

Report on the Testing of the
Landis + Gyr Technology, Inc.
Series-5 MCM0 modular radio

In accordance with:
FCC 47 CFR part 15.247
ISED RSS-247 Issue 2, February 2017

Prepared for: Landis + Gyr Technology, Inc.
30000 Mill Creek Ave., Suite 100
Alpharetta, GA 30022



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Kirby Munroe	Wireless / EMC Technical and Certification Manager, NA TUV SUD America Inc.	Authorized Signatory	1/25/2022

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FCC Accreditation Designation Number US1233
FCC Test Site Registration Number 967699
Innovation, Science, and Economic Development Canada Lab Code 23932

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with the standards listed above.



A2LA Cert. No. 2955.09

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TÜV SÜD America
5945 Cabot Parkway, Suite 100
Alpharetta, GA 3005

Phone: 678-341-5900
www.tuv-sud-america.com



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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.

Table 1.1-1 – Modification Record

Issue	Description of Change	Date of Issue
0	First Issue	1/25/2022

1.2 Introduction

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC’s Code of Federal Regulations Section 15.247 and Innovation Science and Economic Development Canada’s Radio Standards Specification RSS-247 for the tests documented herein to support a permissive change by adding new antenna / host combination to the S5 MCMO pre-certified single module.

The host detailed in this report contains the integral antenna, therefore compliance for use with this antenna is limited to the host identified.

Applicant	Goteti Raghav
Manufacturer	Landis + Gyr Technology, Inc
Applicant’s Email Address	Raghav.Goteti@landisgyr.com
Host Model / Marketing Name	G5i Streetlight V2 G5 Streetlight V2
Module Model Number(s)	S5-MCM0
Module FCC ID	R7PNG0R1S7
Module ISED Certification Number	5294A-NG0R1S7
Hardware Version(s)	G5i Streetlight V2: M1250 G5 Streetlight V2: 40-2586
Software Version(s)	N/A
Number of Samples Tested	1
Test Specification/Issue/Date	US Code of Federal REgulation (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2021 ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.



Order Number	72172663
Date of Receipt of EUT	11/16/2021
Start of Test	11/16/2021
Finish of Test	11/17/2021
Related Document(s)	<p>ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device.</p> <p>FCC OET KDB 558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules, April 2, 2019</p> <p>US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2021.</p> <p>ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1 (March 2019), Amendment 2 (February 2021)</p>

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC Part 15.247 and ISED Canada's RSS-247 is shown below.

Table 1.3-1: Test Result Summary

Test Parameter	Test Plan (Yes/No)	Test Result	FCC 47 CFR Rule Part	ISED Canada's RSS	Test Report Page No
Antenna Requirement	Yes	Pass	15.203	-----	12
Power Line Conducted Emissions	Yes	Pass	15.207	RSS-GEN 8.8	13
Carrier Frequency Separation	No	Not Tested	15.247(a)(1)	RSS-247 5.1(b)	-----
Number of Hopping Channels	No	Not Tested	15.247(a)(1)(i)	RSS-247 5.1(c)	-----
Channel Dwell Time	No	Not Tested	15.247(a)(1)(i)	RSS-247 5.1(c)	-----
20 dB Bandwidth	No	Not Tested	15.247(a)(1)(i)	RSS-247 5.1(c)	-----
99% Bandwidth	No	Not Tested	-----	RSS-GEN 6.7	-----
Peak Output Power	No	Not Tested	15.247(b)(2)	RSS-247 5.4(a)	-----
Avg Output Power	No	Not Tested	15.247(b)(3)	RSS-247 5.4(a)	-----
Band-Edge Compliance of RF Conducted Emissions	No	Not Tested	15.247(d)	RSS-247 5.5	-----
RF Conducted Spurious Emissions	No	Not Tested	15.247(d)	RSS-247 5.5	-----
Radiated Spurious Emissions into Restricted Frequency Bands	Yes	Pass	15.205, 15.209	RSS-GEN 8.9, 8.10	16
Power Spectral Density	No	Not Tested	15.247(e)	RSS-247 5.2(b)	-----
Duty Cycle	No	-----			-----

1.4 Product Information

1.4.1 Technical Description

The S5-MCM0 manufactured by Landis+ Gry Technology, Inc. is a fully functional, radio on a chip that is enabled for simple sensor device integration.

The host device which includes the integral antenna is the Gen-2 LRL Series-5 Streetlight Adapter which employs the Series-5 MCM0, a multi-chip module.

Table 1.4-1 – Wireless Technical Information

Detail	Description
Module FCC ID	R7PNG0R1S7
Module IC ID	5294A-NG0R1S7
Host Marketing / Model Name	G5i Streetlight V2: Series-5 MCM0 with SBS firmware G5 Streetlight V2: Series-5 MCM0 with GSP firmware
Modulation Format	FSK
Antenna Type / Description:	Planar Inverted-F Antenna / -4dBi

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



Figure 1.4.1-1 –Host front view of the EUT



Figure 1.4.1-2– Host back view of the EUT

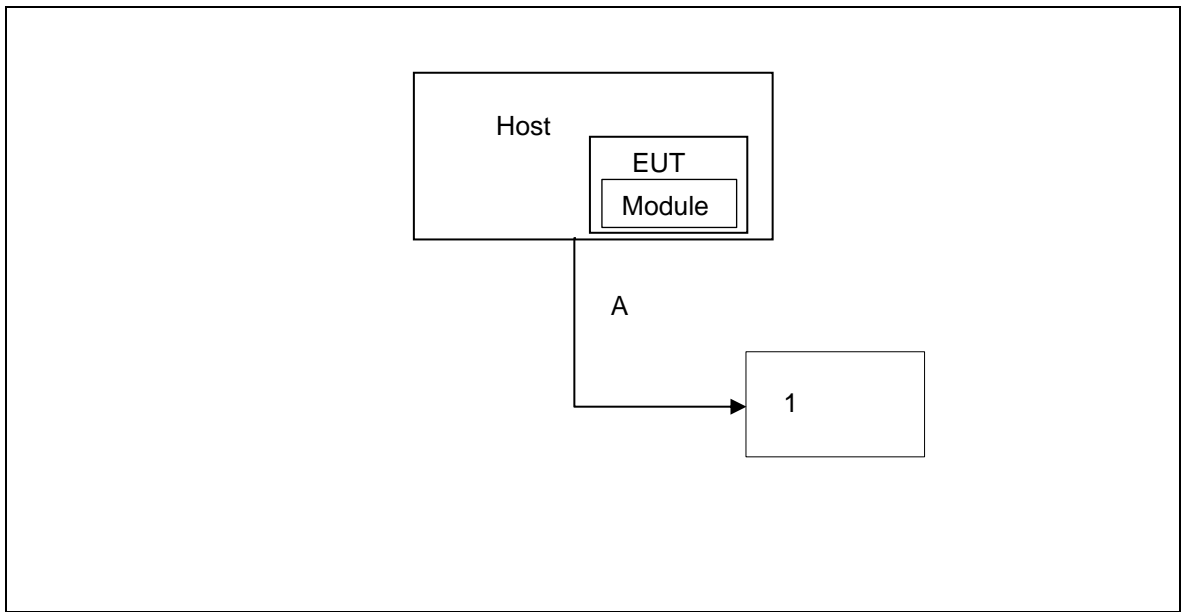


Figure 1.4.1-4 – Test Setup Block Diagram

Table 1.4.1-1 – Cable Descriptions

Item	Cable/Port	Description
A	USB	Power Cable

Table 1.4.1-2 – Support Equipment Descriptions

Item	Make/Model	Description
1	Lenovo	Laptop used for configuring wireless module – Landis + Gyr provided

1.4.2 Modes of Operation

The module model S5-MCM0 provides 4 distinct frequency hopping modes of operation as outlined below.

Mode of Operation	Frequency Range (MHz)	Number of Channels	Channel Separation (kHz)	Data Rates Supported (kbps)
1	902.3 - 927.8	86	300	9.6, 19.2, 38.4, 115.2
2	904.0 - 927.8	239	100	9.6, 19.2, 38.4
3	902.4 - 927.6	64	400	10.0, 20.0, 50.0, 150.0, 200.0
4	902.2 - 927.8	129	200	50.0, 150.0

1.4.3 Monitoring of Performance

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was X-position. See test setup photos for more information. The EUT was programmed to generate a continuously modulated signal on each channel evaluated.

The data presented in this report represents the worst case where applicable. The worst-case mode and data rate for the radiated emission measurements was Mesh with 9.6kbps.

Power setting during test: Mode of operation 1: 27 dBm

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 program. 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
0	Initial State		

The equipment was tested as provided without any modifications.

1.7 Test Location

TÜV SÜD conducted the following tests at our Alpharetta, GA test laboratory.

Test Name	Name of Engineer(s)	Accreditation
Antenna Requirement	Divya Adusumilli	A2LA
Power Line Conducted Emissions	Divya Adusumilli	A2LA
Radiated Spurious Emissions into Restricted Frequency Bands	Bhagyashree Chaudhary	A2LA

Office address:
TÜV SÜD America
5945 Cabot Parkway, Suite 100
Alpharetta, GA 30005, USA

2 Test Details

2.1 Antenna Requirement

2.1.1 Specification Reference

FCC Section: 15.203

2.1.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.1.3 Date of Test

11/16/2021

2.1.4 Test Method

N/A

2.1.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	23 °C
Relative Humidity	53 %

2.1.6 Test Results

The EUT utilizes host integrated Planar Inverted-F (PIFA) antenna with gain -4 dBi, therefore satisfying the requirements of Section 15.203.

2.2 Power Line Conducted Emissions

2.2.1 Specification Reference

FCC Section: 15.207
ISED Canada: RSS-Gen 8.8

2.2.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.2.3 Date of Test

11/17/2021

2.2.4 Test Method

ANSI C63.10 section 6 was the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

$$\text{Corrected Reading} = \text{Analyzer Reading} + \text{LISN Loss} + \text{Cable Loss}$$
$$\text{Margin} = \text{Corrected Reading} - \text{Applicable Limit}$$

2.2.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature 23 °C
Relative Humidity 53 %

2.2.6 Test Results

Table 2.2.6-1: Conducted EMI Results-Avg – Line 1

Frequency (MHz)	Avg Limit	Avg Level Corrected	Avg Level	Correction Fact.	Avg Margin	Result
1.31	46	15.2	5.5	9.668	-30.8	PASS
1.95	46	17.8	8.2	9.669	-28.2	PASS
2.75	46	13.9	4.2	9.69	-32.1	PASS
3.97	46	12.4	2.7	9.68	-33.6	PASS
6.44	50	12.9	3.2	9.71	-37.1	PASS
22.9	50	11.4	1.5	9.89	-38.6	PASS

Table 2.2.6-2: Conducted EMI Results-QP – Line 1

Frequency (MHz)	QP Limit	QP Level Corrected	QP Level	Correction Fact.	QP Margin	Result
1.31	56	19.2	9.5	9.668	-36.8	PASS
1.95	56	22.2	12.5	9.669	-33.8	PASS
2.75	56	18	8.3	9.69	-38	PASS
3.97	56	16.5	6.9	9.68	-39.5	PASS
6.44	60	16.5	6.8	9.71	-43.5	PASS
22.9	60	15.4	5.5	9.89	-44.6	PASS

Table 2.2.6-3: Conducted EMI Results-Avg – Line 2

Frequency (MHz)	Avg Limit	Avg Level Corrected	Avg Level	Correction Fact.	Avg Margin	Result
0.5	46.1	14.7	5.1	9.63	-31.3	PASS
0.55	46	15.7	6	9.633	-30.3	PASS
2.07	46	17.2	7.5	9.661	-28.8	PASS
3.3	46	12.7	3	9.696	-33.3	PASS
11.84	50	11.1	1.2	9.878	-38.9	PASS
24.07	50	12.2	2.2	9.99	-37.8	PASS

Table 2.2.6-4: Conducted EMI Results-QP – Line 2

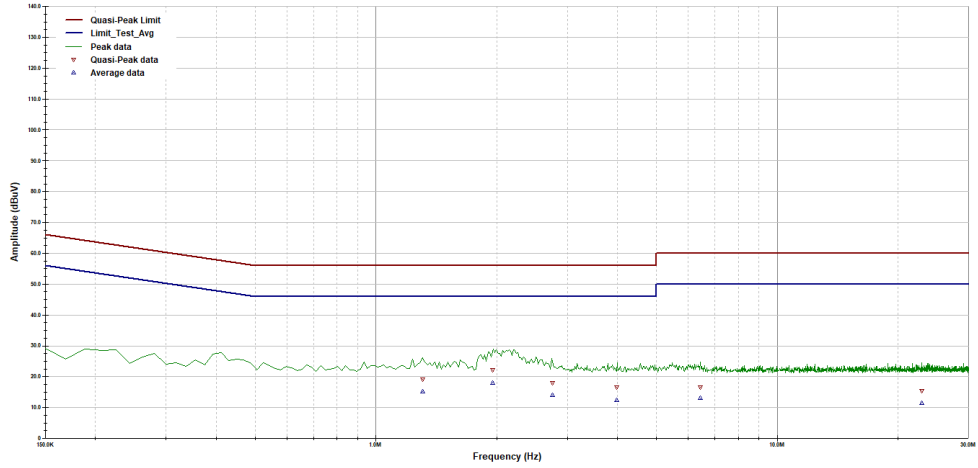
Frequency (MHz)	QP Limit	QP Level Corrected	QP Level	Correction Fact.	QP Margin	Result
0.5	56.1	18.8	9.2	9.63	-37.3	PASS
0.55	56	19.9	10.3	9.633	-36.1	PASS
2.07	56	21.3	11.6	9.661	-34.7	PASS
3.3	56	16.8	7.1	9.696	-39.2	PASS
11.84	60	15.5	5.6	9.878	-44.5	PASS
24.07	60	16.1	6.1	9.99	-43.9	PASS

TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 1 Results

EUT Name - 72171190.L&G
Model Number - LRL Streetlight
Part Number - N/A
Serial Number - N/A
Voltage - FCC/IC-Class B; 120Vac/60Hz
Operating Mode - Tx On 902.3M



Operator: Divya A

72171190- CE DATA.tif

Last Data Update 01:52:38 PM, Wednesday, November 17, 2021

Temperature = 22C
Relative Humidity = 30%
RF Bandwidth: 9kHz
VBW if Analyzer: 30kHz

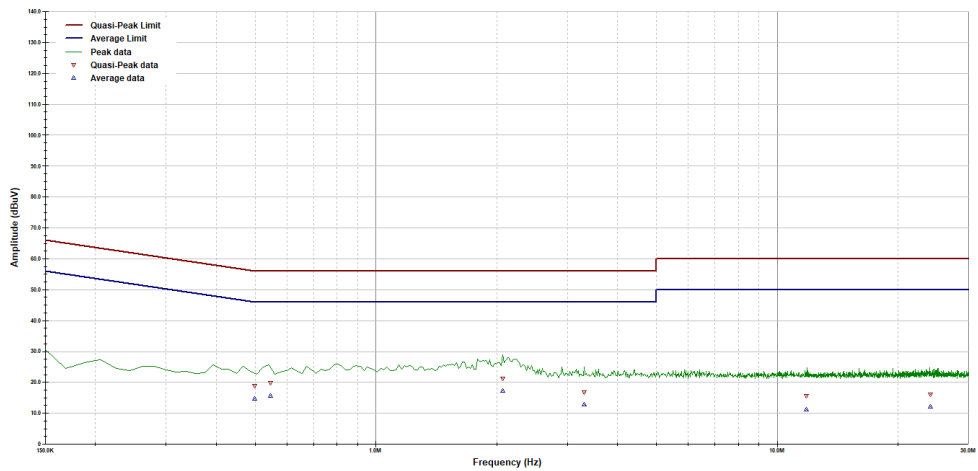
Figure 1: Conducted Emission Plot – Line 1

TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 2 Results

EUT Name - 72171190.L&G
Model Number - LRL Streetlight
Part Number - N/A
Serial Number - N/A
Voltage - FCC/IC-Class B; 120Vac/60Hz
Operating Mode - Tx On 902.3M



Operator: Divya A

72171190- CE DATA.tif

Last Data Update 02:01:25 PM, Wednesday, November 17, 2021

Temperature = 22C
Relative Humidity = 30%
RF Bandwidth: 9kHz
VBW if Analyzer: 30kHz

Figure 2: Conducted Emission Plot – Neutral

2.3 Radiated Spurious Emissions into Restricted Frequency Bands

2.3.1 Specification Reference

FCC Sections: 15.205, 15.209.
ISED Canada: RSS – Gen 8.9/8.10

2.3.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.3.3 Date of Test

11/16/2021 to 11/17/2021

2.3.4 Test Method

Radiated emissions tests were made over the frequency range of 9 kHz to 10 GHz, 10 times the highest fundamental frequency of 900 MHz. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in Section 15.209.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 150 kHz, quasi-peak measurements were made using a resolution bandwidth RBW of 300 Hz and a video bandwidth VBW of 1 kHz and frequencies between 150 kHz and 30MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 10 kHz and a video bandwidth VBW of 30 kHz. For frequencies between 30 MHz and 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 100 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW of 1 MHz and VBW of 3 MHz.

2.3.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	23 °C
Relative Humidity	53 %

2.3.6 Test Results

Test Summary: EUT was set to transmit mode.

Test Results: Pass

See data below for detailed results.

Table 2.3.6-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel - 902.3MHz										
2706.9	51.10	47.70	H	-3.84	47.26	43.86	74.0	54.0	26.7	10.1
2706.9	52.30	48.60	V	-3.84	48.46	44.76	74.0	54.0	25.5	9.2
3609.2	43.00	36.60	H	0.34	43.34	36.94	74.0	54.0	30.7	17.1
3609.2	40.10	31.30	V	0.34	40.44	31.64	74.0	54.0	33.6	22.4
Middle Channel - 915.0MHz										
2745	50.80	41.40	H	-3.69	47.11	37.71	74.0	54.0	26.9	16.3
2745	50.40	40.20	V	-3.69	46.71	36.51	74.0	54.0	27.3	17.5
3660	47.50	36.50	H	0.60	48.10	37.10	74.0	54.0	25.9	16.9
3660	47.00	34.70	V	0.60	47.60	35.30	74.0	54.0	26.4	18.7
High Channel - 927.8MHz										
2783.4	50.10	40.30	H	-3.54	46.56	36.76	74.0	54.0	27.4	17.2
2783.4	50.10	40.30	V	-3.54	46.56	36.76	74.0	54.0	27.4	17.2

Sample Calculation:

$$R_c = R_u + CF_T$$

Where:

- CF_T = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
- R_u = Uncorrected Reading
- R_c = Corrected Level
- AF = Antenna Factor
- CA = Cable Attenuation
- AG = Amplifier Gain
- DC = Duty Cycle Correction Factor

Example Calculation: Peak

$$\text{Corrected Level: } 51.10 + -3.84 = 47.26 \text{ dBuV/m}$$

$$\text{Margin: } 74\text{dBuV/m} - 47.26\text{dBuV/m} = 26.74\text{dB}$$

Example Calculation: Average

$$\text{Corrected Level: } 47.70 + -3.84 - 0 = 43.86\text{dBuV}$$

$$\text{Margin: } 54\text{dBuV} - 43.86\text{dBuV} = 10.14\text{dB}$$

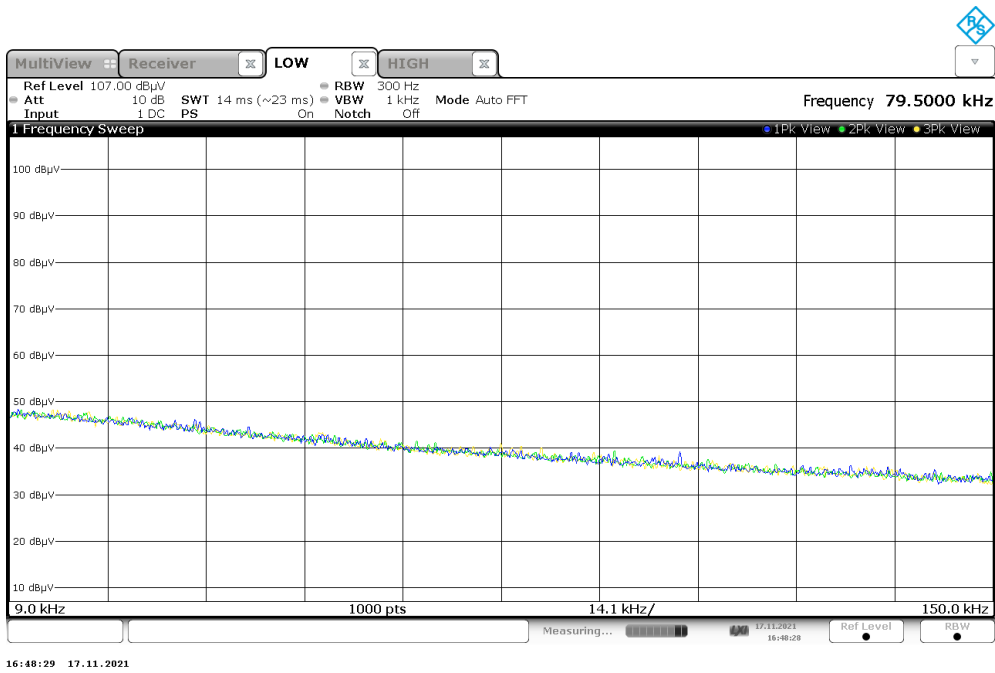


Figure 1: Reference plot for Radiated Spurious Emissions – 9 kHz – 150 kHz

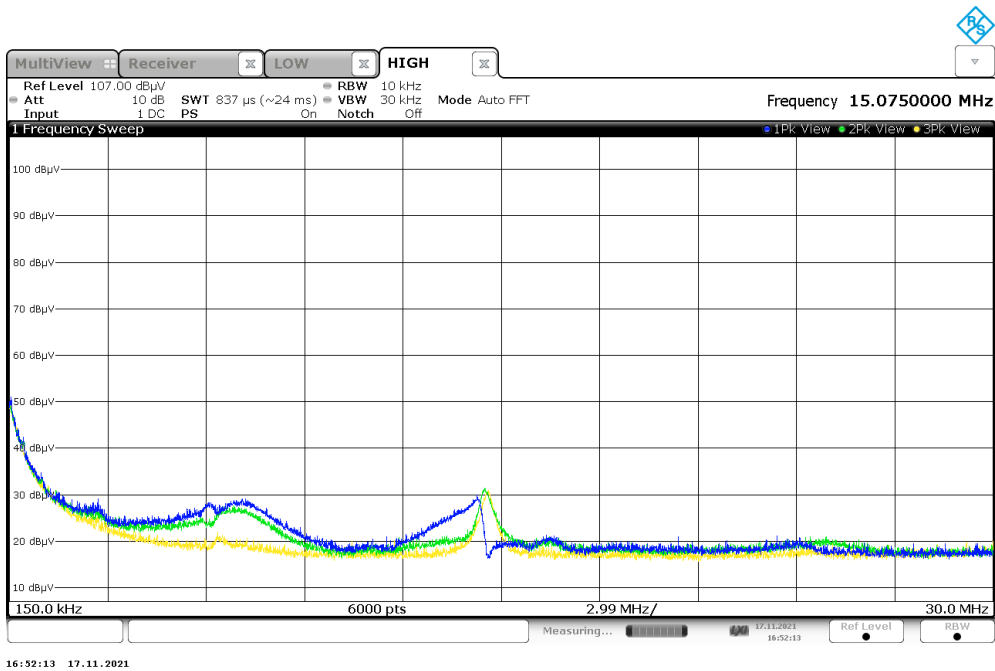


Figure 2: Reference plot for Radiated Spurious Emissions– 150 kHz – 30 MHz
 Note: Emissions above the noise floor are ambient not associated with the EUT.

Full Spectrum

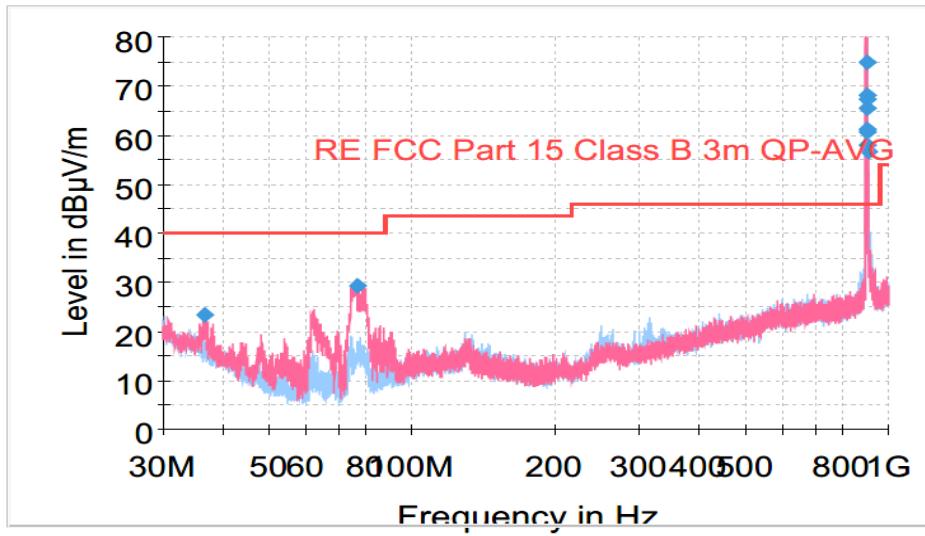


Figure 3: Reference plot for Radiated Spurious Emissions – 30 MHz – 1 GHz
 Note: Emissions above the noise floor do not falls within restricted bands.

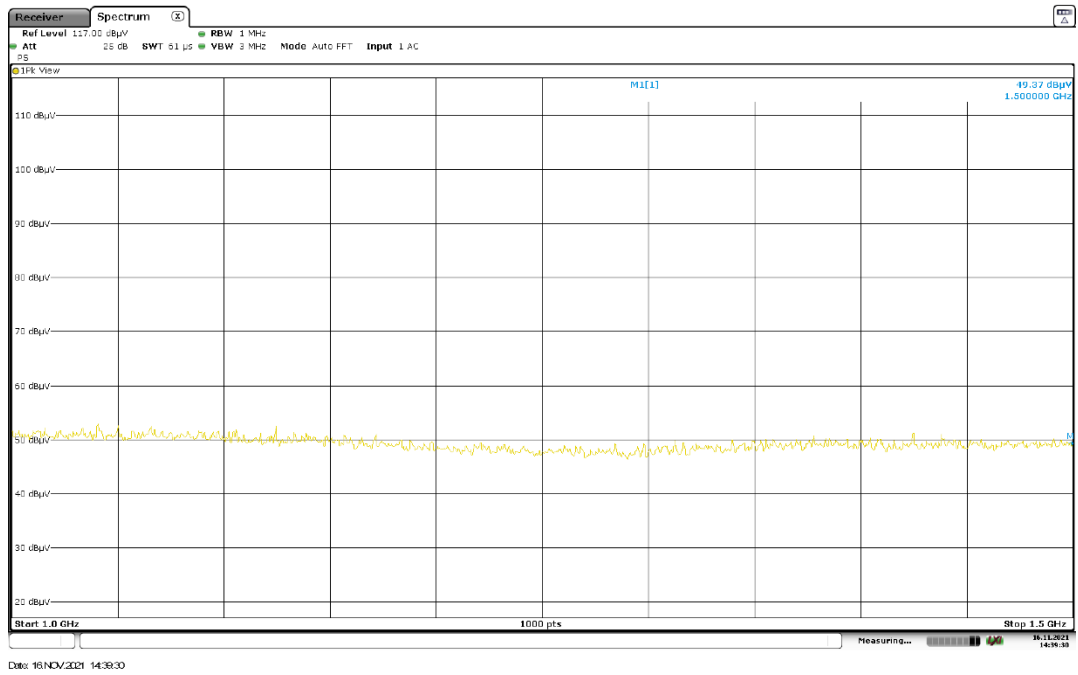


Figure 4: Reference plot for Radiated Spurious Emissions – 1 GHz – 1.5 GHz

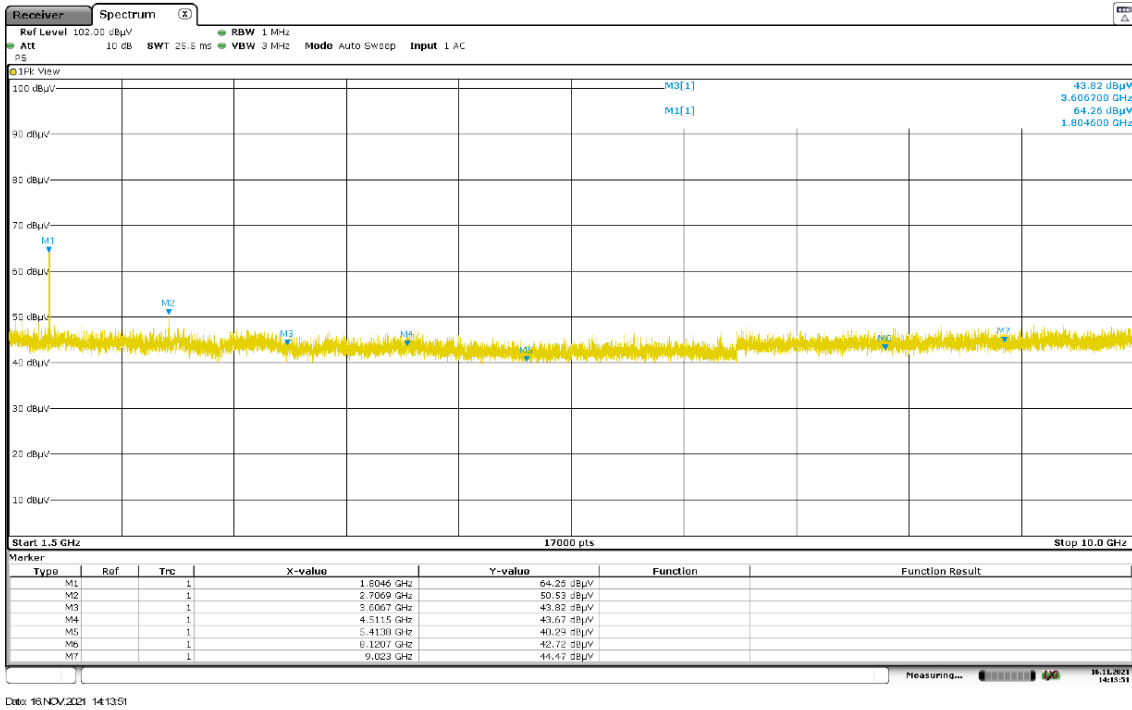


Figure 5: Reference plot for Radiated Spurious Emissions – 1.5 GHz – 10 GHz
 Note: Emissions above the noise floor that falls within restricted bands were only evaluated.

2.4 Test Equipment Used

Table 2.4-1 –Equipment List

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	6/8/2021	6/8/2023
1956	Fei Teng Wireless Technology	HA-07M18G-NF	Horn Antenna 1-18GHz	2013120203	05/12/2021	05/12/2022
852	Teseq	CBL 6112D	Bilog Antenna; Attenuator	51617	10/13/2020	10/13/2022
213	TEC	PA 102	Amplifier	44927	7/30/2021	7/30/2022
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	06/22/2021	06/22/2023
331	Microwave Circuits	H1G513G1	Microwave Bandpass Filter	31417	6/9/2021	6/9/2022
882	Rohde & Schwarz	ESW44	Test Receiver	111961	6/24/2021	6/24/2022
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	5/11/2021	5/11/2022
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	6/23/2021	6/23/2022
872	Agilent	E7402A	EMC Spectrum Analyzer	US40240258	6/22/2021	6/22/2022
861	Com-Power Corporation	LI-1100C	Line Impedance Stabilization Network	20180038	2/26/2021	2/26/2022
862	Com-Power Corporation	LI01100C	Line Impedance Stabilization Network	20180039	2/26/2021	2/26/2022
703	Hewlett Packard	8594E	Spectrum Analyzer	3523A02134	NCR	NCR
856	Huber & Suhner	Multiplex 104	Blue Cable	326050	NCR	NCR
813	PMM	9010	EMI Receiver; RF Input 50ohm; 10Hz-50MHz; 10Hz-30MHz	697WW3060 6	6/8/2021	6/8/2022
168	Hewlett Packard	11947A	Transient Pulse Limiter	44829	3/3/2021	3/3/2022

N/A – Not Applicable

NCR – No Calibration Required

3 Diagram of Test Set-ups

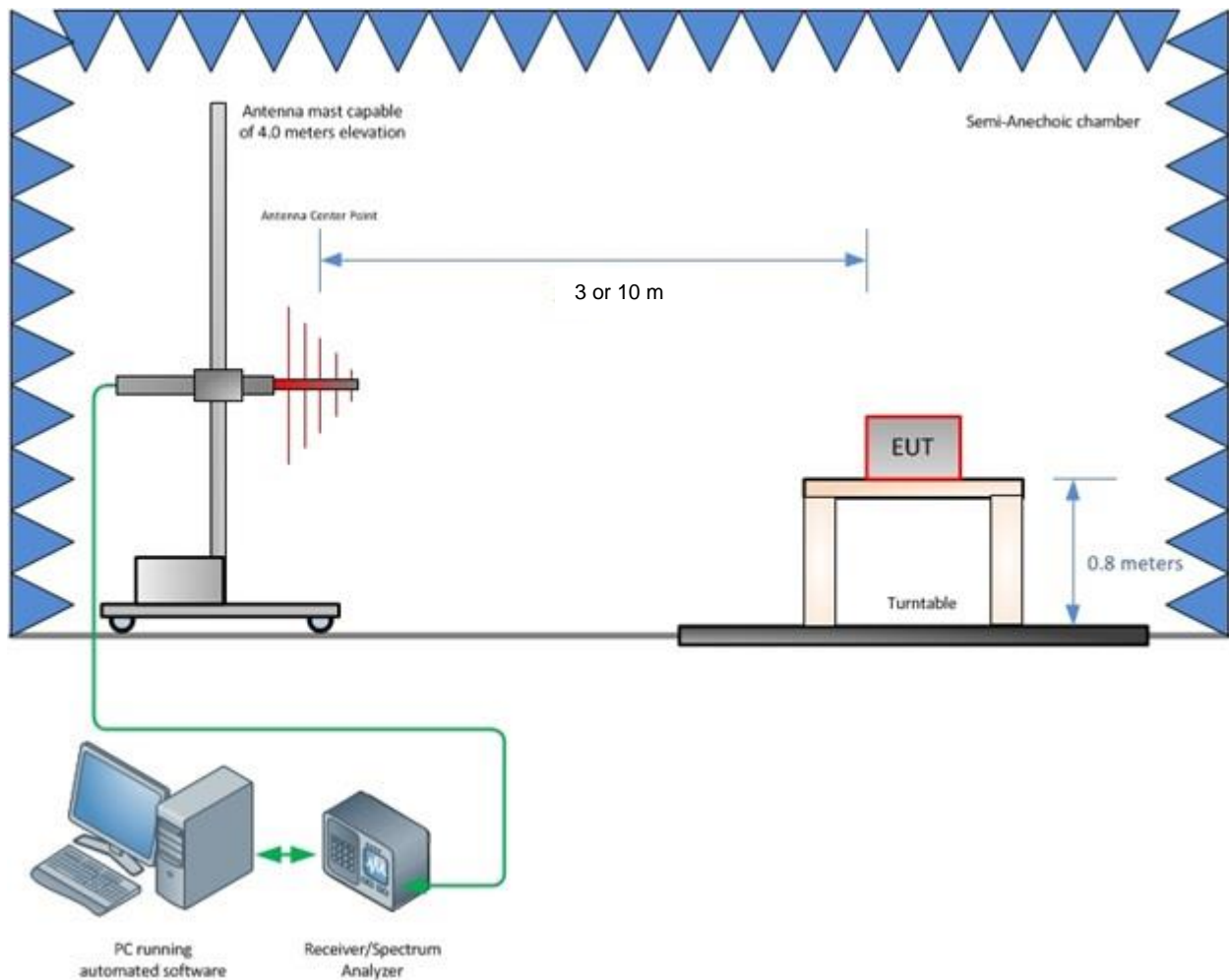


Figure 3-1 – Radiated Emissions Test Setup up to 1 GHz

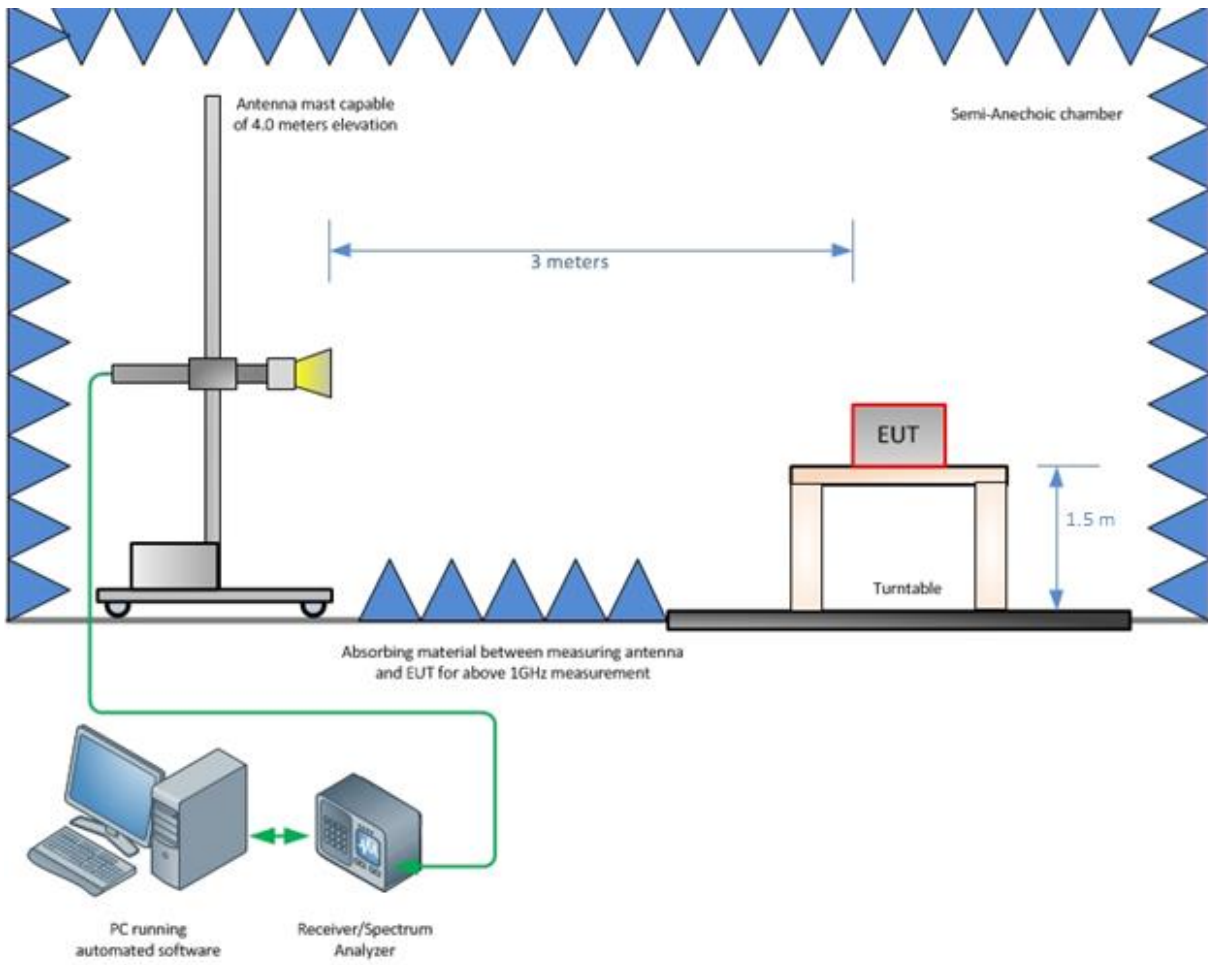


Figure 3-2 – Radiated Emissions Test Setup above 1 GHz

4 Accreditation, Disclaimers and Copyright

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STATEMENT OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) $k = 1.96$ which provide confidence levels of 95%.

Table 4-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Radiated Emissions ≤ 1 GHz	± 5.814 dB
Radiated Emissions > 1 GHz	± 4.318 dB
Temperature	± 0.860 °C
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	± 3.360 dB

TEST EQUIPMENT

All measurement instrumentation is traceable to the National Institute of Standards and Technology and is calibrated to meet test method standard requirements and/or manufacturer's specifications