Certification Test Report

FCC ID: 2AG9G-FCL5324

FCC Rule Part: 15.247

Report Number: AT72136736-1C0

Manufacturer: Flextronics
Model: FCL5324

Test Begin Date: April 12, 2018
Test End Date: April 27, 2018

Report Issue Date: November 12, 2018

FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Prepared by:

Jeremy Pickens
Senior Wireless Engineer
TÜV SÜD America Inc.

Reviewed by:

Ryan McGann
Senior Engineer
TÜV SÜD America Inc.

This report contains 32 pages

TABLE OF CONTENTS

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations for modular approval.

1.2 Product Description

The AMS-1 LoRa model # FCL5324 product defines a smart home gateway which acts as a wireless router. It provides Wi-Fi where computers, smartphones and other terminals can communicate freely. Also, its Lora technology provides an environment where smart living appliances, metering, etc. can communicate through the wireless. What's more, PCs, laptops and smartphones can control electric devices in the house through the Smart Home Gateway.

This test report documents the compliance of the LoRaWAN radio operating in digital transmission mode.

Technical Information:

Detail	Description
Frequency Range	923.3 – 927.5 MHz
Number of Channels	8
Modulation Format	CSS (Chirp Spread Spectrum)
Data Rates	12500 bps (Spreading Factors 7 and 12)
Number of Inputs/Outputs	1T1R
Operating Voltage	120 Vac / 60 Hz
Antenna Type / Gain	PIF Antenna / 1 dBi

Manufacturer Information:
Flextronics
1600 Alabama Highway 226
Tallassee, AL 36078

Test Sample Serial Number: Radiated Emissions: BR-346172-1
AC Power Line Conducted Emissions: BR-346172-1
RF Conducted Emissions: BR-346172-5

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

All modes of operation, including all data rates, were evaluated and the data presented in this report represents the worst case where applicable.

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was Y-orientation. See test setup photos for more information.

For AC power line conducted emissions, the EUT was evaluated in an orientation typical of installation. The EUT was set to continuously transmit on a single channel

For RF Conducted Emissions, the EUT was modified with a temporary SMA pigtail to facilitate connection to the test equipment. The client provided test software to continuously transmit on every channel under investigation.

Power setting during test: 15

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America, Inc.
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. (Buford Facility) is accredited to ISO/IEC 17025 by the ANSI-ASQ National Accreditation Board/ANAB accreditation program and has been issued certificate number AT-2021 in recognition of this accreditation.

TÜV SÜD America, Inc. (Alpharetta Facility) is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites, Open Area Test Sites (OATS) and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

Buford Facility

FCC Registration Number:	391271
ISED Canada Lab Code:	23597
VCCI Member Number:	1831
• VCCI Registration Number	A-0259

Alpharetta Facility

FCC Registration Number:	967699
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site (Buford Facility)

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

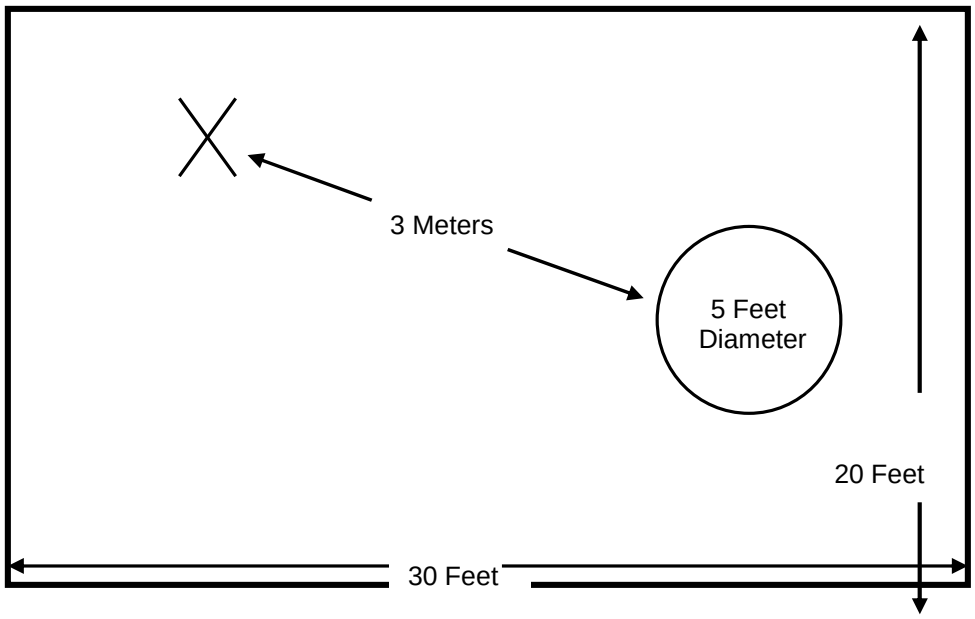


Figure 2.3.1: Semi-Anechoic Chamber Test Site (Buford Facility)

2.3.2 Semi-Anechoic Chamber Test Site (Alpharetta Facility)

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170, and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

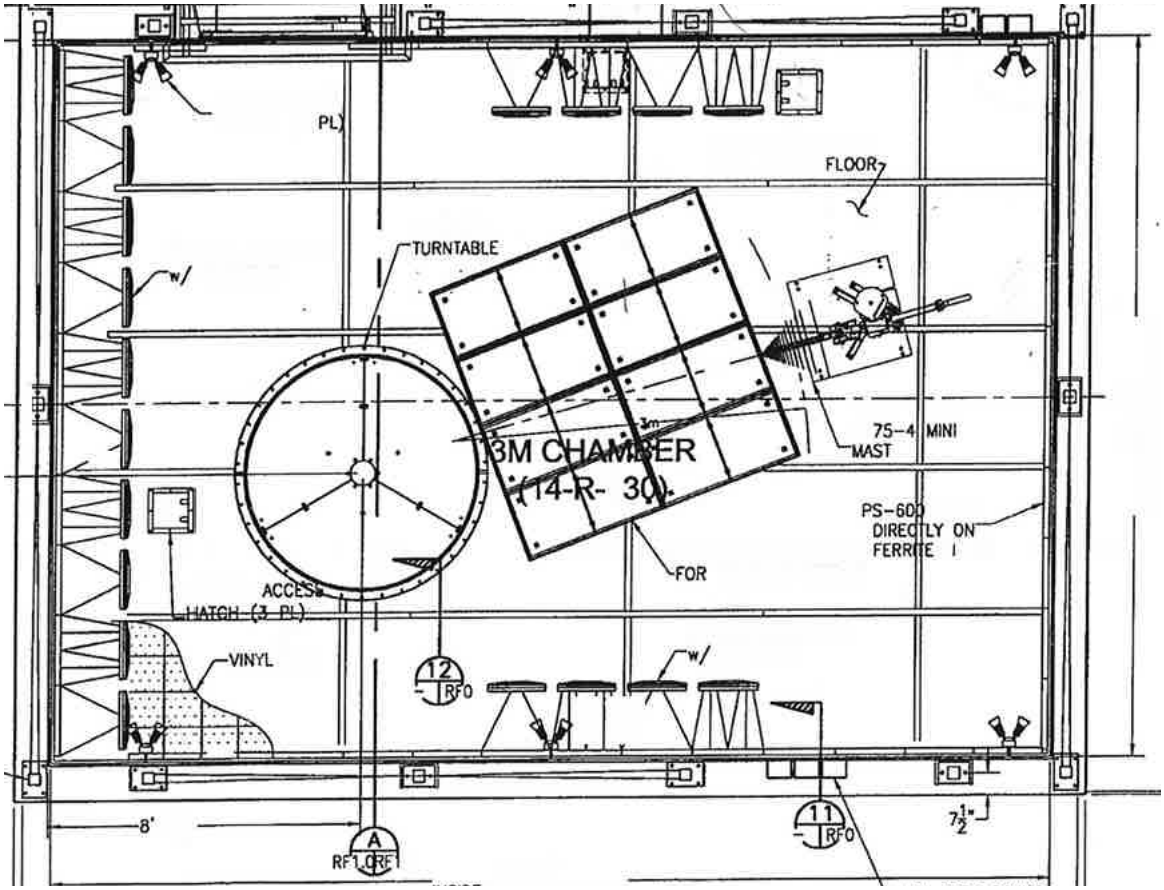


Figure 2.3.2: Semi-Anechoic Chamber Test Site (Alpharetta Facility)

2.3.3 Open Area Tests Site (Buford Facility)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

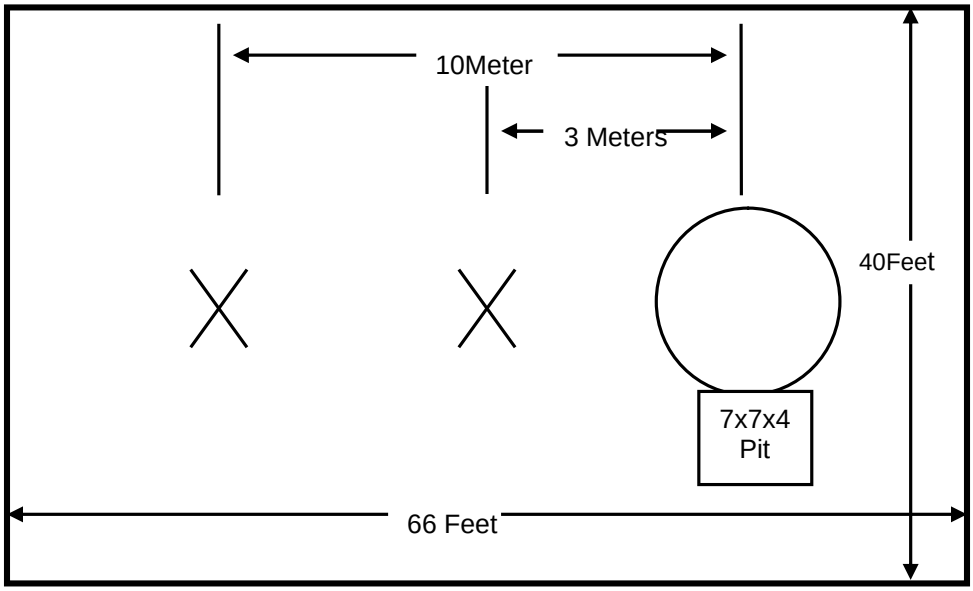


Figure 2.3.3: Open Area Test Site (Buford Facility)

2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site (Buford Facility)

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal ground reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

A diagram of the room is shown below in figure 4.1.3-1:

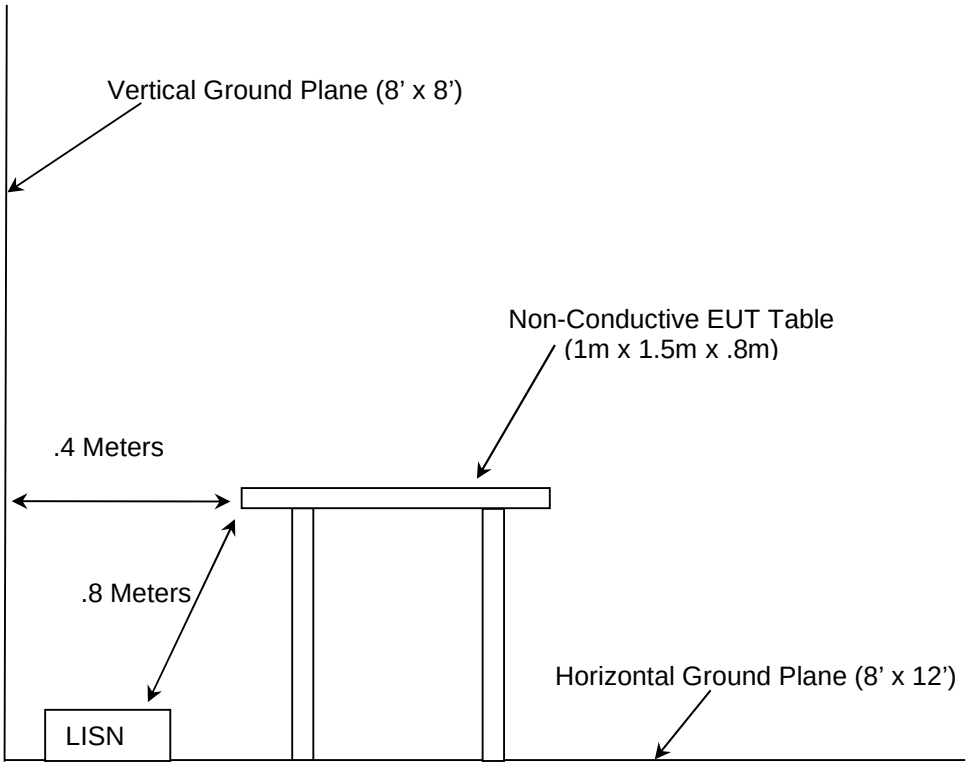


Figure 2.4.1: AC Mains Conducted EMI Site (Buford Facility)

2.4.2 Conducted Emissions Test Site (Buford Facility)

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane(HCP) as well as a 12'x8' vertical coupling plane(VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4:2003 and 2009.

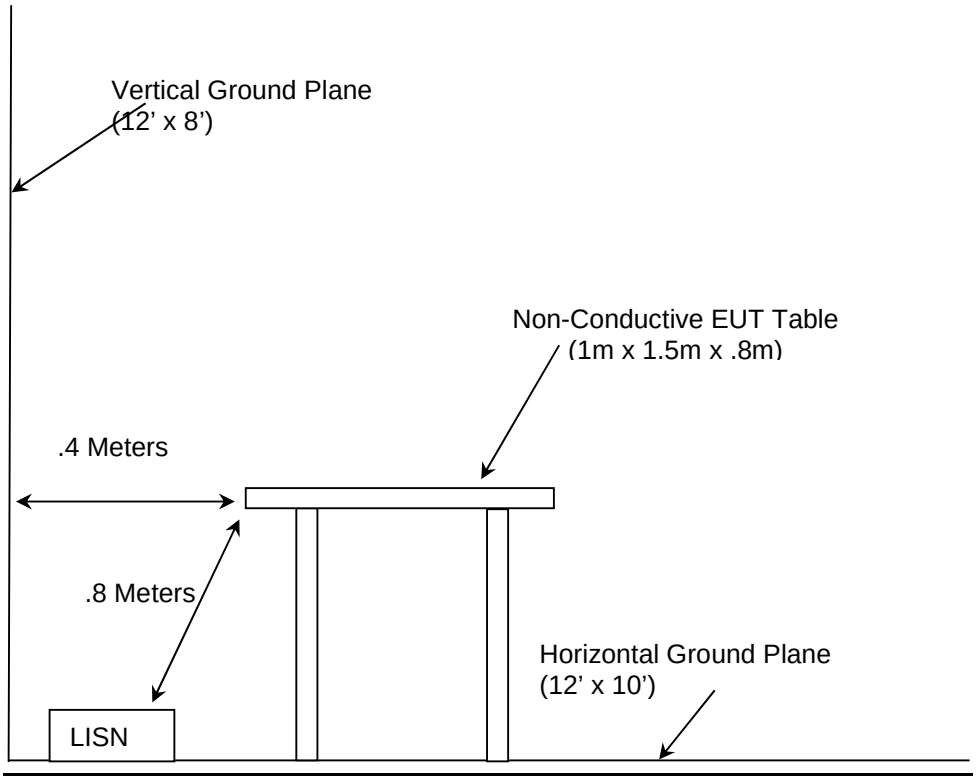


Figure 2.4.2: AC Mains Conducted EMI Site (Alpharetta Facility)

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2018
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2018
- FCC KDB 558074 D01 DTS Meas Guidance v05 - Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section15.247 of the FCC Rules, August 24, 2018
- ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, Feb 2017.
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, April 2018.

4 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

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	1-18GHz Horn Antenna	970102	05/09/2017	05/09/2019
40	EMCO	3104	Bicon Antenna	3211	06/08/2016	06/08/2018
73	Hewlett Packard	8447D	Pre-Amp	2727A05624	07/24/2017	07/24/2018
167	ACS	Chamber EMI Cable Set	Consisits of cables 485, 242, 204 and 10	167	09/29/2017	09/29/2018
267	Hewlett Packard	N1911A	Power Meter	MY45100129	08/22/2017	08/22/2019
268	Hewlett Packard	N1921A	Power Sensor	MY45240184	08/22/2017	08/22/2019
324	ACS	Belden	Conducted EMI Cable	8214	04/05/2018	04/05/2019
331	Microwave Circuits	H1G513G1	Microwave Bandpass Filter	31417	05/13/2017	05/13/2018
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/11/2017	07/11/2019
340	Aeroflex/Weinschel	AS-20	Attenuator	7136	07/10/2017	07/10/2018
412	Electro Metrics	LPA-25	Log Periodic Antenna	1241	08/08/2016	08/08/2018
422	Florida RF	SMS-200AW-72.0-SMR	Cable	805	11/27/2017	11/27/2018
616	Florida RF Cables	SMRE-200W-12.0-SMRE	High Frequency Cable	N/A	10/07/2017	10/07/2018
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	07/15/2016	07/15/2018
676	Florida RF Labs	SMS-290AW-480.0-SMS	Cable	MFR2Y194	01/08/2018	01/08/2019
813	PMM	9010	EMI Receiver; RF Input 50ohm; 10Hz-50MHz; 10Hz-30MHz	697WW30606	02/12/2018	02/12/2019
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	10/31/2017	10/31/2018
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	07/11/2017	07/11/2018

NCR = No Calibration Required
NOTE: All test equipment was used only during active calibration cycles.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
The EUT is an AC Mains powered device therefore no ancillary or support equipment was utilized. The EUT was tested stand-alone.				

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
The EUT is an AC Mains powered device therefore no ancillary or support equipment was utilized. The EUT was tested stand-alone.				

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

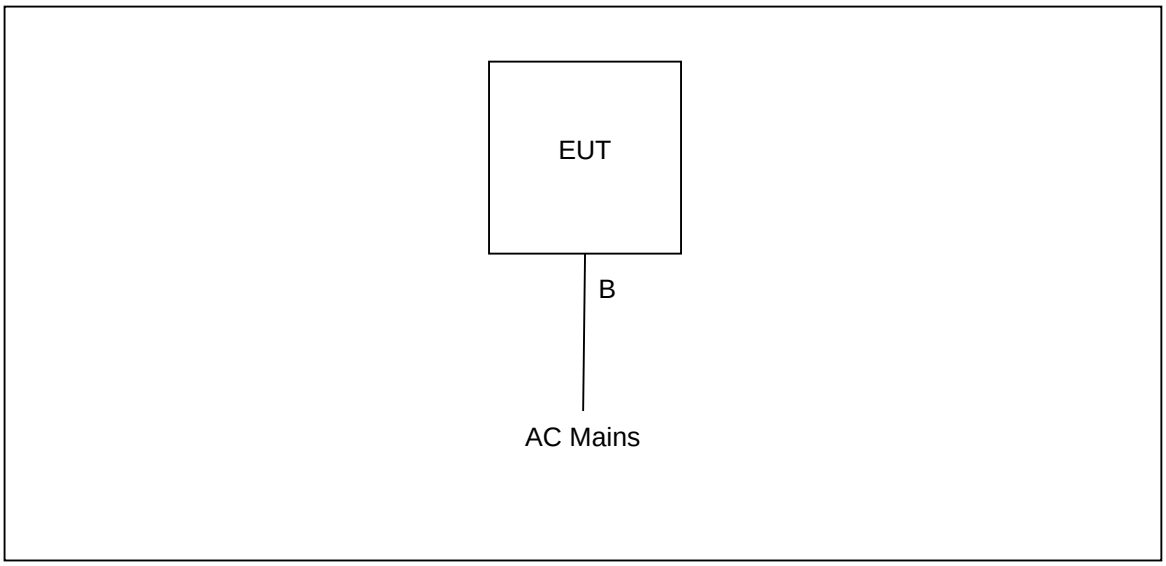


Figure 6-1: Test Setup Block Diagram

7 SUMMARY OF TESTS

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

7.1 Antenna Requirement – FCC: Section 15.203

The Printed Inverted F-Antenna interfaces with the EUT via a SMD spring contact. The gain of the antenna is 1 dBi.

7.2 Power Line Conducted Emissions – FCC 15.207, ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

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:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.2.2 Measurement Results

Performed by: Tyler Leeson in Alpharetta Facility

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	
0.15	31.42	17.89	66	56	34.58	38.11	9.59
0.17	35.92	29.12	64.96	54.96	29.04	25.84	9.58
0.182	34.21	17.54	64.39	54.39	30.18	36.85	9.58
0.194	27.68	13.36	63.86	53.86	36.18	40.5	9.58
0.418	28.69	15.77	57.49	47.49	28.8	31.72	9.59
0.454	35.13	23.13	56.8	46.8	21.67	23.67	9.59
0.47	36.42	19.84	56.51	46.51	20.09	26.67	9.59
0.482	35.3	15.25	56.3	46.3	21	31.05	9.59
0.646	29.15	15.64	56	46	26.85	30.36	9.59
29.986	27.48	13.4	60	50	32.52	36.6	9.91

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Corrected Reading		Limit		Margin		Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	
0.15	26.58	17.94	66	56	39.42	38.06	9.59
0.162	26.55	20.43	65.36	55.36	38.81	34.93	9.58
0.198	25.38	13.04	63.69	53.69	38.31	40.65	9.58
0.418	25.37	14.41	57.49	47.49	32.12	33.08	9.59
0.458	34.4	24.18	56.73	46.73	22.33	22.55	9.59
0.466	34.54	22.02	56.58	46.58	22.04	24.56	9.59
0.474	34.39	16.49	56.44	46.44	22.05	29.95	9.59
2.618	25.2	10.63	56	46	30.8	35.37	9.62
2.682	24.74	10.65	56	46	31.26	35.35	9.62
29.998	28.8	13.49	60	50	31.2	36.51	10

7.3 6 dB / 99 % Bandwidth – FCC: Section 15.247(a)(2); ISED Canada: RSS-247 5.2(a)

7.3.1 Measurement Procedure

The 6 dB bandwidth was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99 % bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set from 1 % to 5 % of the occupied bandwidth and the video bandwidth set to at least 3 times the resolution bandwidth. A peak detector was used.

7.3.2 Measurement Results

Performed by: Ryan McGann in Buford Facility

Table 7.3.2-1: 6 dB / 99 % Bandwidth

Frequency [MHz]	6 dB Bandwidth [kHz]	99 % Bandwidth [kHz]
Spreading Factor 7		
923.3	615.543	508.234
925.7	612.543	506.984
927.5	611.043	506.422
Spreading Factor 12		
923.3	633.918	503.172
925.7	630.168	502.672
927.5	611.043	502.359

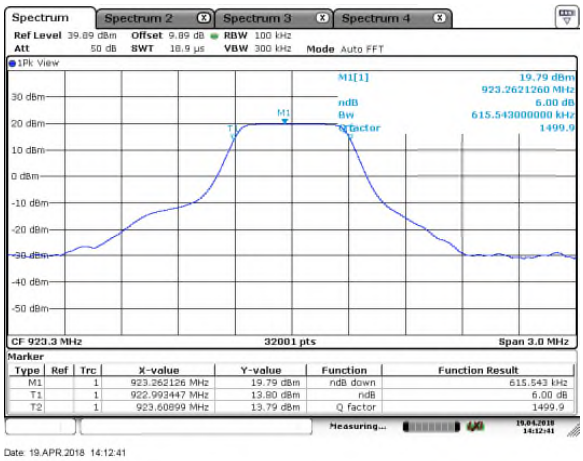


Figure 7.3.2-1: 6dB BW – LCH , SF=7

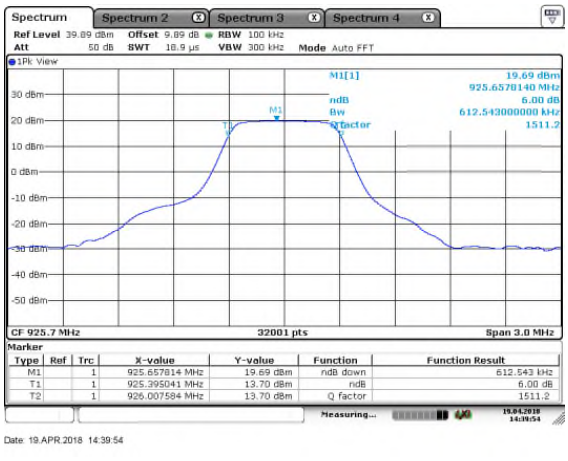


Figure 7.3.2-2: 6dB BW – MCH , SF=7

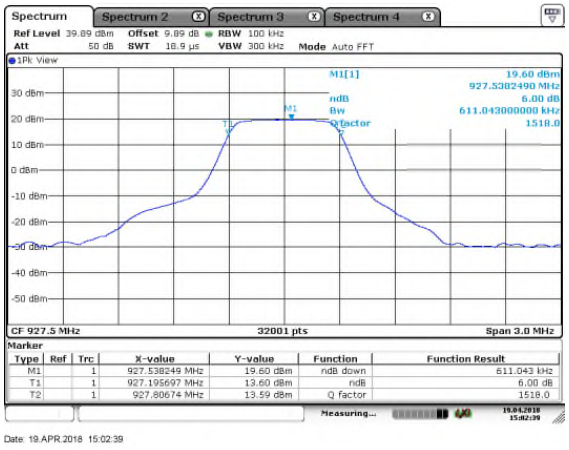


Figure 7.3.2-3: 6dB BW – HCH , SF=7

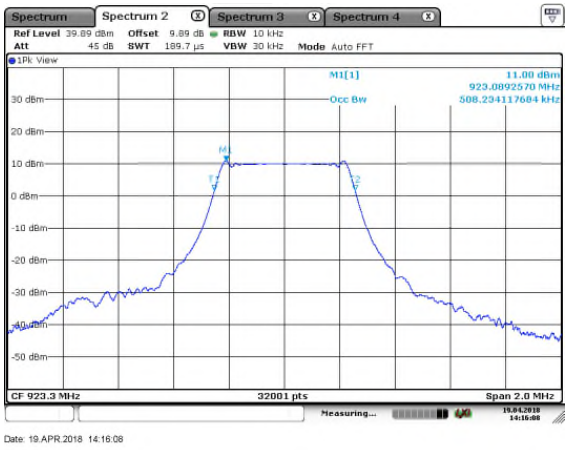


Figure 7.3.2-4: 99% OBW – LCH , SF=7

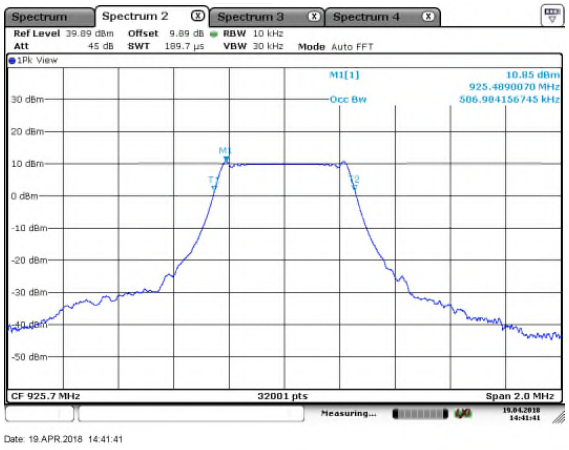


Figure 7.3.2-5: 99% OBW – MCH , SF=7

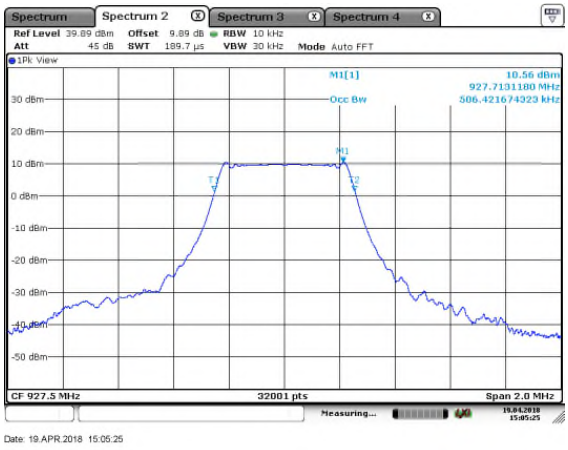


Figure 7.3.2-6: 99% OBW – HCH , SF=7

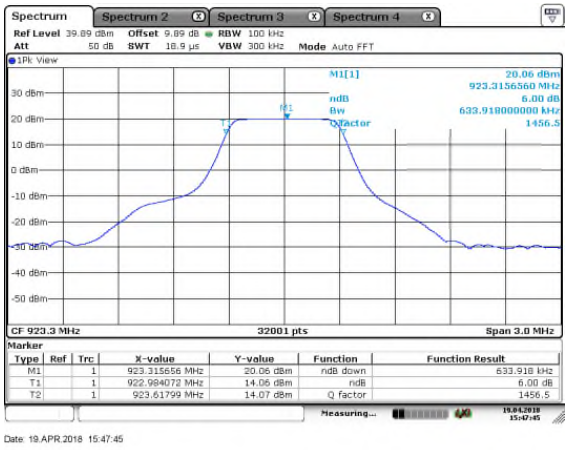


Figure 7.3.2-7: 6dB BW – LCH , SF=12

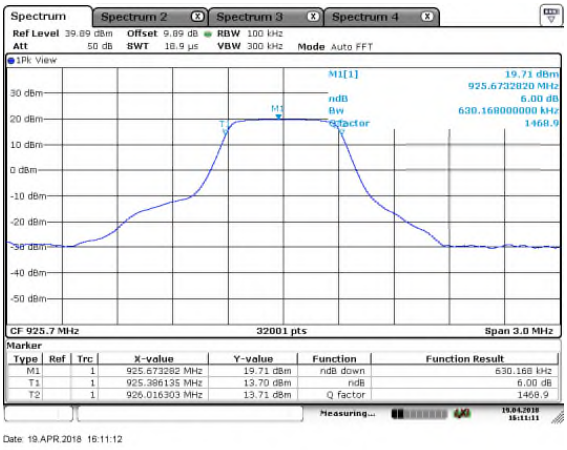


Figure 7.3.2-8: 6dB BW – MCH , SF=12

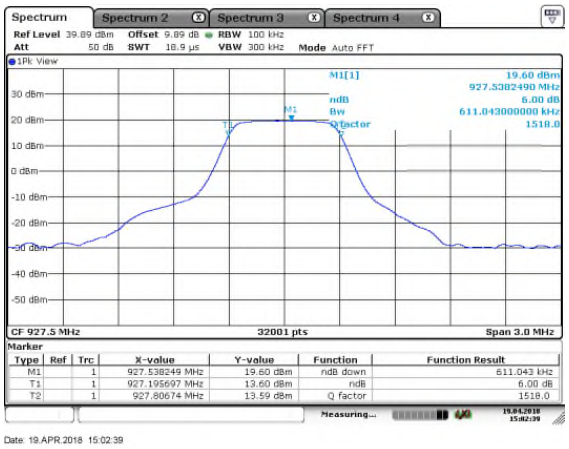


Figure 7.3.2-9: 6dB BW – HCH , SF=12

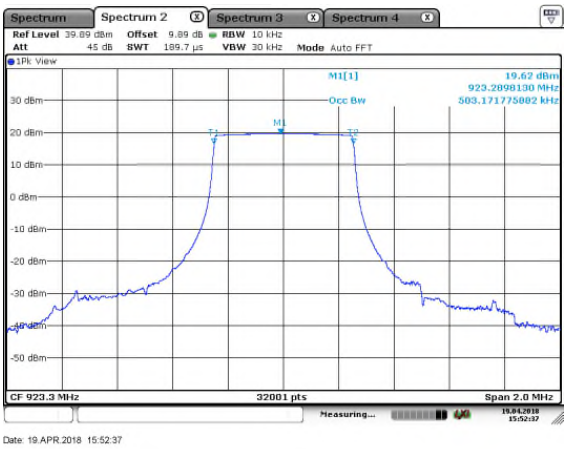


Figure 7.3.2-10: 99% OBW – LCH , SF=12

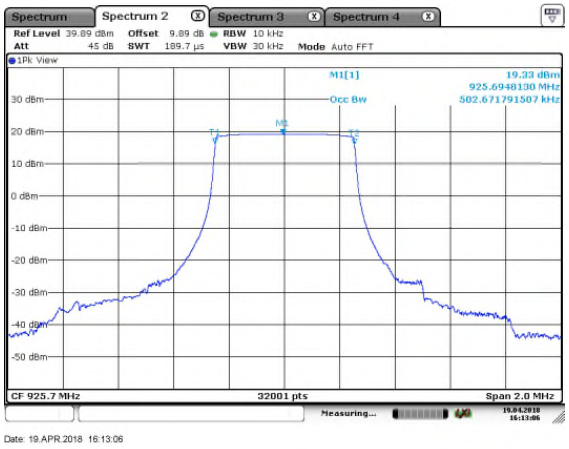


Figure 7.3.2-11: 99% OBW – MCH , SF=12

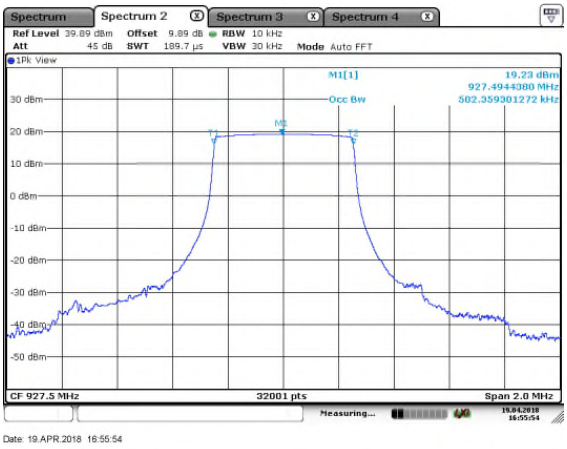


Figure 7.3.2-12: 99% OBW – HCH , SF=12

7.4 Fundamental Emission Output Power – FCC: Section 15.247(b)(3); ISED Canada: RSS-247 5.4(d)

7.4.1 Measurement Procedure

The maximum conducted output power was measured in accordance with FCC KDB 558074 D01 DTS Meas Guidance utilizing the AVGPM-G procedure. The RF output of the equipment under test was directly connected to the input of the power meter applying suitable attenuation.

7.4.2 Measurement Results

Performed by: Ryan McGann in Buford Facility

Table 7.4.2-1: Maximum Average Conducted Output Power

Frequency [MHz]	Level [dBm]
Spreading Factor 7	
923.3	19.86
925.7	19.76
927.5	19.62
Spreading Factor 12	
923.3	19.82
925.7	19.73
927.5	19.61

7.5 Emission Levels

7.5.1 Emissions into Non-restricted Frequency Bands – FCC: Section 15.247(d); ISED Canada: RSS-247 5.5

7.5.1.1 Measurement Procedure

The unwanted emissions into non-restricted bands were measured conducted in accordance with FCC KDB 558074 D01 DTS Meas Guidance. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 300 kHz. Span was set to 1.5 times the DTS bandwidth. The trace was set to max hold with a peak detector active. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 30 dBc limit. The spectrum span was then adjusted for the measurement of spurious emissions from 30 MHz to 10 GHz, 10 times the highest fundamental frequency.

Band-edge compliance was determined using the conducted marker-delta method in which the radio frequency power that is produced by the EUT is at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

7.5.1.2 Measurement Results

Performed by: Ryan McGann, Jeremy Pickens in Buford Facility

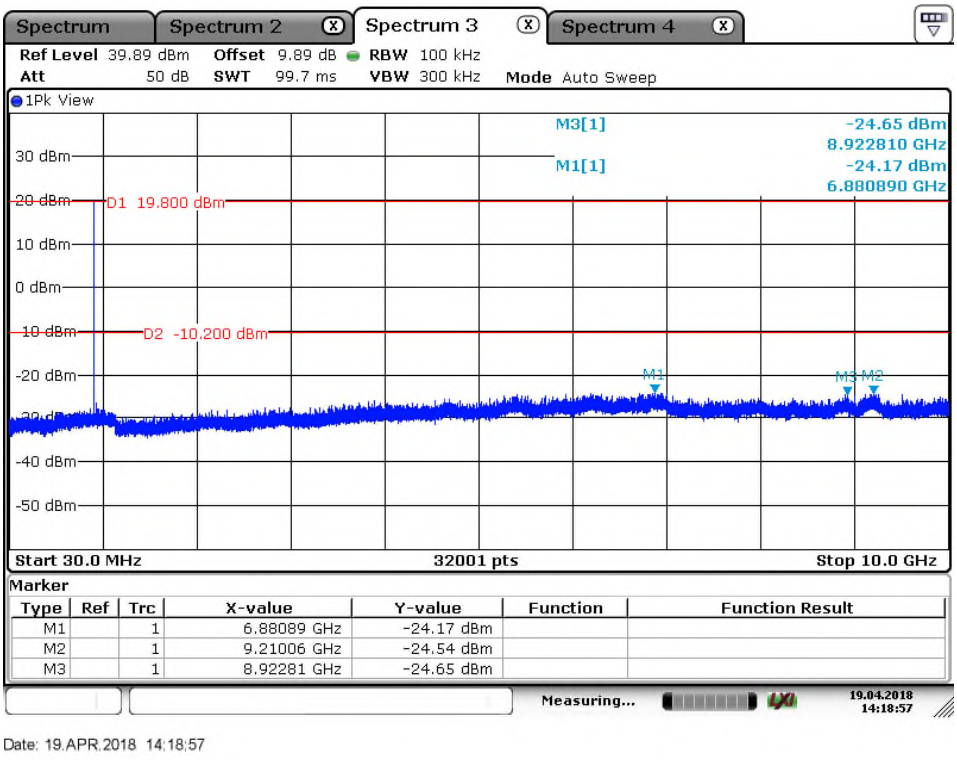
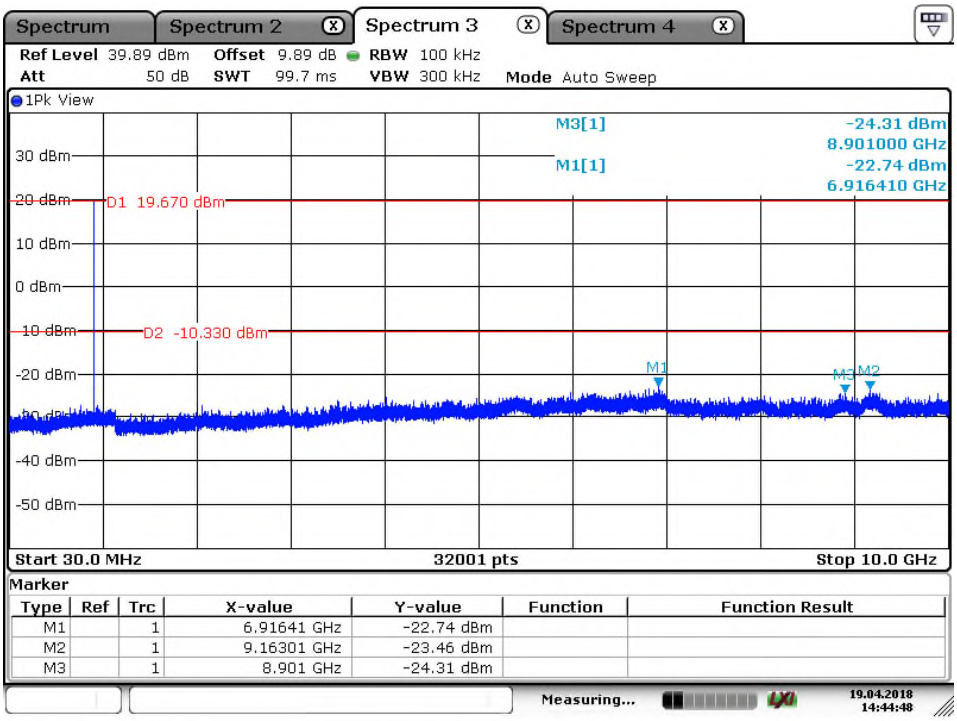
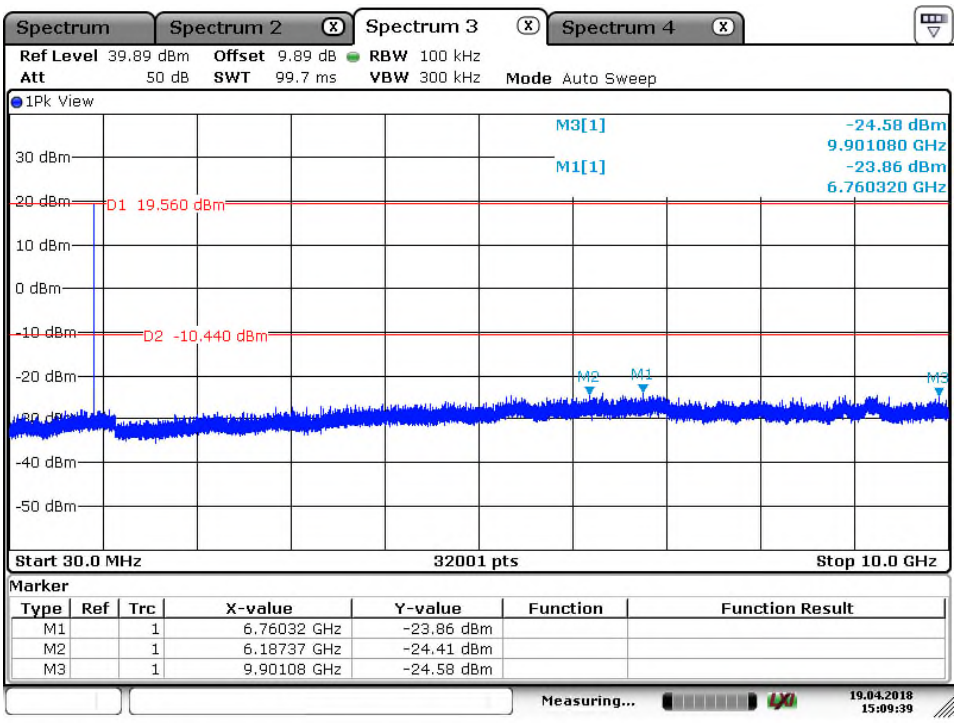


Figure 7.5.1.2-1: RF Conducted Emissions – LCH, SF=7



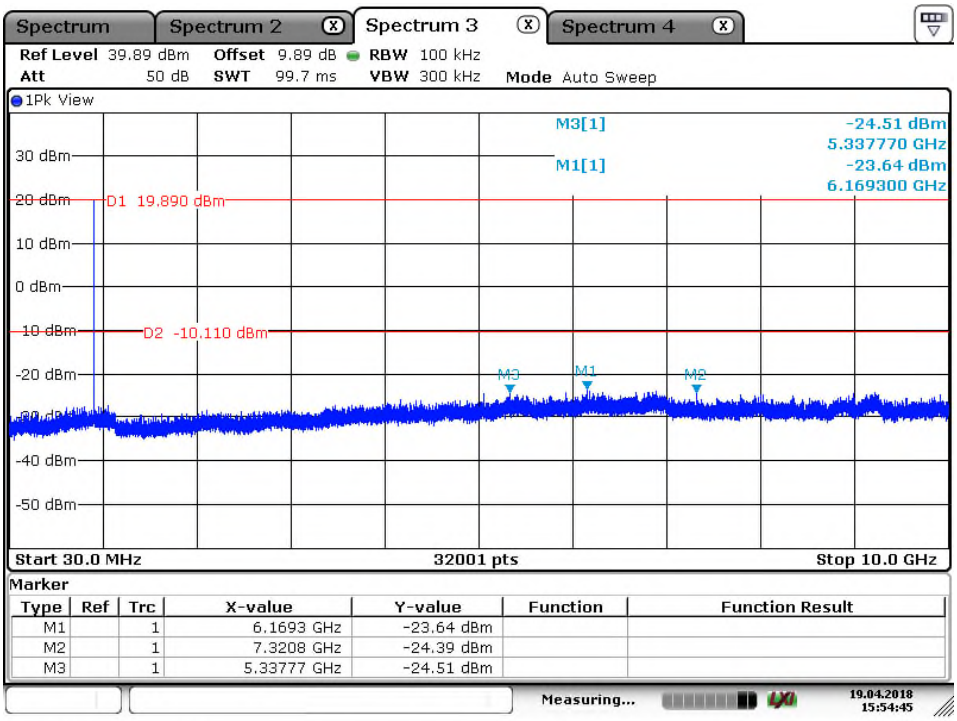
Date: 19.APR.2018 14:44:48

Figure 7.5.1.2-2: RF Conducted Emissions – MCH, SF=7



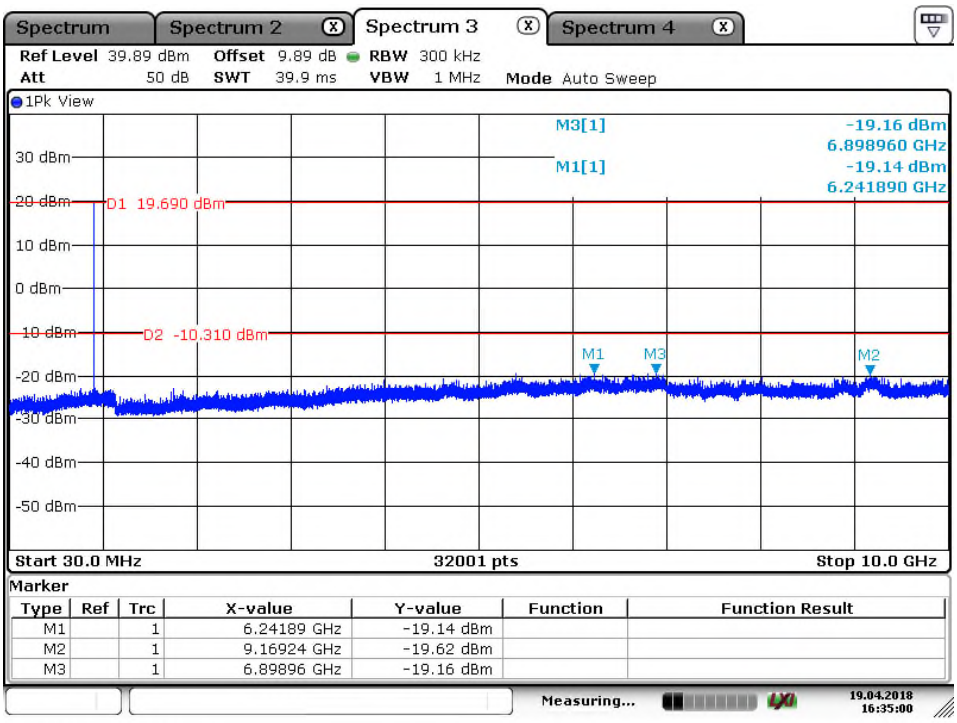
Date: 19.APR.2018 15:09:39

Figure 7.5.1.2-3: RF Conducted Emissions – HCH, SF=7



Date: 19.APR.2018 15:54:44

Figure 7.5.1.2-4: RF Conducted Emissions – LCH, SF=12



Date: 19.APR.2018 16:35:00

Figure 7.5.1.2-5: RF Conducted Emissions – MCH, SF=12

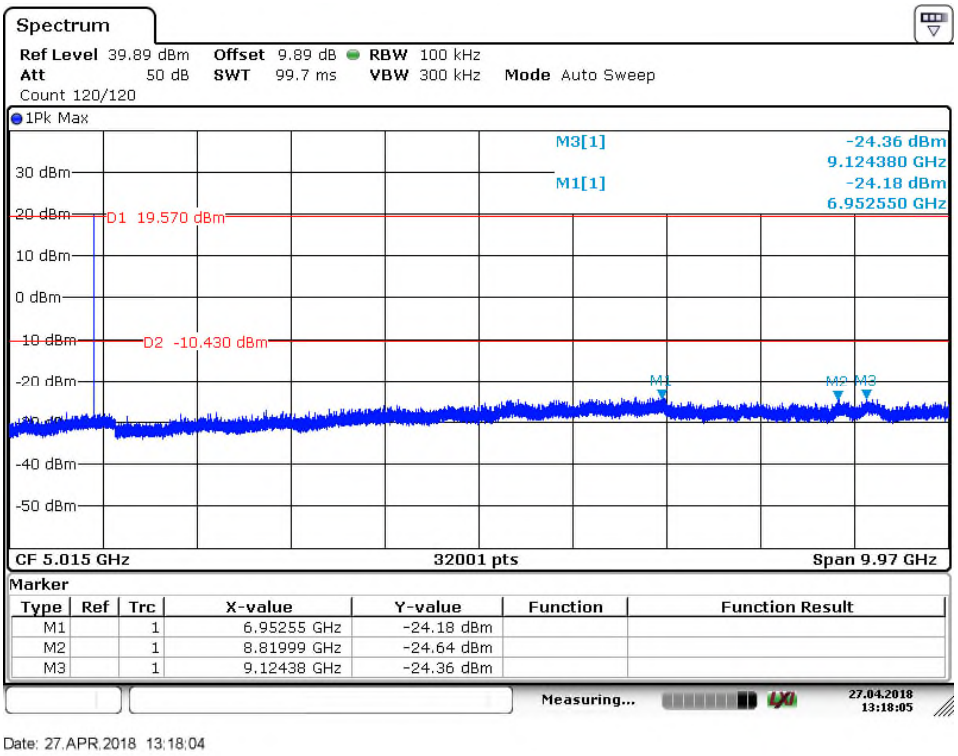


Figure 7.5.1.2-6: RF Conducted Emissions – HCH, SF=12

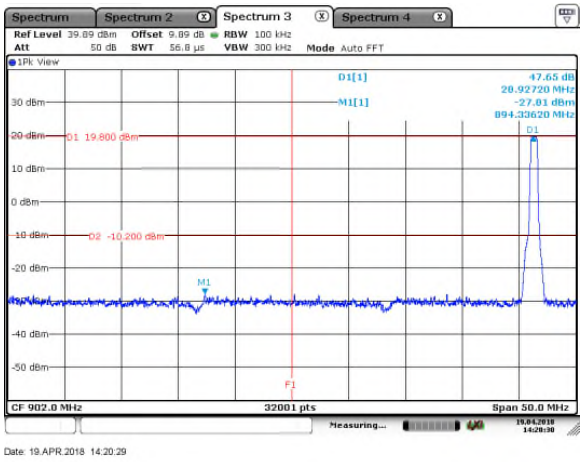


Figure 7.5.1.2-7: Lower Band-edge, SF=7

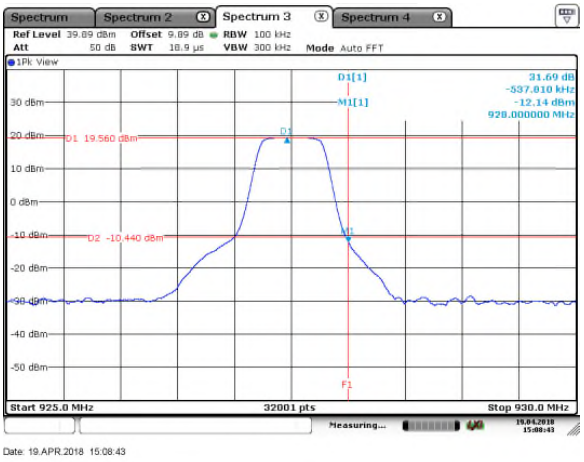


Figure 7.5.1.2-8: Upper Band-edge, SF=7

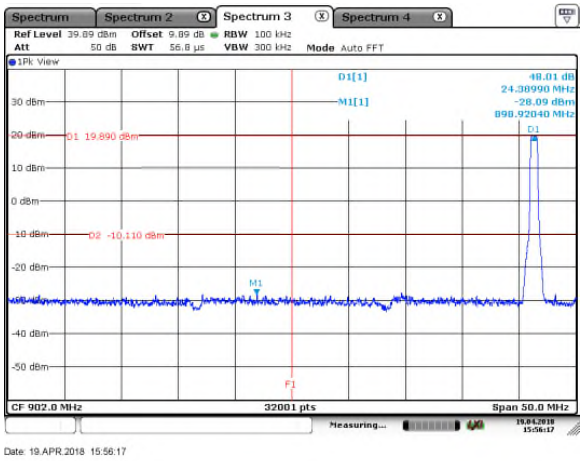


Figure 7.5.1.2-9: Lower Band-edge, SF=12

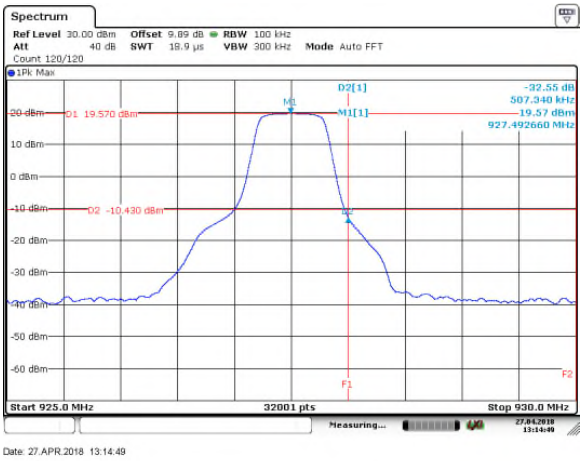


Figure 7.5.1.2-10: Upper Band-edge, SF=12

7.5.2 Emissions into Restricted Frequency Bands – FCC: Section 15.205, 15.209; ISED Canada: RSS-Gen 8.9 / 8.10

7.5.2.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30 MHz to 10 GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1 meter to 4 meters so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made in the Alpharetta Facility using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made in the Buford Facility with RBW and VBW of 1 MHz and 3 MHz respectively.

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.

7.5.2.2 Measurement Results

Performed by: Tommy Payton, Alton Smith, Arthur Sumner, Sean Vick

Radiated spurious emissions found in the band of 30 MHz to 10 GHz are reported in the Tables 7.5.2.2-1 and 7.5.2.2-2 below.

Table 7.5.2.2-1: Radiated Spurious Emissions Tabulated Data – SF=7

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Lowest Channel										
2769.9	51.80	41.90	H	-2.72	49.08	39.18	74.0	54.0	24.9	14.8
2769.9	52.80	44.50	V	-2.72	50.08	41.78	74.0	54.0	23.9	12.2
3693.2	48.60	35.90	H	0.76	49.36	36.66	74.0	54.0	24.6	17.3
3693.2	47.10	34.00	V	0.76	47.86	34.76	74.0	54.0	26.1	19.2
4616.5	48.40	35.50	H	2.62	51.02	38.12	74.0	54.0	23.0	15.9
4616.5	49.50	37.00	V	2.62	52.12	39.62	74.0	54.0	21.9	14.4
7386.4	50.30	35.60	H	8.86	59.16	44.46	74.0	54.0	14.8	9.5
7386.4	48.10	34.40	V	8.86	56.96	43.26	74.0	54.0	17.0	10.7
8309.7	49.00	35.00	H	9.20	58.20	44.20	74.0	54.0	15.8	9.8
8309.7	47.70	34.30	V	9.20	56.90	43.50	74.0	54.0	17.1	10.5
Middle Channel										
2777.1	51.30	41.60	H	-2.70	48.60	38.90	74.0	54.0	25.4	15.1
2777.1	53.00	44.60	V	-2.70	50.30	41.90	74.0	54.0	23.7	12.1
3702.8	48.00	35.70	H	0.80	48.80	36.50	74.0	54.0	25.2	17.5
3702.8	47.40	34.00	V	0.80	48.20	34.80	74.0	54.0	25.8	19.2
4628.5	48.70	35.50	H	2.67	51.37	38.17	74.0	54.0	22.6	15.8
4628.5	49.40	36.90	V	2.67	52.07	39.57	74.0	54.0	21.9	14.4
7405.6	48.00	34.40	H	8.88	56.88	43.28	74.0	54.0	17.1	10.7
7405.6	47.30	34.10	V	8.88	56.18	42.98	74.0	54.0	17.8	11.0
8331.3	50.30	36.50	H	9.22	59.52	45.72	74.0	54.0	14.5	8.3
8331.3	47.60	34.10	V	9.22	56.82	43.32	74.0	54.0	17.2	10.7
Highest Channel										
2782.5	51.20	41.60	H	-2.68	48.52	38.92	74.0	54.0	25.5	15.1
2782.5	52.90	43.90	V	-2.68	50.22	41.22	74.0	54.0	23.8	12.8
3710	47.80	34.00	H	0.83	48.63	34.83	74.0	54.0	25.4	19.2
3710	46.90	33.90	V	0.83	47.73	34.73	74.0	54.0	26.3	19.3
4637.5	48.70	35.00	H	2.70	51.40	37.70	74.0	54.0	22.6	16.3
4637.5	49.00	36.50	V	2.70	51.70	39.20	74.0	54.0	22.3	14.8
7420	47.10	33.90	H	8.90	56.00	42.80	74.0	54.0	18.0	11.2
7420	47.30	34.10	V	8.90	56.20	43.00	74.0	54.0	17.8	11.0
8347.5	49.70	36.10	H	9.24	58.94	45.34	74.0	54.0	15.1	8.7
8347.5	48.20	34.20	V	9.24	57.44	43.44	74.0	54.0	16.6	10.6

Table 7.5.2.2-2: Radiated Spurious Emissions Tabulated Data – SF=12

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Lowest Channel										
329.75	39.76	28.22	H	-8.21	---------	20.02	--------	46.0	---------	26.0
329.75	60.17	52.85	V	-8.21	---------	44.65	--------	46.0	---------	1.4
2769.9	51.17	40.35	H	-2.72	48.45	37.63	74.0	54.0	25.6	16.4
2769.9	52.36	42.88	V	-2.72	49.64	40.16	74.0	54.0	24.4	13.8
3693.2	48.21	35.07	H	0.76	48.97	35.83	74.0	54.0	25.0	18.2
4616.5	48.76	35.48	H	2.62	51.38	38.10	74.0	54.0	22.6	15.9
4616.5	49.77	36.52	V	2.62	52.39	39.14	74.0	54.0	21.6	14.9
7386.4	49.33	35.29	H	8.86	58.19	44.15	74.0	54.0	15.8	9.8
7386.4	48.45	34.17	V	8.86	57.31	43.03	74.0	54.0	16.7	11.0
8309.7	51.34	37.48	H	9.20	60.54	46.68	74.0	54.0	13.5	7.3
8309.7	49.05	34.77	V	9.20	58.25	43.97	74.0	54.0	15.7	10.0
Middle Channel										
2777.1	49.74	37.31	H	-2.70	47.04	34.61	74.0	54.0	27.0	19.4
2777.1	51.23	41.37	V	-2.70	48.53	38.67	74.0	54.0	25.5	15.3
4628.5	47.92	34.99	H	2.67	50.59	37.66	74.0	54.0	23.4	16.3
4628.5	48.76	35.71	V	2.67	51.43	38.38	74.0	54.0	22.6	15.6
7405.6	47.65	34.43	H	8.88	56.53	43.31	74.0	54.0	17.5	10.7
7405.6	47.92	34.14	V	8.88	56.80	43.02	74.0	54.0	17.2	11.0
8331.3	50.41	36.17	H	9.22	59.63	45.39	74.0	54.0	14.4	8.6
8331.3	47.96	34.23	V	9.22	57.18	43.45	74.0	54.0	16.8	10.5
Highest Channel										
2782.5	50.43	41.76	H	-2.68	47.75	39.08	74.0	54.0	26.2	14.9
2782.5	52.48	45.45	V	-2.68	49.80	42.77	74.0	54.0	24.2	11.2
3710	46.42	34.96	H	0.83	47.25	35.79	74.0	54.0	26.8	18.2
3710	48.26	34.42	V	0.83	49.09	35.25	74.0	54.0	24.9	18.8
4637.5	48.07	37.92	H	2.70	50.77	40.62	74.0	54.0	23.2	13.4
4637.5	50.05	40.03	V	2.70	52.75	42.73	74.0	54.0	21.2	11.3
7420	49.68	39.14	H	8.90	58.58	48.04	74.0	54.0	15.4	6.0
7420	47.67	34.61	V	8.90	56.57	43.51	74.0	54.0	17.4	10.5
8347.5	48.61	36.38	H	9.24	57.85	45.62	74.0	54.0	16.2	8.4
8347.5	48.13	35.05	V	9.24	57.37	44.29	74.0	54.0	16.6	9.7

7.5.2.3 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

Corrected Level: 48.13 + 9.24 = 57.37dBuV/m
Margin: 74dBuV/m – 57.37dBuV/m = 16.6dB

Example Calculation: Average

Corrected Level: 35.05 + 9.24 - 0 = 44.29dBuV
Margin: 54dBuV – 44.29dBuV = 9.7dB

7.6 Maximum Power Spectral Density in the Fundamental Emission – FCC: Section 15.247(e); ISED Canada: RSS-247 5.2(b)

7.6.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB 558074 D01 utilizing the AVGPSD-1 method. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 3 kHz. The Video Bandwidth (VBW) was set to 10 kHz. Span was set to 1.5 times the Occupied Bandwidth. The trace was set to average over a minimum of 100 traces with an RMS detector active.

7.6.2 Measurement Results

Performed by: Ryan McGann in Buford Facility

Table 7.6.2-1: Power Spectral Density

Frequency [MHz]	PSD Level [dBm]
Spreading Factor 7	
923.3	0.06
925.7	-0.22
927.5	-0.39
Spreading Factor 12	
923.3	1.97
925.7	1.34
927.5	1.05

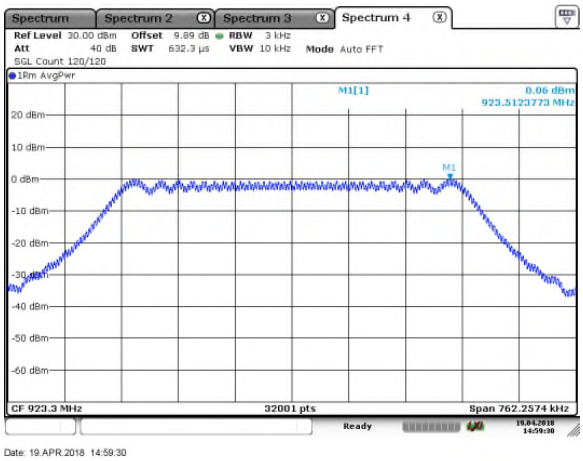


Figure 7.6.2-1: PSD – LCH, SF=7

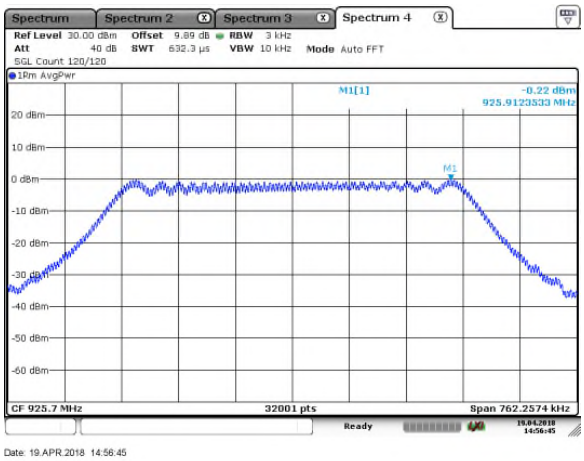


Figure 7.6.2-2: PSD – MCH, SF=7

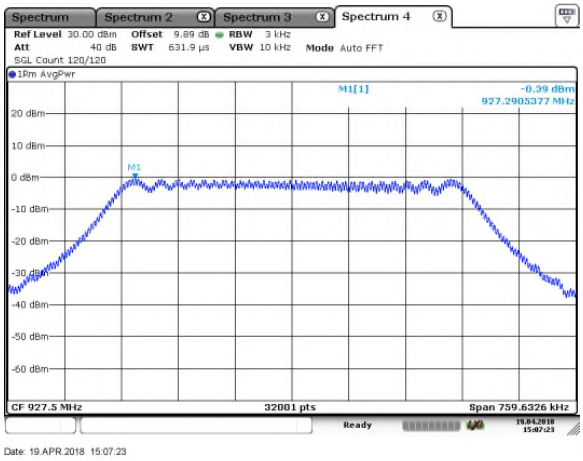


Figure 7.6.2-3: PSD – HCH, SF=7

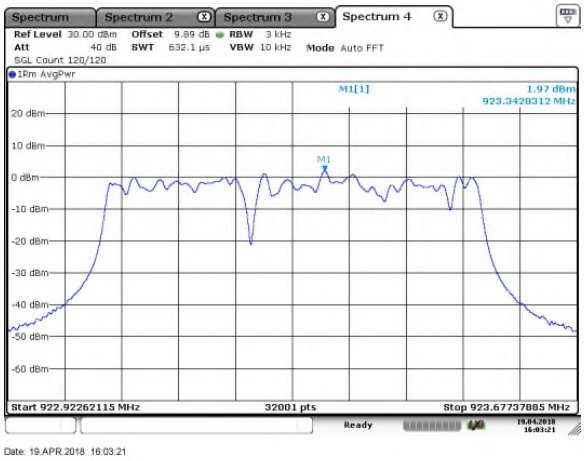


Figure 7.6.2-4: PSD – LCH, SF=12

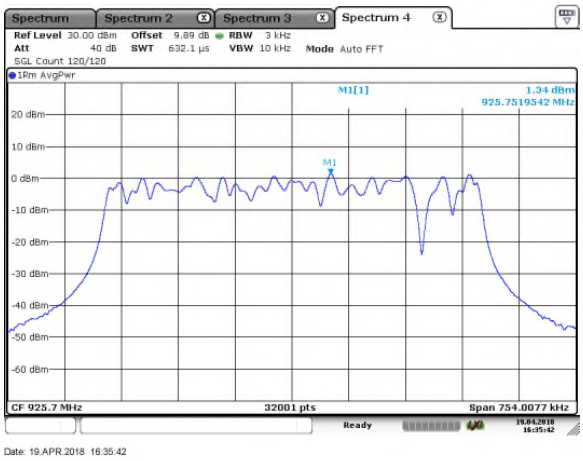


Figure 7.6.2-5: PSD – MCH, SF=12

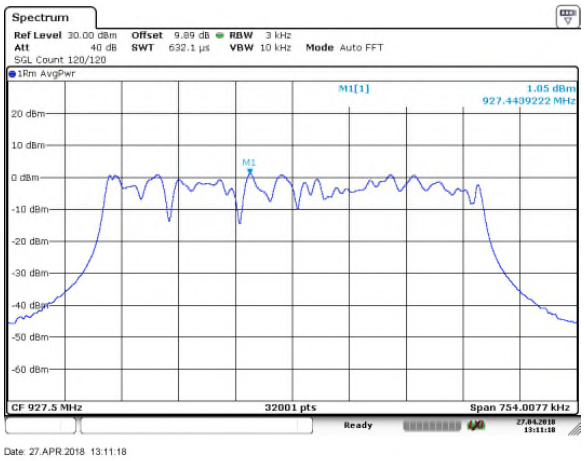


Figure 7.6.2-6: PSD – HCH, SF=12

8 ESTIMATION 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 8-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 0.349 dB
Power Spectral Density	± 0.372 dB
Antenna Port Conducted Emissions	± 1.264 dB
Radiated Emissions ≤ 1 GHz	± 5.814 dB
Radiated Emissions > 1 GHz	± 4.318 dB
Temperature	± 0.860 °C
Radio Frequency	± 2.832×10^{-8}
AC Power Line Conducted Emissions	± 3.360 dB

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the FCL5324, manufactured by Flextronics meets the requirements of FCC Part 15 subpart C for the tests documented in this test report.

END REPORT

10 Appendix A – ANAB Accreditation Certificate

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board
500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

TÜV SÜD America, Inc.
5015 B. U. Bowman Drive
Buford, GA 30518

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

while demonstrating technical competence in the field of

TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of tests to which this accreditation applies.

AT-2021
Certificate Number

ANAB Approval

Certificate Valid: 03/14/2018 - 12/17/2018
Version No. 013 Issued: 03/14/2018

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).