FCC and ISED Canada Radio Testing of the

Sensus Metering Systems Inc.
FLXI2102

In accordance with FCC 47 CFR Part 24 Subpart D, Part 101 Subpart C and ISED Canada's Radio Standards Specifications RSS-119, RSS-134

America

Add value.
Inspire trust.

Prepared for: Sensus Metering Systems Inc.
639 Davis Drive
Morrisville, NC 27560

FCC ID: SDBFLXI2102
IC: 2220A-FLXI2102

COMMERCIAL-IN-CONFIDENCE

Document Number: TP72171706.202 | Version Number: 03

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Peter Walsh	2022 -April-11	
Testing	Thierry Jean-Charles	2022-April-11	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

FCC Accreditation Designation Number US1063 Tampa, FL Test Laboratory	Innovation, Science, and Economic Development Canada Accreditation Site Number 2087A-2 Tampa, FL Test Laboratory

EXECUTIVE SUMMARY
Samples of this product were tested and found to be in compliance with FCC Part 24 Subpart D, Part 101 Subpart C and ISED Canada's RSS-119, RSS-134.

A2LA Cert. No. 2955.15

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Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2022-February-01
2	Updated the Declaration of Build Status	2022-February-05
3	Updated to include test data reference	2022-April-11

1.2 Introduction

The purpose of this report is to verify the RF power output of the FLXI2102 with the FCC's Code of Federal Regulations Part 24 Subpart D, Part 101 Subpart C and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-119, RSS-134 for the tests documented herein.

The test report provides supplemental data to test report RD72162913.102. Both test reports provide spot check results in order to reference radio data parameters in original test reports

The worst-case modulations from the original filing of the FXZIG210 (RD72127191.100) and the Class 2 Permissive Change (RD72144961.100) were assessed and documented in this report.

The test data in original test reports are verified and are representative to the new depopulated equipment version.

Applicant	Sensus Metering Systems Inc.
Manufacturer	Sensus Metering Systems Inc.
Applicant's Email Address	Pam.Sequeira@xylem.com
Model Number(s)	FLXI2102
Serial Number(s)	7300515
Hardware Version(s)	REV K
Software Version(s)	v35520066
Number of Samples Tested	1
Test Specification/Issue/Date	US Code of Federal Regulations (CFR): Title 47, Part 24, Subpart D: Personal Communications Services – 2021 US Code of Federal Regulations (CFR): Title 47, Part 101, Subpart C: Fixed Microwave Services -2012 Industry Canada Radio Standards Specification: RSS-119 - Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41-960 MHz, Issue 12, May 2015 Industry Canada Radio Standards Specification: RSS-134 - 900 MHz Narrowband Personal Communication Service, Issue 2, February 2016
Test Plan/Issue/Date	2021-July-21
Order Number	72171706
Date	2021-July-28
Date of Receipt of EUT	2021-July-29
Start of Test	2021-July-30
Finish of Test	2022-January-14
Name of Engineer(s)	Thierry Jean-Charles
Related Document(s)	US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures - 2021 Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN - General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1, March 2019 ANSI C63.26: 2015: American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with 24 Subpart D, Part 101 Subpart C and ISED Canada's RSS-119, RSS-134 is shown below.

Table 1.3-1: Test Result Summary

Test Parameter	Test Plan (Yes/No)	Test Results	FCC 47 CFR Rule Part	ISED Canada's RSS	Test Report Page No.
RF Power Output	Yes	Pass	2.1046; 24.132; 101.113(a)	RSS-Gen 6.12; RSS-119 5.4; RSS-134 4.3(a), (b)	12
Out of Band Unwanted Emissions	Yes	Pass	2.1053; 24.133 a(1), a(2); 101.111 a(5), 101.111 a(6)	RSS-Gen 6.13; RSS-119 5.8.3, RSS-119 5.8.6; RSS-134 4.4	18
Occupied Bandwidth	No	--------	2.1049; 101.109	RSS-Gen 6.7	
Spurious Emissions at Antenna Terminals	No	--------	2.1053; 24.133 a(1), a(2); 101.111 a(5), 101.111 a(6)	RSS-Gen 6.13; RSS-119 5.8.3, RSS-119 5.8.6; RSS-134 4.4	
Field Strength of Spurious Radiation	No	--------	2.1053; 24.133 a(1), a(2); 101.111 a(5), 101.111a(6)	RSS-Gen 6.13; RSS-119 5.8.3, RSS-119 5.8.6; RSS-134 4.4	
Frequency Stability	No	--------	2.1055; 24.135; 101.107	RSS-Gen 6.11; RSS-119 5.3; RSS-134 4.5	

1.4 Product Information

1.4.1 Technical Description

The equipment under test was the FLXI2102 transceiver module that incorporates a Sensus FLEXNET 900MHz transceiver.

The FLXI2102 is meant as an endpoint state-of-the-art supporting communications WAN and HAN communication. The electronics package is designed to be installed in the Aclara I210+c meter. The Aclara I210+c meter is Aclara's flagship residential meter product supporting Demand, TOU, LP as well as a service switch

Technical Details per the Manufacturer
Mode of Operation: FLEXNET 900 MHz
Frequency Range: 901 MHz - 960 MHz
Antenna Type/Gain: ¼ wave printed monopole, 2.77 dBi
Input Power: 4 VDC

The FLXI2102 transmitters produce 14 distinct modulation formats. The emissions designators for the modulation types used by the FLXI2102 transmitters are as follows:

EMISSIONS DESIGNATORS:

Mode	Emission Designator	Modulation
Normal	9K60F2D	7-FSK
Double Density	9K60F2D	13-FSK
C & I (Half Baud)	4K80F2D	7-FSK
Priority	4K80F2D	13-FSK
MPass (5 kbps)	5K90F1D	2-GFSK
MPass (10 kbps)	11K8F1D	2-GFSK
2SFSK (Half Baud)	5K00F1D	2-SFSK
4SFSK (Half Baud)	5K60F1D	4-SFSK
8SFSK (Half Baud)	5K90F1D	8-SFSK
2SFSK	10K0F1D	2-SFSK
4SFSK	11K3F1D	4-SFSK
8SFSK	11K9F1D	8-SFSK
m4Pass (10k)	4K70F1D	4-GFSK
m4Pass (20k)	9K30F1D	4-GFSK

A full description and detailed product specification details are available from the manufacturer.

Table 1.4.1-1 – Cable Descriptions

Cable/Port	Description
Power Cable	1.2m, Not Shielded, EUT to DC Power Supply

Note: The EUT is a standalone module. The DC power supply and cables were used for testing purposes only.

Table 1.4.1-2 – Support Equipment Descriptions

Make/Model	Description
Xantrex / XHR60-18	DC Power Supply, S/N 27098

Note: The EUT is a standalone module. The DC power supply and cables were used for testing purposes only.

Declaration of Build Status

EQUIPMENT DESCRIPTION	
Model Name/Number	FLXI2102
Part Number	70033-112-70001
Hardware Version	REV K
Software Version	v35520066
FCC ID (if applicable)	SDBFLXI2102
ISED ID (if applicable)	2220A-FLXI2102
Technical Description (Please provide a brief description of the intended use of the equipment)	The radio module for the Aclara meter contains a licensed 900MHz fully digital transceiver that is supplied to Aclara fully tested and calibrated. It is installed by Aclara at their manufacturing facility.

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	960.000MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	901.000 MHz
Class A Digital Device (Use in commercial, industrial or business environment) ☐ Class B Digital Device (Use in residential environment only) ☒	

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
	☐	☐	
External DC	Nominal Voltage		Maximum Current
	4.0V (+/- 5%)		1A
Battery	Nominal Voltage		Battery Operating End Point Voltage

EXTREME CONDITIONS					
Maximum temperature	+ 85	°C	Minimum temperature	- 40	°C

Ancillaries
Please list all ancillaries which will be used with the device.

I hereby declare that the information supplied is correct and complete.

Name: James Francisco

Position held: Sr. HW Regulatory Engineer Date: 02/04/2022

1.4.2 Modes of Operation

The tested mode of operation was for the EUT in constant TX mode for the 900 MHz Flexnet transmitter. The EUT was operating at the maximum TX output power per the manufacturer. TX output power was not configurable via the programming Flexnet Utility user interface.

1.4.3 Monitoring of Performance

The RF conducted measurements were performed on a sample configured with an RF connector at the antenna port to allow direct coupling to the spectrum analyzer.

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
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.
24D	901.0 - 902.0	Middle	901.5000
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

1.4.4 Performance Criteria

The parameters evaluated are summarized below.

Table 1.4.4-1: Performance Criteria

Parameter	Requirement
RF Output Power	FCC 47 CFR Part 2.1046; 24.132; 101.113(a) ISED Canada RSS-119 5.4; RSS-134 4.3(a),(b)
Out-of-Band Unwanted Emissions	FCC 47 CFR Parts: 2.1053; 24.133 a(1), a(2); 101.111 a(5), 101.111 a(6) ISED Canada RSS-119 5.8.3, RSS-119 5.8.6; RSS-134 4.4

1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
None			

1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Tampa FL Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Battery Powered Operating		
RF Power Output	Thierry Jean-Charles	A2LA
Out of Band Unwanted Emissions	Thierry Jean-Charles	A2LA

Office Address:

TÜV SÜD America, Inc.
5610 W. Sligh Ave, Suite 100
Tampa, FL 33634
USA

2 Test Details

2.1 RF Power Output

2.1.1 Specification Reference

FCC 47 CFR Part 2.1046; 24.132; 101.113(a)
ISED Canada RSS-119 5.4; RSS-134 4.3(a),(b)

2.1.2 Equipment Under Test and Modification State

Model: FLXI2102, Serial Number: 7300515

2.1.3 Date of Test

2021-July-30 to 2022-January-06

2.1.4 Test Method

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 30 dB of passive attenuation. The resolution and video bandwidths of the spectrum analyzer were set at sufficient levels, >> signal bandwidth.

2.1.5 Environmental Conditions

Ambient Temperature	26.3 °C
Relative Humidity	41.3 %
Atmospheric Pressure	1016.4 mbar

2.1.6 Test Results

FCC 47 CFR Part 2.1046; 24.132; ISED Canada RSS-134 4.3(a),(b)

Table 2.1.6-1: RF Output Power

Frequency (MHz)	Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
901.5	30.38	2.77	33.15	40.6	7.45
930.5	30.27	2.77	33.04	40.6	7.56
940.0125	30.65	2.77	33.42	40.6	7.18

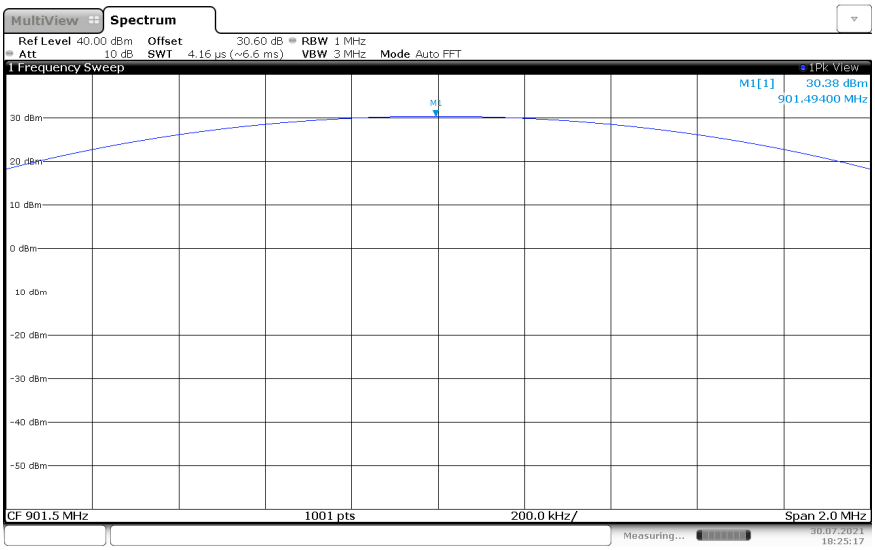

Figure 2.1.6-1: RF Output Power – 901.5 MHz

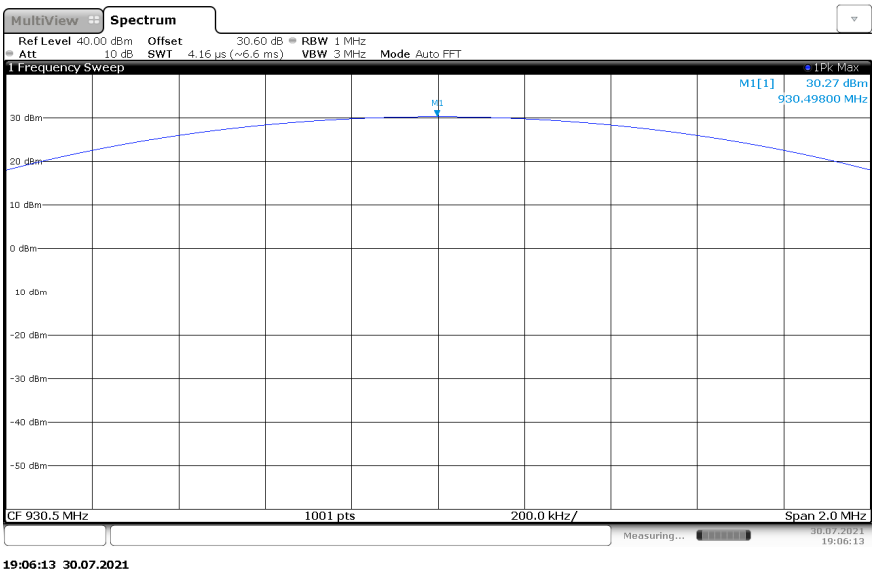

Figure 2.1.6-2: RF Output Power – 930.5 MHz

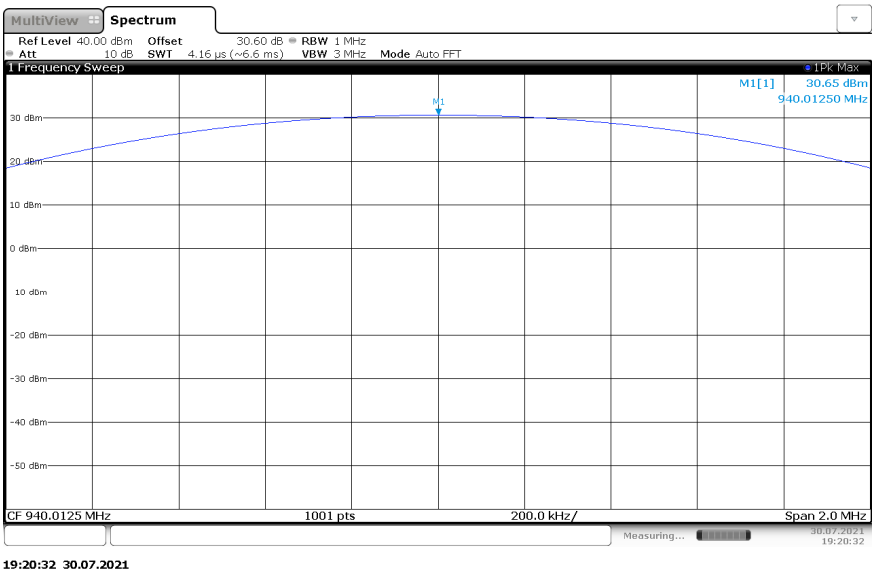

Figure 2.1.6-3: RF Output Power – 940.0125 MHz

FCC 47 CFR Part 2.1046;101.113(a); ISED Canada RSS-119 5.4

Table 2.1.6-2: RF Output Power

Frequency (MHz)	Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)
928.925	30.94	2.77	33.71	47	13.29
932.25	30.12	2.77	32.89	47	14.11
941.4875	30.1	2.77	32.87	44	11.13
952.5	29.86	2.77	32.63	44	11.37
959.925	29.55	2.77	32.32	44	11.68

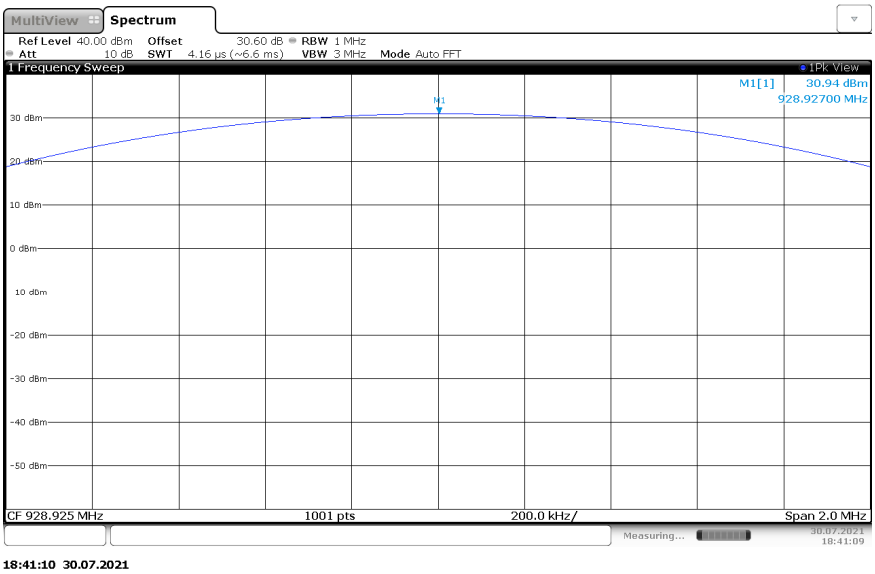

Figure 2.1.6-4: RF Output Power – 928.925 MHz

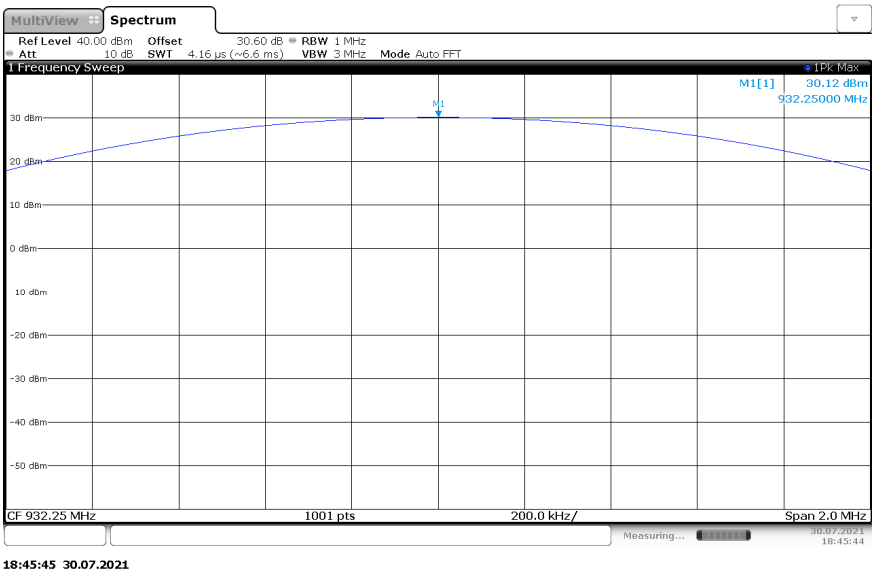

Figure 2.1.6-5: RF Output Power – 932.25 MHz

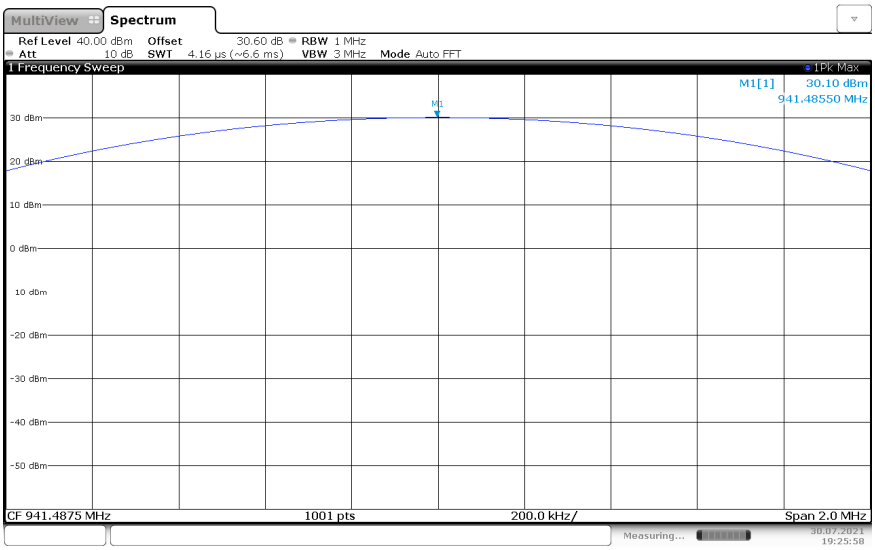

Figure 2.1.6-6: RF Output Power – 941.4875 MHz

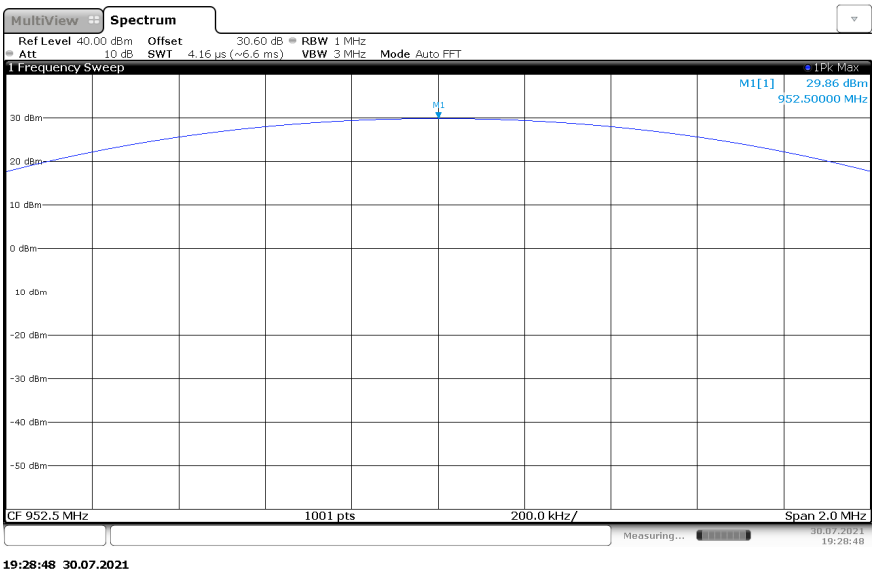

Figure 2.1.6-7: RF Output Power – 952.5 MHz

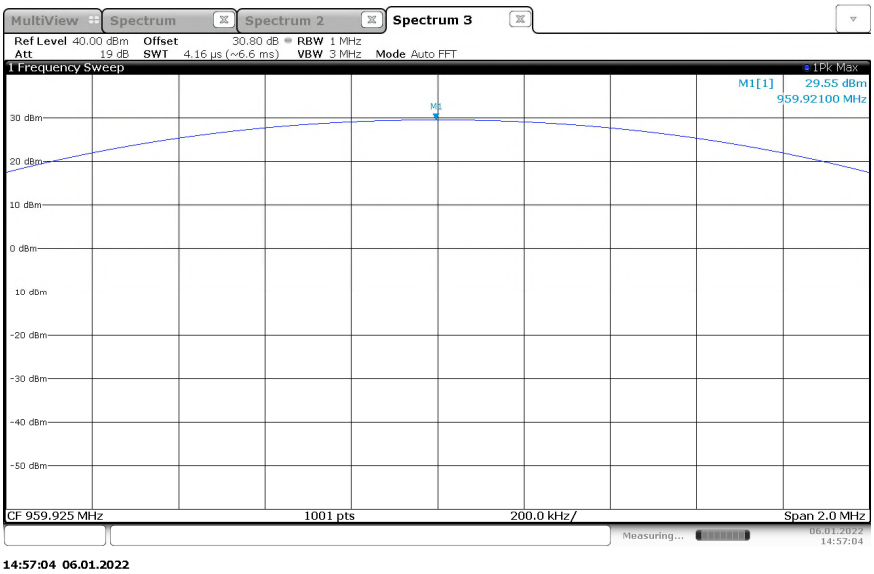

Figure 2.1.6-8: RF Output Power – 959.925 MHz

2.1.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

Instrument	Manufacturer	Type No	TE No	Firmware / Software Revision	Calibration Period (months)	Calibration Due
Duratest High Frequency Cable 26.5GHz	Teledyne Storm Products	921-0101-036	BEMC02112	N/A	12	20-Oct-2022
Signal & Spectrum Analyzer	Rohde & Schwarz	FSW43	DEMC3085	2.90 SP1	24	07-Dec-2022
DC Power Supply	Xantrex	XHR60-18	TEMC00001	N/A	N/A	NCR
2.92mm Attenuator M/F 40GHz 30dB 2W VSWR 1.45	Centric RF	C402-30	TEMC00222	N/A	12	08-Mar-2022

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

2.2 Out of Band Unwanted Emissions

2.2.1 Specification Reference

FCC 47 CFR Parts: 2.1053; 24.133 a(1), a(2); 101.111 a(5), 101.111 a(6)
ISED Canada RSS-119 5.8.3, RSS-119 5.8.6; RSS-134 4.4

2.2.2 Equipment Under Test and Modification State

Model: FLXI2102, Serial Number: 7300515

2.2.3 Date of Test

2021-October-27 to 2022-January-14

2.2.4 Test Method

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer through 20.05 dB of passive attenuation. The spectrum analyzer resolution and video bandwidths were set to 300 Hz and 1000 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.

2.2.5 Environmental Conditions

Ambient Temperature	23.8 °C
Relative Humidity	45.1 %
Atmospheric Pressure	1000.6 mbar

2.2.6 Test Results

DC Powered Operating

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

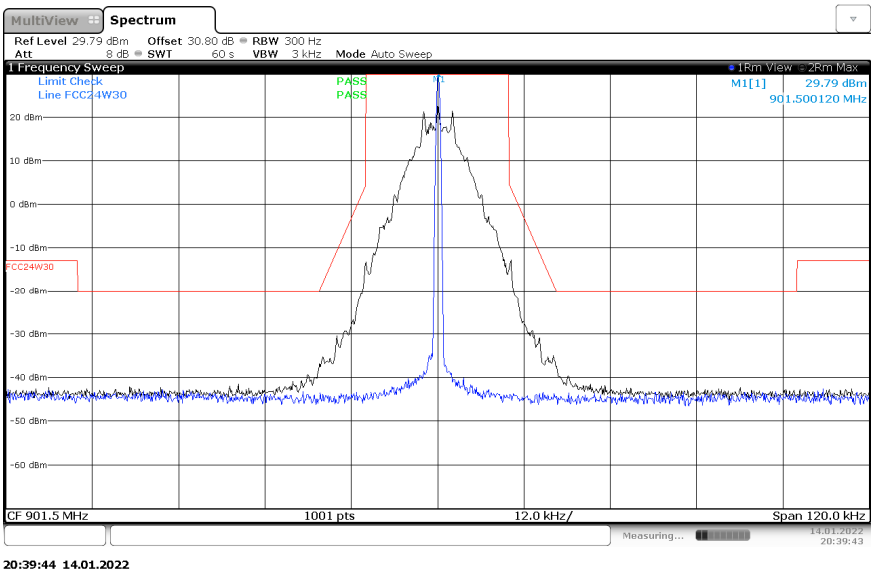

Figure 2.2.6-1: 901.5 MHz – 25 kHz Channel Spacing – Normal Mode

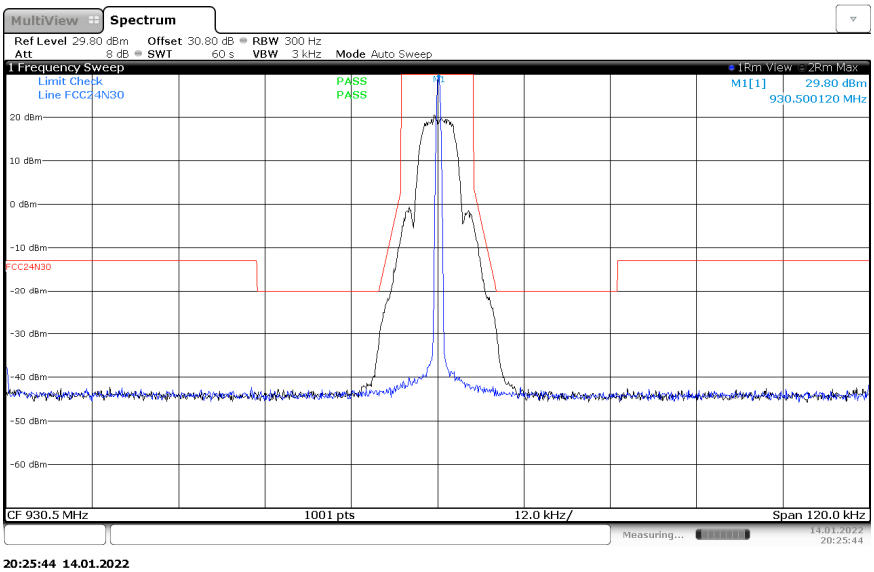

Figure 2.2.6-2: 930.5 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

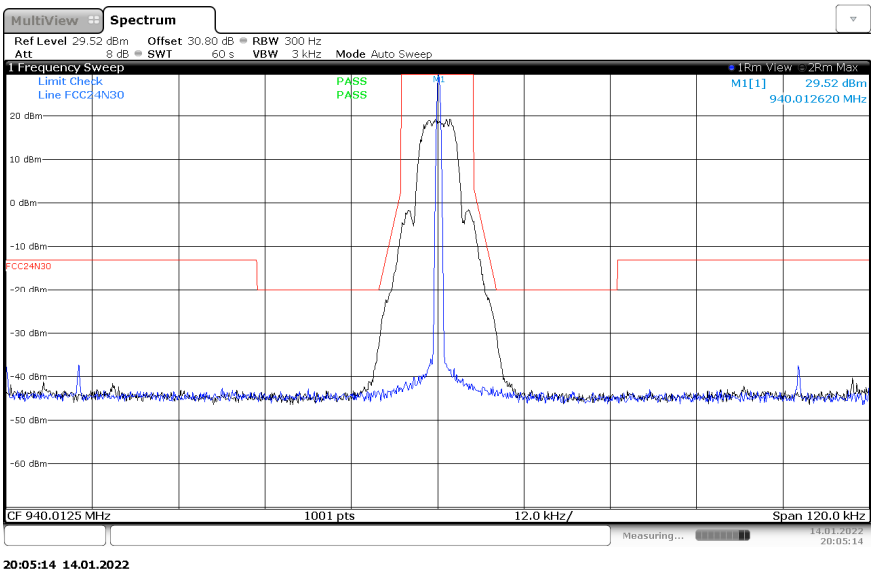

Figure 2.2.6-3: 940.0125 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

Part 101.111 a(5), a(6), RSS-119 5.8.6

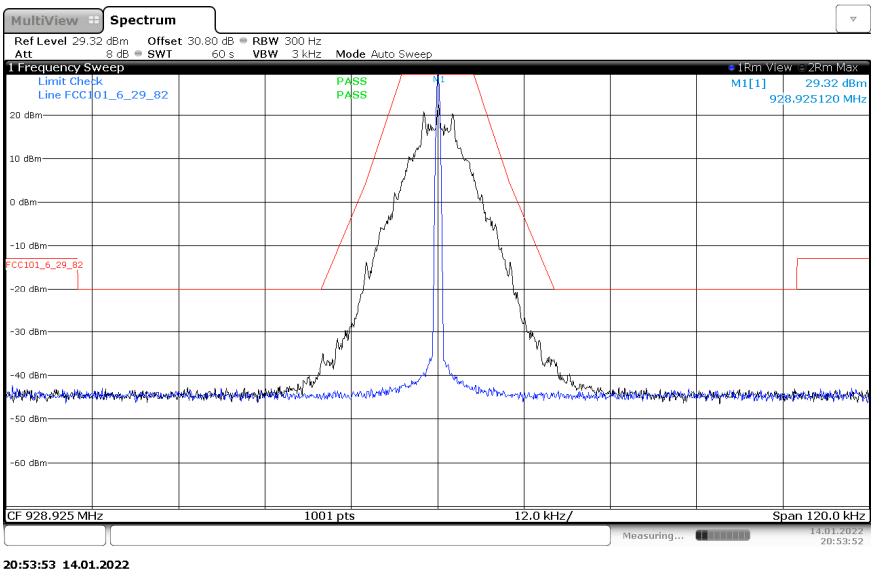

Figure 2.2.6-4: 928.925 MHz – 25 kHz Channel Spacing – Normal Mode

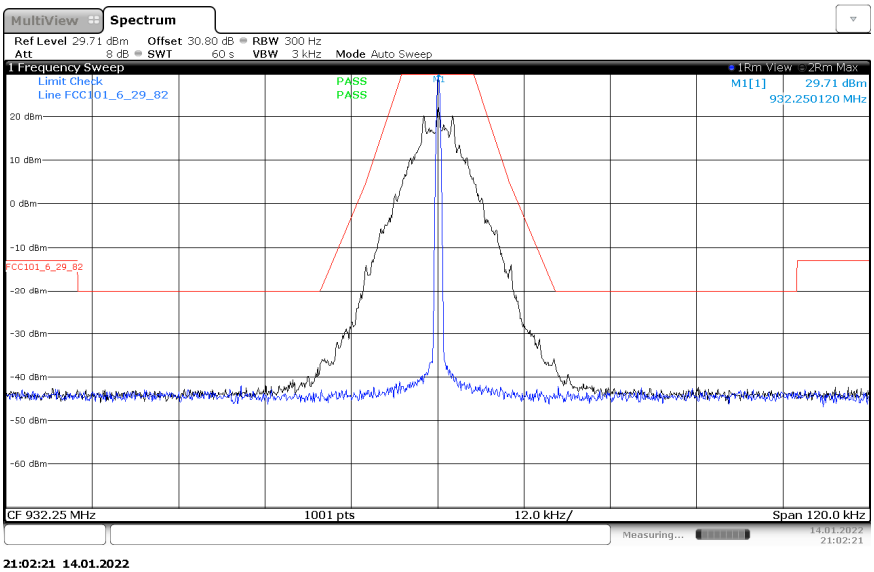

Figure 2.2.6-5: 932.25 MHz – 25 kHz Channel Spacing – Normal Mode

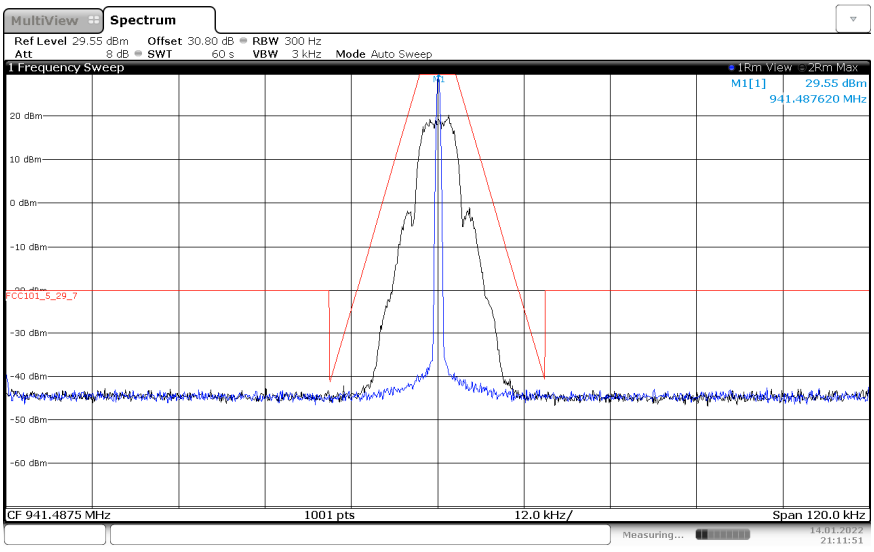

Figure 2.2.6-6: 941.4875 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

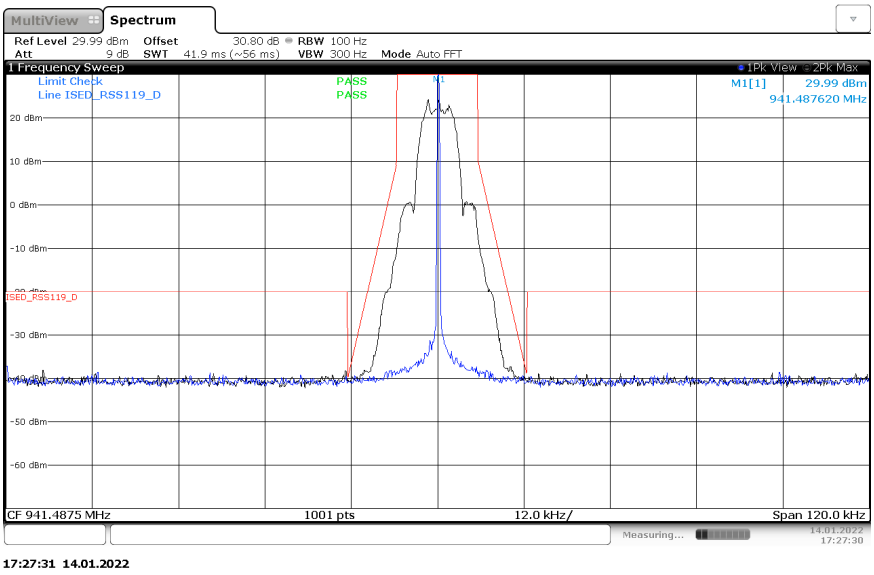

Figure 2.2.6-7: 941.4875 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode – RSS-119 Mask D

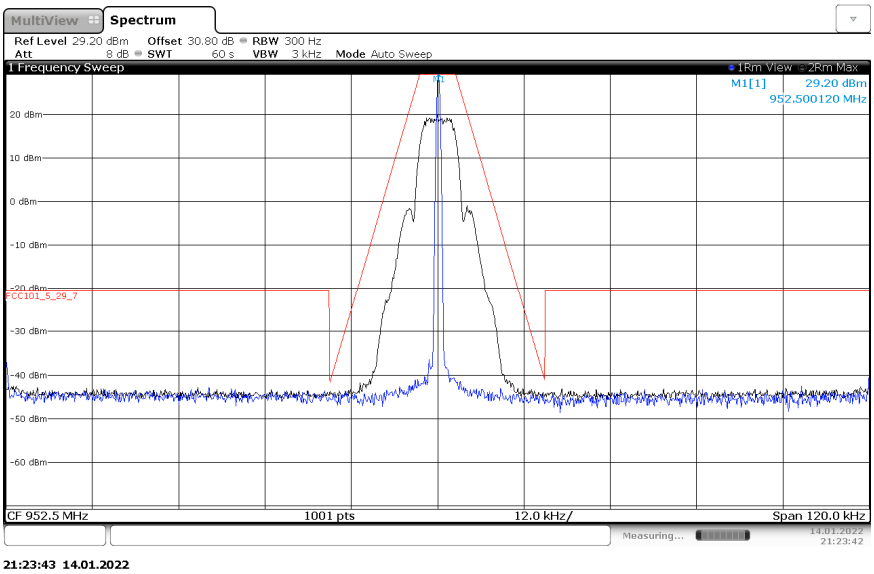

Figure 2.2.6-8: 952.5 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

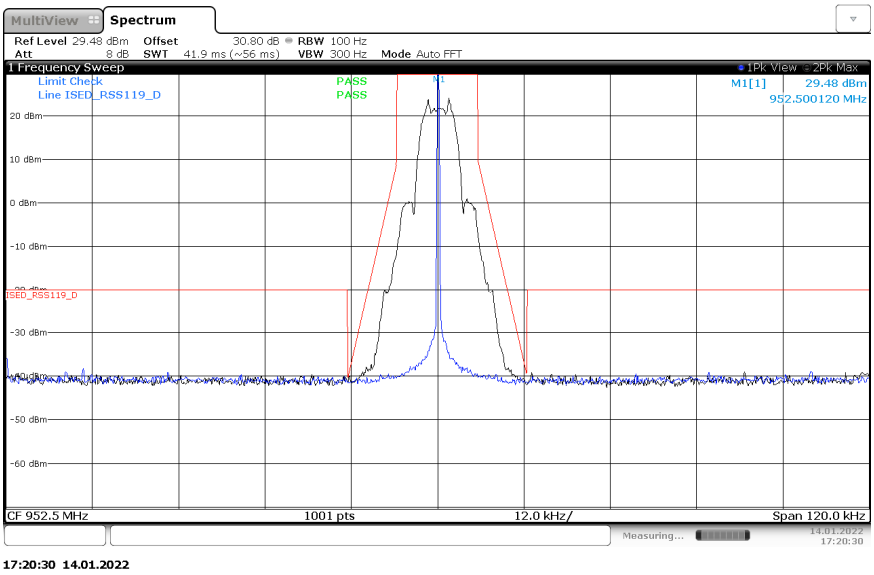

Figure 2.2.6-9: 952.5 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode – RSS-119 Mask D

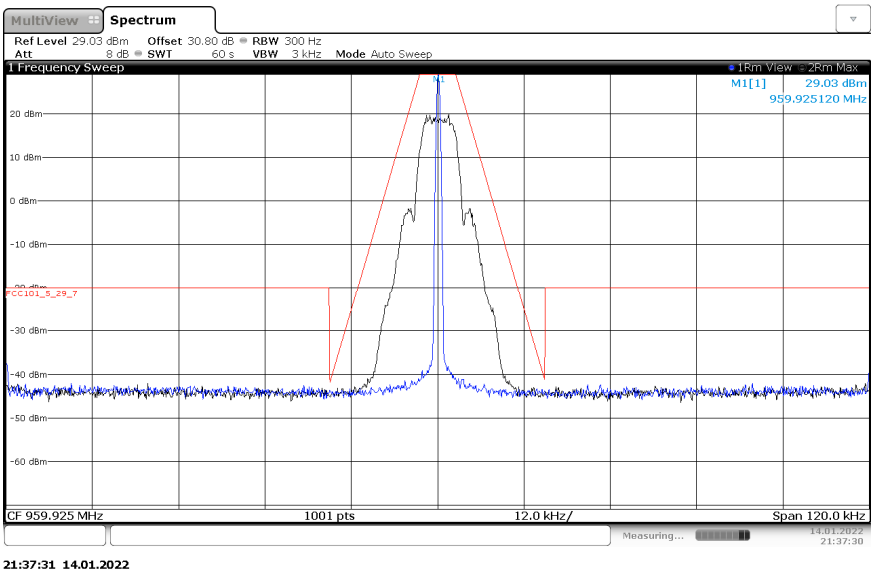

Figure 2.2.6-10: 959.925 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode

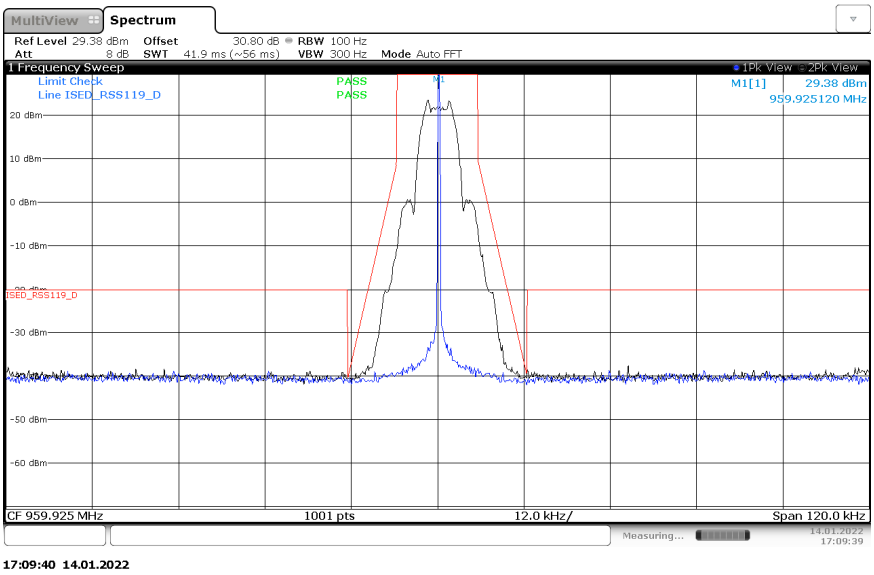

Figure 2.2.6-11: 959.925 MHz – 12.5 kHz Channel Spacing – mPass 5k Mode – RSS-119 Mask D

2.2.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., Presidential Drive, Suite 101, Durham, NC 27703, USA.

Instrument	Manufacturer	Type No	TE No	Firmware / Software Revision	Calibration Period (months)	Calibration Due
Duratest High Frequency Cable 26.5GHz	Teledyne Storm Products	921-0101-036	BEMC02112	N/A	12	20-Oct-2022
Signal & Spectrum Analyzer	Rohde & Schwarz	FSW43	DEMC3085	2.90 SP1	24	07-Dec-2022
DC Power Supply	Xantrex	XHR60-18	TEMC00001	N/A	N/A	NCR
2.92mm Attenuator M/F 40GHz 30dB 2W VSWR 1.45	Centric RF	C402-30	TEMC00222	N/A	12	08-Mar-2022

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

3 Test Equipment Information

3.1 General Test Equipment Used

Table 3-1: Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Firmware / Software Revision	Calibration Period (months)	Calibration Due
Duratest High Frequency Cable 26.5GHz	Teledyne Storm Products	921-0101-036	BEMC02112	N/A	12	20-Oct-2022
Signal & Spectrum Analyzer	Rohde & Schwarz	FSW43	DEMC3085	2.90 SP1	24	07-Dec-2022
DC Power Supply	Xantrex	XHR60-18	TEMC00001	N/A	N/A	NCR
2.92mm Attenuator M/F 40GHz 30dB 2W VSWR 1.45	Centric RF	C402-30	TEMC00222	N/A	12	08-Mar-2022

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

4 Diagram of Test Set-ups

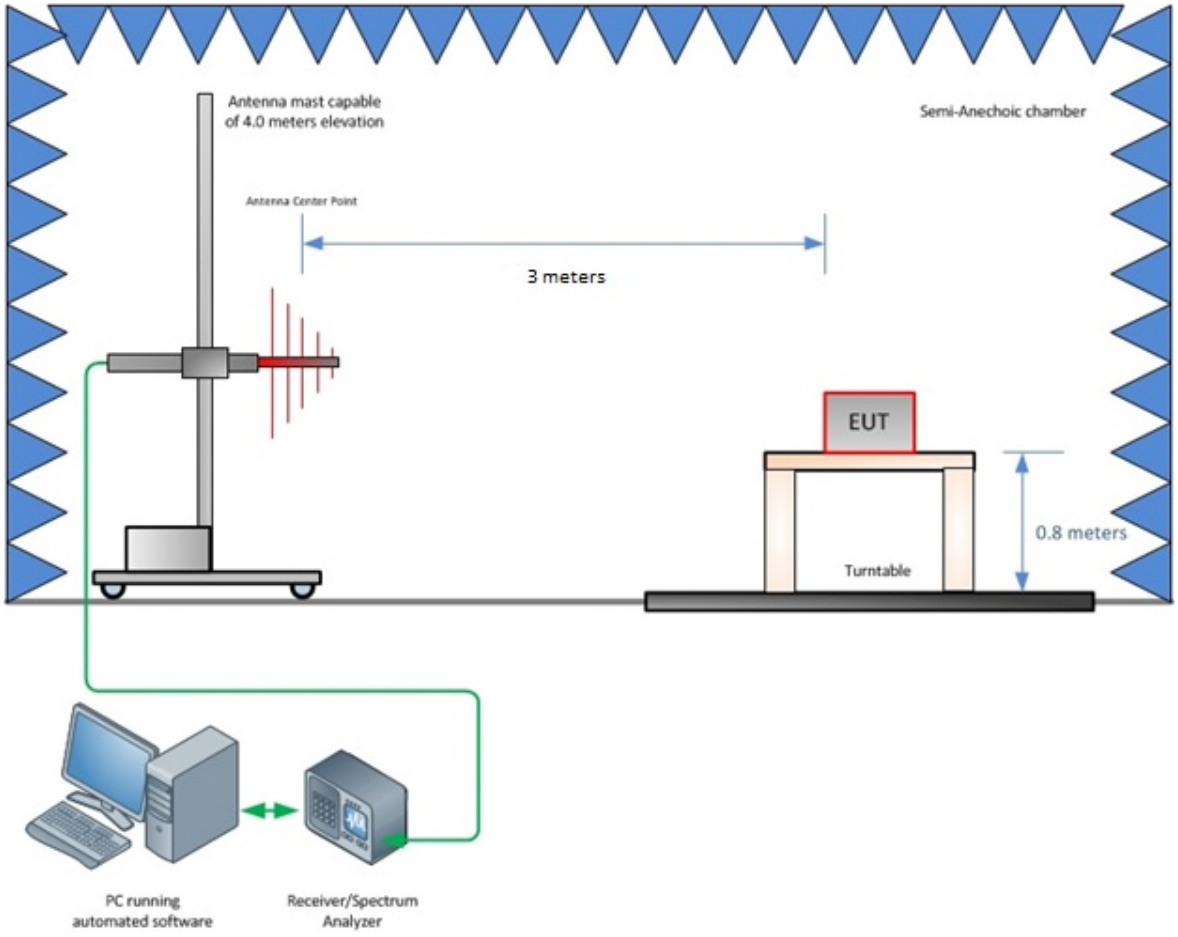

Figure 4-1 - Radiated Emissions Test Setup up to 1 GHz

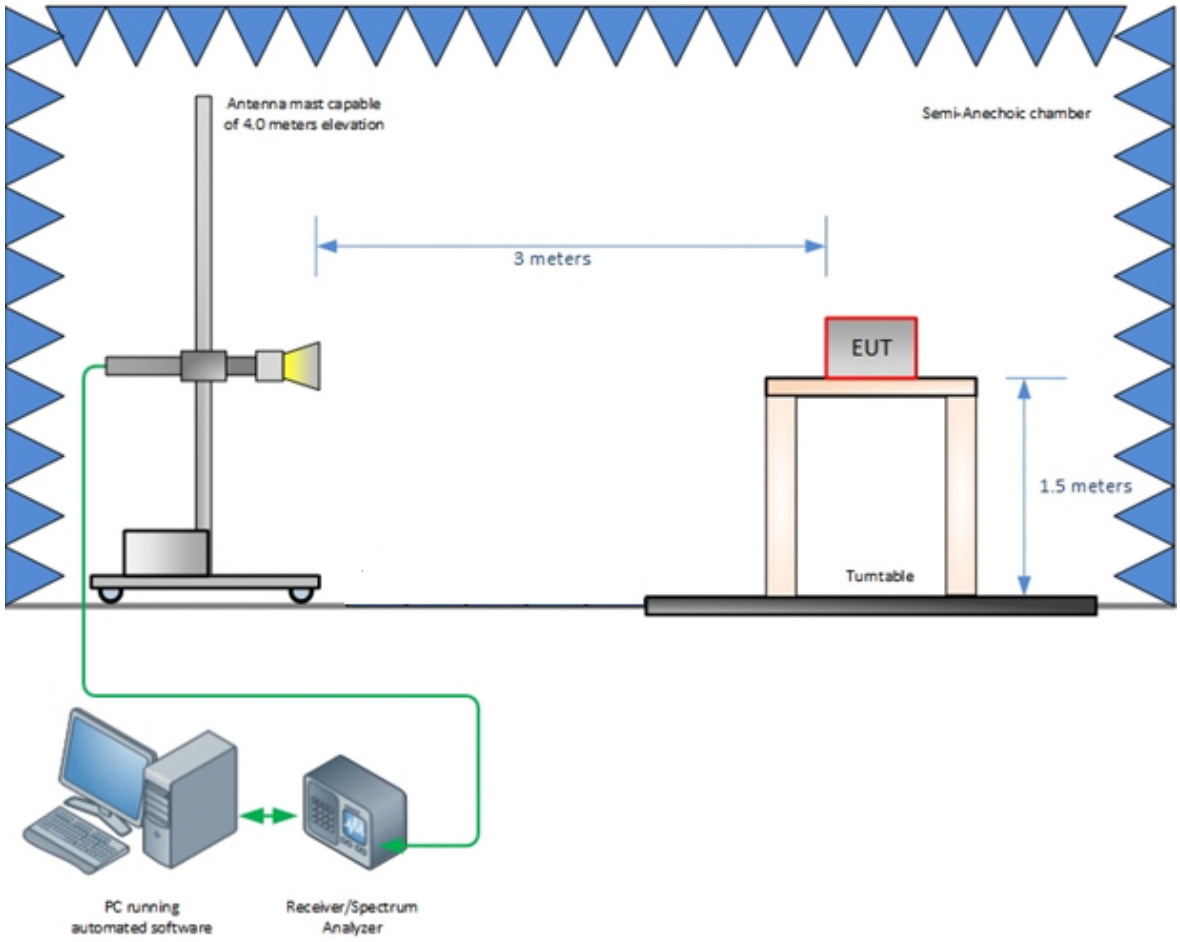

Figure 4-2 - Radiated Emissions Test Setup above 1 GHz

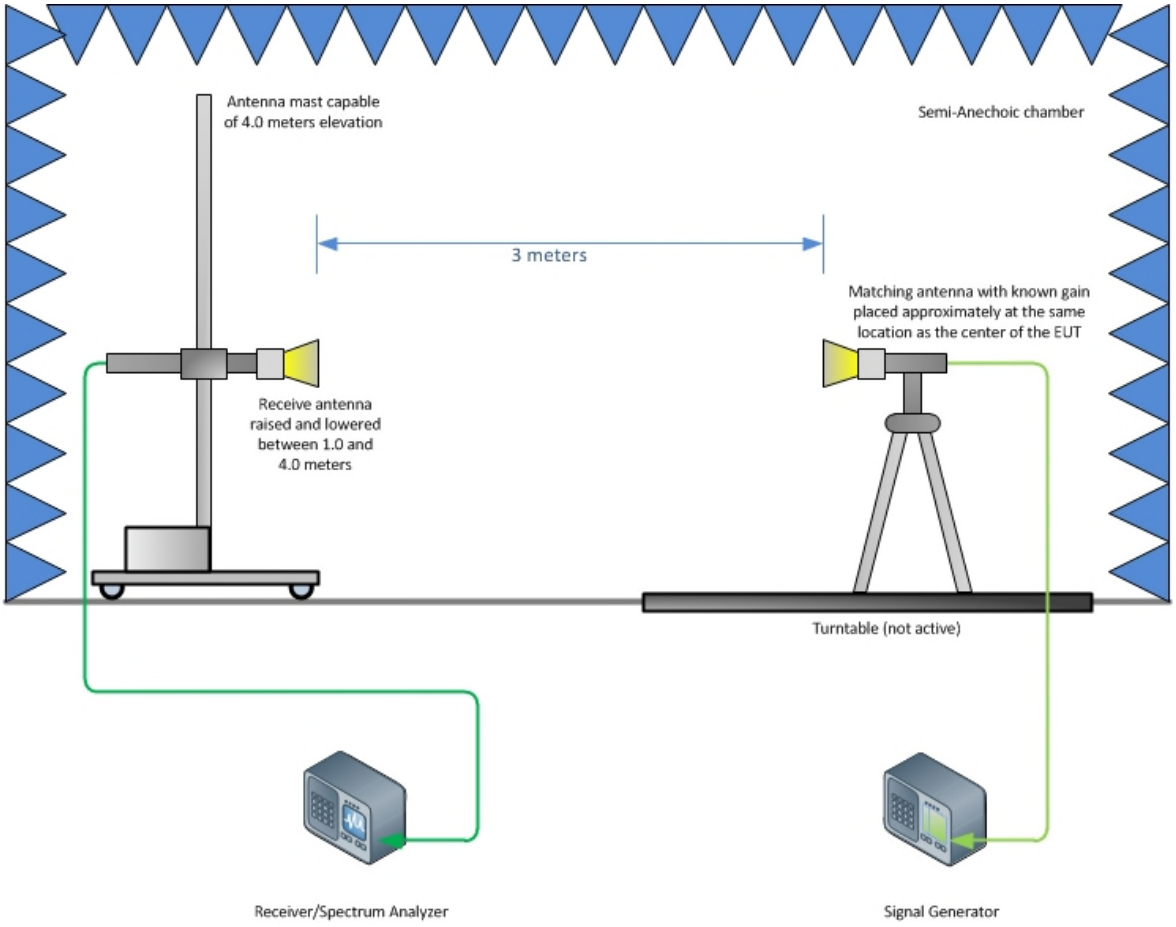

Figure 4-3 - Substitution Test Setup above 1 GHz

5 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Table 5-1 – Measurement Uncertainties , Tampa , FL

Test Discipline	MU		Unit
Transmitter Unwanted Emissions in the Spurious Domain	Conducted	1.13	dB
	Radiated	5.92	dB
Humidity		5.00	%
Temperature		1.00	°C
DC and Low Frequency Voltages		0.05	%
RF Output Power,		1.13	dB

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