Certification Test Report

FCC ID: AZ489FT6018
IC: 109U-89FT6018

FCC Rule Part: 15.209
ISED Canada Radio Standards Specification: RSS-210

Report Number: BO72133883.100

Manufacturer: Motorola Solutions, Inc.
Model(s): PMLN7848

Test Begin Date: **December 22, 2017**
Test End Date: **January 3, 2018**

Report Issue Date: January 5, 2018

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 15 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-210.

1.2 Manufacturer Information

Motorola Solutions Sdn Bhd
Plot 2 Bayan Lepas Innoplex,
Industrial Park Mukim 12 SWD
11900 Bayan Lepas, Penang Malaysia

1.3 Product Description

The Motorola Solutions, Inc. model PMLN7848 is a metal sensing device. The device resonates at 735 kHz and also houses a Bluetooth Low Energy module (FCC ID: QOQBLE113 / IC: 5123A-BGTBLE113). The report documents the compliance of the 735 kHz transmitter.

Technical Details
Frequency of Operation: 735 kHz
Number of Channels: 1
Modulation: Not Modulated
Data Rate: Not Applicable
Antenna: Inductive Coil Antenna
Input Voltage: 3 VDC (CR2450)

Test Sample Serial Number(s): 000780RF4B46

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

1.4 Test Methodology and Considerations

The EUT was evaluated for radiated emissions. The EUT is battery operated only without any provision for connection to the AC Mains. The EUT is exempted from the power line conducted emissions requirements.

Preliminary radiated emissions measurements were performed for the EUT in three orthorgonal orientations. The EUT flat on the table top was found to be the configuration leading to the highest emissions with respect to the limits.

The EUT was also evaluated for intermodulation products with the co-located BLE radio. All intermodulation products generated by the co-transmission of the 735 kHz and the 2.4GHz radios were found in compliance with the limits of FCC 15.209 and ISED Canada RSS-210.

The EUT 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
ISED 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 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:

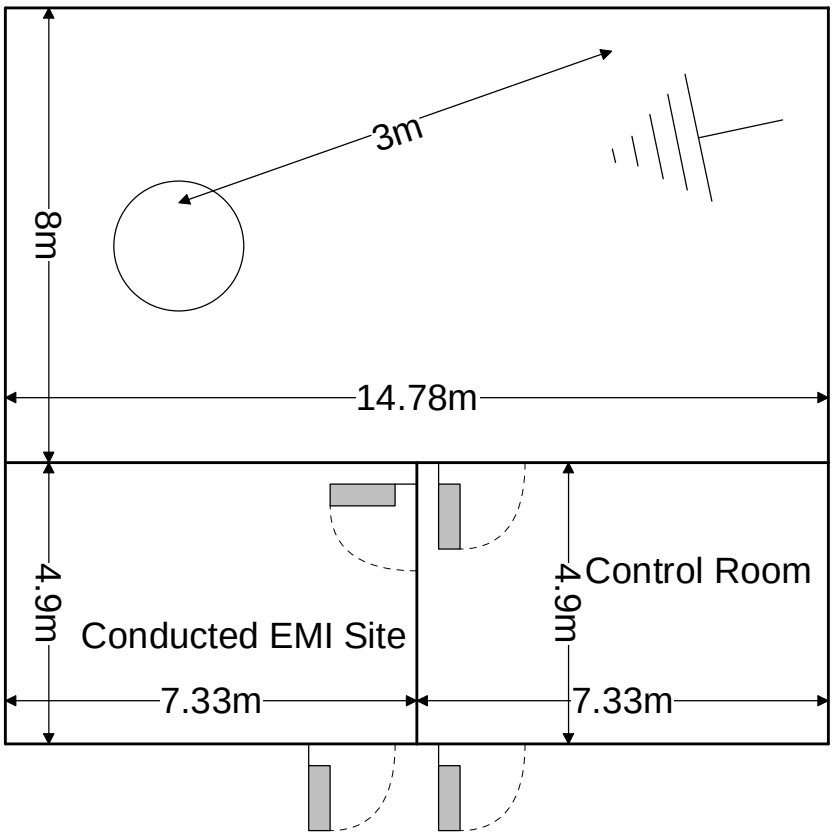

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m3. 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:

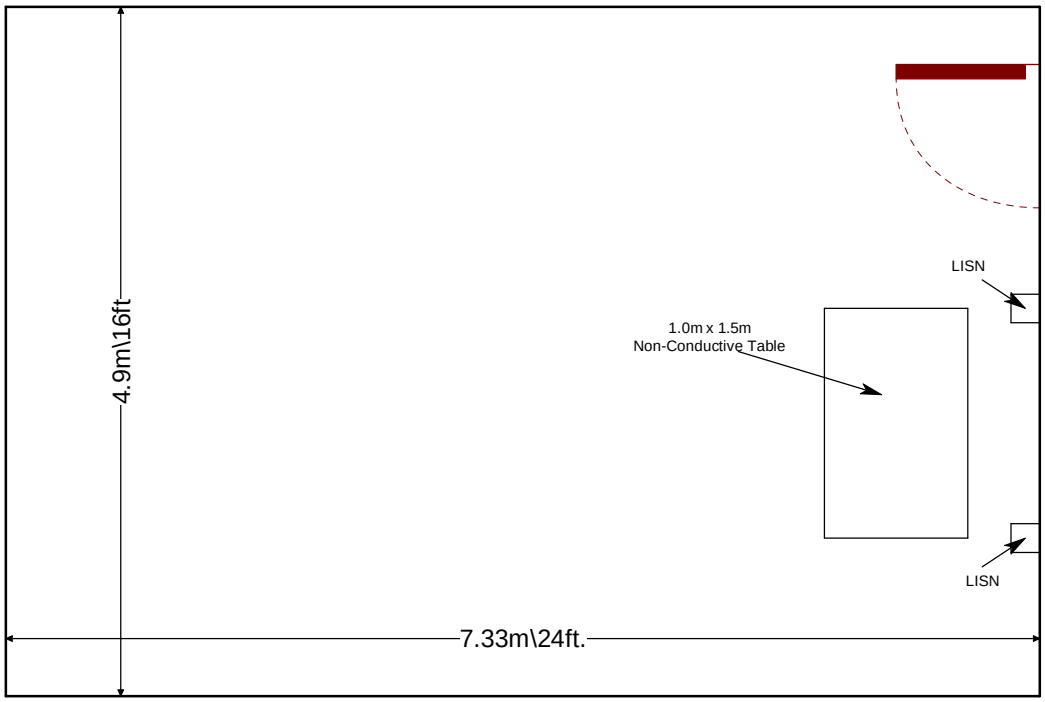

Figure 2.3.2-1: AC Mains Conducted EMI Site

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-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, November 2014.
- Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-210 - Licence-Exempt Radio Apparatus: Category I Equipment, Issue 9 August 2016.

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

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
79	EMCO	7405	Antennas	93	NCR	NCR
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
2003	EMCO	3108	Antennas	2148	2/29/2016	2/28/2018
2005	FAU EMI R&D Lab	Lazarus	Antennas	EM001	2/16/2016	2/16/2018
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	10/27/2017	10/27/2018
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	10/27/2017	10/27/2018
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR
2112	Teledyne Storm Products	921-0101-036	Cables	12-06-698	10/27/2017	10/27/2018
2121	ACS Boca	Radiated Cable Set	Cable Set	2121	7/31/2017	7/31/2018

Notes: NCR=No Calibration Required

5 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Motorola Solutions, Inc.	PMLN7848	000780RF4B46
2	BLE Module	Bluegiga	BLE113	N/A

Note: The EUT is standalone only and does not offer any provision for wired connection to other devices.

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

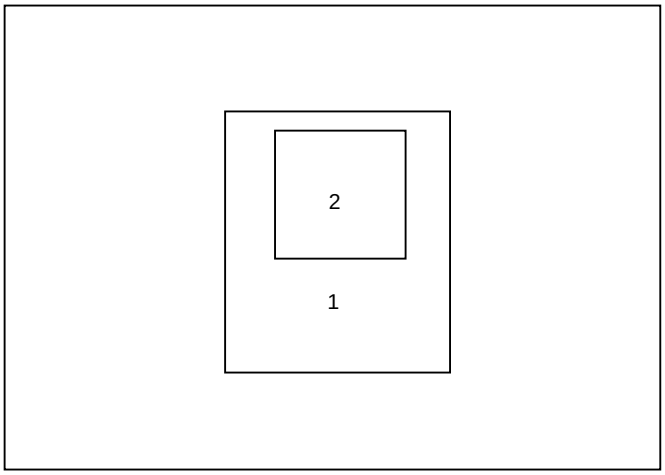

Figure 6-1: EUT Test Setup Block Diagram

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 uses an internal spiral coil antenna which is integral to the PCB. The antenna is not detachable, thus meeting the requirements of FCC 15.203.

7.2 20dB / 99% Bandwidth: FCC: Section 15.215; ISED Canada: RSS-Gen 6.6

7.2.1 Measurement Procedure

The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was set from 1% to 5% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The delta marker 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, including the emissions skirts. The RBW was set from 1% to 5% of the estimated 99% bandwidth. The occupied 99% bandwidth was measured by using the occupied bandwidth function of the spectrum analyzer set to 99% with a peak detector.

7.2.2 Measurement Results

Performed by: Thierry Jean-Charles

Table 7.2.2-1: 20dB / 99% Bandwidth

Frequency [kHz]	20dB Bandwidth [Hz]	99% Bandwidth [Hz]
735	308	800

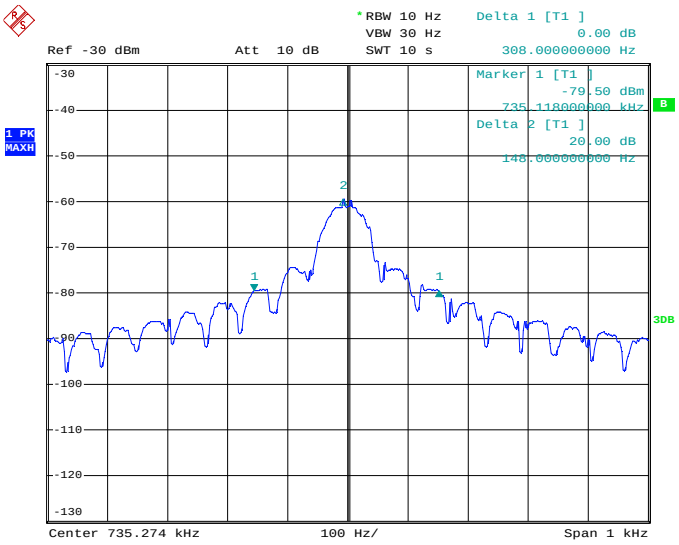

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Figure 7.2.2-1: 20 dB BW

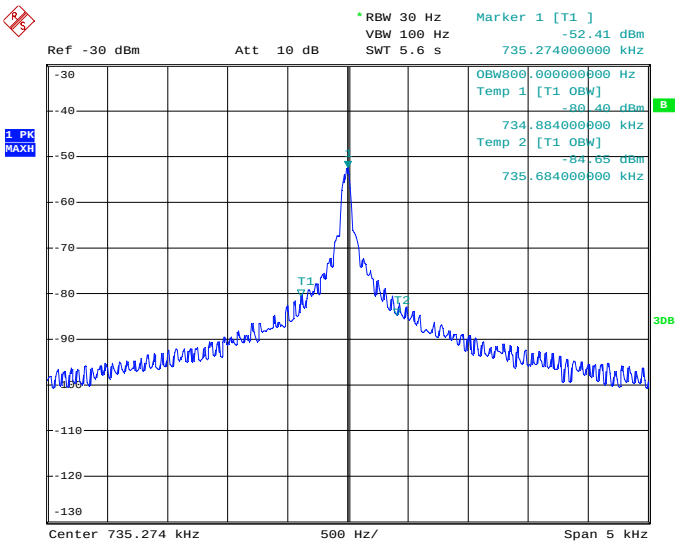

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Figure 7.2.2-2: 99% BW

7.3 Radiated Spurious Emissions – FCC: Section 15.209; ISED Canada: RSS-210 2.5

7.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 1 GHz. Section 15.33(a)(4) specifies, if the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to frequency specified in 15.33(b)(1) for unintentional radiators. The upper frequency range for the digital device is 1000 MHz which greater than the 10^{th} harmonic of the fundamental frequency. The upper frequency range measured was 1000 MHz.

Measurements below 30 MHz were performed in a semi-anechoic chamber with a 3-meter separation distance between the EUT and measurement antenna. The magnetic loop receiving antenna was positioned 1 meter above the ground. The EUT was rotated 360° to maximize each emission. The spectrum analyzer's resolution and video bandwidths were set to 200 Hz and 1000 Hz respectively for frequencies below 150 kHz, and to 9 kHz and 30 kHz respectively for frequencies between 150 kHz and 30 MHz. The fundamental levels were measured using a resolution bandwidth of 30 kHz which is greater than the measured emission bandwidth. For measurements in the frequency bands 9-90 kHz and 110-490 kHz, an average detector was used. When average measurements are specified, the peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. All other emissions were measured using a Quasi-peak detector. The final measurements were then corrected by antenna correction factors and cable loss for comparison to the limits.

Measurements above 30 MHz were performed in a semi-anechoic chamber with a 3-meter separation distance between the EUT and measurement antenna. 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 using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz.

7.3.2 Distance Correction for Measurements below 30 MHz – FCC: Section 15.31

Radiated measurements were performed at a distance closer than 300 meters and 30m as required, according to Part 15.209. Therefore, a correction factor was applied to account for propagation loss at the specified distance. The propagation loss was determined by using the square of an inverse linear distance extrapolation factor (40dB/decade) according to 15.31. A sample calculation of the distance correction factor is shown below for limits expressed at a 300m measurement distance and a 30m measurement distance.

Distance correction factor (300m Specified Test Distance) = 40*Log (Test Distance/300)
= 40*Log (3/300)
= - 80 dB

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (3/30)
= - 40 dB

7.3.3 Measurement Results

Performed by: Thierry Jean-Charles

Radiated spurious emissions found in the band of 9 kHz to 1 GHz are reported in the table below.

Table 7.3.3-1: 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
Fundamental Frequency										
0.735	---------	43.28	H	10.27	---------	53.55	--------	70.3	--------	16.8
Spurious Emissions										
30.2919	--------	24.08	H	-13.30	---------	10.78	--------	40	---------	29.2
80.0215	--------	34.20	H	-18.38	---------	15.82	--------	40	---------	24.2
850.552	--------	22.40	H	-1.13	---------	21.27	--------	46	---------	24.7
992.426	--------	22.79	H	0.68	---------	23.47	--------	54	---------	30.5
33.8651	--------	25.70	V	-13.78	---------	11.92	--------	40	---------	28.1
79.9863	--------	36.24	V	-18.38	---------	17.86	--------	40	---------	22.1
124.647	--------	29.25	V	-14.65	---------	14.60	--------	43.5	---------	28.9
980.143	--------	22.58	V	0.15	---------	22.73	--------	54	---------	31.3

Notes:

- The distance correction factor per Section 7.3.2 of this document was applied to the limits below 30 MHz.
- No spurious emissions could be found below 30 MHz besides the fundamental frequency.

7.3.4 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: Quasi-Peak
Corrected Level: 24.08 + (-13.3) = 10.78 dBµV/m
Margin: 40 dBµV/m – 10.78 dBµV/m = 29.2 dB

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%.

Table 8-1: Measurement Uncertainties

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 1.15 dB
Power Spectral Density	± 1.15 dB
Antenna Port Conducted Emissions	± 1.15 dB
Radiated Emissions ≤ 1GHz	± 5.86 dB
Radiated Emissions > 1GHz	± 4.65 dB
Temperature	± 0.860 °C
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	±3.72 dB

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the PMLN7848 manufactured by Motorola Solutions, Inc. meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-210.

END REPORT