Excellence in Compliance Testing

Certification Test Report

FCC ID: AZ492FT7089
IC: 109U-92FT7089

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

ACS Report Number: 16-2041.W06.1C

Applicant: Motorola Solutions

Model(s): M37TSS9PW1AN

Test Begin Date: **August 11, 2016**
Test End Date: **September 2, 2016**

Report Issue Date: November 8, 2016

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

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.

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This report contains 30 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 and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

1.2 Applicant Information

Motorola Solutions
8000 West Sunrise Blvd
Sunrise, FL 33322

1.3 Product Description

The Motorola Solutions, Inc, APX8500 model M37TSS9PW1AN is a two-way mobile radio, which supports multiple land mobile radio bands such as VHF, UHF and 7/800 MHz. Additionally, the equipment provides 2.4 GHz 802.11b/g/n Wi-Fi as well as a Bluetooth Classic and Bluetooth Low Energy (BLE) capabilities. The test report documents the evaluation of the Bluetooth Low Energy transceiver.

Technical Details

Mode of Operation:	Bluetooth Low Energy (BLE)
Frequency Range:	2402 MHz - 2480 MHz
Number of Channels:	40
Channel Separation:	2 MHz
Modulations:	GFSK
Antenna Type/Gain:	Monopole, 5.15 dBi
Input Power:	15 VDC Power Supply

Model Number: M37TSS9PW1AN

Test Sample Serial Number(s): AM3C573

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

1.4 Test Methodology and Considerations

The EUT was evaluated for radiated, power line and RF conducted measurements for the Bluetooth Low Energy radio using test software power setting 24.

For the RF conducted measurements, the EUT was coupled to a spectrum analyzer to a QMA to SMA adapter and suitable attenuation.

The EUT was evaluated for radiated emissions up to the 10th harmonic of the fundamental frequency in the orientation of typical installation. A counterpoise of 1m diameter was provided for the evaluation.

The EUT was also investigated for unintentional emissions. The results are documented separately in a verification test report.

2 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

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

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS 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.

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 is capable of supporting 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:

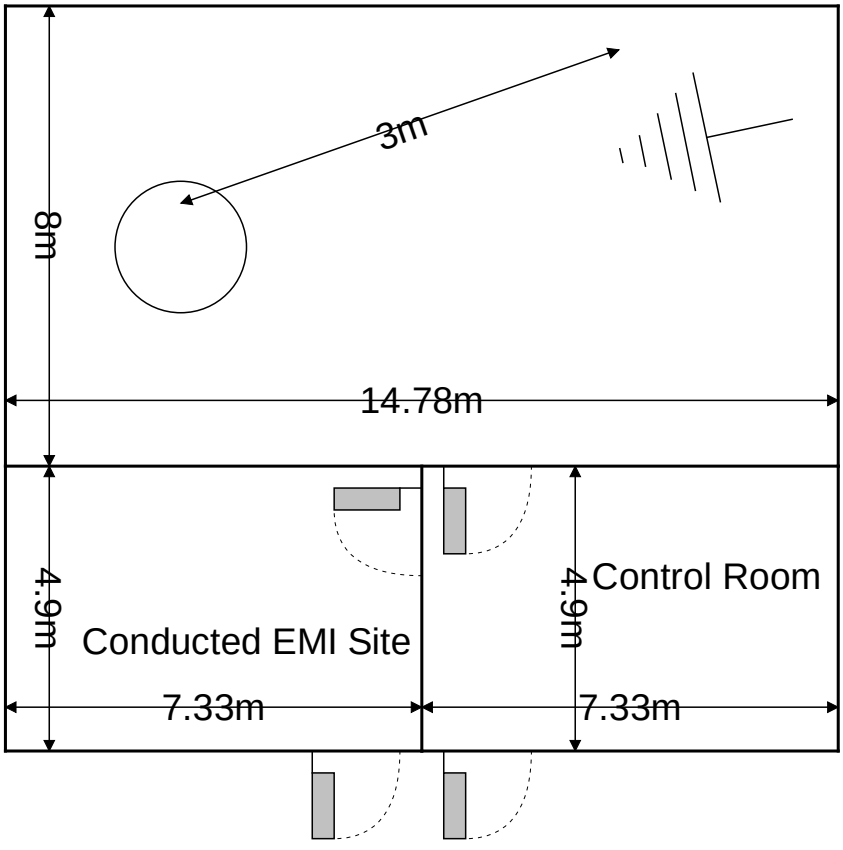

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

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:

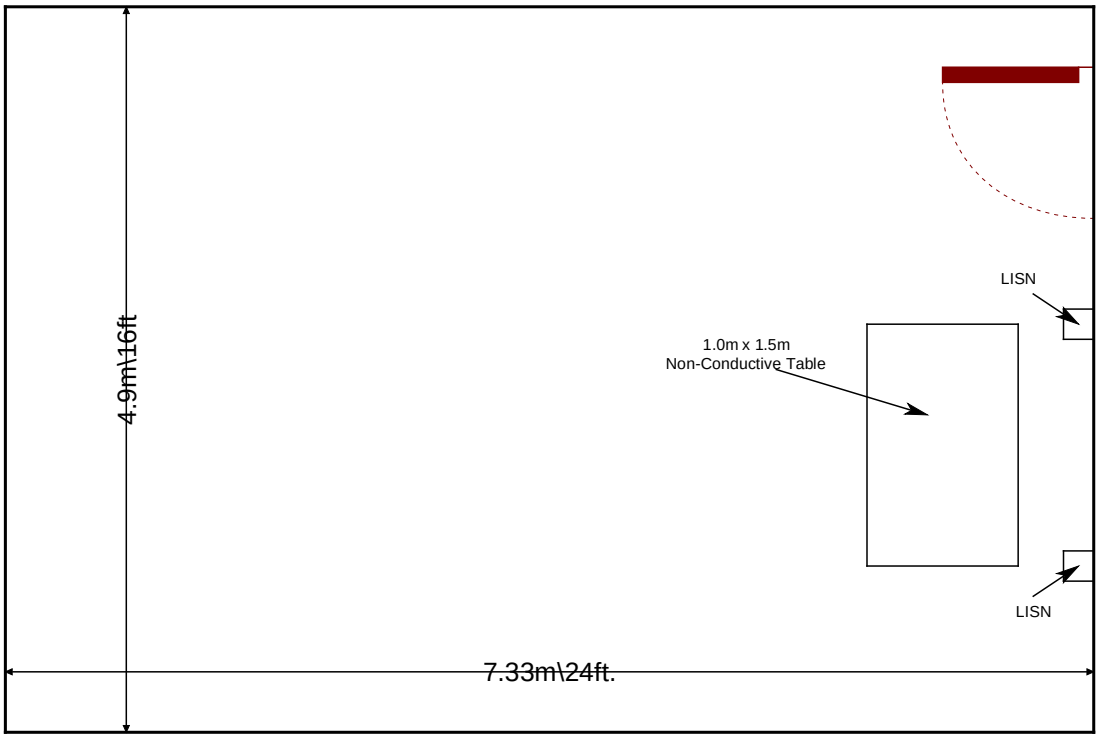

Figure 2.3.2-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40 GHz.
- 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, 2016.
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- FCC KDB 558074 D01 DTS Meas Guidance v03r05 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 8, 2016.
- 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 1, May 2015.
- 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

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	12/26/2014	12/26/2016
653	Suhner	SF-102A	Cables	0944/2A	9/15/2015	9/15/2016
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	4/14/2015	4/14/2017
2008	COM-Power	AH-826	Antennas	81009	NCR	NCR
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	11/18/2015	11/18/2016
2022	EMCO	LISN3825/2R	LISN	1095	9/14/2015	9/14/2017
2045	ACS Boca	Conducted Cable Set	Cable Set	2045	11/11/2015	11/11/2016
2070	Mini Circuits	VHF-8400+	Filter	2070	11/17/2015	11/17/2016
2072	Mini Circuits	VHF-3100+	Filter	30737	11/17/2015	11/17/2016
2082	Teledyne Storm Products	90-010-048	Cables	2082	4/21/2016	4/21/2017
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	11/16/2015	11/16/2016
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/9/2015	12/9/2016
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	11/13/2015	11/13/2016
2121	ACS Boca	Radiated Cable Set	Cable Set	2121	8/1/2016	8/1/2017
3004	Teseq	CFL 9206A	Attenuators	34720	10/7/2015	10/7/2016

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	Motorola	M37TSS9PW1AN	AM3C573
2	Microphone	Motorola	HMN1090A	N/A
3	Speaker	Motorola	HSN4038A	N/A
4	LMR Antenna	Motorola	AN000131A01	562948
5	WiFi/BT/GPS Antenna	Motorola	AN000163A01	N/A
6	15 VDC Power Supply	Motorola	PS000280A01	EB58704875
7	Laptop	DELL	Latitude D531	CN-0XM006-48643-789-2125
8	Laptop AC Adapter	DELL	LA65NS2-01	CN-06TM1C-72438-358- 218F-A01
9	Mouse	DELL	M-UARDEL7	LZ9440C43W5

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	USB	1.39 m	No	EUT to Laptop
B	Coil Microphone	3.05 m	No	EUT to Microphone
C	Audio	2.82 m	No	EUT to Speaker
D	Coaxial	5.12 m	Yes	LMR Antenna to EUT
E	Coaxial	5.08 m	Yes	Wi-Fi/BT Antenna to EUT
F	Coaxial	5.06 m	Yes	GPS Antenna to EUT
G	Power	1.17 m	No	EUT to 15 VDC Power Supply
H	Power	2.28 m	No	15 VDC Power Supply to extension Cord
I	Extension Power Cord	2.7 m	No	Power Cord to AC Mains
J	Ignition Wire	3.09 m	No	Not Terminated
K	USB	1.8 m	No	Laptop to Mouse
L	Power	1.85 m	No	Laptop to AC Adapter
M	Power	0.90 m	No	Laptop AC Adapter to AC Mains

Note: Item I was not used for the power line conducted emissions evaluation.

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

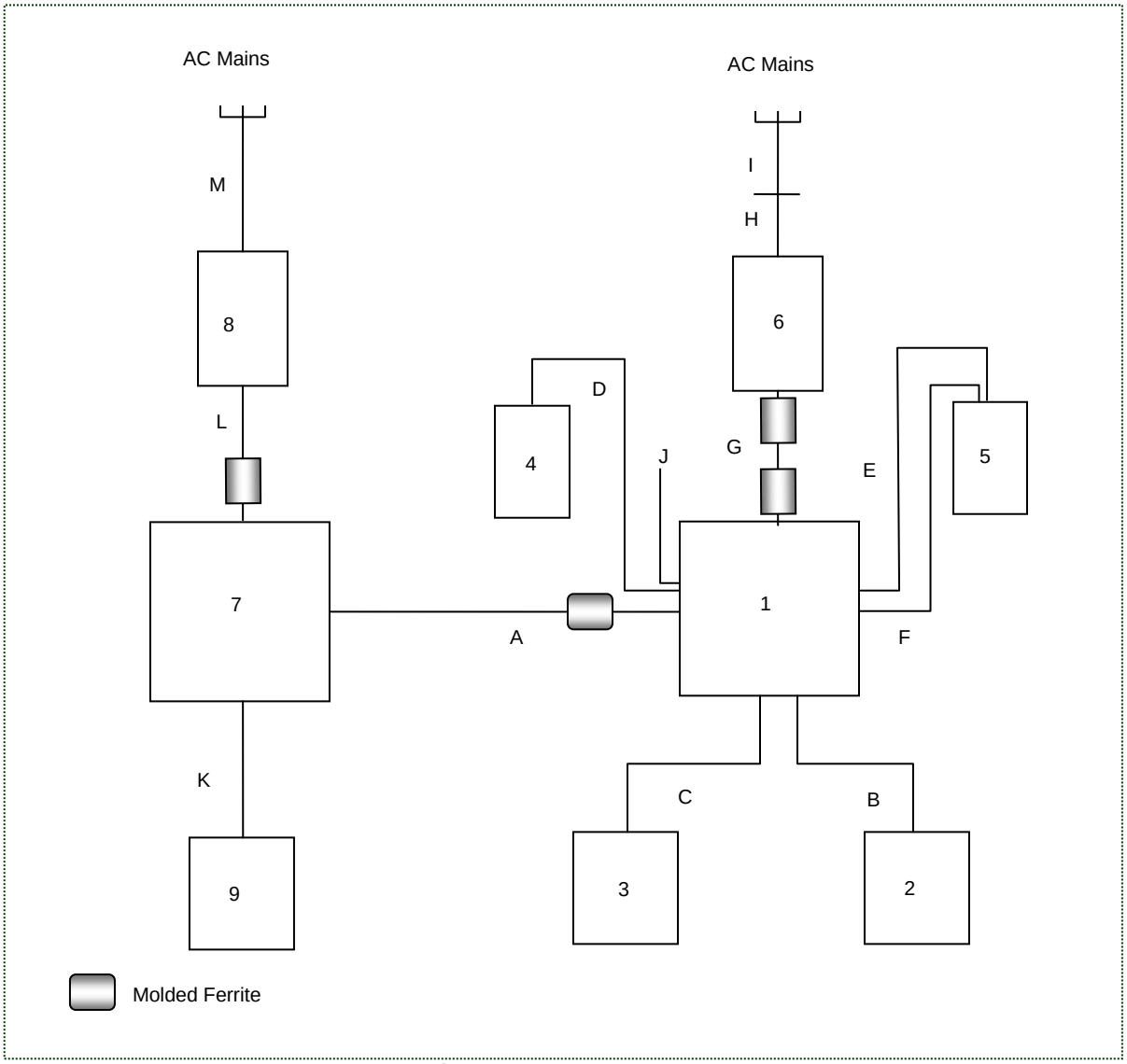

Figure 6-1: EUT Test Setup

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 and the applicable 5.15 dBi monopole antenna use a QMA connector for the 2.4 GHz ISM radio. The antenna connector is unique thus meeting the requirements of FCC Section 15.203.

7.2 6 dB Bandwidth - FCC: Section 15.247(a)(2); ISED Canada: RSS-247 5.2(1); 99% Bandwidth ISED Canada: RSS-GEN 6.6

7.2.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r05 Section 8.2 Option 2. The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the emissions and >> RBW.

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.

7.2.2 Measurement Results

Results are shown below.

Table 7.2.2-1: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [kHz]	99% Bandwidth [kHz]
2402	760.00	1050.00
2440	756.00	1050.00
2480	756.00	1050.00

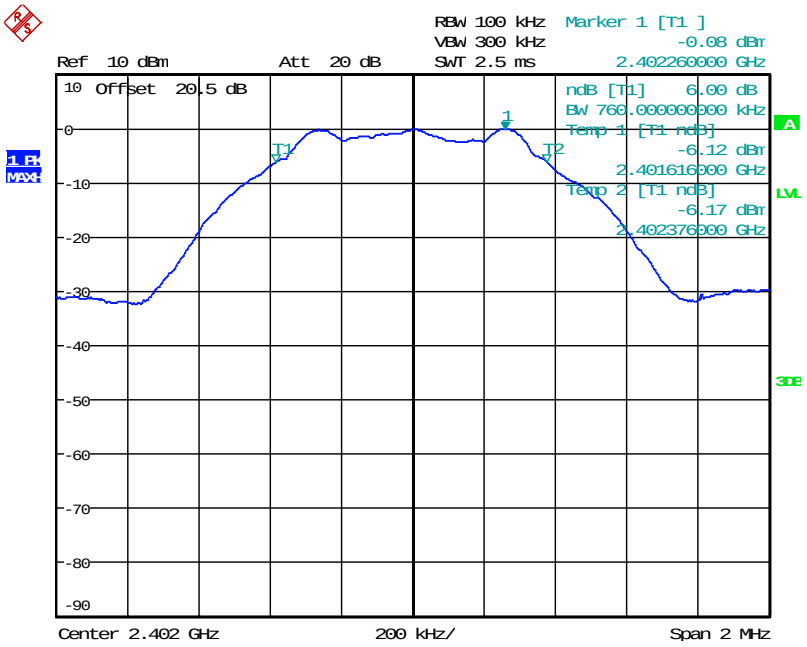

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Figure 7.2.2-1: 6dB BW - Low Channel

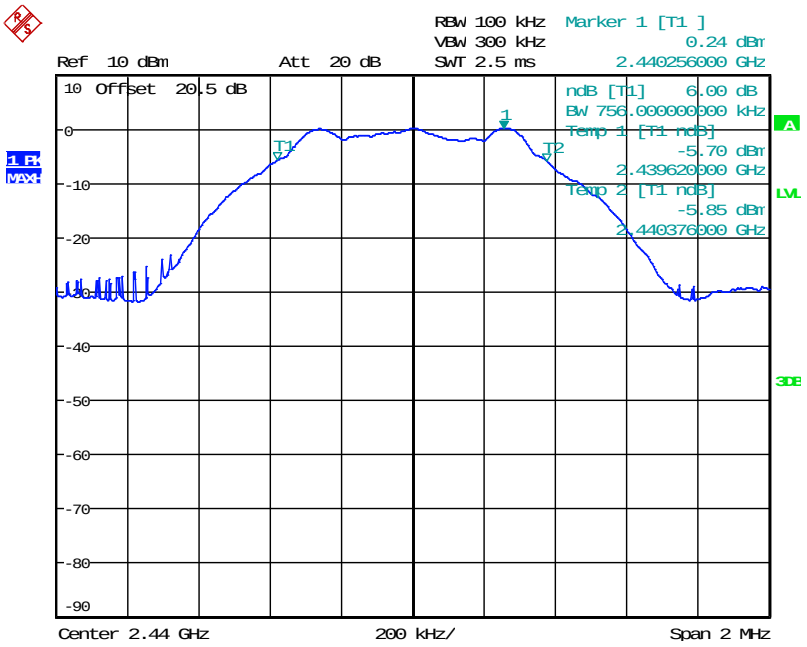

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Figure 7.2.2-2: 6dB BW - Middle Channel

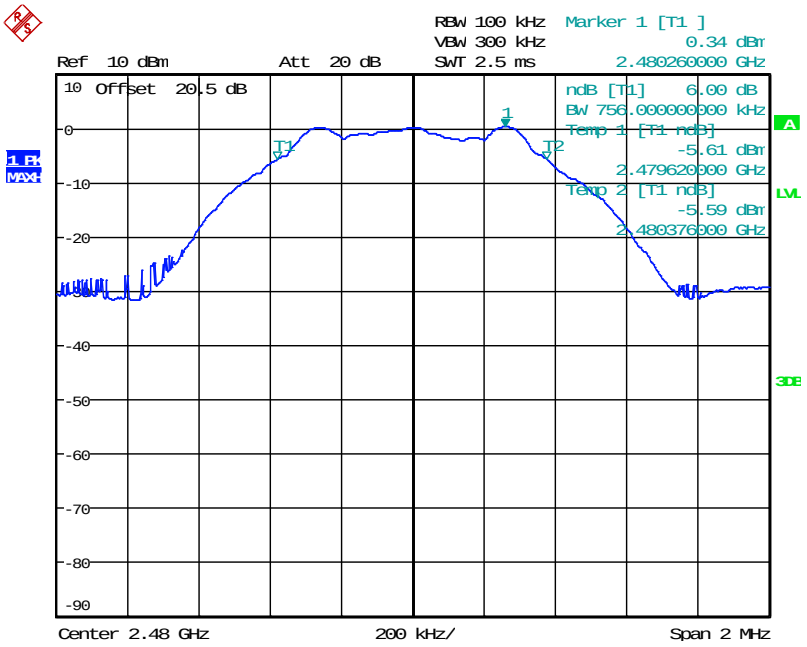

Figure 7.2.2-3: 6dB BW - High Channel

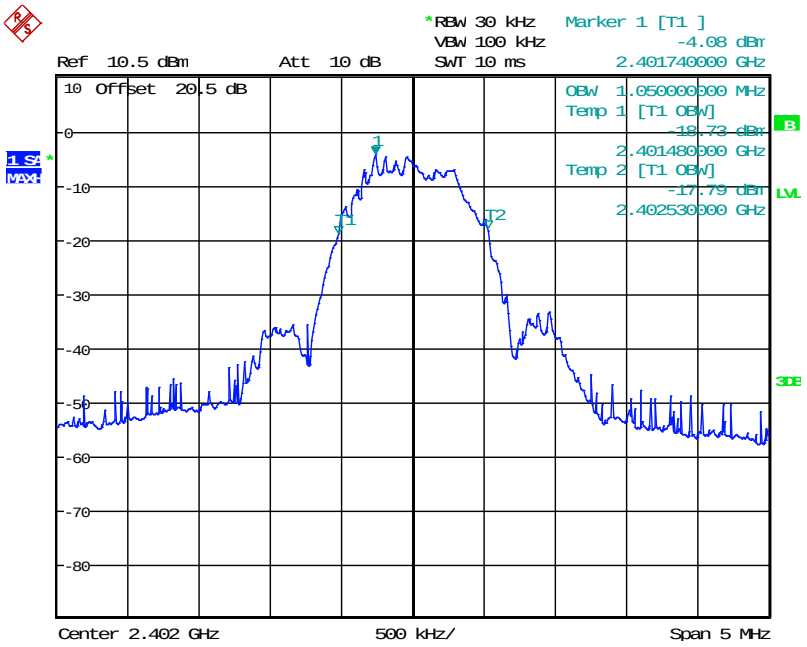

Figure 7.2.2-4: 99% OBW - Low Channel

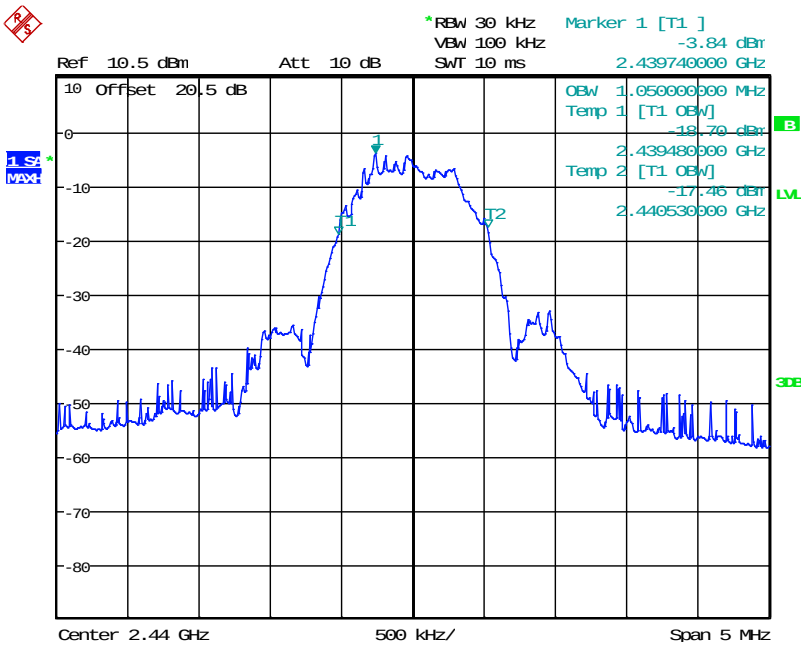

Figure 7.2.2-5: 99% OBW - Middle Channel

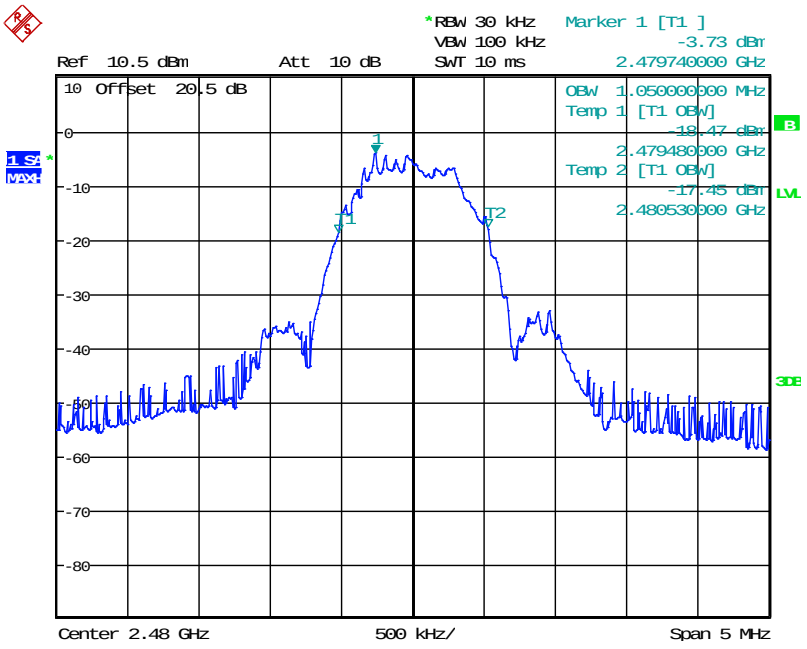

Figure 7.2.2-6: 99% OBW - High Channel

7.3 Peak Output Power - FCC Section 15.247(b)(3); ISED Canada: RSS-247 5.4(4)

7.3.1 Measurement Procedure (Conducted Method)

The fundamental emission output power was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r05 Section 9.1.1 RBW ≥ DTS bandwidth. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer through suitable attenuation.

7.3.2 Measurement Results

Results are shown below.

Table 7.3.2-1: RF Output Power

Frequency [MHz]	Level [dBm]
2402	0.97
2440	1.58
2480	1.61

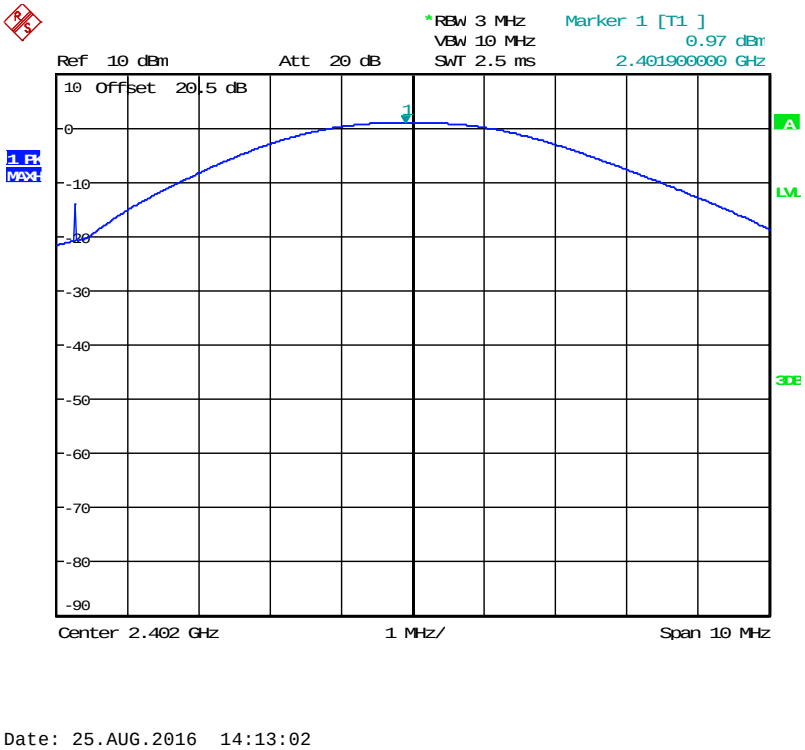

Figure 7.3.2-1: RF Output Power - Low Channel

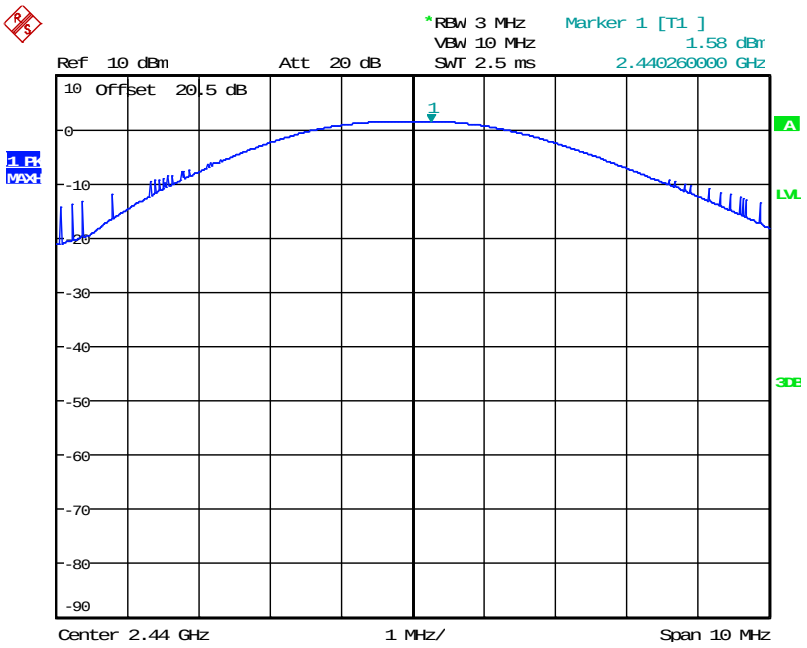

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Figure 7.3.2-2: RF Output Power - Middle Channel

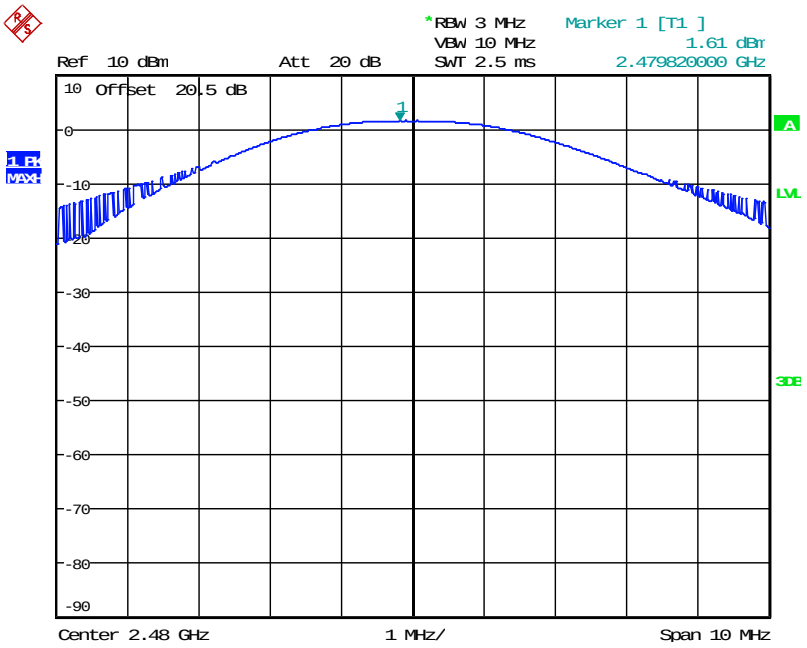

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Figure 7.3.2-3: RF Output Power - High Channel

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

Results are shown below.

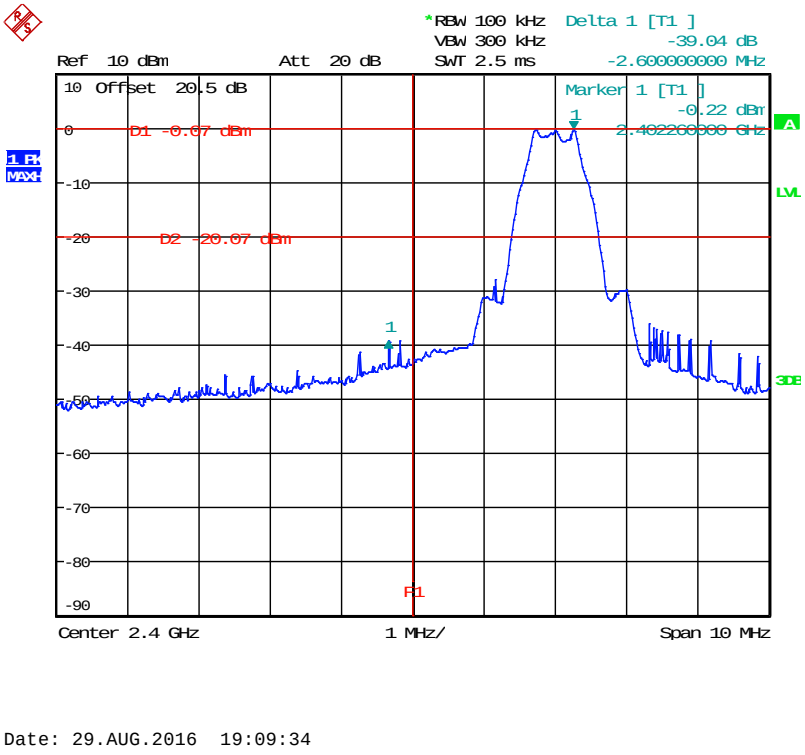

Figure 7.4.1.2-1: Lower Band-edge

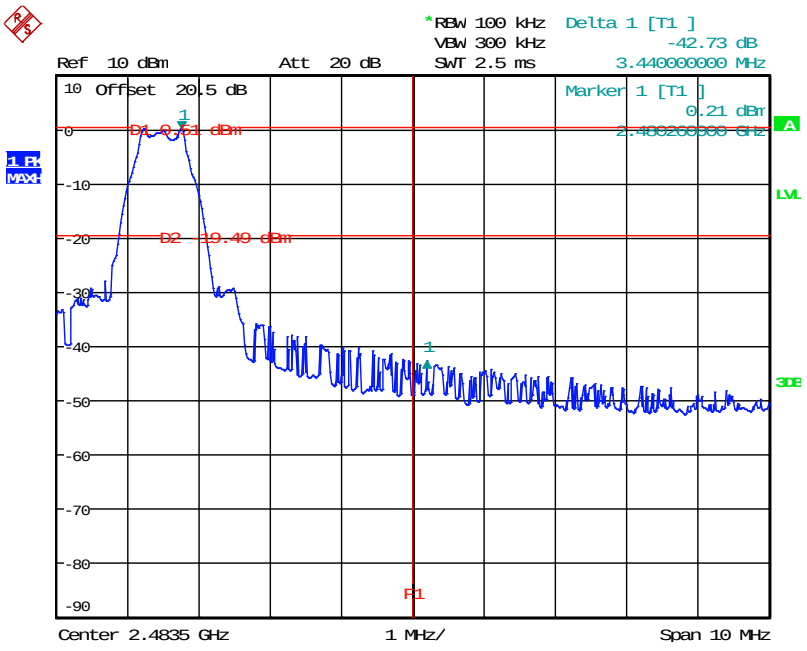

Figure 7.4.1.2-2: Upper Band-edge

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 Conducted Spurious Emissions were measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r05 Section 11.3 Emission level measurement. 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 30MHz to 26 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. The reference level was determined by measuring the Peak PSD level in any 100 kHz bandwidth within the DTS channel bandwidth.

7.4.2.2 Measurement Results

Results are shown below.

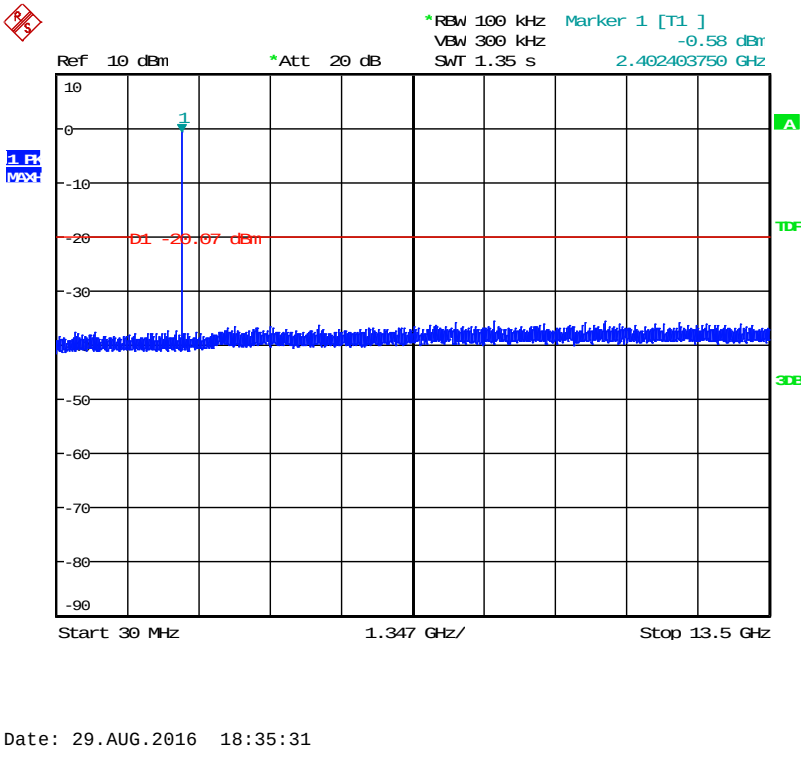

Figure 7.4.2.2-1: 30 MHz – 13.5 GHz – Low Channel

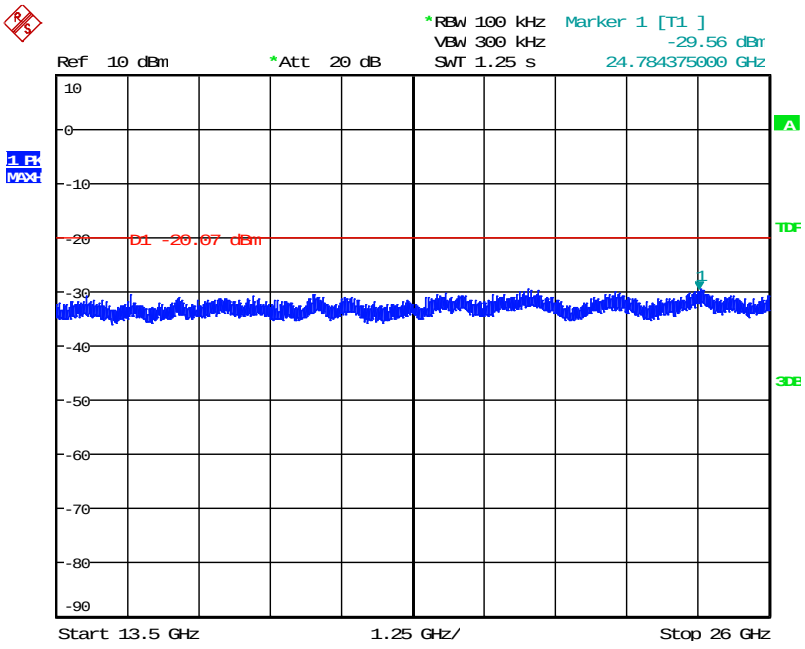

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Figure 7.4.2.2-2: 13.5 GHz –26 GHz – Low Channel

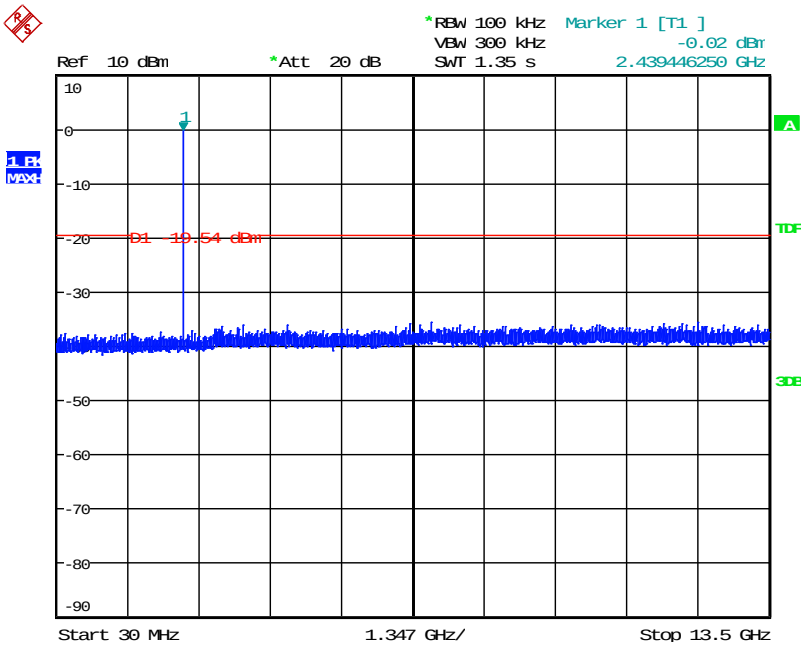

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Figure 7.4.2.2-3: 30 MHz – 13.5 GHz –Middle Channel

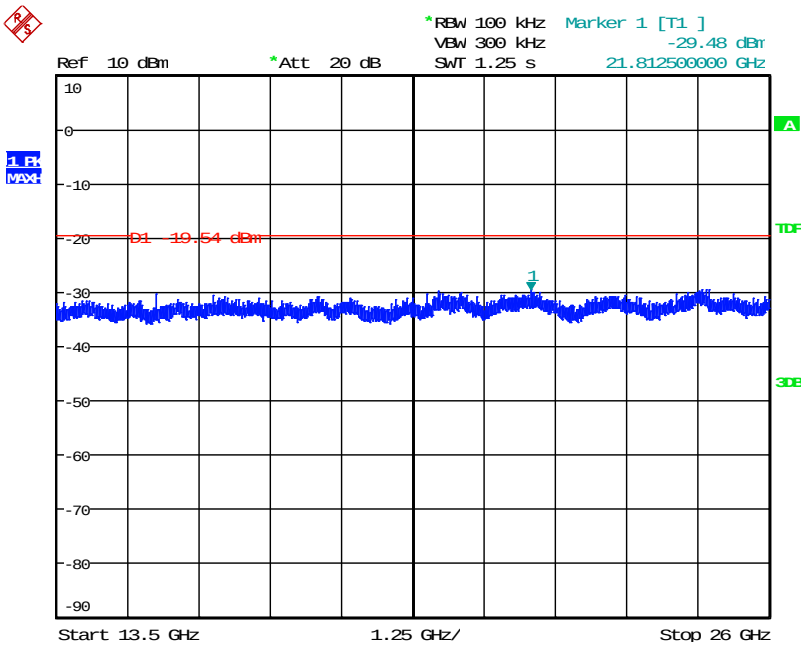


Figure 7.4.2.2-4: 13.5 GHz –26 GHz – Middle Channel

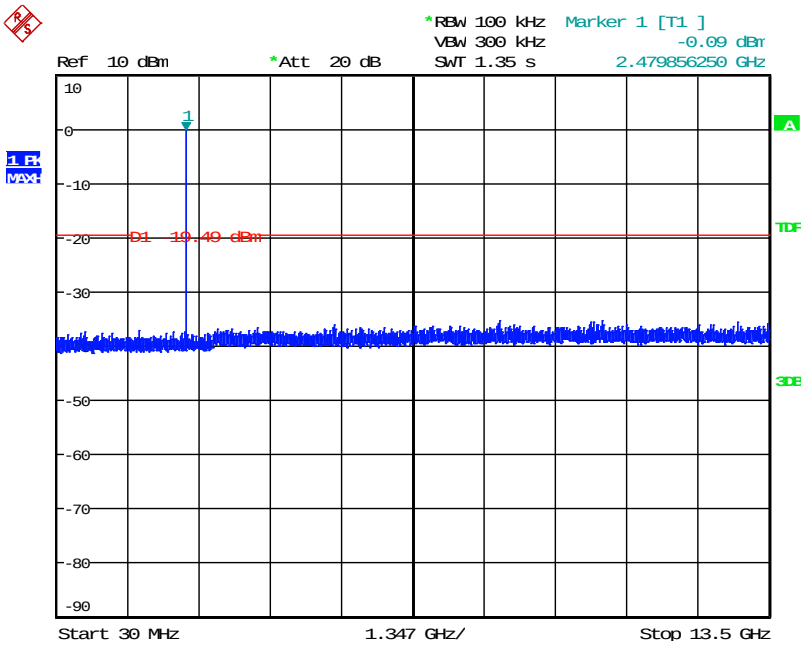


Figure 7.4.2.2-5: 30 MHz – 13.5 GHz – High Channel

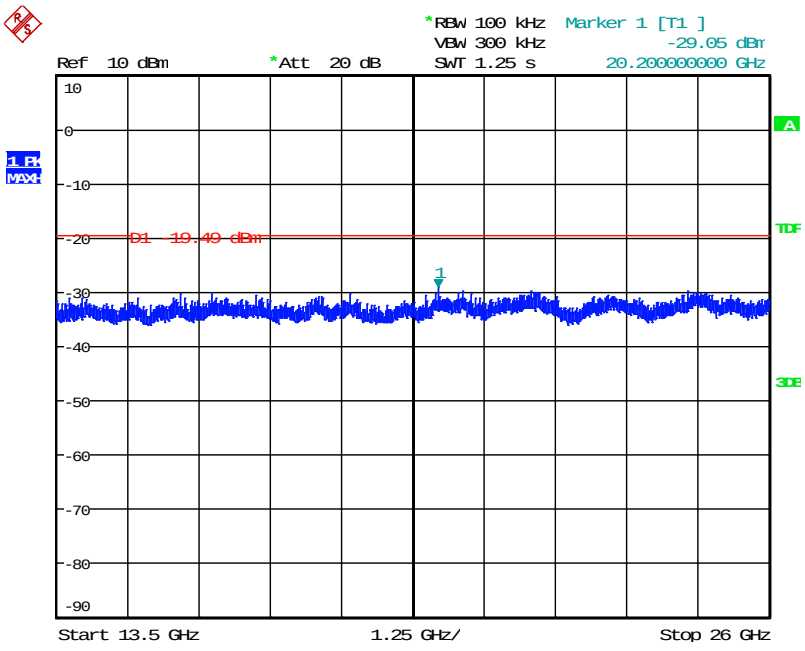


Figure 7.4.2.2-6: 13.5 GHz –26 GHz –High Channel

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 26 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 1000MHz, 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

Radiated band-edge and spurious emissions found in the restricted frequency bands of 9 kHz to 26 GHz are reported in the tables below.

Table 7.4.3.2-1: Radiated Spurious Emissions Tabulated Data

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 2402 MHz										
2390	61.19	46.86	V	-5.35	55.84	41.51	74.0	54.0	18.2	12.5
Middle Channel 2440 MHz										
7320	43.58	32.24	H	9.46	53.04	41.70	74.0	54.0	21.0	12.3
7320	45.45	35.01	V	9.46	54.91	44.47	74.0	54.0	19.1	9.5
High Channel 2480 MHz										
2483.5	61.53	44.88	H	-4.89	56.64	39.99	74.0	54.0	17.4	14.0
2483.5	77.51	53.11	V	-4.89	72.62	48.22	74.0	54.0	1.4	5.8
7440	42.82	31.15	H	9.80	52.62	40.95	74.0	54.0	21.4	13.1
7440	44.82	34.13	V	9.80	54.62	43.93	74.0	54.0	19.4	10.1

Note: All emissions above 7.44 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: 61.19 + (-5.35) = 55.84 dBµV/m
Margin: 74 dBµV/m – 55.84 dBµV/m = 18.2 dB

Example Calculation: Average
Corrected Level: 46.86 + (-5.35) = 41.51 dBµV/m
Margin: 54 dBµV/m – 41.51 dBµV/m = 12.5 dB

7.5 Power Spectral Density - FCC Section 15.247(e); ISED Canada: RSS-247 5.2(2)

7.5.1 PSD Measurement Procedure (Conducted Method)

The power spectral density was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r05 Section 10.2 Method PKPSD (peak PSD). The RF output port of the EUT was directly connected to the input of the spectrum analyzer. Offset values were input for cable and external attenuation. The spectrum analyzer RBW was set to 3 kHz and VBW 10 kHz. Span was adjusted to 1.5 times the 6 dB bandwidth and the sweep time was set to auto.

7.5.2 Measurement Results

Results are shown below.

Table 7.5.2-1: Power Spectral Density

Frequency [MHz]	PSD [dBm]	Limit [dBm]	Margin [dB]
2402	-14.45	8.0	22.45
2440	-13.85	8.0	21.85
2480	-13.77	8.0	21.77

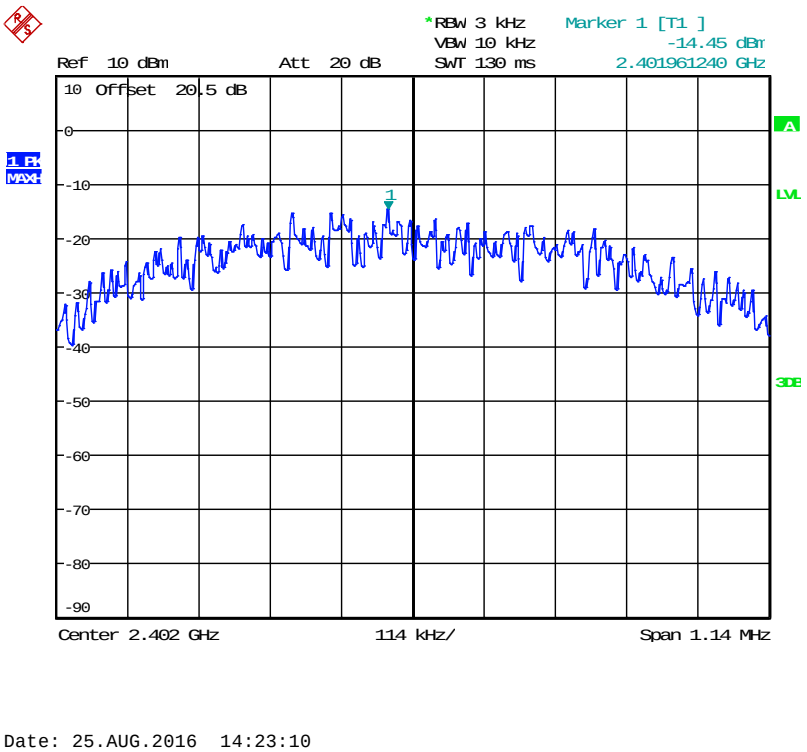
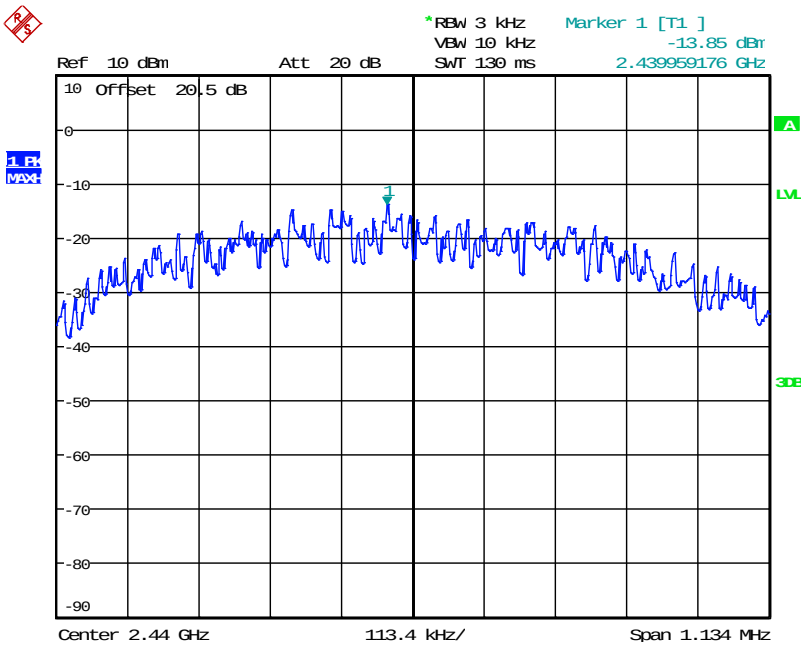


Figure 7.5.2-1: Power Spectral Density - Low Channel



Date: 29.AUG.2016 16:24:53

Figure 7.5.2-2: Power Spectral Density - Middle Channel

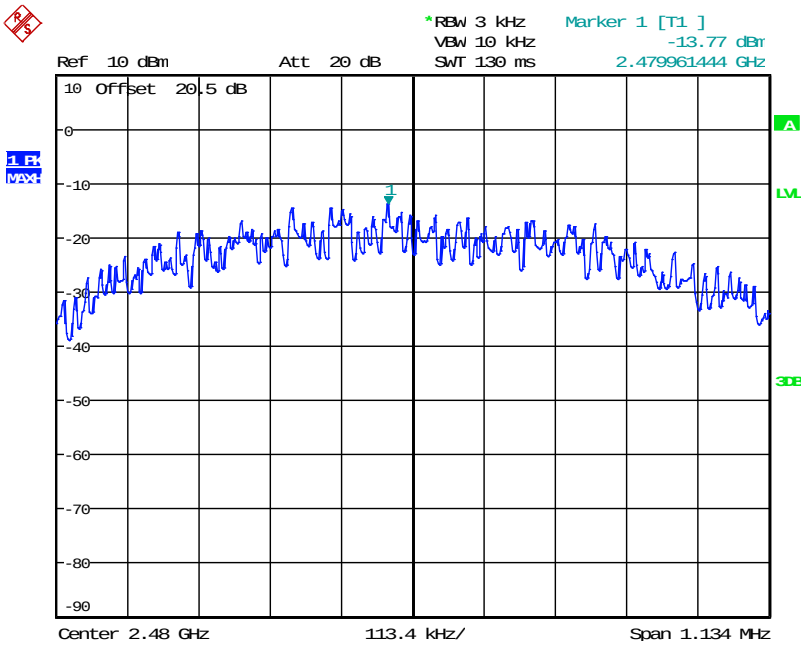


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Figure 7.5.2-3: Power Spectral Density – High Channel

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

7.6.1 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

7.6.2 Measurement Results

Results are shown below.

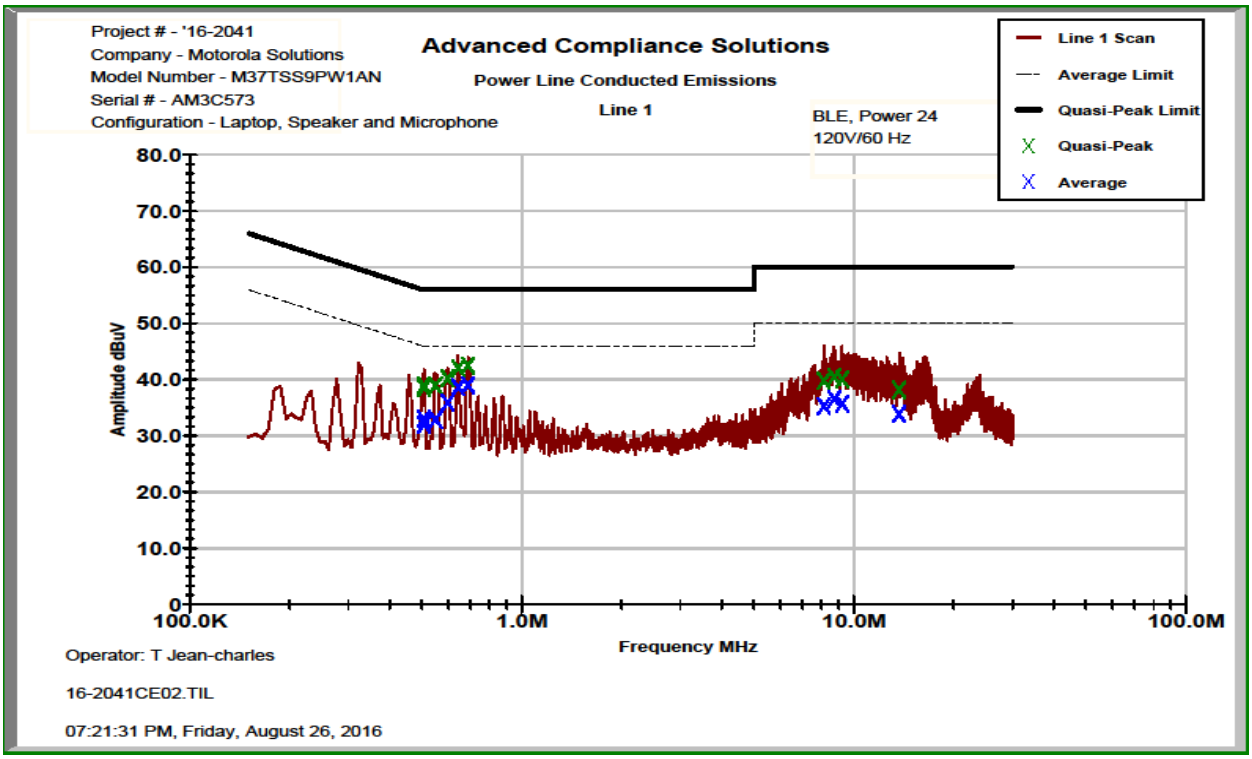

Figure 7.6.2-1: Conducted Emissions Results – Line 1

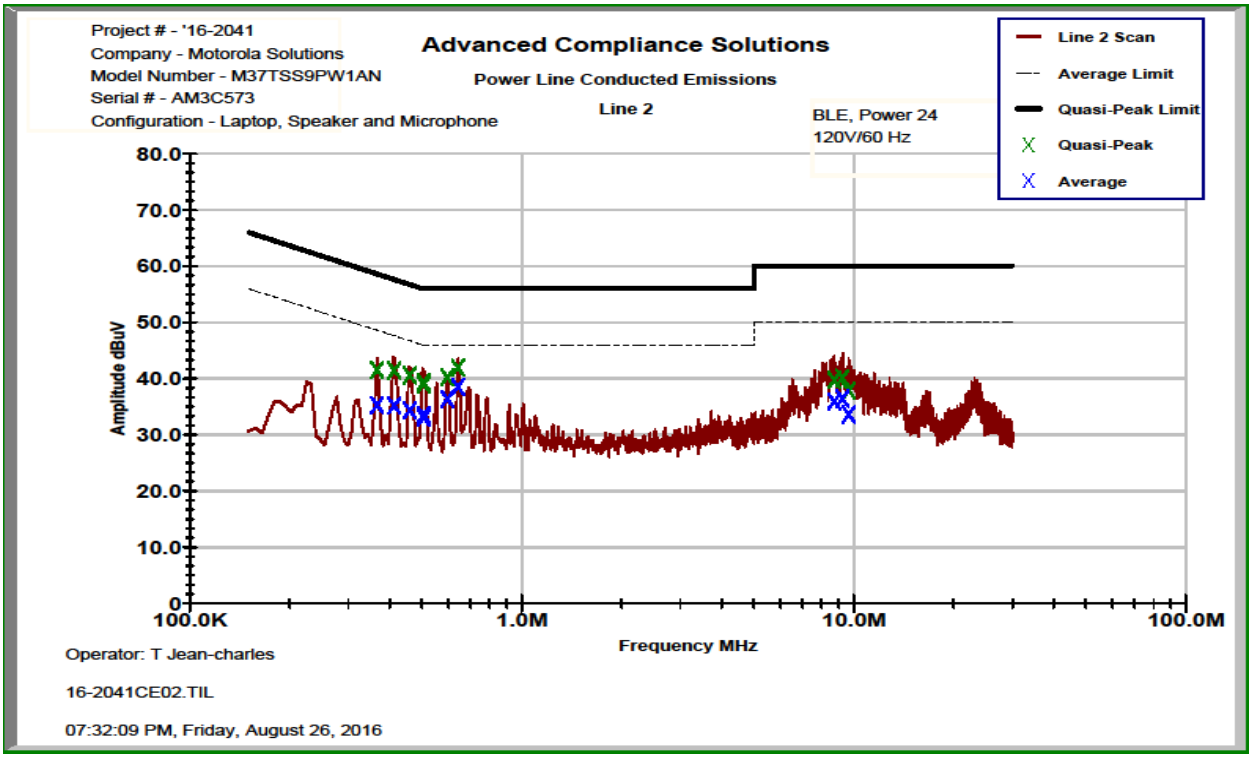

Figure 7.6.2-2: Conducted Emissions Results – Line 2

Table 7.6.2-1: Conducted EMI Results

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

Plot Number: 16-2041CE02
Power Supply Description: 15 VDC power supply

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									
0.50615	28.75	22.784	10.20	38.95	32.99	56.00	46.00	17.0	13.0
0.5071	28.292	21.775	10.20	38.50	31.98	56.00	46.00	17.5	14.0
0.548812	28.742	22.674	10.20	38.95	32.88	56.00	46.00	17.1	13.1
0.59745	30.007	25.665	10.20	40.21	35.87	56.00	46.00	15.8	10.1
0.642424	31.843	28.399	10.20	42.04	38.60	56.00	46.00	14.0	7.4
0.688	32.281	28.786	10.20	42.48	38.98	56.00	46.00	13.5	7.0
8.11995	29.162	24.688	10.59	39.75	35.28	60.00	50.00	20.2	14.7
8.7221	29.845	25.936	10.61	40.46	36.55	60.00	50.00	19.5	13.5
9.21061	29.383	25.029	10.63	40.01	35.66	60.00	50.00	20.0	14.3
13.6656	27.33	22.964	10.79	38.12	33.76	60.00	50.00	21.9	16.2
Line 2									
0.366163	31.309	25.065	10.20	41.51	35.27	58.59	48.59	17.1	13.3
0.412787	31.209	24.937	10.21	41.42	35.15	57.59	47.59	16.2	12.4
0.459513	30.355	24.105	10.21	40.57	34.32	56.70	46.70	16.1	12.4
0.505038	29.121	23.322	10.21	39.33	33.53	56.00	46.00	16.7	12.5
0.50595	28.749	22.791	10.21	38.95	33.00	56.00	46.00	17.0	13.0
0.5965	30.021	26.155	10.21	40.23	36.37	56.00	46.00	15.8	9.6
0.641374	31.692	28.321	10.21	41.90	38.53	56.00	46.00	14.1	7.5
8.718	29.05	25.264	10.65	39.70	35.91	60.00	50.00	20.3	14.1
9.22867	29.415	25.727	10.67	40.08	36.39	60.00	50.00	19.9	13.6
9.64089	27.127	22.889	10.68	37.81	33.57	60.00	50.00	22.2	16.4

8 CONCLUSION

In the opinion of ACS, Inc., the model M37TSS9PW1AN manufactured by Motorola Solutions meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the test procedures documented in the test report.

END REPORT