Certification Test Report

FCC ID: SM6-HUBTTU
IC: 9235A-HUBTTU

FCC Rule Part: 15.247
ISED Canada's Radio Standards Specification: RSS-247

Report Number: BO72126877.300

Applicant: Mueller Systems

Model(s): MiHUB-TTU

Test Begin Date: **April 19, 2017**
Test End Date: **June 14, 2017**

Report Issue Date: August 24, 2017

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

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

Prepared by:

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This report contains 46 pages

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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 Section 15.247 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

1.2 Applicant Information

Mueller Systems
48 Leona Drive, Suite C
Middleboro, MA 02346

1.3 Product Description

The MIHUB-TTU is intended for use as an unattended data collector for automatic meter monitoring and control applications. The device contains a 900 MHz ISM transceiver which operates in both FHSS and DTS modes. The device incorporates a MutiTech MTSMC-H5 cellular modem (FCC ID: RI7HE910/ IC: 5131A-HE910) which provides wireless 3G network connectivity. This test report documents the compliance of the 900 MHz DSS transceiver.

Technical Details

Mode of Operation:	FHSS
Frequency Range:	912.31 MHz - 927 MHz
Number of Channels:	50
Channel Separation:	300 kHz
Modulations:	FHSS
Data Rates:	2604.2 and 4557.3 bps
Antenna Type/Gain:	Omnidirectional Dipole, LCom Model HGV-906U / 6dBi Omnidirectional Dipole, LCom Model HG908U-PRO / 8dBi
Input Power:	120V/60 Hz, 15 VDC

Model Number: MiHUB-TTU

Test Sample Serial Number(s): 42000351

Test Sample Condition: The EUT was in good condition without any physical damage.

1.4 Test Methodology and Considerations

The equipment RF output power was not configurable during the evaluation. The EUT was configured to the maximum RF output power per the manufacturer. The RF conducted emissions were measured at the output of the external amplifier.

The device was evaluated in the orientation of typical installation. The radiated spurious and power line conducted emissions evaluations were performed using the two antenna models and available data rates. Where applicable the worst case results are reported.

The device was also evaluated for unintentional emissions. The results are documented in a separate test report.

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
http://www.tuv-sud-america.com

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD AMERICA, INC. is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1533 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

FCC Test Firm Registration #: 475089
Innovation, Science and Economic Development Canada Lab Code: 4175C

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 flooring.

The turntable is driven by pneumatic motor, which can support a 2000 lb. load. The turntable is flush with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1060 Multi-device controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

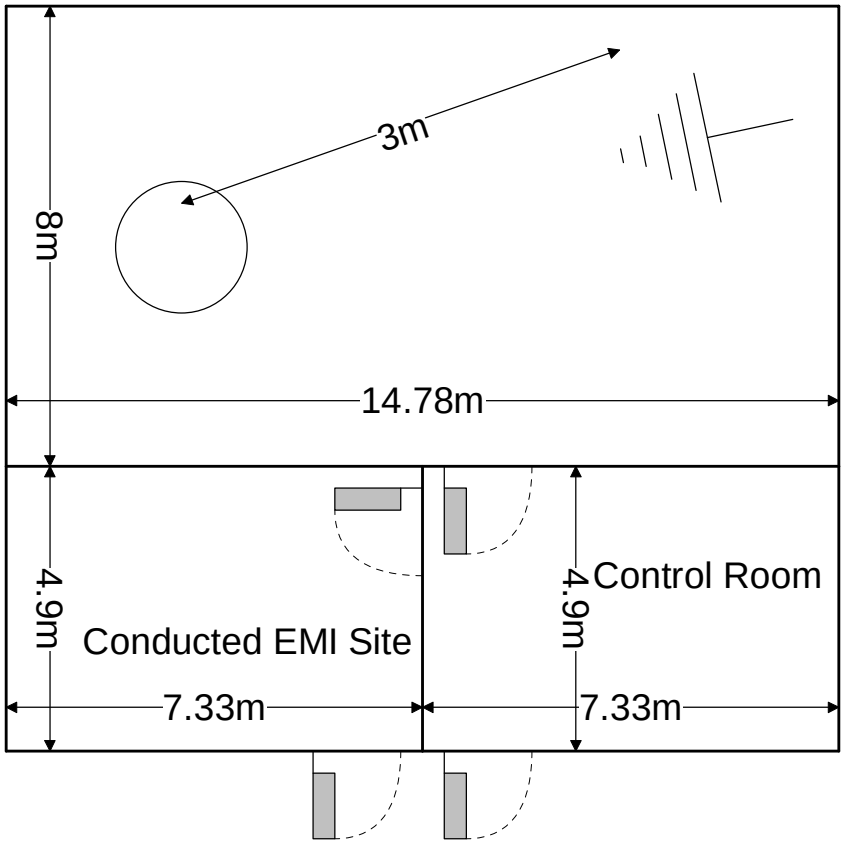


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m^3. The power line conducted emission site includes two LISNs: a Solar Model 8028-50 50 Ω/50 µH and an EMCO Model 3825/2R, which are installed as shown in the figure below. For evaluations requiring 230 V, 50 Hz AC input, a Polarad LISN (S/N 879341/048) is used in conjunction with a California Instruments signal generator Model 2001RP-OP1.

A diagram of the room is shown below in figure 2.3.2-1:

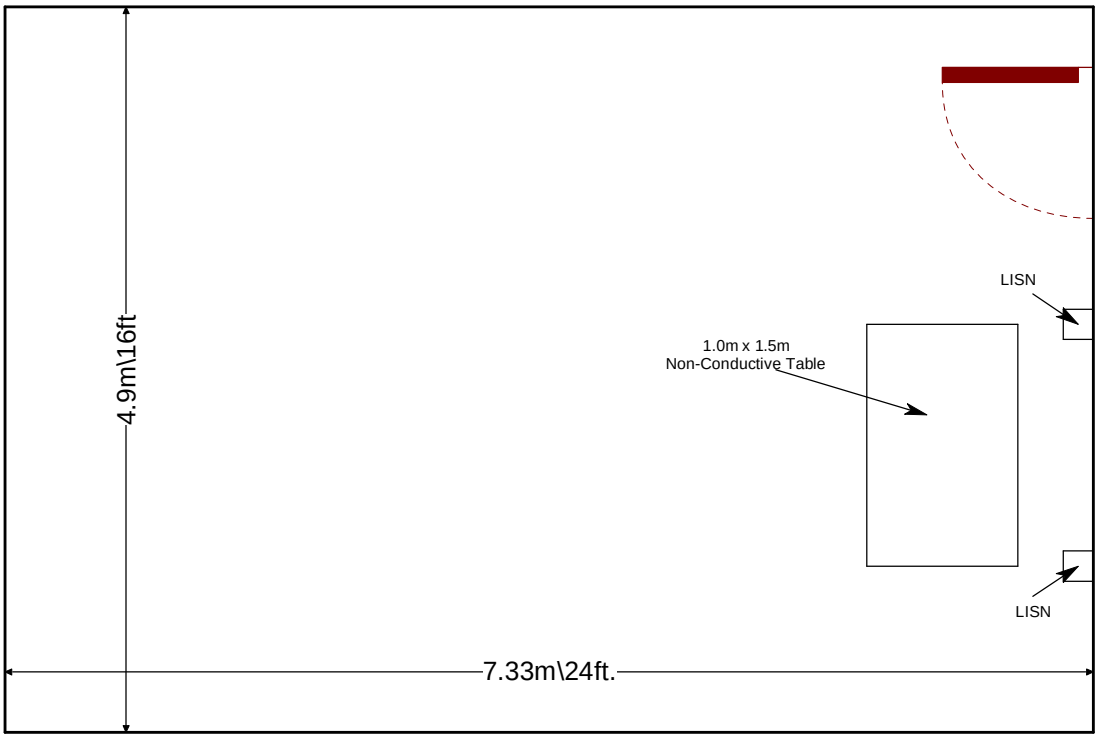


Figure 2.3.2-1: AC Mains Conducted EMI Site

3 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, 2017.
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2017
- Innovation, Science and Economic Development 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, February 2017.
- Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, November 2014.

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 List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
78	EMCO	6502	Antennas	9104-2608	5/11/2016	5/11/2018
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	7/21/2016	7/21/2018
523	Agilent	E7405	Spectrum Analyzers	MY45103293	12/9/2016	12/9/2018
2002	EMCO	3108	Antennas	2147	11/19/2015	11/19/2017
2004	EMCO	3146	Antennas	1385	11/19/2015	11/19/2017
2006	EMCO	3115	Antennas	2573	4/7/2017	4/7/2019
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	11/2/2016	11/2/2017
2022	EMCO	LISN3825/2R	LISN	1095	9/14/2015	9/14/2017
2045	ACS Boca	Conducted Cable Set	Cable Set	2045	10/31/2016	10/31/2017
2071	Trilithic, Inc.	4HC1400-1-KK	Filter	9643263	11/1/2016	11/1/2017
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	11/2/2016	11/2/2017
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/2/2016	12/2/2017
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR
2111	Aeroflex Inmet	40AH2W-20	Attenuator	2111	7/20/2016	7/20/2017
2112	Teledyne Storm Products	921-0101-036	Cables	12-06-698	11/2/2016	11/2/2017
2121	ACS Boca	Radiated Cable Set	Cable Set	2121	8/1/2016	8/1/2017
3004	Teseq	CFL 9206A	Attenuators	34720	9/14/2016	9/14/2017

Note: NCR=No Calibration Required

5 SUPPORT EQUIPMENT

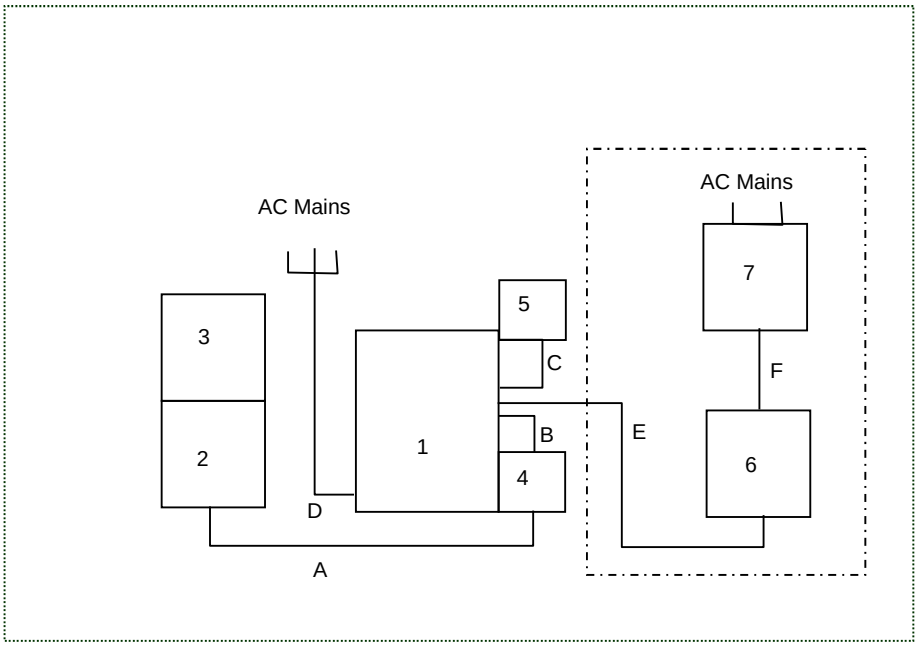
Table 5-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Mueller Systems	MiHUB-TTU	42000351
2	EUT (PA)	Mueller Systems	MS-G-EX-TTU-KIT-R	#2
3	Antenna	L-Com HyperLink Technologies	HG908U-PRO	#3
			HGV-906U	#4
4	Surge Protector	PolyPhaser	CGX+15NFNF-A	DL2013000023087
5	Cellular Antenna	Taoglas	FW.91.TNC.M	N/A
6	Ethernet Switch	NetGear	GS108	2162463553EED
7	Power Supply	Sagemcom	MSP-C0500IC12.0-6W-US	021308070448920

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Coaxial	1.83 m	Yes	Surger Protector to Power Amplifier
B	Coaxial	1.83 m	Yes	Control Unit to Surge Protector
C	Coaxial	1.83 m	Yes	Control Unit to Cell Antenna
D	Power	3.25 m	No	Control Unit to Power Source
E	Ethernet	2.07m / 10 m	No	Control Unit to Ethernet Switch
F	Power	2.2 m	No	Ethernet Switch to Power Supply

6 EQUIPMENT UNDER 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 EUT is marketed with a 8 dBi and a 6 dBi omnidirectional dipole antenna as described in Section 1.3. The EUT uses an N-type connector at the antenna port for the 900 MHz transceiver. The device is profesionally installed by trained Mueller technicians only and therefore satisfies the requirements of FCC Section 15.203.

7.2 Peak Output Power – FCC: Section 15.247(b)(2); ISED Canada: RSS-247 5.4(a)

7.2.1 Measurement Procedure (Conducted Method)

The RF output port of the equipment under test was directly connected to the input of the spectrum analyzer through suitable attenuation. The device employs 50 channels in this mode of operation. Therefore, the power is limited to 1 Watt. The measurements were performed using a peak detector.

7.2.2 Measurement Results

Performed by: Thierry Jean-Charles

Table 7.2.2-1: RF Output Power

Frequency [MHz]	Level [dBm]	Data Rate [bps]
912.31	27.96	4557.3
919.51	28.01	4557.3
927.01	26.61	4557.3
912.31	27.97	2604.2
919.51	28.02	2604.2
927.01	26.47	2604.2

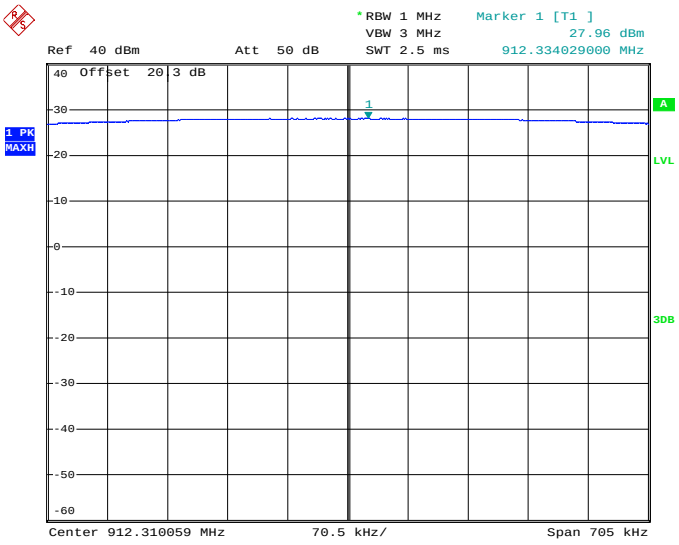


Figure 7.2.2-1: RF Output Power - Low Channel – 4557.3 bps

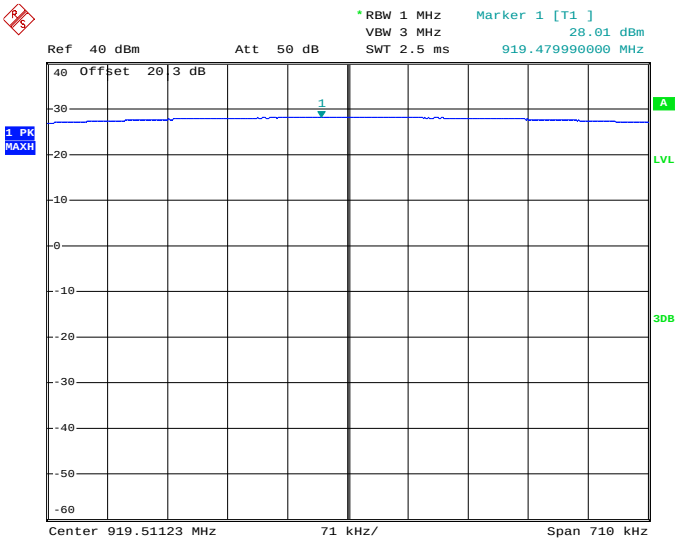


Figure 7.2.2-2: RF Output Power - Middle Channel – 4557.3 bps

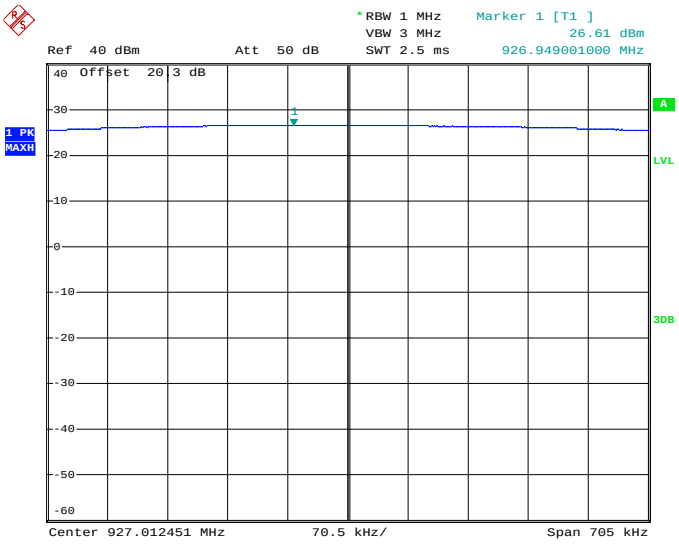


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Figure 7.2.2-3: RF Output Power - High Channel – 4557.3 bps

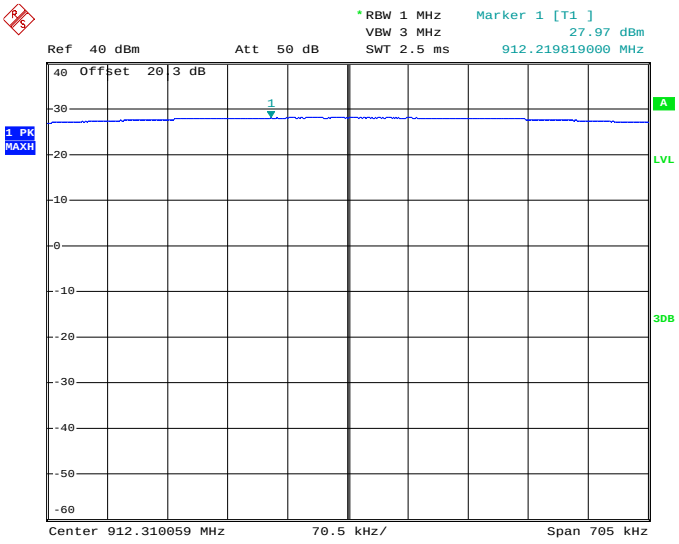

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Figure 7.2.2-4: RF Output Power - Low Channel – 2604.2 bps

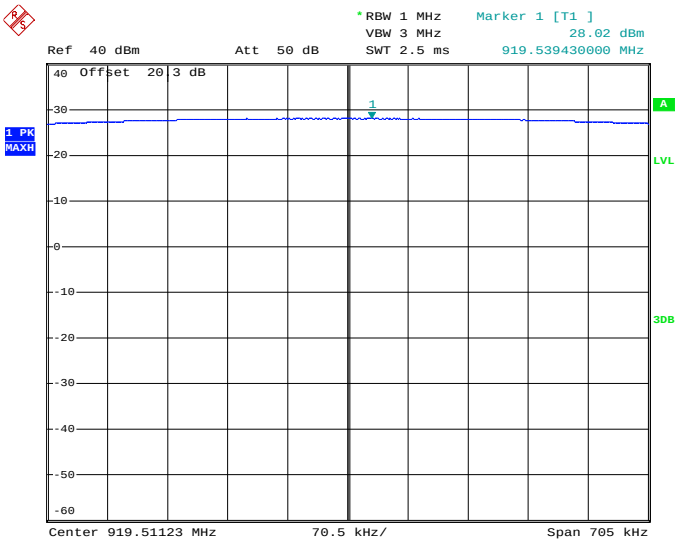

Figure 7.2.2-5: RF Output Power - Middle Channel – 2604.2 bps

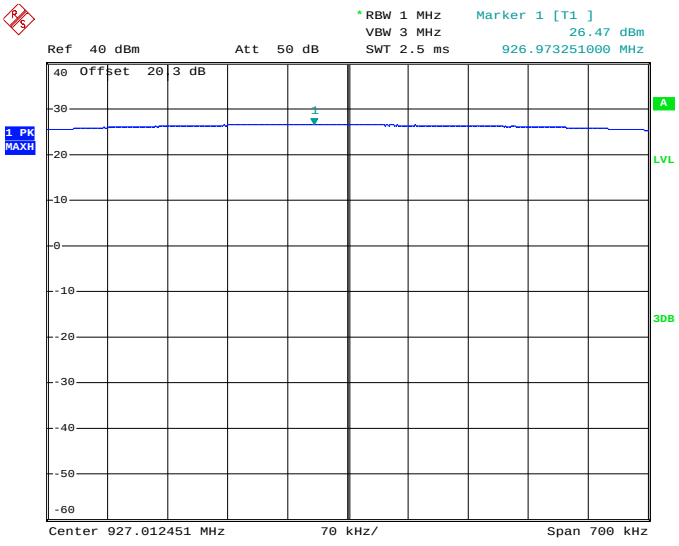

Figure 7.2.2-6: RF Output Power - High Channel – 2604.2 bps

7.3 Channel Usage Requirements

7.3.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1); ISED Canada: RSS-247 5.1(b)

7.3.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks. The RBW was set to approximately 30 % of the channel spacing and adjusted as necessary to best identify the center of each channel. The VBW was set > RBW.

7.3.1.2 Measurement Results

Performed by: Thierry Jean-Charles

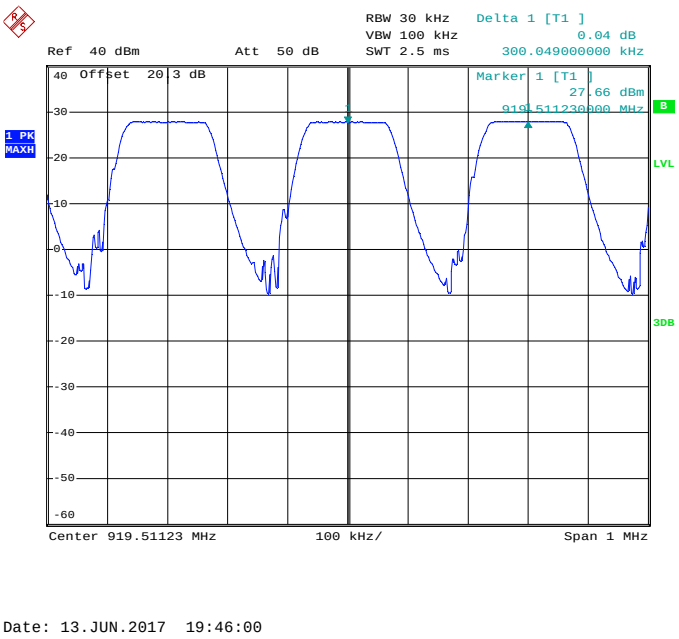

Figure 7.3.1.2-1: Frequency Separation – 4557.3 bps

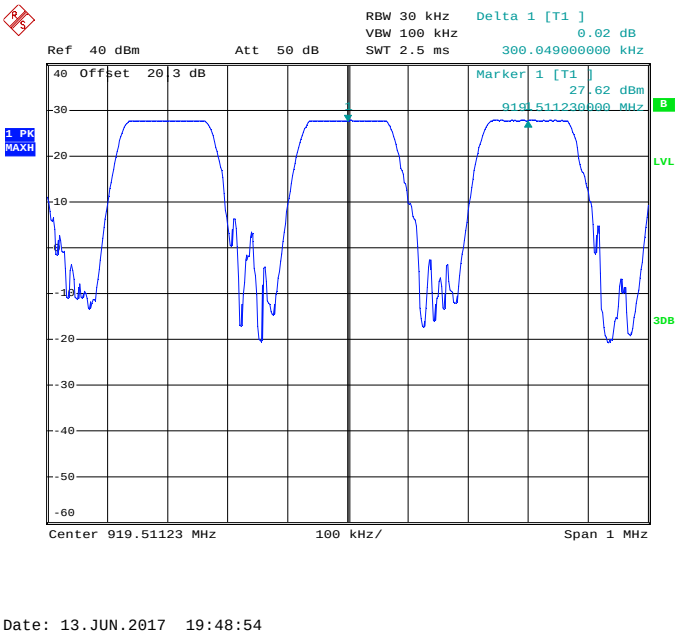

Figure 7.3.1.2-2: Frequency Separation – 2604.2 bps

7.3.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(c)

7.3.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The span of the spectrum analyzer was set wide enough to capture the frequency band of operation. The RBW was set to < 30 % of the channel spacing and VBW set to ≥ RBW.

7.3.2.2 Measurement Results

Performed by: Thierry Jean-Charles

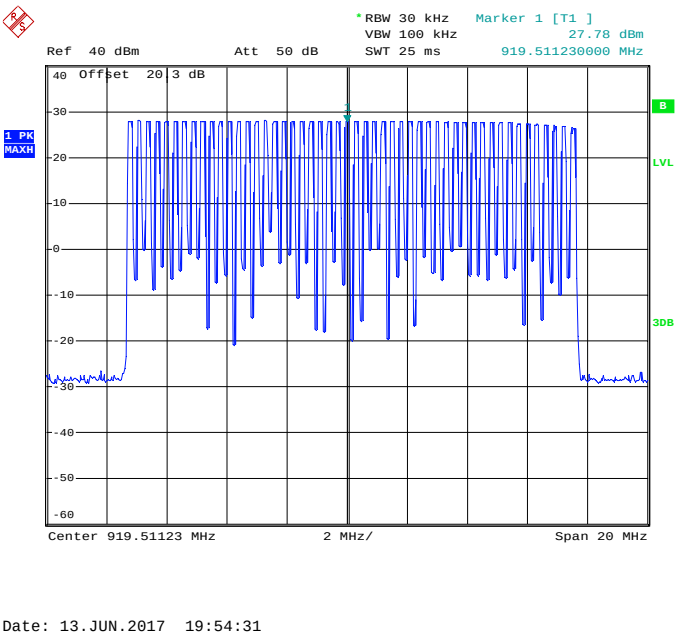

Figure 7.3.2.2-1: No. of Hopping Channels – 4557.3 bps

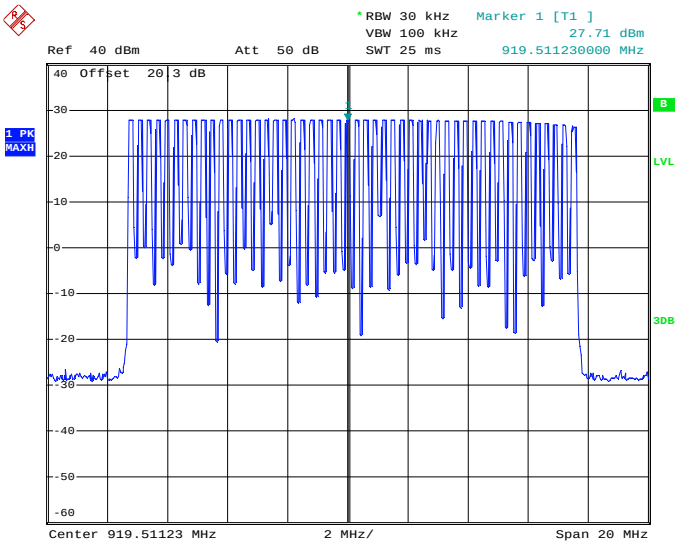

Figure 7.3.2.2-2: No. of Hopping Channels – 2604.2 bps

7.3.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1(4)

7.3.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set 0 Hz centered on a hopping channel. The RBW was set to less than 30% of the channel spacing and the sweep time adjusted to capture the entire dwell time per channel with peak detector max hold function.

7.3.3.2 Measurement Results

Results are shown below:

Table 7.3.3.2-1 Dwell Time on a 20 Second Cycle

Number of hops on a 20 s Cycle [NHP]	Measured Dwell Times [ms]	Dwell Times on a 20 s Cycle [ms]	Limit [ms]	Data Rate [bps]	Status
1	205.500	205.50	400	4557.3	PASS
1	387.500	387.50	400	2604.2	PASS

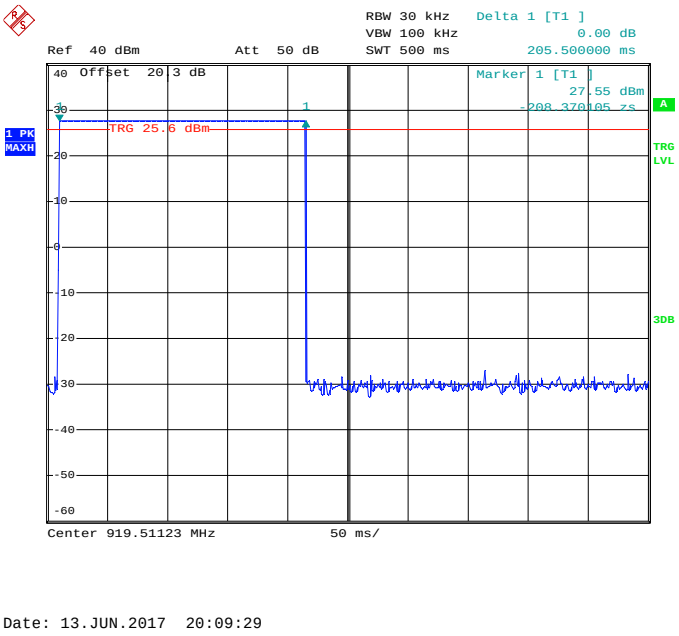

Figure 7.3.3.2-1: Channel Dwell Time - 4557.3 bps

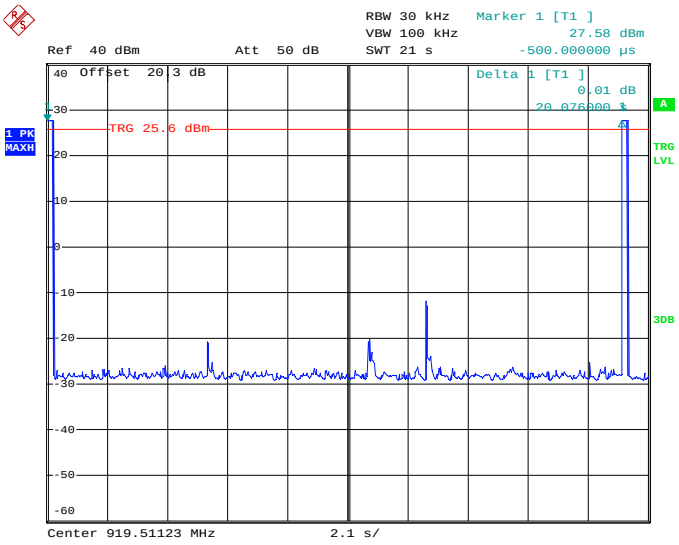

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Figure 7.3.3.2-2: Channel Dwell Time - 4557.3 bps (20 s)

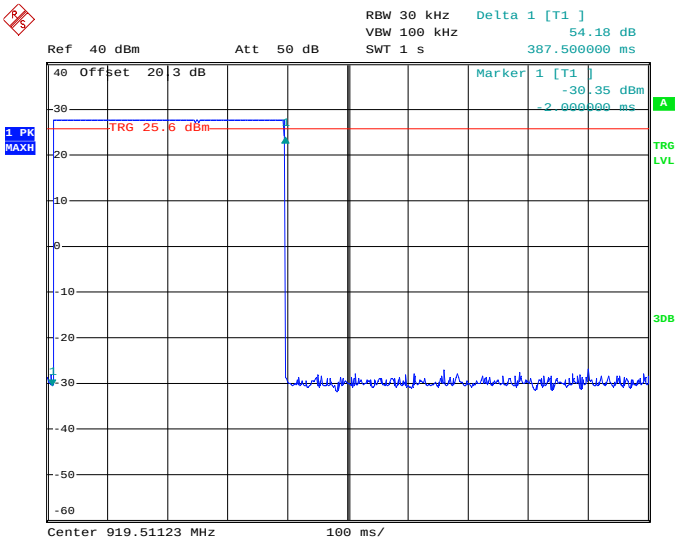

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Figure 7.3.3.2-3: Channel Dwell Time – 2604.2 bps

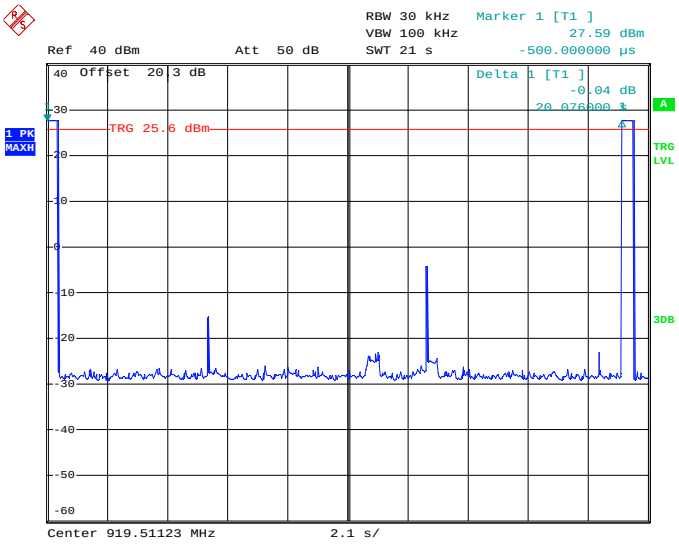

Figure 7.3.3.2-4: Channel Dwell Time – 2604.2 bps (20 s)

7.3.4 20 dB Bandwidth - FCC: Section 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(c); 99% Bandwidth ISED Canada: RSS-GEN 6.6

7.3.4.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The span of the spectrum analyzer display was set between two times and five times the estimated bandwidth of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The trace was set to max hold with a peak detector active. The ndB down measurement function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission. The RBW was set to 1% to 5% of the approximated bandwidth. The occupied 99% bandwidth was measured by using 99% bandwidth equipment function of the spectrum analyzer using a peak detector.

7.3.4.2 Measurement Results

Performed by: Thierry Jean-Charles

Table 7.3.4.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]	Data Rate [bps]
912.31	141.00	125.00	4557.3
919.51	142.00	126.00	4557.3
927.01	141.00	125.00	4557.3
912.31	141.00	126.00	2604.2
919.51	141.00	126.00	2604.2
927.01	140.00	126.00	2604.2

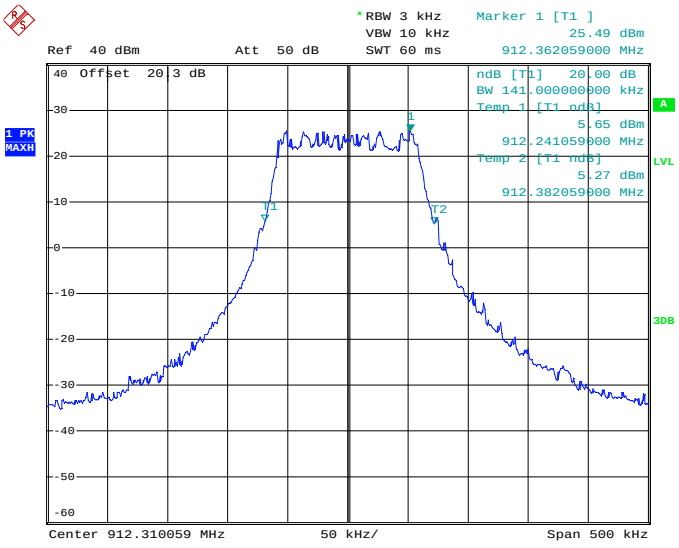

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Figure 7.3.4.2-1: 20dB BW - Low Channel – 4557.3 bps

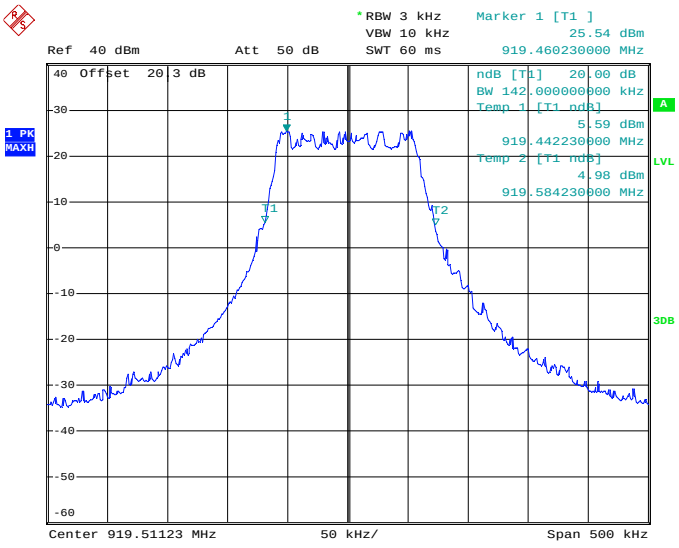

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Figure 7.3.4.2-2: 20dB BW - Middle Channel – 4557.3 bps

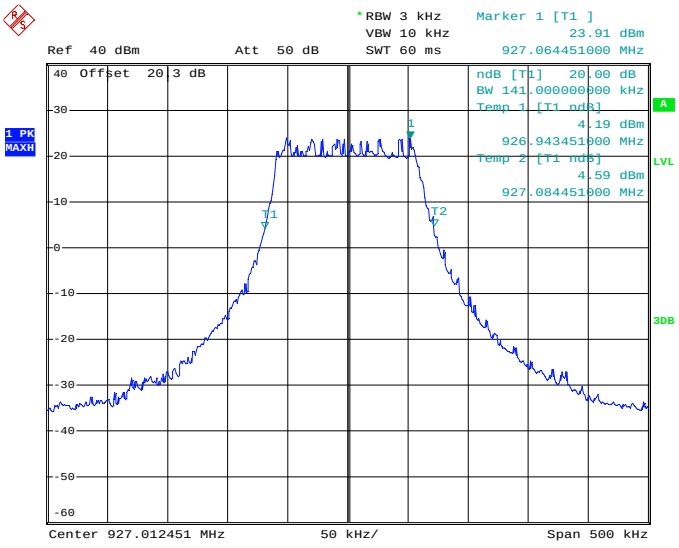

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Figure 7.3.4.2-3: 20dB BW - High Channel – 4557.3 bps

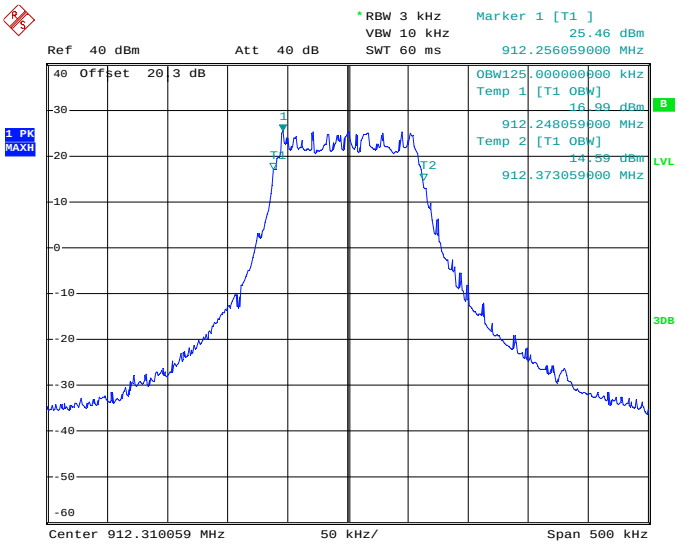

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Figure 7.3.4.2-4: 99% OBW - Low Channel – 4557.3 bps

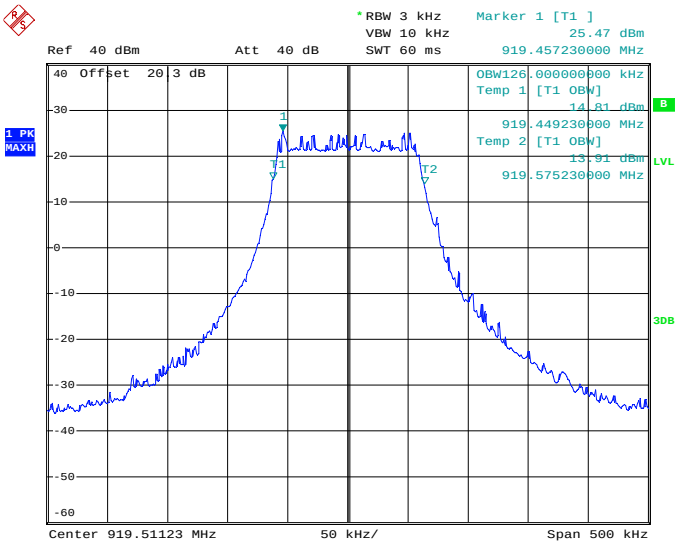

Figure 7.3.4.2-5: 99% OBW - Middle Channel – 4557.3 bps

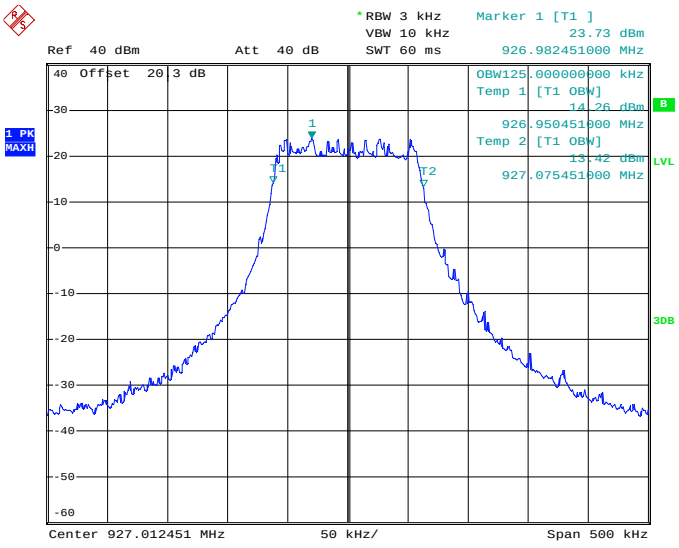

Figure 7.3.4.2-6: 99% OBW - High Channel – 4557.3 bps

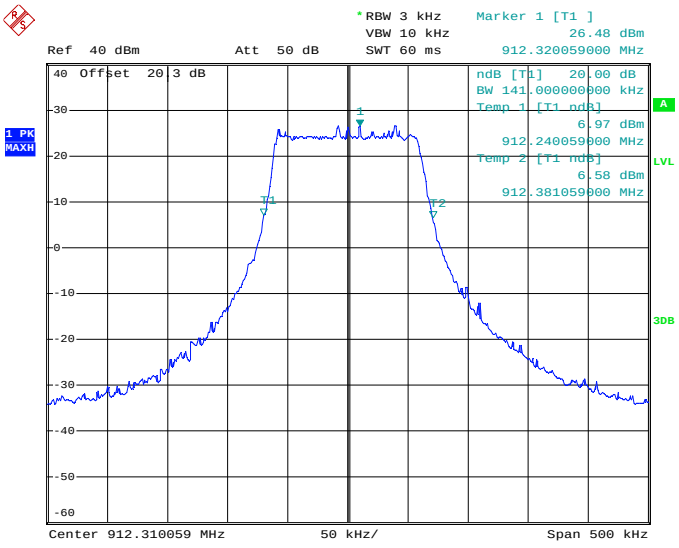

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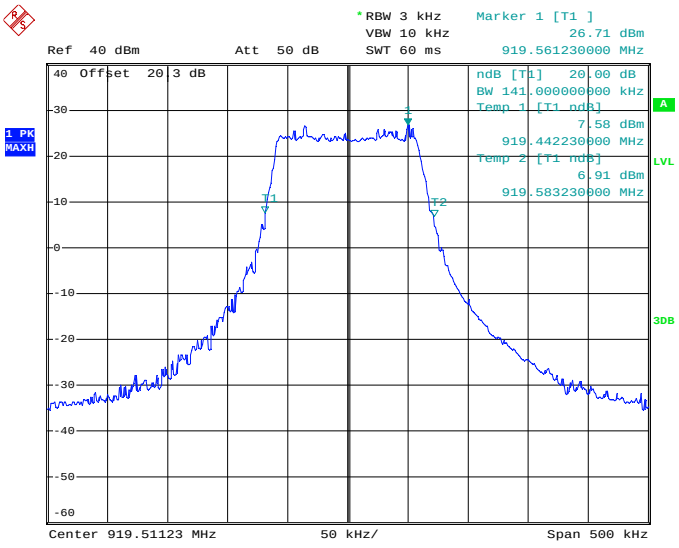
Figure 7.3.4.2-7: 20dB BW - Low Channel – 2604.2 bps



Date: 14.JUN.2017 09:50:47

Figure 7.3.4.2-8: 20dB BW - Middle Channel – 2604.2 bps

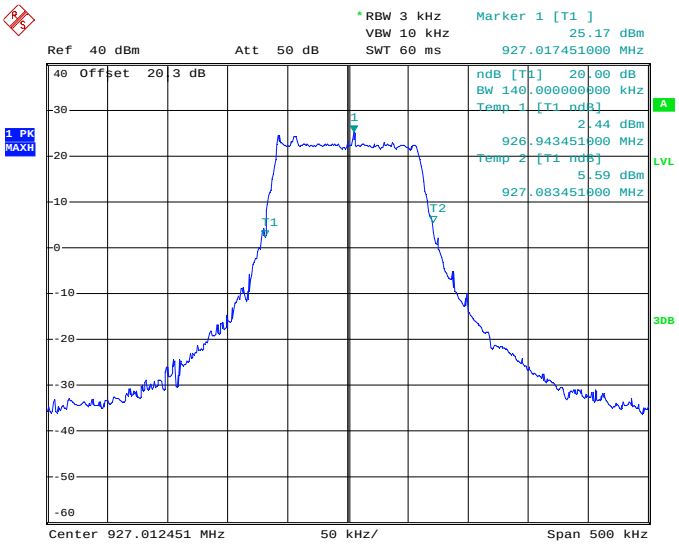


Figure 7.3.4.2-9: 20dB BW - High Channel – 2604.2 bps

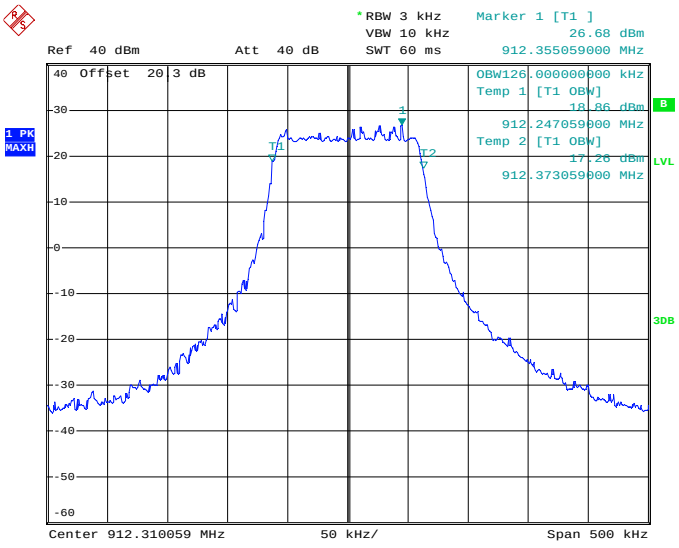
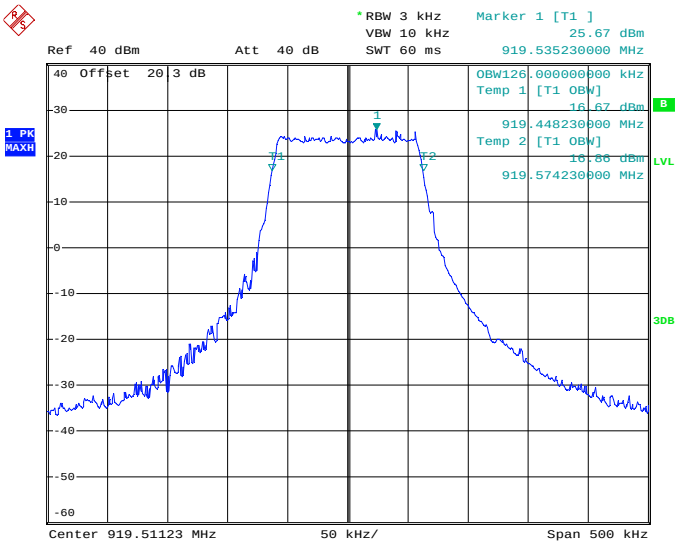
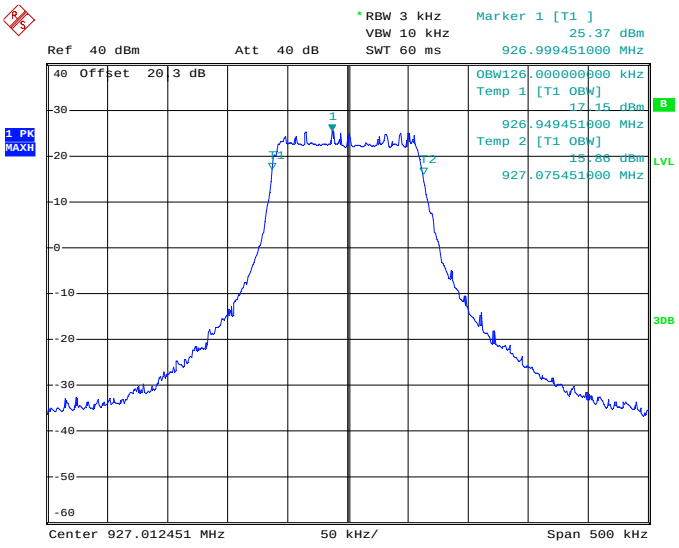


Figure 7.3.4.2-10: 99% OBW - Low Channel – 2604.2 bps



Date: 14.JUN.2017 09:48:34

Figure 7.3.4.2-11: 99% OBW - Middle Channel – 2604.2 bps



Date: 14.JUN.2017 10:00:19

Figure 7.3.4.2-12: 99% OBW - High Channel – 2604.2 bps

7.4 Band-Edge and Spurious Emissions

7.4.1 Band-Edge Compliance of RF Conducted Emissions – FCC: Section 15.247(d); ISED Canada: RSS-247 5.5

7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer via suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement, the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to 300 kHz.

7.4.1.2 Measurement Results

Performed by: Thierry Jean-Charles

Non-Hopping Mode

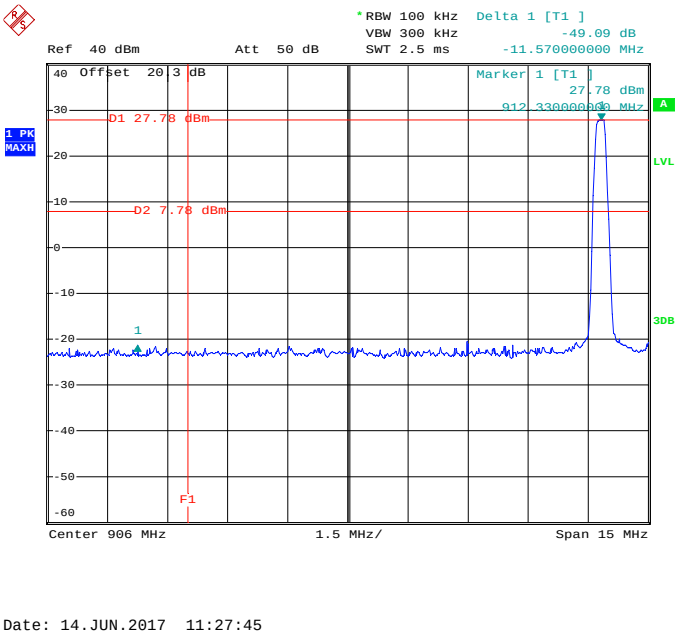
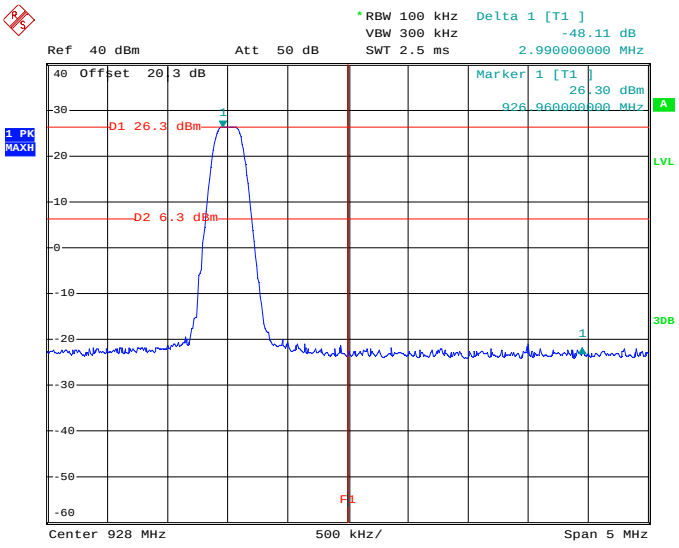
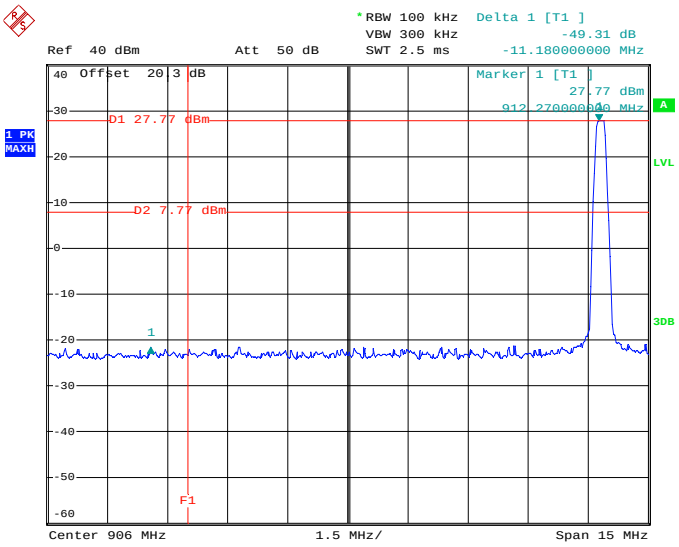


Figure 7.4.1.2-1: Lower Band-edge – 4557.3 bps



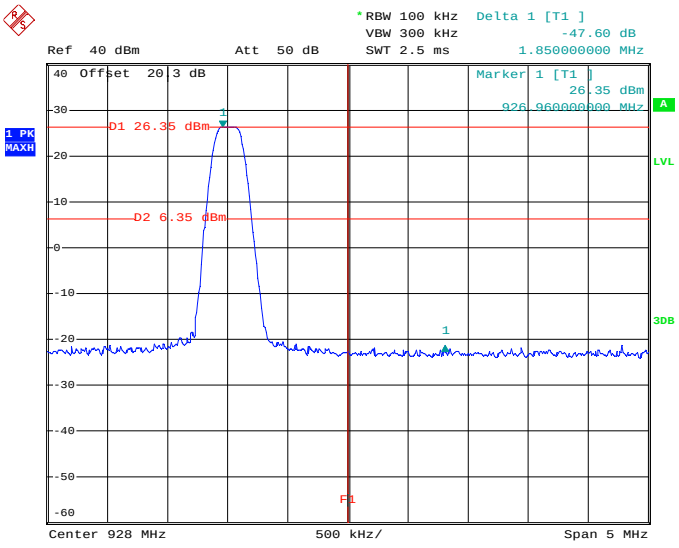
Date: 14.JUN.2017 10:26:38

Figure 7.4.1.2-2: Upper Band-edge – 4557.3 bps



Date: 14.JUN.2017 10:55:13

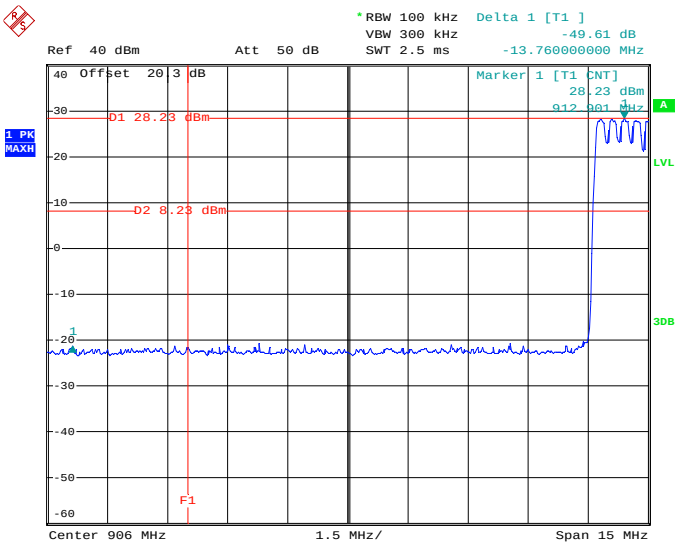
Figure 7.4.1.2-3: Lower Band-edge – 2604.2 bps



Date: 14.JUN.2017 10:49:59

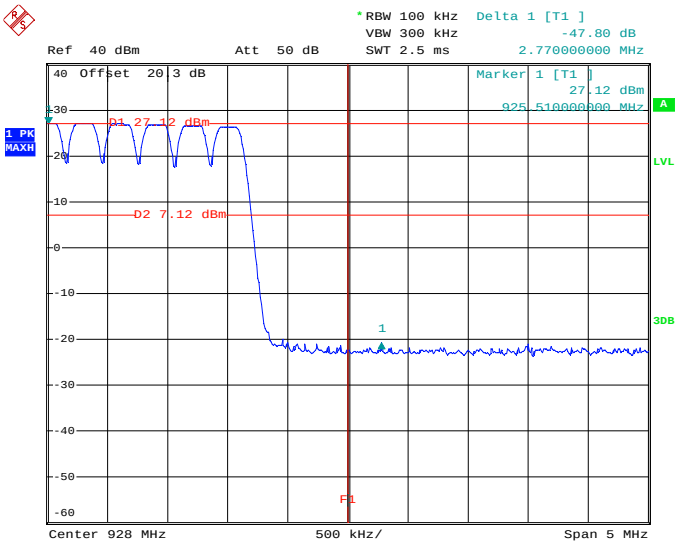
Figure 7.4.1.2-4: Upper Band-edge – 2604.2 bps

Hopping Mode



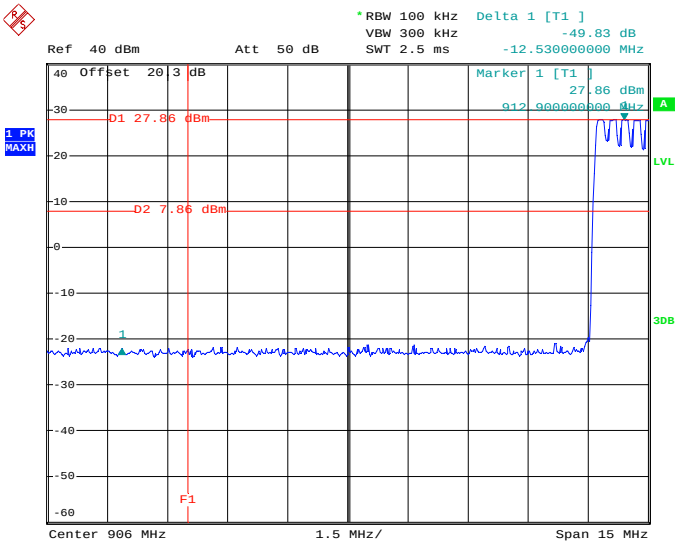
Date: 14.JUN.2017 11:22:55

Figure 7.4.1.2-5: Lower Band-edge – 4557.3 bps



Date: 14.JUN.2017 10:35:02

Figure 7.4.1.2-6: Upper Band-edge – 4557.3 bps



Date: 14.JUN.2017 11:01:52

Figure 7.4.1.2-7: Lower Band-edge – 2604.2 bps

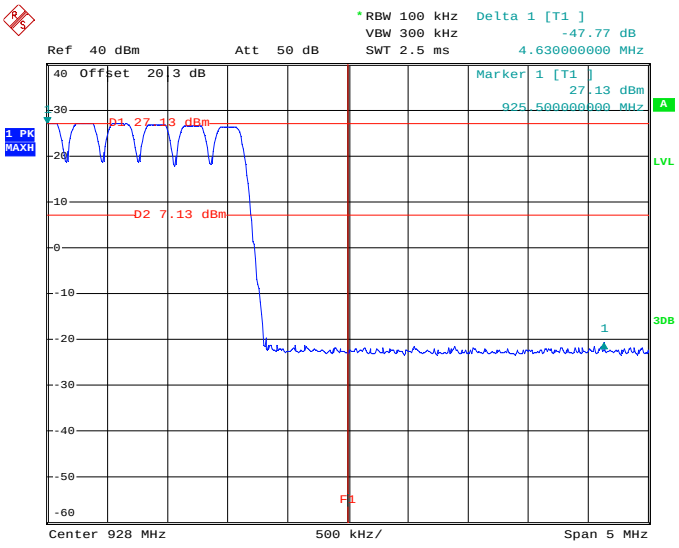


Figure 7.4.1.2-8: Upper Band-edge – 2604.2 bps

7.4.2 RF Conducted Spurious Emissions – FCC: Section 15.247(d); ISED Canada: RSS-247 5.5

7.4.2.1 Measurement Procedure

The RF output port of the equipment under test was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30 MHz to 10 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak Max Hold function of the analyzer was utilized.

7.4.2.2 Measurement Results

Performed by: Thierry Jean-Charles

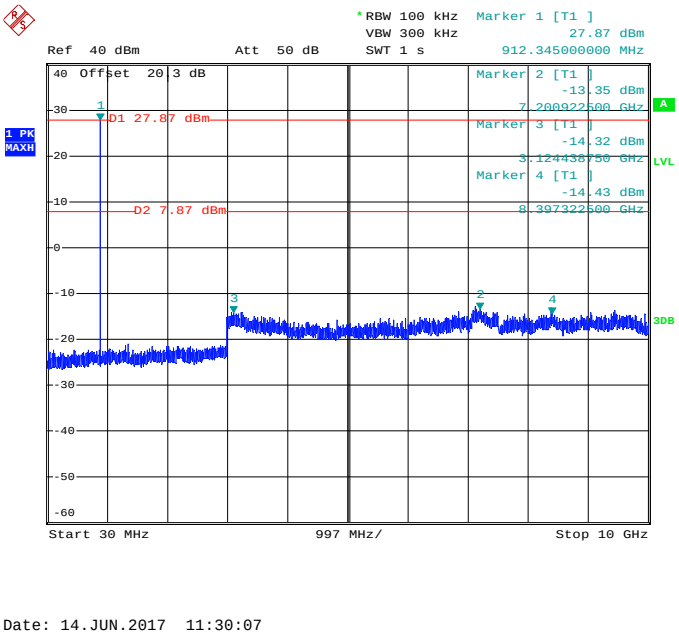
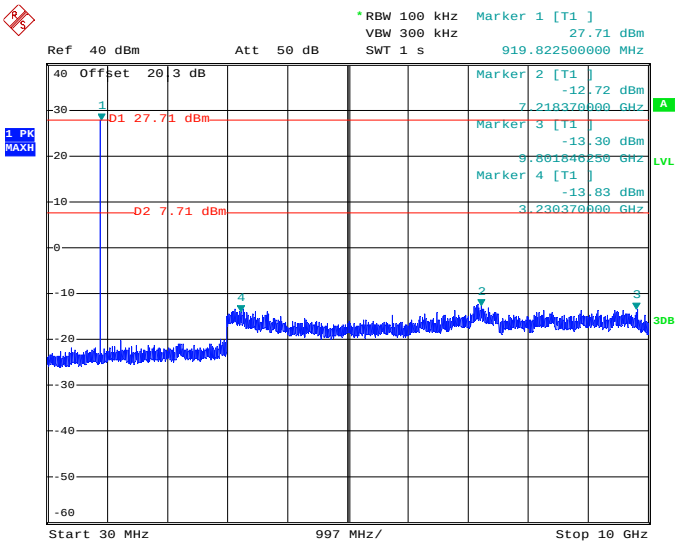
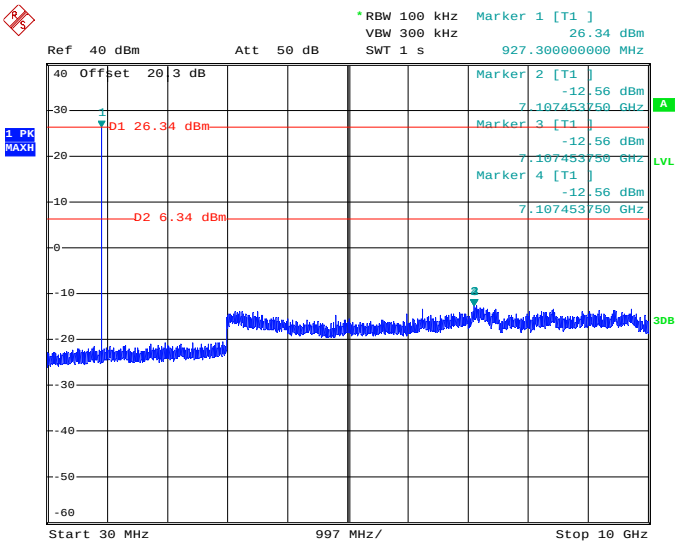


Figure 7.4.2.2-1: 30 MHz – 10 GHz – Low Channel – 4557.3 bps



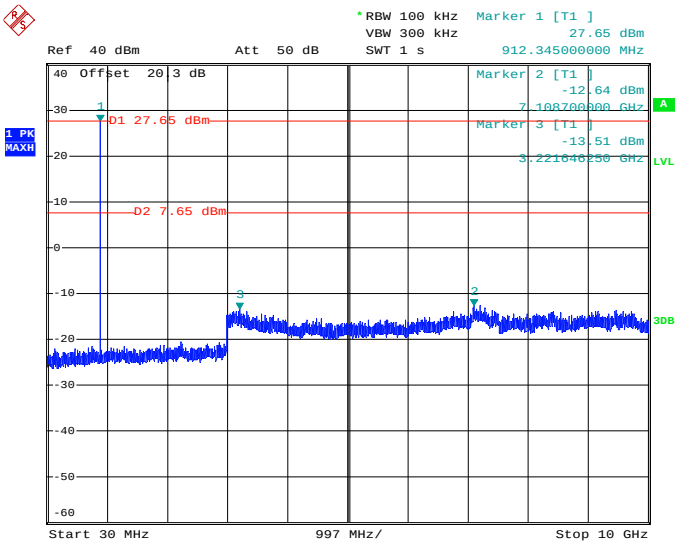
Date: 14.JUN.2017 11:33:50

Figure 7.4.2.2-2: 30 MHz – 10 GHz –Middle Channel – 4557.3 bps



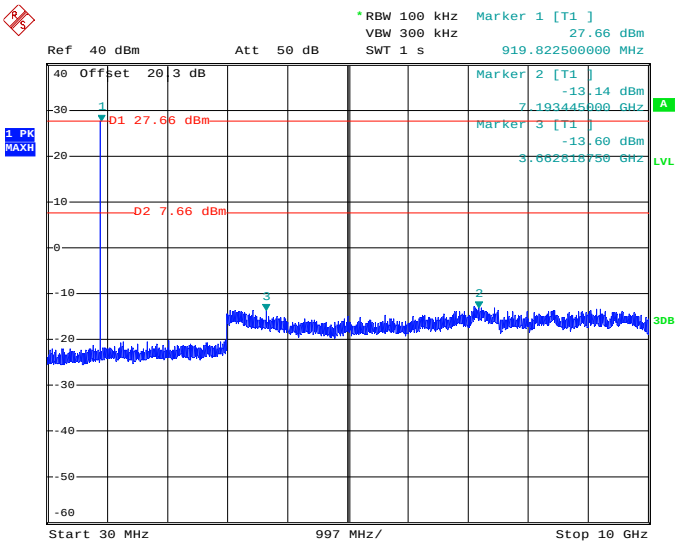
Date: 14.JUN.2017 11:38:16

Figure 7.4.2.2-3: 30 MHz – 10 GHz – High Channel – 4557.3 bps



Date: 14.JUN.2017 11:41:33

Figure 7.4.2.2-4: 30 MHz – 10 GHz – Low Channel – 2604.2 bps



Date: 14.JUN.2017 11:48:19

Figure 7.4.2.2-5: 30 MHz – 10 GHz –Middle Channel – 2604.2 bps

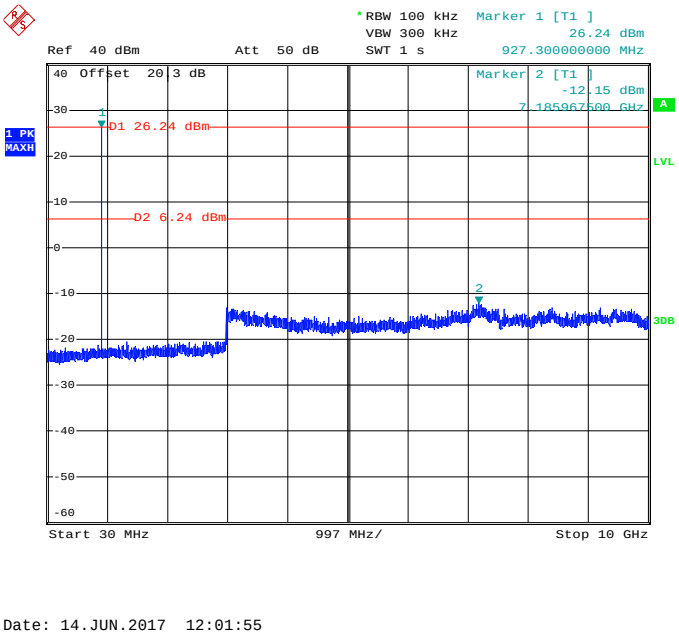


Figure 7.4.2.2-6: 30 MHz – 10 GHz – High Channel – 2604.2 bps

7.4.3 Radiated Spurious Emissions into Restricted Frequency Bands – FCC: Sections 15.205, 15.209; ISED Canada: RSS-Gen 8.9, 8.10

7.4.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 10 GHz, 10 times the highest fundamental frequency. 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.

For measurements below 30 MHz, the receive antenna height was set to 1m and the EUT was rotated through 360 degrees. The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

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 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak measurements are made with RBW of 1 MHz and VBW of 3 MHz. Average measurements are performed in the linear scale using VBW of 30 Hz.

7.4.3.2 Measurement Results

Performed by: Jean Rene

Radiated band-edge and spurious emissions found in the restricted frequency bands of 9 kHz to 10 GHz are reported in the tables below.

Table 7.4.3.2-1: Radiated Spurious Emissions Tabulated Data - HG908U-PRO Antenna

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
Low Channel										
2736.93	50.38	43.40	H	-3.36	47.02	40.04	74.0	54.0	27.0	14.0
2736.93	48.72	38.91	V	-3.36	45.36	35.55	74.0	54.0	28.6	18.4
3649.24	46.21	36.53	H	0.19	46.40	36.72	74.0	54.0	27.6	17.3
3649.24	47.83	40.60	V	0.19	48.02	40.79	74.0	54.0	26.0	13.2
4561.55	44.87	31.80	H	2.50	47.37	34.30	74.0	54.0	26.6	19.7
4561.55	43.86	30.48	V	2.50	46.36	32.98	74.0	54.0	27.6	21.0
7298.48	44.75	33.79	H	9.18	53.93	42.97	74.0	54.0	20.1	11.0
7298.48	46.93	38.31	V	9.18	56.11	47.49	74.0	54.0	17.9	6.5
Middle Channel										
2758.53	50.55	43.70	H	-3.26	47.29	40.44	74.0	54.0	26.7	13.6
2758.53	47.89	39.06	V	-3.26	44.63	35.80	74.0	54.0	29.4	18.2
3678.04	46.67	36.42	H	0.31	46.98	36.73	74.0	54.0	27.0	17.3
3678.04	48.60	40.78	V	0.31	48.91	41.09	74.0	54.0	25.1	12.9
4597.55	43.83	31.17	H	2.63	46.46	33.80	74.0	54.0	27.5	20.2
4597.55	43.53	30.90	V	2.63	46.16	33.53	74.0	54.0	27.8	20.5
7356.08	46.04	35.59	H	9.25	55.29	44.84	74.0	54.0	18.7	9.2
7356.08	47.14	38.94	V	9.25	56.39	48.19	74.0	54.0	17.6	5.8
High Channel										
2781.036	50.01	43.03	H	-3.15	46.86	39.88	74.0	54.0	27.1	14.1
2781.036	48.00	38.58	V	-3.15	44.85	35.43	74.0	54.0	29.1	18.6
3708.048	47.10	36.54	H	0.44	47.54	36.98	74.0	54.0	26.5	17.0
3708.048	48.61	40.96	V	0.44	49.05	41.40	74.0	54.0	25.0	12.6
4635.06	44.08	31.02	H	2.77	46.85	33.79	74.0	54.0	27.1	20.2
4635.06	43.87	30.98	V	2.77	46.64	33.75	74.0	54.0	27.4	20.2
7416.096	46.47	36.33	H	9.33	55.80	45.66	74.0	54.0	18.2	8.3
7416.096	46.71	38.06	V	9.33	56.04	47.39	74.0	54.0	18.0	6.6

Notes:

All emissions above 7.42 GHz were attenuated below the limits and the noise floor of the measurement equipment.

Table 7.4.3.2-2: Radiated Spurious Emissions Tabulated Data – HGV-906U Antenna

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
Low Channel										
2736.93	49.94	42.49	H	-3.36	46.58	39.13	74.0	54.0	27.4	14.9
2736.93	48.69	38.60	V	-3.36	45.33	35.24	74.0	54.0	28.7	18.8
3649.24	46.26	36.31	H	0.19	46.45	36.50	74.0	54.0	27.5	17.5
3649.24	47.70	40.48	V	0.19	47.89	40.67	74.0	54.0	26.1	13.3
4561.55	44.36	32.01	H	2.50	46.86	34.51	74.0	54.0	27.1	19.5
4561.55	43.78	30.48	V	2.50	46.28	32.98	74.0	54.0	27.7	21.0
7298.48	45.52	34.77	H	9.18	54.70	43.95	74.0	54.0	19.3	10.1
7298.48	46.71	38.35	V	9.18	55.89	47.53	74.0	54.0	18.1	6.5
Middle Channel										
2758.53	49.62	43.09	H	-3.26	46.36	39.83	74.0	54.0	27.6	14.2
2758.53	47.33	38.43	V	-3.26	44.07	35.17	74.0	54.0	29.9	18.8
3678.04	46.03	36.19	H	0.31	46.34	36.50	74.0	54.0	27.7	17.5
3678.04	47.90	40.46	V	0.31	48.21	40.77	74.0	54.0	25.8	13.2
4597.55	43.94	31.08	H	2.63	46.57	33.71	74.0	54.0	27.4	20.3
4597.55	43.39	30.37	V	2.63	46.02	33.00	74.0	54.0	28.0	21.0
7356.08	45.96	35.97	H	9.25	55.21	45.22	74.0	54.0	18.8	8.8
7356.08	46.75	38.30	V	9.25	56.00	47.55	74.0	54.0	18.0	6.4
High Channel										
2781.036	50.06	42.73	H	-3.15	46.91	39.58	74.0	54.0	27.1	14.4
2781.036	48.07	38.30	V	-3.15	44.92	35.15	74.0	54.0	29.1	18.8
3708.048	46.38	36.21	H	0.44	46.82	36.65	74.0	54.0	27.2	17.4
3708.048	48.24	40.58	V	0.44	48.68	41.02	74.0	54.0	25.3	13.0
4635.06	43.75	30.84	H	2.77	46.52	33.61	74.0	54.0	27.5	20.4
4635.06	43.54	31.01	V	2.77	46.31	33.78	74.0	54.0	27.7	20.2
7416.096	46.52	36.60	H	9.33	55.85	45.93	74.0	54.0	18.2	8.1
7416.096	47.07	38.03	V	9.33	56.40	47.36	74.0	54.0	17.6	6.6

Notes:

All emissions above 7.42 GHz were attenuated below the limits and the noise floor of the measurement equipment.

7.4.3.3 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: 50.38+ (-3.36) = 47.02 dBµV/m
Margin: 74 dBµV/m – 47.02 dBµV/m = 27.0 dB

Example Calculation: Average
Corrected Level: 43.4 + (-3.36) = 40.04 dBµV/m
Margin: 54 dBµV/m – 40.04 dBµV/m = 14.0 dB

7.5 Power Line Conducted Emissions – FCC: Section 15.207; ISED Canada: RSS-Gen 8.8

7.5.1 Measurement Procedure

ANSI C63.10 section 6.2 was the guiding document for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

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

7.5.2 Measurement Results

Performed by: Jean Rene

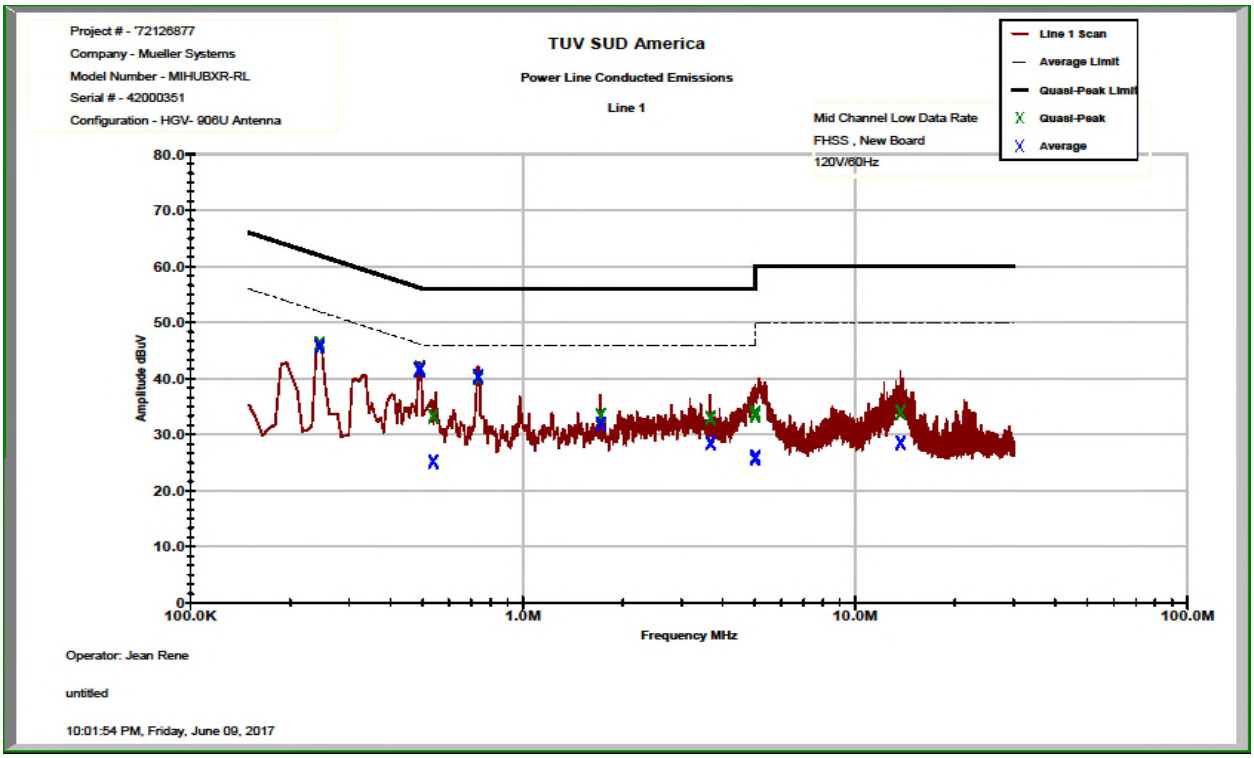


Figure 7.5.2-1: Conducted Emissions Results – Line 1

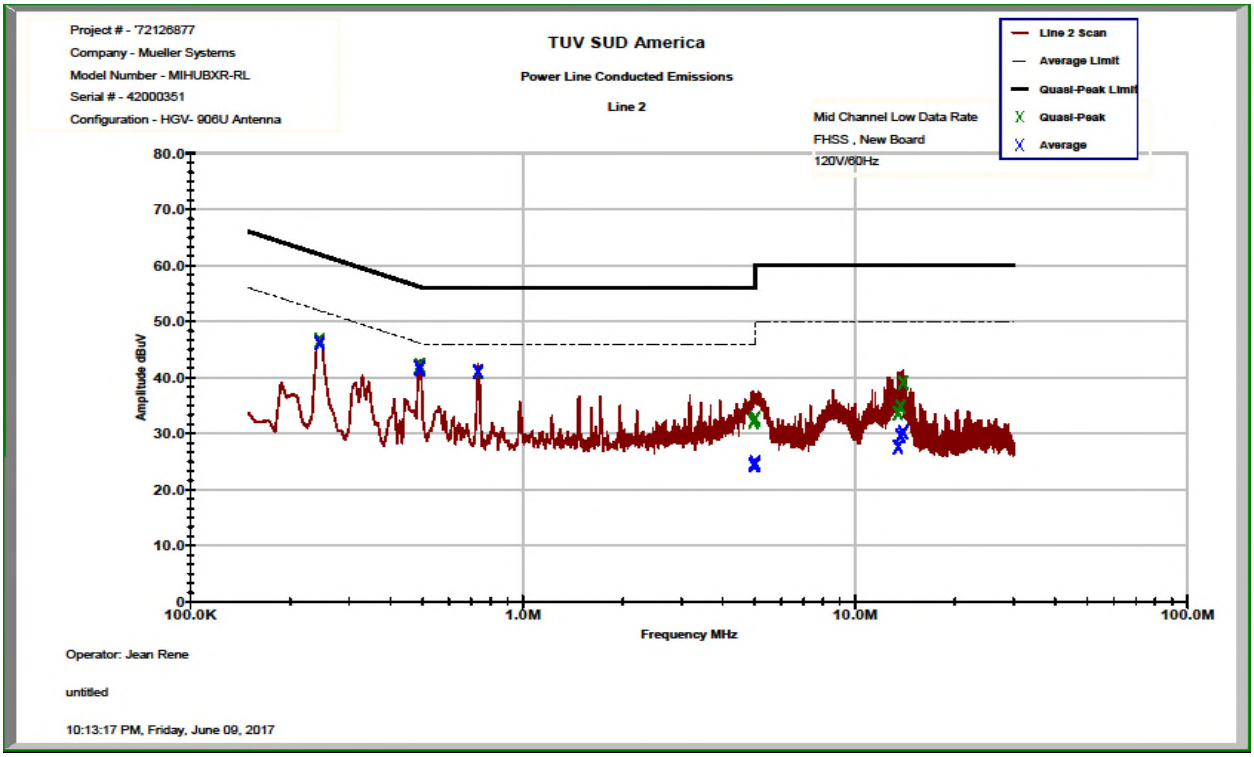


Figure 7.5.2-2: Conducted Emissions Results – Line 2

Table 7.5.2-1: Conducted EMI Results

☒ Line 1 ☒ Line 2 ☐ Line 3
☐ Line 4
☒ To Ground ☐ Floating
☐ Telecom Port _____
☒ dBµV ☐ dBµA

Plot Number:
72126877_MUE_CE01
Power Supply Description: N/A

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.245363	36.015	35.447	10.27	46.28	45.72	61.91	51.91	15.6	6.2
0.488299	31.477	31.204	10.28	41.76	41.49	56.20	46.20	14.4	4.7
0.490025	31.614	31.337	10.28	41.90	41.62	56.17	46.17	14.3	4.5
0.537013	23.016	14.945	10.26	33.28	25.21	56.00	46.00	22.7	20.8
0.734875	29.857	30.112	10.27	40.12	40.38	56.00	46.00	15.9	5.6
1.71436	23.053	21.58	10.29	33.34	31.87	56.00	46.00	22.7	14.1
3.66659	22.493	18.008	10.44	32.94	28.45	56.00	46.00	23.1	17.6
4.99945	22.92	15.11	10.50	33.42	25.61	56.00	46.00	22.6	20.4
5.01435	23.353	15.482	10.55	33.91	26.04	60.00	50.00	26.1	24.0
13.6973	23.046	17.6	10.90	33.95	28.50	60.00	50.00	26.1	21.5
Line 2									
0.245463	36.366	35.92	10.21	46.58	46.13	61.91	51.91	15.3	5.8
0.488875	31.705	31.421	10.23	41.93	41.65	56.19	46.19	14.3	4.5
0.489499	31.948	31.228	10.23	42.17	41.45	56.18	46.18	14.0	4.7
0.734375	30.733	30.84	10.22	40.96	41.06	56.00	46.00	15.0	4.9
4.94029	21.629	13.964	10.47	32.10	24.43	56.00	46.00	23.9	21.6
4.9981	22.076	13.965	10.47	32.54	24.43	56.00	46.00	23.5	21.6
4.99905	22.118	14.241	10.47	32.59	24.71	56.00	46.00	23.4	21.3
13.4712	22.764	16.733	10.86	33.62	27.59	60.00	50.00	26.4	22.4
13.6958	23.909	18.701	10.86	34.77	29.57	60.00	50.00	25.2	20.4
13.9385	28.174	19.237	10.87	39.05	30.11	60.00	50.00	21.0	19.9

8 MEASUREMENT UNCERTAINTIES

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%.

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 ≤ 1GHz	± 3.93 dB
Radiated Emissions > 1GHz	± 5.814 dB
Temperature	± 0.860 °C
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	±2.93 dB

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the model MiHUB-TTU, manufactured by Mueller Systems, meets the requirements of FCC Part 15.247 and Industry Canada's Radio Standards Specification RSS-247 for the tests documented herein.

END REPORT