MOTOROLA SOLUTIONS

MS ISO/IEC 17025 TESTING SAMM No. 0826

CERTIFICATE 2518.05

DECLARATION OF COMPLIANCE: MPE ASSESSMENT

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Date of Report: 02/11/2020
Report Revision: A

Responsible Engineer:	Goh Jue Yie (EME Engineer)
Report author:	Goh Jue Yie (EME Engineer)
Date(s) Tested:	12/29/2019
Manufacturer:	Motorola Solutions Inc.
Date submitted for test:	12/23/2019
DUT Description:	APX6500 UHF R1 - Multiple HW Encryption WiFi Interoperability Data Modem Tethering via WiFi or Cable
Test TX mode(s):	CW
Max. Power output:	18W (380-470 MHz); 11.2 mW (Bluetooth); 6.3 mW (Bluetooth LE); 39.8 mW (WLAN 2.4GHz 802.11b), 15.8 mW (WLAN 2.4GHz 802.11g), 12.6 mW (WLAN 2.4 GHz 802.11n); 15.8mW (WLAN 5 GHz 802.11a/n/ac)
TX Frequency Bands:	380-470 MHz; WLAN 2412-2462 MHz; WLAN 5180-5825 MHz; BT 2402-2480 MHz
Signaling type:	FM, TDMA, FHSS (Bluetooth), 802.11b/g/n (WLAN 2.4 GHz), 802.11 a/n/ac (WLAN 5 GHz)
Model(s) Tested:	M25QSS9PW1BN (PMUE5620A) with G138 option
Model(s) Certified:	M25QSS9PW1BN (PMUE5620A) with G138 option, M24QSS9PW1BN (PMUE5620A) with G138 option
Serial Number(s):	471TVZ0922
Classification:	Occupational/Controlled Environment
FCC ID:	AZ492FT7129 406.1-470 MHz, 2402-2480 MHz, 2412-2462 MHz; 5180-5825 MHz This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
ISED:	109U-92FT7129 This report contains results that are immaterial for ISED Canada equipment approval, which are clearly identified.

The MPE results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits. FCC rules require compliance for Passengers and Bystanders to the FCC General Population/Uncontrolled limits. The test results clearly demonstrate compliance with ICNIRP Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with the national and international reference standards and guidelines listed in section 4.0 of this report (no deviation from standard methods)**. This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc. EME Laboratory.**
I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements.
This reporting format is consistent with the suggested guidelines of the TIA TSB-159 April 2006
The results and statements contained in this report pertain only to the device(s) evaluated herein.

Tiong Nguk Ing Digitally signed by Tiong Nguk Ing Date: 2020.02.25 15:30:03 +08'00'

Tiong Nguk Ing
Deputy Technical Manager (Approved Signatory)
Approval Date: 2/25/2020

Document Revision History

Date	Revision	Comments
02/11/2020	A	Initial release

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1.0 Introduction

This report details the test setup, test equipment and test results of Maximum Permissible Exposure (MPE) performed at Motorola Solutions' outside test site for product model M25QSS9PW1BN (PMUE5620A) with G138 option.

2.0 FCC MPE Summary

Table 1

Equipment Class	Frequency band (MHz)	Bystander		Operator	
		Power Density (mW/cm^2)	Percentage of Limit (%)	Power Density (mW/cm^2)	Percentage of Limit (%)
TNB	406.1 - 470	0.077	28.50	0.197	14.5
DTS	2412 – 2462 (WLAN 2.4 GHz)	0.025	2.50	0.025	2.50
NII	5180 - 5825 (WLAN 5 GHz)	0.011	1.06	0.011	1.06
DSS	2402-2480 (Bluetooth)	0.007	0.71	0.007	0.71
Simultaneous (Highest Combined Percentage of Limit)			31.00		17.0

3.0 Abbreviations / Definitions

CNR: Calibration Not Required
CW: Continuous Wave
DUT: Device Under Test
EME: Electromagnetic Energy
FHSS: Frequency Hopping Spread Spectrum
FM: Frequency Modulation
MPE: Maximum Permissible Exposure
GPS: Global Positioning System
LMR: Land Mobile Radio
SAR: Specific Absorption Rate
NA: Not Applicable
BS: Bystander
PTT: Push to Talk
WLAN: Wireless Local Area Network
TDMA: Time Division Multiple Access

4.0 Referenced Standards and Guidelines

This product is designed to comply with the following applicable national and international standards and guidelines.

- United States Federal Communications Commission, Code of Federal Regulations; Rule Part 47CFR § 1.1310, § 2.1091 (d) and § 2.1093 for RF Exposure, where applicable.
- Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65 (Edition 97-01), FCC, Washington, D.C.: August 1997.
- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1999
- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1992. Specific to FCC rules and regulations.
- Institute of Electrical and Electronics Engineers (IEEE) C95.3-2002
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6 (2015), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz
- RSS-102 (Issue 5) – Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands)
- FCC KDB – 447498 D01 General RF Exposure Guidance v06
- FCC KDB – 865664 D02 RF Exposure Reporting v01r02
- EN 62311:2008 Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz).

5.0 Power Density Limits

Table 2 – Occupational / Controlled Exposure Limits

Frequency Range (MHz)	FCC OET Bulletin 65 mW/cm^2	ICNIRP W/m^2	IEEE C95.1 1992/1999 mW/cm^2	IEEE C95.1 2005 W/m^2	RSS-102 Issue 5 2015 W/m^2
10 – 20					10.0
20 – 48					$44.72 / f^{0.5}$
30 – 300	1.0				
48 – 100					6.455
10 – 400		10.0			
100 – 300			1.0	10.0	
100 – 6,000					$0.6455 f^{0.5}$
300 – 1,500	f/300				

Table 2 – Occupational / Controlled Exposure Limits (Con't.)

Frequency Range (MHz)	FCC OET Bulletin 65 mW/cm^2	ICNIRP W/m^2	IEEE C95.1 1992/1999 mW/cm^2	IEEE C95.1 2005 W/m^2	RSS-102 Issue 5 2015 W/m^2
300 – 3,000			f/300	f/30	
400 – 2,000		f/40			
1,500 – 15,000					
1,500 – 100,000	5.0				
2,000 – 300,000		50.0			
3,000 – 300,000			10.0	100.0	
6,000 – 15,000					50.0
15000 – 150,000					50.0
150000 –300,000					$3.33\times10^{-4}\,f$

Table 3 – General Population / Uncontrolled Exposure Limits

Frequency Range (MHz)	FCC OET Bulletin 65 mW/cm^2	ICNIRP W/m^2	IEEE C95.1 1992/1999 mW/cm^2	IEEE C95.1 2005 W/m^2	RSS-102 Issue 5 2015 W/m^2
10 – 20					2.0
20 – 48					$8.944 / f^{0.5}$
30 – 300	0.2				
48 – 300					1.291
10 – 400		2.0			
100 – 300			0.2		
100 – 400				2.0	
300 – 1,500	f/1,500				
300 – 6000					$0.02619\,f^{0.6834}$
400 – 2,000		f/200		f/200	
300 – 15,000			f/1,500		
1,500 – 15,000					
1,500 – 100,000	1.0				
2,000 – 100,000				10.0	
2,000 – 300,000		10.0			
6,000 – 15,000					10.0
15,000 – 150,000					10.0
150,000 – 300,000					$6.67\times10^{-5}\,f$

6.0 N_c Test Channels

The number of test channels is determined by using Equation 1 below. This equation is available in FCC's KDB 447498. The test channels are appropriately spaced across the antenna's frequency range.

Equation 1 – Number of test channels

$N_c = \text{Round } \{[100(f_{high} - f_{low})/f_c]^{0.5} \times (f_c / 100)^{0.2}\}$

where N_c is the number of test channels, f_{high} and f_{low} are the highest and lowest frequencies within the transmission band, f_c is the mid-band frequency, and frequencies are in MHz.

7.0 Measurement Equipment

Table 4 – Equipment

Equipment Type	Model #	SN	Calibration Date	Calibration Due Date
Motorcycle	Honda CBX750-2003	NA	NA	NA
Survey Meter Probe – E-Field	ETS Model HI-2200 ETS Model E100	00206805 00126277	4/1/2019	4/1/2020

E-field measurements are in mW/cm^2.

8.0 Measurement System Uncertainty Levels

Table 5 – Uncertainty Budget for Near Field Probe Measurements

	Tol. (± %)	Prob. Dist.	Divisor	u_i (±%)		v_i
Measurement System						
Probe Calibration	7.1	N	1.00	7.1	50.4	∞
Survey Meter Calibration	0.0	N	1.00	0.0	0.0	¥
Hemispherical Isotropy	8.0	R	1.73	4.6	21.33	∞
Linearity	5.0	R	1.73	2.9	8.33	∞
Pulse Response	1.0	R	1.73	0.6	0.33	∞
RF Ambient Noise	3.0	R	1.73	1.7	3.00	∞
RF Reflections	8.0	R	1.73	4.6	21.33	∞
Probe Positioning	10.0	R	1.73	5.8	33.333	∞
Test sample Related					0.00	
Antenna Positioning	3.0	N	1.00	3.0	9.0	∞
Power drift	5.0	R	1.73	2.9	8.33	∞
Bystander measurement uncertainty	4.8	N	1.00	4.8	23.04	∞
Passenger measurement uncertainty	8.1	N	1.00	8.1	65.61	∞
Combined Standard Uncertainty		RSS		15.6	15.6	∞
Expanded Uncertainty (95% CONFIDENCE LEVEL)		k=2		31	31	

9.0 Product and System Description

This mobile device operates in the LMR bands using either frequency modulation (FM) with 100% transmit duty cycle or TDMA signals with maximum of 50% transmit duty cycle. For conservative assessment, FM signal was tested. A duty factor of 50% applies for PTT operation mode.

This device also incorporates a Class 1 Bluetooth device which is a Frequency Hopping Spread Spectrum (FHSS) technology. The Bluetooth radio modem is used to wireless link audio accessories. The maximum actual transmission duty cycle is imposed by the Bluetooth standard. The maximum duty cycle for BT is 100%. Bluetooth Low Energy (BT LE) intended to reduce power consumption.

This device also contains WLAN technology for data capabilities over 802.11b/g/n 2.4 GHz and 802.11 a/n/ac 5 GHz wireless networks.

Table 6 below summarizes the technologies, bands, maximum duty cycles and maximum output powers. Maximum output powers are defined as upper limit of the production line final test station.

Table 6

Technologies	Bands (MHz)	Duty Cycle (%)	Max Power (W)
LMR	380-470	50 (PTT)	18
BT	2402-2480	100	0.0112
BT LE	2402-2480	100	0.0063
WLAN	2400 – 2462 (802.11b/g/n)	100	0.0398 (802.11b)
			0.0158 (802.11g)
			0.0126 (802.11n)
	5180-5825 (802.11 a/n/ac)	100	0.0158

This device will be marketed to and used by employees solely for work-related operations, such as public safety agencies, e.g. police, fire and emergency medical. User training is the responsibility of these agencies which can be expected to employ the usage instructions, safety information and operational cautions set forth in the user's manual, instructional sessions or other means.

Accordingly this product is classified as Occupational/Controlled Exposure. However, in accordance with FCC requirements, the bystanders external to the test vehicle are evaluated to the General Population/Uncontrolled Exposure Limits.

(Note that “Bystanders” as used herein are people other than operator)

10.0 Additional Options and Accessories

Not available.

11.0 Test Set-Up Description

Assessments were performed with mobile radio installed on the test vehicle, at the specified distances and test locations indicated in section 12.0, 13.0 and Appendix A.

All antennas described in Table 7 were considered in order to develop the test plan for this product. Antennas were installed and tested per their defined test channels reported in Appendix D.

12.0 Method of Measurement for motorcycle mounted antenna(s)

12.1 Bystander vehicle MPE measurements

Antenna is located at the rear of the test vehicle. Refer to Appendix A for antenna location with respect to the bystander.

MPE measurements for bystander (BS) conditions are determined by taking the average of (10) measurements in a 2m vertical line for the bystander test location indicated in Appendix A with 20 cm height increments, with the distance between the antenna and the geometric center of the probe sensor equal to 60 cm, directly behind the motorcycle. Unlike a car, the motorcycle does not feature a large rectangular trunk and other features (e.g. windows) that may produce significantly distinct exposures depending on the location of a bystander relative to the trunk. For a motorcycle equipped with a wire antenna mounted on a small ground plane, the separation distance between the antenna and bystander is the main factor determining the exposure levels and for this reason the rear test location is employed.

The separation distance used for testing is defined from the antenna where as the RF safety booklet defines the same distance from the vehicle body to ensure that the assessment is applicable to other vehicles. The measurement probe is positioned orthogonal to antenna (typically parallel to ground with a vertically mounted antenna) and aimed directly at the antenna's axis. These measurements are representative of persons other than the operator standing next to the vehicle.

12.2 Operator vehicle MPE measurements

Antenna is located at the rear of the test vehicle. Refer to Appendix A for antenna location with respect to the operator.

MPE measurements for operator (OP) conditions are determined by taking the average of the (3) measurements (Head, Chest) at the test distance of 37.5cm from the operators' seat area to antennas. (Lower Trunk) at test distance of 48.5 cm to maintain 20 cm separation distance between probe sensor and reradiating objects (motorcycle's enclosure).

The measurement probe is oriented parallel (horizontal) to the ground and positioned above the motorcycle operator's seat. The probe head is pointed towards the back of the vehicle and aimed directly at the antenna's axis while maintaining a twenty (20) centimeter separation distance between the probe sensor and reradiating structures. These (3) measurements are representative of the operator.

13.0 MPE Calculations

The final MPE results for this mobile radio are presented in section 15.0. These results are based on 50% duty cycle for PTT for LMR bands.

Below is an explanation of how the MPE results are calculated. Refer to Appendix D for MPE measurement results and calculations for LMR band.

Bystander - 10 measurements are averaged over the body (*Avg_over_body*).

Operator - 3 measurements are averaged over the top portion of body (*Avg_TopPortion_body*).

The Average over Body test methodology is consistent with IEEE/ANSI C95.3-2002 guidelines.

Therefore;

Equation 2 – Power Density Calculation *(Calc._P.D.)*

$$Calc.\_P.D. = (Avg\_over\_body) * (probe\_frequency\_cal\_factor) * (duty\_cycle)$$

$$Calc.\_P.D. = (Avg\_TopPortion\_body) * \frac{2}{3} * (probe\_frequency\_cal\_factor) * (duty\_cycle)$$

Note 1: The highest "average" cal factors from the calibration certificates were selected for the applicable frequency range. Linear interpretation was used to determine "probe_frequency_cal_factor" for the specific test frequencies.

Note 2: The E-field probe calibration certificate's frequency cal factors were determined by measuring V/m. The survey meter's results were measured in power density (mW/cm^2) and therefore the "probe_frequency_cal_factor" was squared in equation 2 to account for these results.

Note 3: The H-field probe calibration certificate's frequency cal factors were determined by measuring A/m. The survey meter's results were measured in A/m and therefore the "Avg_over_body" A/m results were converted to

power density (mW/cm^2) using the equation 3. H-field measurements are only applicable to frequencies below 300MHz.

Equation 3 – Converting A/m to mW/cm^2

$$mW/cm\text{^}2 = (A/m)\text{^}2 * 37.699$$

Equation 4 – Power Density Maximum Calculation

$$Max\_Calc.\_P.D. = P.D.\_calc * \frac{\max\_output\_power}{initial\_output\_power}$$

Note 4: For initial output power> max_output_power; max_output_power / initial output power = 1

14.0 Antenna Summary

Table 7 below summarizes the tested antennas and their descriptions, overlap of FCC bands, number of test channels per FCC KDB 447498 (FCC N_c) and actual number of tested channels (Actual N_c). This information was used to determine the test configurations presented in this report.

Table 7

Antenna No.	Antenna Model	Frequency Range (MHz)	Physical Length (cm)	Gain (dBi)	Remarks	Overlap FCC Bands (MHz)	FCC N_c	Actual N_c
1	HAE6014A	380-433	18.5	2.15	1/4 wave	406.1-433	3	5
2	HAE6032A	425-470	15.5	2.15	1/4 wave	425-470	4	4
3	HAE6033A	450-482	14.7	2.15	1/4 wave	450-470	3	3
4	HAE6035A	450-512	8.2	2.15	1/4 wave	450-470	3	3
BT/WLAN								
5	AN000163A02	2400-2500 / 4900-5900	7	5.0 / 5.25	Monopole	2412-2462 ; 5180-5825	3	3

15.0 Test Results Summary

15.1 MPE Test Results Summary for LMR

The following tables below summarize the MPE results for each test configuration: test positions (BS-Bystander, OP-Operator), E/H field measurements, antenna model & freq. range, maximum output power, initial power, TX frequency, max calculated power density results, applicable FCC/ICNIRP/ISED Canada specification limits and % of the applicable specification limits.

Table 8
UHF1 Band Bystander MPE assessment to General Population / Uncontrolled Exposure Limits

Test Pos.	E/H field	Antenna No.	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To FCC Spec Limit	ICNIRP Limit	% To ICNIRP Spec Limit	ISED Limit	% To ISED Spec Limit
BS	E	1	HAE6014A, 380 - 433 MHz	18.0	17.8	380.0125	0.077	0.25	30.3	0.20	38.4	0.15	50.7
				18.0	17.7	393.0125	0.071	0.26	27.0	0.20	35.3	0.16	45.5
				18.0	17.7	406.5000	0.077	0.27	28.5	0.20	38.0	0.16	48.6
				18.0	17.5	419.5000	0.073	0.28	26.0	0.21	34.6	0.16	44.7
				18.0	17.3	432.9875	0.064	0.29	22.3	0.22	29.7	0.17	38.8
BS	E	2	HAE6032A, 425- 470 MHz	18.0	17.3	425.0125	0.064	0.28	22.5	0.21	30.0	0.16	38.9
				18.0	17.3	440.0000	0.067	0.29	22.9	0.22	30.6	0.17	40.1
				18.0	17.4	455.0000	0.066	0.30	21.8	0.23	29.0	0.17	38.5
				18.0	17.9	469.9875	0.044	0.31	13.9	0.23	18.6	0.18	24.9
BS	E	3	HAE6033A, 450 - 482 MHz	18.0	17.3	450.0125	0.067	0.30	22.2	0.23	29.6	0.17	39.1
				18.0	17.5	460.0000	0.065	0.31	21.0	0.23	28.0	0.17	37.3
				18.0	17.9	469.9875	0.039	0.31	12.6	0.23	16.8	0.18	22.5
BS	E	4	HAE6035A, 450 - 512 MHz	18.0	17.3	450.0125	0.063	0.30	21.1	0.23	28.1	0.17	37.1
				18.0	17.5	460.0000	0.056	0.31	18.3	0.23	24.4	0.17	32.5
				18.0	17.9	469.9875	0.062	0.31	19.8	0.23	26.4	0.18	35.3

Notes:
Results highlight in yellow are configurations with highest percentage of limits for bystander.
Blue fonts: Frequencies not regulated by FCC.

Table 9
UHF1 Band Operator MPE assessment to Occupational /Controlled Exposure Limits

Test Pos.	E/H field	Antenna No.	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To FCC Spec Limit	ICNIRP Limit	% To ICNIRP Spec Limit	ISED Limit	% To ISED Spec Limit
OP	E	1	HAE6014A, 380 - 433 MHz	18.0	17.8	380.0125	0.187	1.27	14.7	1.00	18.7	1.26	14.8
				18.0	17.7	393.0125	0.209	1.31	15.9	1.00	20.9	1.28	16.3
				18.0	17.7	406.5000	0.197	1.36	14.5	1.02	19.4	1.30	15.1
				18.0	17.5	419.5000	0.155	1.40	11.1	1.05	14.8	1.32	11.7
				18.0	17.3	432.9875	0.158	1.44	10.9	1.08	14.6	1.34	11.7
OP	E	2	HAE6032A, 425- 470 MHz	18.0	17.3	425.0125	0.150	1.42	10.6	1.06	14.1	1.33	11.3
				18.0	17.3	440.0000	0.133	1.47	9.1	1.10	12.1	1.35	9.8
				18.0	17.4	455.0000	0.153	1.52	10.1	1.14	13.5	1.38	11.1
				18.0	17.9	469.9875	0.130	1.57	8.3	1.17	11.1	1.40	9.3
OP	E	3	HAE6033A, 450 - 482 MHz	18.0	17.3	450.0125	0.153	1.50	10.2	1.13	13.6	1.37	11.2
				18.0	17.5	460.0000	0.158	1.53	10.3	1.15	13.8	1.38	11.4
				18.0	17.9	469.9875	0.146	1.57	9.3	1.17	12.4	1.40	10.4
OP	E	4	HAE6035A, 450 - 512 MHz	18.0	17.3	450.0125	0.146	1.50	9.7	1.13	13.0	1.37	10.6
				18.0	17.5	460.0000	0.161	1.53	10.5	1.15	14.0	1.38	11.6
				18.0	17.9	469.9875	0.170	1.57	10.8	1.17	14.4	1.40	12.1

Notes:
Results highlight in yellow are configurations with highest percentage of limits for operator.
Blue fonts: Frequencies not regulated by FCC.

15.2 MPE Test Results for Bluetooth and WLAN

Antenna AN000163A02 supports BT and WLAN 2.4 GHz / 5 GHz should be installed at motorcycle's enclosure. BT, WLAN 2.4 GHz and 5 GHz will not transmit simultaneously.

MPE calculation was use to determine power density for these transmitters due to lower power. According to FCC's OET Bulletin 65 Edition 97-01 Section 2, calculations can be made to predict RF field strength and power density levels around typical RF sources. Equation (5) is generally accurate in far-field of an antenna.

Equation 5 – Power Density Calculation

$$S = \frac{P_t G}{4\pi d^2 L} \mathrm{F}$$

Equation (5) accounts for the maximum duty cycle of the signal, and the factor, F, to provide a worst-case prediction of power density per FCC OET Bulletin 65, Edition 97-01 1997.

Where: S = power density
P_t = maximum output power scaled by the maximum duty cycle of the signal
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
d = distance from antenna
F = Enhancement factor [1 or 2.56 for predicting ground-level field strength]

Table below summarized the MPE calculation for each standalone transmitter bands, Bluetooth and WLAN.

Table 10
BT/WLAN Bystander MPE assessment to General Population / Uncontrolled Exposure Limits

Antenna #	Max Power (W)	Duty Cycle (%)	Tx Frequency (MHz)	Antenna Gain (dBi)	Cable Loss, L (dB)	Dist., d (cm)	Enhance Factor, F	Max Calc. MPE (mW/cm^2)	MPE Spec Limit (mW/cm^2)					
									FCC	% To FCC Spec Limit	ICNIRP	% To ICNIRP Spec Limit	ISED limit	% To ISED Spec Limit
WLAN 2.4 GHz														
AN000163A02	0.040	100%	2412.0	5.00	0.00	20	1.00	0.025	1.00	2.50	1.00	2.50	0.54	4.67
AN000163A02	0.040	100%	2437.0	5.00	0.00	20	1.00	0.025	1.00	2.50	1.00	2.50	0.54	4.63
AN000163A02	0.040	100%	2462.0	5.00	0.00	20	1.00	0.025	1.00	2.50	1.00	2.50	0.54	4.60
WLAN 5 GHz														
AN000163A02	0.016	100%	5180.0	5.25	0.00	20	1.00	0.011	1.00	1.06	1.00	1.06	0.90	1.17
AN000163A02	0.016	100%	5502.5	5.25	0.00	20	1.00	0.011	1.00	1.06	1.00	1.06	0.94	1.12
AN000163A02	0.016	100%	5825.0	5.25	0.00	20	1.00	0.011	1.00	1.06	1.00	1.06	0.98	1.08
Bluetooth 2.4 GHz														
AN000163A02	0.011	100%	2402.0	5.00	0.00	20	1.00	0.007	1.00	0.71	1.00	0.71	0.54	1.32
AN000163A02	0.011	100%	2441.0	5.00	0.00	20	1.00	0.007	1.00	0.71	1.00	0.71	0.54	1.30
AN000163A02	0.011	100%	2480.0	5.00	0.00	20	1.00	0.007	1.00	0.71	1.00	0.71	0.55	1.29

Notes:
1) Distance from antenna (d), 20cm for more conservative estimation.
2) Cable loss (L), all cable loss include in antenna gain, 0 dB.
3) Enhancement Factor (F), 1 (Ground reflection already factor in during antenna characterization)

15.3 Simultaneous Transmission

LMR bands can transmit simultaneously with Bluetooth or WLAN 2.4 GHz or WLAN 5 GHz. Bluetooth and WLAN 2.4 GHz or WLAN 5 GHz transmitters cannot transmit at the same time.

The highest power density results for each standalone transmitters are indicated in Table 11.

Table 11

Transmitters	Frequency Band (MHz)	Bystander (BS)		Operator (OP)	
		Power Density (mW/cm^2)	Percentage of Limit (%)	Power Density (mW/cm^2)	Percentage of Limit (%)
FCC US					
LMR UHF1	406.1 - 470	0.077	28.5	0.197	14.5
Bluetooth	2402 - 2480	0.007	0.71	0.007	0.71
WLAN 2.4 GHz	2412 - 2462	0.025	2.50	0.025	2.50
WLAN 5 GHz	5180 - 5825	0.011	1.06	0.011	1.06
ISED Canada					
LMR UHF1	406.1-470	0.077	48.6	0.197	15.1
Bluetooth	2402 - 2480	0.007	1.32	0.007	1.32
WLAN 2.4 GHz	2412 - 2462	0.025	4.67	0.025	4.67
WLAN 5 GHz	5180 - 5825	0.011	1.17	0.011	1.17
ICNIRP					
LMR UHF1	380-470	0.077	38.4	0.209	20.9
Bluetooth	2402 - 2480	0.007	0.71	0.007	0.71
WLAN 2.4 GHz	2412 - 2462	0.025	2.50	0.025	2.50
WLAN 5 GHz	5180 - 5825	0.011	1.06	0.011	1.06

Per KDB 447498 D01, simultaneous transmission MPE test exclusion applies when the sum of MPE ratios for all simultaneous transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density.

Calculated Maximum Power density for WLAN 2.4 GHz is greater than WLAN 5 GHz and Bluetooth. WLAN 2.4 GHz, WLAN 5 GHz and Bluetooth transmitters cannot transmit at the same time. Thus, WLAN 2.4 GHz will be used to evaluate simultaneous transmission test exclusion. The highest combined power density percentage for simultaneous transmission indicated in Table 12.

Table 12

Designator	Simultaneous Transmission Scenario	Highest Combined Percentage of Limit (%)	
		Bystander (BS)	Operator (OP)
FCC	LMR UHF1 and WLAN	31.0 %	17.0%
ISED Canada	LMR UHF1 and WLAN	53.3 %	19.8%
ICNIRP	LMR UHF1 and WLAN	40.9 %	23.4%

16.0 Conclusion

The assessments for this device were performed with an output power range as indicated in section 15.1 (for LMR) and 15.2 (for BT/WLAN). The maximum allowable output power is equal to the upper limit of the final test factory transmit power specification listed in Table 6. The highest power density results for LMR and BT/WLAN transmitters scaled to maximum allowable power output are indicated in Table 13 and 14 for bystander and operator.

Table 13: Maximum MPE RF Exposure Summary (LMR)

Designator	Transmitters	Frequency Band (MHz)	Bystander (mW/cm²)	Operator (mW/cm²)
FCC	LMR UHF1	406.1-470	0.077	0.197
ISED Canada	LMR UHF1	406.1-430, 450-470	0.077	0.197
ICNIRP	LMR UHF1	380-470	0.077	0.209

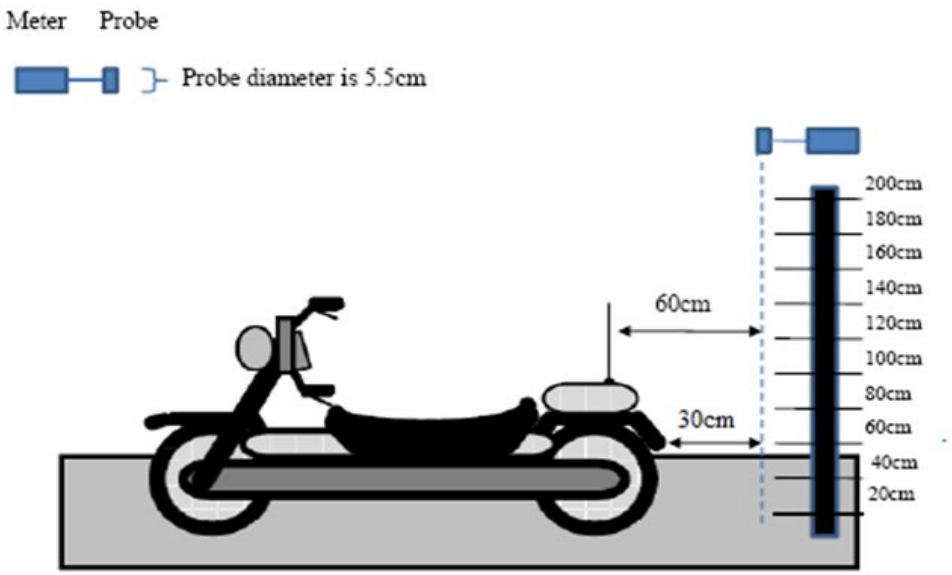
Table 14: Maximum MPE RF Exposure Summary (BT/WLAN)

Designator	Transmitters	Frequency Band (MHz)	Bystander (mW/cm²)	Operator (mW/cm²)
FCC / ISED Canada / ICNIRP	Bluetooth	2402 – 2480	0.007	0.007
	WLAN	2412-2462	0.025	0.025
	WLAN	5180-5825 MHz	0.011	0.011

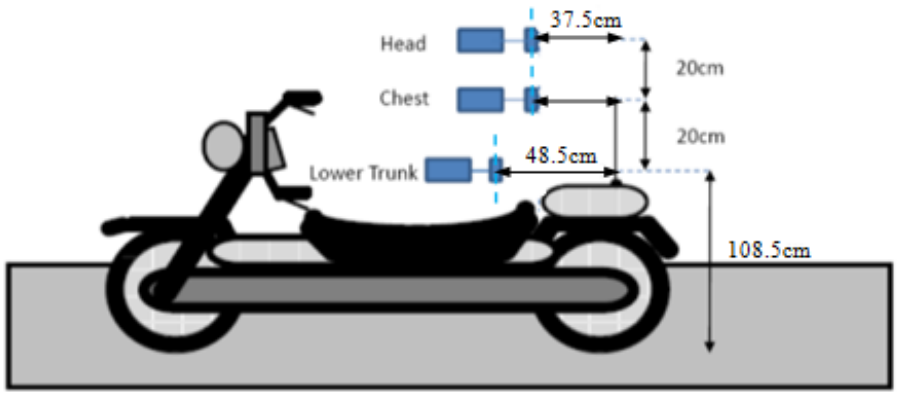
These MPE results herein demonstrate compliance to the FCC/ICNIRP/ISED Canada Occupational/Controlled Exposure limit. FCC rules require compliance for Bystanders to the FCC General Population/Uncontrolled limits.

Appendix A - Illustration of Antenna Location and Test Distances

Bystander Illustration



Operator Illustration



Note: Lower Trunk measurement distance 48.5cm from the antenna is to maintain minimum 20cm separation distance between the probe sensor and reradiating objects (motorcycle's enclosure)

Appendix B - Probe Calibration Certificates

Service Test Report
QAF 1126, 03/11
Report ID: 129185

ETS-LINDGREN
An ESCO Technologies Company
1301 Arrow Point Drive
Cedar Park, Texas 78613
(512) 531-6400

ETS-LINDGREN
An ESCO Technologies Company
Tracking # S000045944
Equipment Check
Attested by GC Date: 01-Apr-19
www.ets-lindgren.com

Certificate of Test Conformance

Page 1 of 1

Reference: S 000045944

Customer: Motorola Solutions Malaysia Sdn Bhd (Innoplex) - Plot 2A, Medan Bayan Lepas, Mukim 12 SWD 11900 Bayan Lepas Penang, Malaysia. Bayan Lepas Penang 11900 Malaysia

The instrument listed below has been tested and verified to Internal Quality Standards. Test data is Attached. Equipment used during instrument testing is controlled by laboratory compliance with ISO/IEC 17025-2005 and ANSI/NCSL Z540-1-1994 using ETS-Lindgren Quality Management System internal procedures.

Manufacturer	ETS-Lindgren
Instrument Type	RF Survey Meter
Model	HI-2200
Serial Number/ID	00206805

Status In
In Tolerance
Date Completed
01-Apr-19
Status Out
Compliant with Internal Quality Standards

Remarks
Functional test performed with customer's E100 S/N: 00126277 and H200 S/N: 00084225. Firmware Updated.

I would like to take this opportunity to express our appreciation for using ETS-Lindgren for your EMI test equipment services and I am looking forward to continued business with your organization. Please feel free to contact our offices at (512) 531-6400, if you have any questions regarding this report.

Sincerely,

George Cisneros
Calibration Supervisor

Date Attested: 01-Apr-19

ACCREDITED Calibration Laboratory Certificate 1207.01

Cert I.D.: 129186

ETS-LINDGREN
An ESCO Technologies Company
1301 Arrow Point Drive
Cedar Park, Texas 78613
(512) 531-6400

ETS-LINDGREN An ESCO Technologies Company
Track# S000045944 Ltd Cal ☐
By JAA Date 01-Apr-19
Next Cal Due
www.ets-lindgren.com

Certificate of Calibration Conformance

The instrument identified below has been individually calibrated in compliance with the following standard(s):

IEEE 1309 - 2013, Institute of Electrical and Electronics Engineers, Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas from 9 kHz to 40 GHz

Environment: Laboratory MTE is maintained in a temperature controlled environment with ambient conditions from 18 to 28 C, relative humidity less than 90%. The instrument under test has been calibrated in a suitable environment using an EMCO TEM Cell 5101C, GTEM 5305/5402 and an RF Shielded EMC Chamber which is conducive to maintaining accurate and reliable measurement quality.

Manufacturer:	ETS-Lindgren	**Operating Range:**	100kHz - 5GHz
Model Number:	E100	**Instrument Type:**	Isotropic Probe > 1 GHz
Serial Number/ ID:	*00126277*	**Date Code:**	
Tracking Number:	**S 000045944**	**Alternate ID:**	
Date Completed:	01-Apr-19	**Customer:**	Motorola Solutions Malaysia Sdn Bhd (Innoplex) - Plot 2A, Medan Bayan Lepas, Mukim 12 SWD 11900 Bayan Lepas Penang, Malaysia. Bayan Lepas Penang 11900 Malaysia
Test Type:	Standard Field, Field Strength		

Calibration Uncertainty: Std Field Method 100kHz - 6 GHz, +/-0.64 dB, Linearity +/- 0.95 dB, Isotropicity +/- 0.86

k=2, (95% Confidence Level)

Test Remarks: Probe received in tolerance thus before and after data are the same. Probe calibrated with customer's HI-2200 S/N: 00206805.

Calibration Traceability: All Measuring and Test Equipment (M/TE) identified below are traceable to the SI units through the National Institute for Standards and Technology (NIST) or other recognized National Metrology Institute. Calibration Laboratory and Quality System controls are compliant with ISO/IEC 17025-2005 and ANSI/NCSL Z540-1-1994.

Standards and Equipment Used:

Make / Model / Name / S/N / Recall Date				
HP	8648C	Signal Generator	3836U02236	18-Apr-19
Keysight	E9304A	Power Sensor	MY56100039	18-Apr-19
Hewlett Packard	E4422B	Signal Generator	US40050591	09-Aug-19
Agilent	E4419B	Power Meter	MY45104171	20-May-19
Rohde & Schwarz	SMB 100A	Signal Generator	101558	17-Sep-19
Agilent	E9304A	Power Sensor	MY41499013	18-Apr-19
Agilent	E9304A	Power Sensor	MY41499012	18-Apr-19
Rohde & Schwarz	NRP-Z91	Power Sensor	100734	18-Apr-19
Rohde & Schwarz	NRP-Z91	Power Sensor	100246	29-Jan-20
Agilent	N1913A	Power Meter	MY50000415	19-Feb-20
Marconi	2024	Signal Generator	112343/043	06-Apr-19
Rohde & Schwarz	NRVD	Power Meter	100451	01-Oct-19
Hewlett Packard	E4419B	Power Meter	US39250717	14-Aug-20
Keysight	E9304A	Power Sensor	MY56100005	18-Apr-19
Rohde & Schwarz	NRV-Z55	Thermal Power Sensor	100352	27-Jul-19
Rohde & Schwarz	NRV-Z55	Thermal Power Sensor	100037	28-Sep-19
Rohde & Schwarz	NRV-Z55	Thermal Power Sensor	100362	13-Dec-19
Rohde & Schwarz	NRP-Z91	Power Sensor	100732	19-Apr-19
Keysight	N5183B	MXG Analog Signal Gener	MY53270789	10-Jan-20

Condition of Instrument
Upon Receipt:
In Tolerance to Internal Quality Standards

On Release:
In Tolerance to Internal Quality Standards

Calibration Completed By
Julio A. Aquino, Calibration Technician

Attested and Issued on 01-Apr-19
George Cisneros, Calibration Supervisor

This document provides traceability of measurements to recognized national standards using controlled processes at the ETS-Lindgren Calibration Laboratory. Uncertainties listed are derived from the methods described by NIST Tech Note 1297. This certificate and report may not be reproduced, except in full, without the written approval of ETS-Lindgren Calibration Laboratory in accordance with ISO/IEC 17025-2005 and ANSI/NCSL Z540-1-1994. The results in this document relate only to the item(s) listed and should not be considered representative of a population unless otherwise noted. QAF 1127 (03/11)

CALIBRATION REPORT

Electric Field Sensor

Model	*S/N*
E100	00126277
HI-2200	00206805

Date: 01 Apr 2019

New Instrument
_ Other
_ Out of Tolerance
X Within Tolerance

Frequency Response

Frequency Response		*Nominal Field*	*Cal Factor**	*Deviation*
	MHz	*V/m*	(Eapplied/Eindicated)	*dB*
1	1	20	1.05	-0.44
2	15	20	1.01	-0.04
3	30	20	1.01	-0.06
4	75	20	1.01	-0.09
5	100	20	1.02	-0.13
6	150	20	1.01	-0.12
7	200	20	1.01	-0.06
8	250	20	1.01	-0.06
9	300	20	0.99	0.04
10	400	20	1.06	-0.47
11	500	20	0.94	0.54
12	600	20	0.93	0.63
13	700	20	1.00	0.04
14	800	20	1.01	-0.06
15	900	20	1.04	-0.32
16	1000	20	1.06	-0.52
17	2000	20	1.06	-0.48
18	2450	20	1.10	-0.84
19	3000	20	1.07	-0.62
20	3500	20	0.98	0.13
21	4000	20	1.07	-0.60
22	5000	20	1.41	-2.98
23	5500	20	1.40	-2.89
24	6000	20	1.56	-3.84

* Corrected electric field values (V/m) can be obtained by multiplying the Cal Factor with the indicated E field readings.

Linearity

maximum linearity deviation is 0.49 dB

(measurements taken from 0.3 V/m to 800 V/m at 27.12 MHz)

Test Conditions

Calibration performed at ambient room temperature: 23 ±3°C

Page 2 of 3

ETS·LINDGREN™
An ESCO Technologies Company

PROBE ROTATIONAL RESPONSE

Model	E100
S/N	00126277
Report	S000045944
Date	Date of Calibration 01 April 2019
Time	12:14:50 PM
Isotropy *	+ 0.292 dB/ -0.292 dB

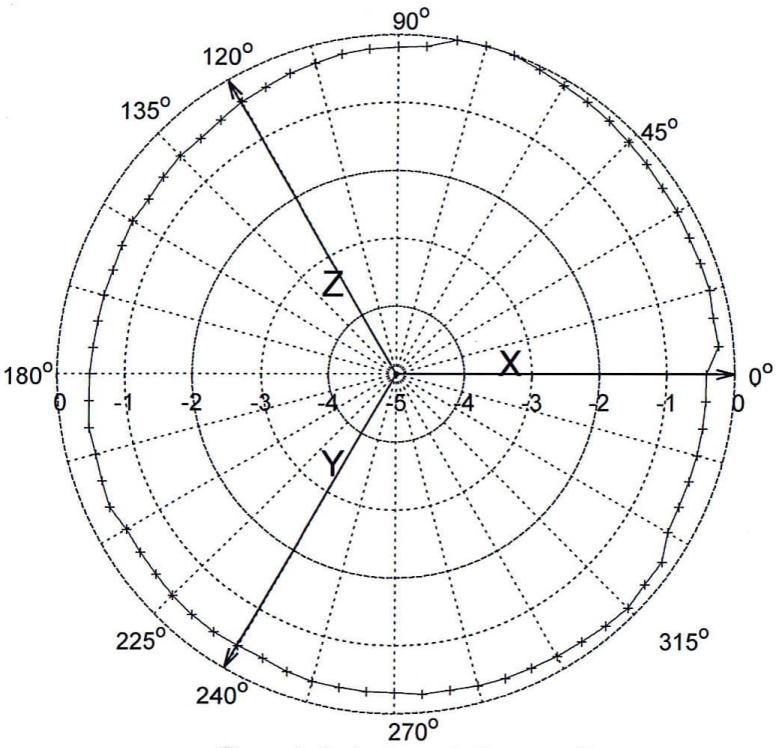


Figure 1: Probe Isotropic Response Chart.

Isotropic response is measured in a 20 V/m field at 400 MHz
*Isotropy is the maximum deviation from the geometric mean as defined by IEEE 1309-2013.

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Appendix C - Photos of Assessed Antennas

(Refer to Exhibit 7B)

Appendix D - MPE Measurement Results

Table D.1

MPE measurement data for Bystander

D.U.T. Info.							Probe Info.		Test Pos.	MPE Measurement										DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
										Bystander (BS) Positions														
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor		20 cm	40 cm	60 cm	80 cm	100 cm	120 cm	140 cm	160 cm	180 cm	200 cm				
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	380.0125	18.0	17.8	CW	E	1.09	BS	0.07	0.085	0.075	0.125	0.275	0.347	0.12	0.11	0.105	0.083	0.5	0.152	0.076	0.077
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	393.0125	18.0	17.7	CW	E	1.11	BS	0.043	0.05	0.094	0.178	0.255	0.22	0.15	0.12	0.08	0.062	0.5	0.139	0.069	0.071
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	406.5000	18.0	17.7	CW	E	1.11	BS	0.017	0.045	0.1	0.18	0.24	0.235	0.21	0.16	0.096	0.085	0.5	0.152	0.076	0.077
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	419.5000	18.0	17.5	CW	E	1.07	BS	0.015	0.035	0.1	0.165	0.2	0.278	0.209	0.172	0.088	0.057	0.5	0.141	0.071	0.073
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	432.9875	18.0	17.3	CW	E	1.04	BS	0.017	0.025	0.072	0.133	0.166	0.255	0.237	0.14	0.08	0.065	0.5	0.124	0.062	0.064
MC	HAE6032A, (425 MHz - 470 MHz)	2.15	425.0125	18.0	17.3	CW	E	1.06	BS	0.022	0.035	0.073	0.118	0.173	0.238	0.2	0.156	0.102	0.04	0.5	0.123	0.061	0.064
MC	HAE6032A, (425 MHz - 470 MHz)	2.15	440.0000	18.0	17.3	CW	E	1.02	BS	0.035	0.055	0.098	0.17	0.185	0.268	0.18	0.144	0.088	0.045	0.5	0.129	0.065	0.067
MC	HAE6032A, (425 MHz - 470 MHz)	2.15	455.0000	18.0	17.4	CW	E	0.99	BS	0.038	0.044	0.062	0.168	0.26	0.263	0.22	0.125	0.08	0.03	0.5	0.128	0.064	0.066
MC	HAE6032A, (425 MHz - 470 MHz)	2.15	469.9875	18.0	17.9	CW	E	0.95	BS	0.04	0.046	0.066	0.12	0.19	0.18	0.13	0.09	0.034	0.018	0.5	0.087	0.043	0.044
MC	HAE6033A, (450 MHz - 482 MHz)	2.15	450.0125	18.0	17.3	CW	E	1.00	BS	0.029	0.05	0.07	0.17	0.24	0.248	0.215	0.145	0.077	0.035	0.5	0.128	0.064	0.067
MC	HAE6033A, (450 MHz - 482 MHz)	2.15	460.0000	18.0	17.5	CW	E	0.98	BS	0.044	0.046	0.086	0.196	0.27	0.277	0.19	0.096	0.05	0.025	0.5	0.125	0.063	0.065
MC	HAE6033A, (450 MHz - 482 MHz)	2.15	469.9875	18.0	17.9	CW	E	0.95	BS	0.045	0.042	0.055	0.118	0.162	0.15	0.13	0.078	0.03	0.015	0.5	0.078	0.039	0.039
MC	HAE6035A, (450 MHz - 512 MHz)	2.15	450.0125	18.0	17.3	CW	E	1.00	BS	0.028	0.045	0.055	0.15	0.26	0.244	0.18	0.14	0.07	0.042	0.5	0.121	0.061	0.063
MC	HAE6035A, (450 MHz - 512 MHz)	2.15	460.0000	18.0	17.5	CW	E	0.98	BS	0.03	0.036	0.08	0.186	0.244	0.252	0.105	0.095	0.05	0.036	0.5	0.109	0.055	0.056
MC	HAE6035A, (450 MHz - 512 MHz)	2.15	469.9875	18.0	17.9	CW	E	0.95	BS	0.04	0.05	0.098	0.208	0.285	0.266	0.14	0.125	0.06	0.025	0.5	0.123	0.062	0.062

MPE calculations are defined in section 13.0.

Table D.2

MPE measurement data for Operator

D.U.T. Info.							Probe Info.			MPE Measurement						
										Operator (OP) Positions						
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head/ Top	Chest/ Middle	Lower Trunk/ Bottom	DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	380.0125	18.0	17.8	CW	E	1.09	OP	0.384	0.725	0.414	0.5	0.369	0.184	0.187
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	393.0125	18.0	17.7	CW	E	1.11	OP	0.421	0.81	0.433	0.5	0.410	0.205	0.209
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	406.5000	18.0	17.7	CW	E	1.11	OP	0.447	0.762	0.362	0.5	0.388	0.194	0.197
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	419.5000	18.0	17.5	CW	E	1.07	OP	0.358	0.628	0.28	0.5	0.301	0.151	0.155
MC	HAE6014A, (380 MHz - 433 MHz)	2.15	432.9875	18.0	17.3	CW	E	1.04	OP	0.325	0.66	0.325	0.5	0.303	0.151	0.158
MC	HAE6032A, (425 MHz - 470 MHz)	2.15	425.0125	18.0	17.3	CW	E	1.06	OP	0.356	0.6	0.27	0.5	0.289	0.144	0.150
MC	HAE6032A, (425 MHz - 470 MHz)	2.15	440.0000	18.0	17.3	CW	E	1.02	OP	0.307	0.565	0.255	0.5	0.255	0.128	0.133
MC	HAE6032A, (425 MHz - 470 MHz)	2.15	455.0000	18.0	17.4	CW	E	0.99	OP	0.494	0.58	0.273	0.5	0.296	0.148	0.153
MC	HAE6032A, (425 MHz - 470 MHz)	2.15	469.9875	18.0	17.9	CW	E	0.95	OP	0.463	0.533	0.233	0.5	0.259	0.130	0.130
MC	HAE6033A, (450 MHz - 482 MHz)	2.15	450.0125	18.0	17.3	CW	E	1.00	OP	0.417	0.637	0.27	0.5	0.294	0.147	0.153
MC	HAE6033A, (450 MHz - 482 MHz)	2.15	460.0000	18.0	17.5	CW	E	0.98	OP	0.478	0.685	0.251	0.5	0.308	0.154	0.158
MC	HAE6033A, (450 MHz - 482 MHz)	2.15	469.9875	18.0	17.9	CW	E	0.95	OP	0.447	0.668	0.256	0.5	0.289	0.145	0.146
MC	HAE6035A, (450 MHz - 512 MHz)	2.15	450.0125	18.0	17.3	CW	E	1.00	OP	0.32	0.665	0.276	0.5	0.280	0.140	0.146
MC	HAE6035A, (450 MHz - 512 MHz)	2.15	460.0000	18.0	17.5	CW	E	0.98	OP	0.331	0.82	0.288	0.5	0.313	0.157	0.161
MC	HAE6035A, (450 MHz - 512 MHz)	2.15	469.9875	18.0	17.9	CW	E	0.95	OP	0.536	0.776	0.287	0.5	0.338	0.169	0.170

MPE calculations are defined in section 13.0.

Table D.3

LMR UHF1 MPE Results for FCC

Note:

Blue fonts: Frequencies not regulated by FCC.

Pmax (W)	18	**P**initial (W)	17.8	17.7	17.7	17.5	17.3	17.3	17.3	17.3	17.4	17.5	17.9
		FCCLimit (mW/cm^2)	0.25	0.26	0.27	0.28	0.28	0.29	0.29	0.29	0.30	0.31	0.31

Table	Test Post	Ant Loc.	E/H Field	Antenna No.	f1	f2	f3	f4	f5	f6	f7	f8	f9	f10	f11
					380.0125	393.0125	406.5000	419.5000	425.0125	432.9875	440.0000	450.0125	455.0000	460.0000	469.9875
D.1	BS	MC	E	1	0.077	0.071	0.077	0.073		0.064					
D.1	BS	MC	E	2					0.064		0.067		0.066		0.044
D.1	BS	MC	E	3								0.067		0.065	0.039
D.1	BS	MC	E	4								0.063		0.056	0.062
D.2	OP	MC	E	1	0.280	0.313	0.296	0.232		0.236					
D.2	OP	MC	E	2					0.225		0.199		0.230		0.196
D.2	OP	MC	E	3								0.230		0.238	0.218
D.2	OP	MC	E	4								0.219		0.242	0.255