHz****Figure 7.1.2-2: Peak Output Power – 463.7875 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 90.210 (c)

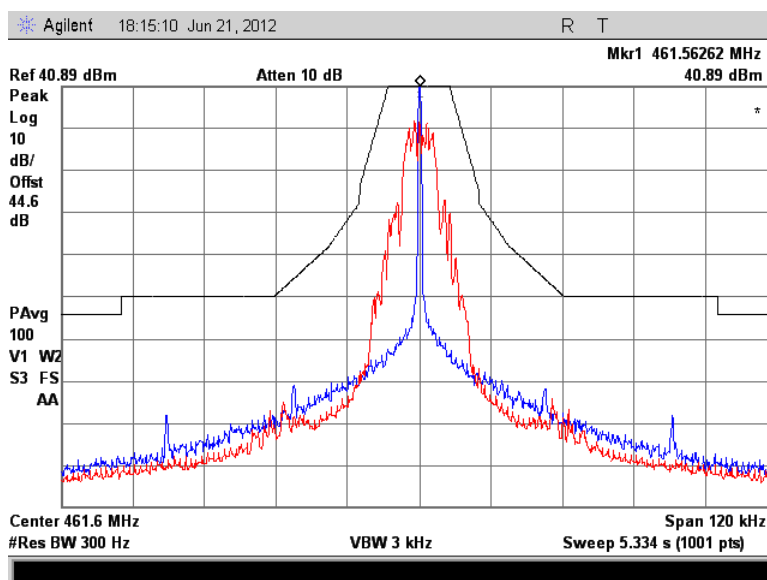


Figure 7.2.2-1: 461.5625 MHz – MPass 5k Mode

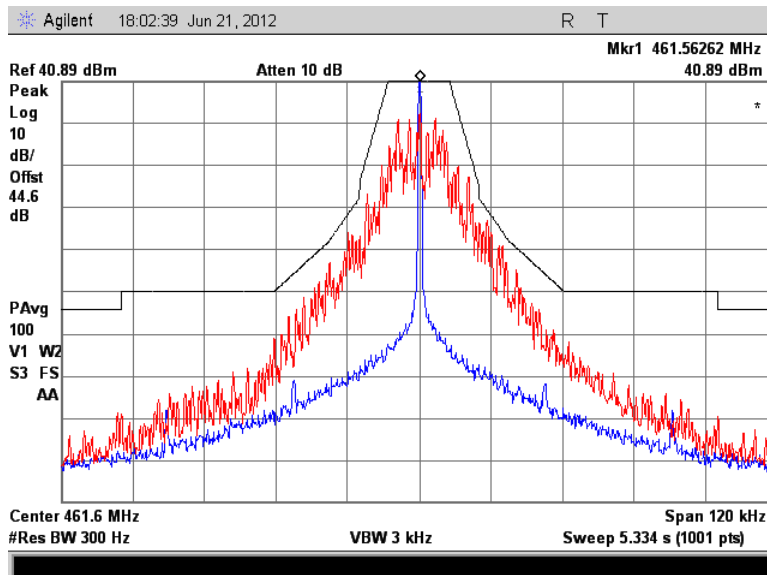


Figure 7.2.2-2: 461.5625 MHz – MPass 10k Mode

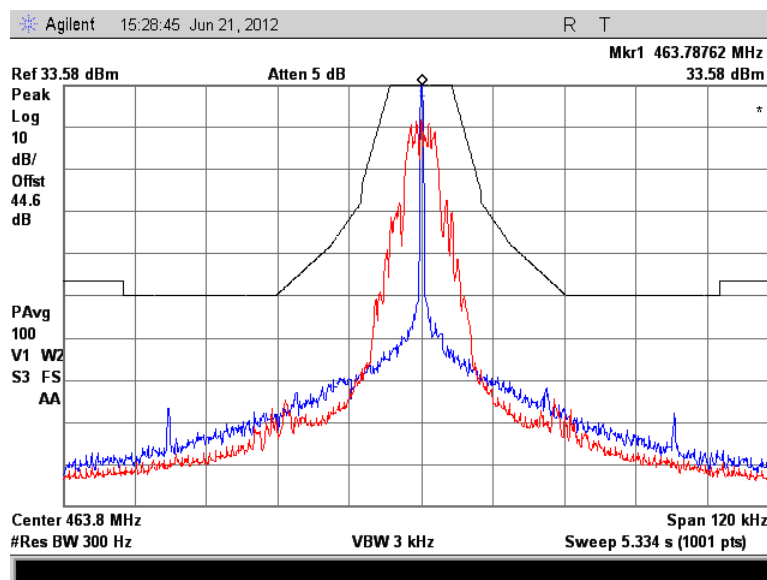


Figure 7.2.2-3: 463.7875 MHz – MPass 5k Mode

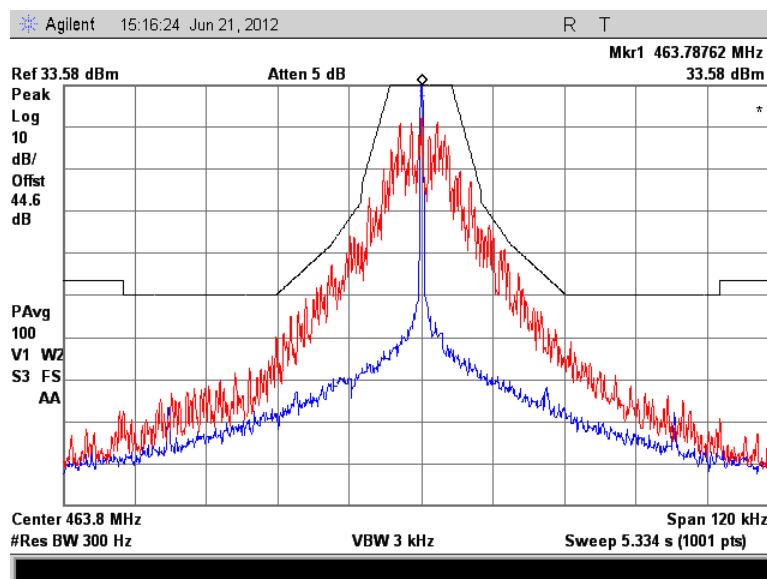


Figure 7.2.2-4: 463.7875 MHz – MPass 10k Mode

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 90.210(c)

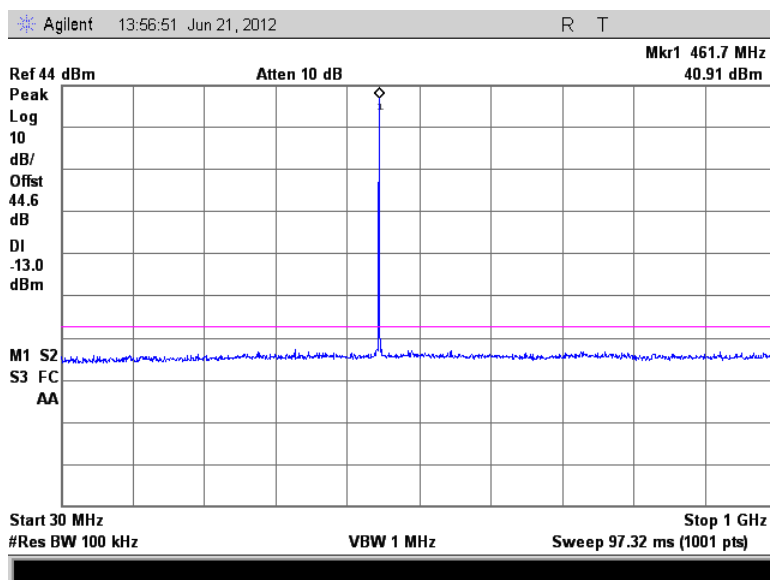


Figure 7.3.2-1: 461.5625 MHz – 30MHz to 1GHz

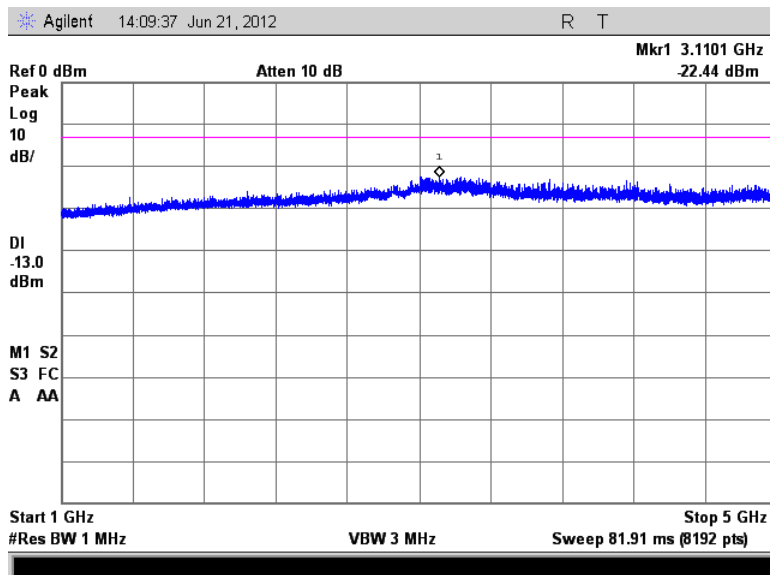


Figure 7.3.2-2: 461.5625 MHz – 1GHz to 5GHz

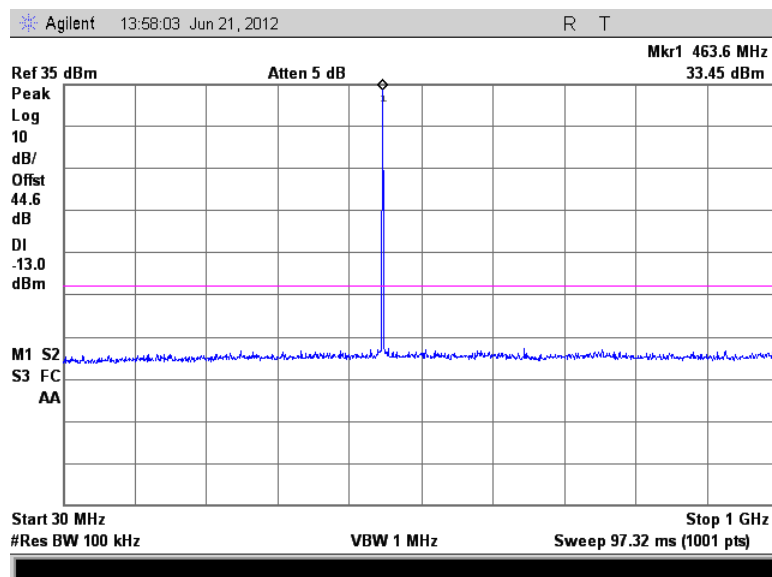


Figure 7.3.2-3: 463.7875 MHz – 30MHz to 1GHz

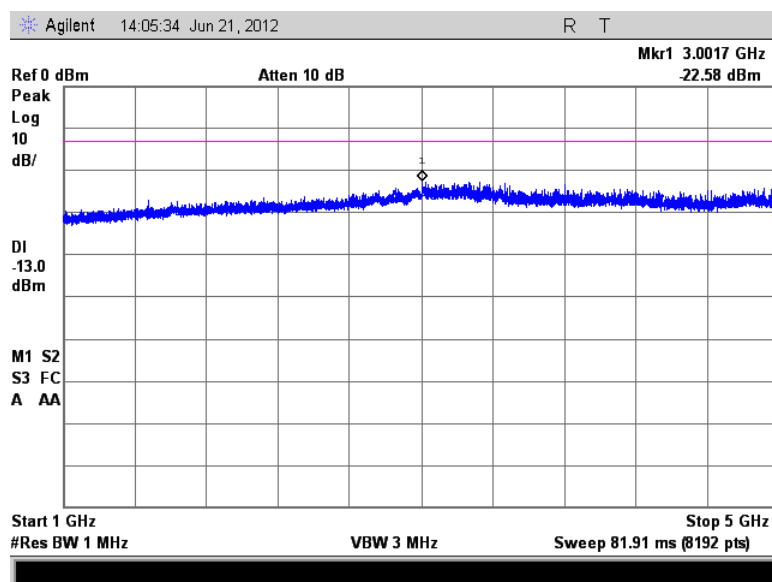


Figure 7.3.2-4: 463.7875 MHz – 1GHz to 5GHz

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 90.210 (c)

Table 7.4.2-1: Field Strength of Spurious Emissions – 461.5625 MHz

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
923.125	-63.75	H	-57.30	-13.00	44.30
3692.5	-58.75	H	-63.42	-13.00	50.42
4615.625	-58.65	H	-57.86	-13.00	44.86
923.125	-66.60	V	-59.70	-13.00	46.70
3692.5	-59.50	V	-64.72	-13.00	51.72
4615.625	-58.70	V	-58.36	-13.00	45.36

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

Table 7.4.2-2: Field Strength of Spurious Emissions – 463.7875 MHz

Frequency (MHz)	Spectrum Analyzer Level (dBm)	Antenna Polarity (H/V)	Spurious ERP (dBm)	Limit (dBm)	Margin (dB)
927.575	-64.15	H	-56.70	-13.00	43.70
3710.3	-58.00	H	-59.19	-13.00	46.19
4174.0875	-59.20	H	-60.67	-13.00	47.67
4637.875	-59.15	H	-60.71	-13.00	47.71
927.575	-67.20	V	-59.70	-13.00	46.70
3710.3	-59.10	V	-61.29	-13.00	48.29
4637.875	-59.50	V	-61.16	-13.00	48.16

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° 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 the endpoint voltage. The maximum variation of frequency was recorded.

7.5.2 Measurement Results

Part 90.213

Frequency Stability

Frequency (MHz): 461.5625

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	461.562503	0.006	100%	24.00
-20 C	461.562504	0.009	100%	24.00
-10 C	461.562504	0.009	100%	24.00
0 C	461.562505	0.011	100%	24.00
10 C	461.562505	0.011	100%	24.00
20 C	461.562505	0.011	100%	24.00
30 C	461.562505	0.011	100%	24.00
40 C	461.562506	0.013	100%	24.00
50 C	461.562506	0.013	100%	24.00
20 C	461.562505	0.011	Endpoint	22.00

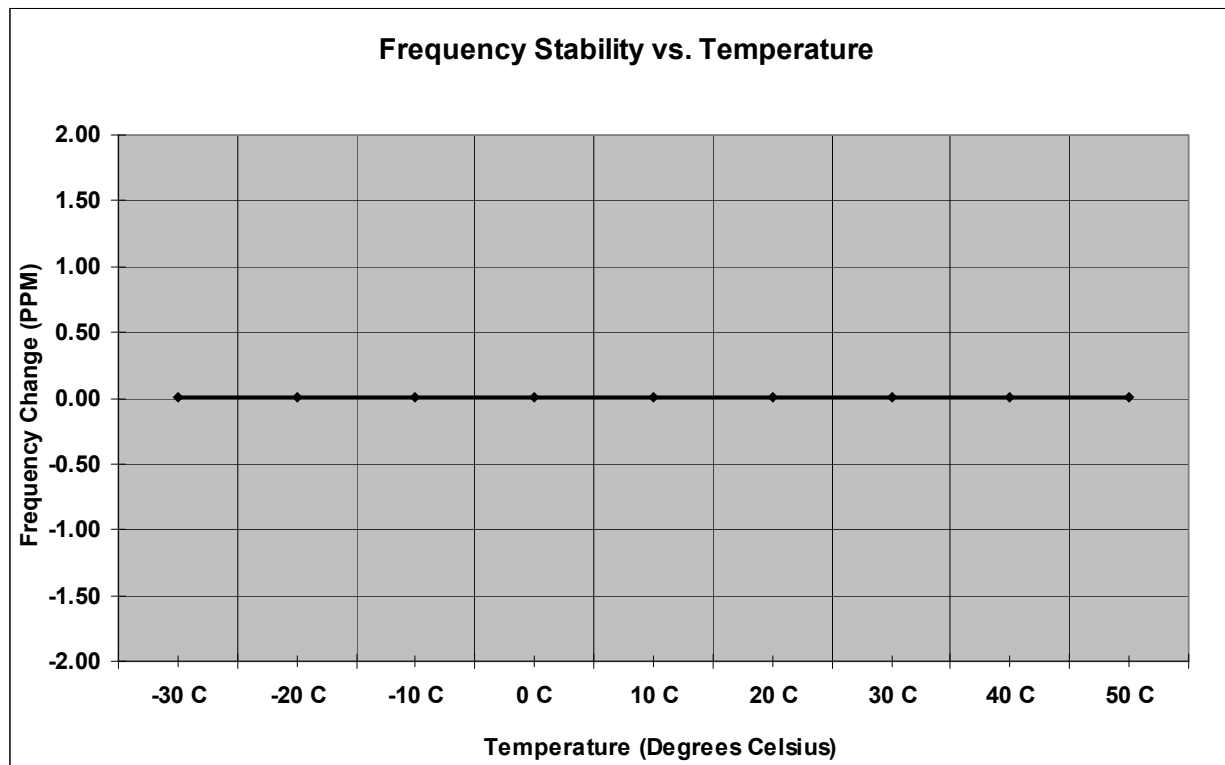


Figure 7.5.2-1: Frequency Stability – 461.5625 MHz

Frequency Stability

Frequency (MHz): 463.7875

Temperature	Frequency	Frequency Error	Voltage	Voltage
C	MHz	(PPM)	(%)	(VDC)
-30 C	463.787503	0.006	100%	24.00
-20 C	463.787504	0.009	100%	24.00
-10 C	463.787504	0.009	100%	24.00
0 C	463.787505	0.011	100%	24.00
10 C	463.787505	0.011	100%	24.00
20 C	463.787505	0.011	100%	24.00
30 C	463.787505	0.011	100%	24.00
40 C	463.787506	0.013	100%	24.00
50 C	463.787506	0.013	100%	24.00
20 C	463.787505	0.011	Endpoint	22.00

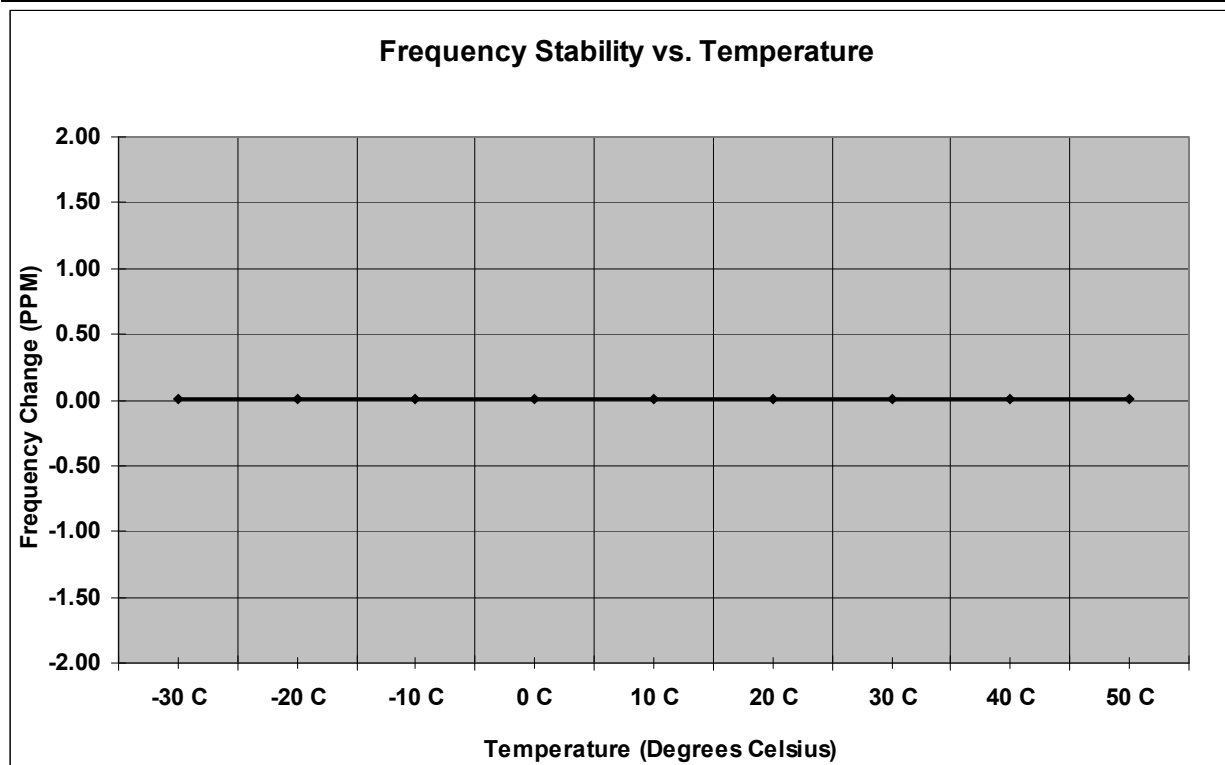


Figure 7.5.2-2: Frequency Stability – 463.7875 MHz

7.6 Transient Frequency Behavior

7.6.1 Measurement Procedure

The measurements were performed using a test receiver. The EUT was connected using the variable attenuator and a 4-way resistive coupler. The transmitter level was set to 40 dB below the test receivers maximum input level, and then the transmitter was turned off. With the transmitter off the signal generator was set 20 dB below the level of the transmitter and maintained at the same amplitude through-out the test. Then, the attenuation between the transmitter and the RF detector was reduced by 30 dB. The transient Frequency Behavior is reported below.

7.6.2 Measurement Results

Part 90.214

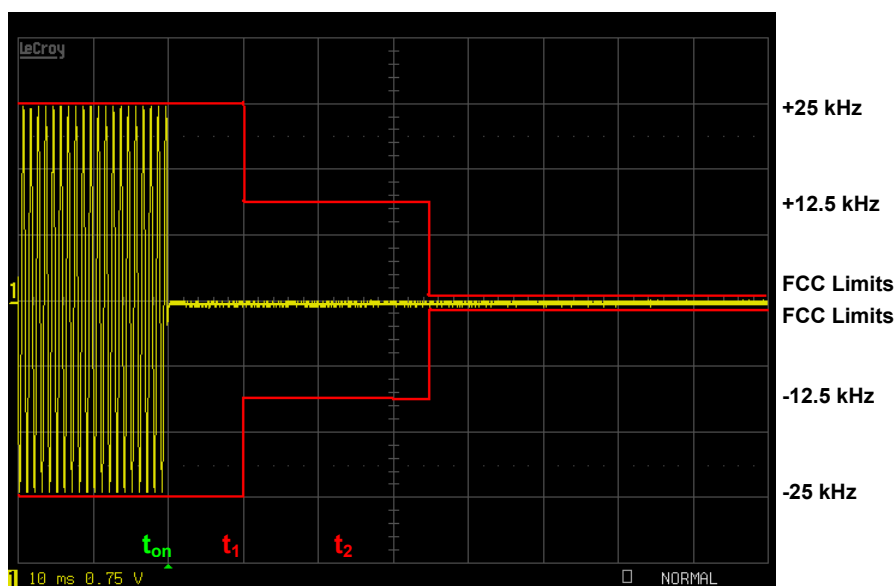


Figure 7.6.2-1: Transient Frequency Behavior – Transmitter On

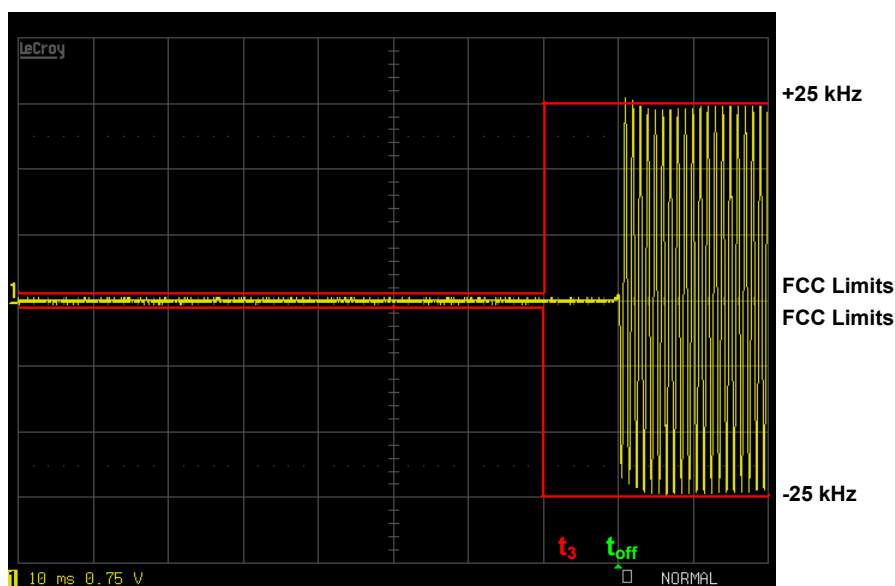


Figure 7.6.2-2: Transient Frequency Behavior – Transmitter Off

8.0 CONCLUSION

In the opinion of ACS, Inc. the model S100QZ, manufactured by Sensus Metering Systems, Inc., meets all the requirements of FCC Part 90 Subpart I, were applicable.

End Report