DECLARATION OF COMPLIANCE: MPE ASSESSMENT

Motorola Solutions Inc.
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Date of Report: 11/16/2022
Report Revision: B

Responsible Engineer:	Puteri Alifah Ilyana binti Nor Rahim (EME Engineer)
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Date(s) Tested:	10/20/2022, 11/06/2022
Manufacturer:	Motorola Solutions Inc.
Date submitted for test:	10/11/2022
DUT Description:	XPR 5550e 136-174M 45W GOB GNSS CD
Test TX mode(s):	CW
Max. Power output:	Refer to Table 6
TX Frequency Bands:	136-174MHz
Signaling type:	FM, TDMA
Model(s) Tested:	AAM28JQN9RA1AN-1 (PMUD3525A) (IC MODEL: PMUD3525ABUNWA)
Model(s) Certified:	AAM28JQN9RA1AN-1 (PMUD3525A) (IC MODEL: PMUD3525ABUNWA), AAM28JQC9RA1AN-1 (PMUD3525A) (IC MODEL: PMUD3525ABTNWA), AAM28JQN9WA1AN-1 (PMUD3525A) (IC MODEL: PMUD3525ABUNYA)
Serial Number(s):	511TYP0127
Firmware Version:	D02.22.02.3002
Applicant Name:	Motorola Solutions Inc.
Applicant Address:	8000 West Sunrise Boulevard, Fort Lauderdale, Florida 33322
Classification:	Occupational/Controlled Environment
FCC ID:	AZ492FT3853 This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
IC:	109U-92FT3853
ISED Test Site registration:	24843
FCC Test Firm Registration Number:	823256

The MPE results clearly demonstrate compliance with FCC/ISED Occupational/Controlled RF Exposure limits. FCC/ISED rules require compliance for Passengers and Bystanders to the FCC/ISED General Population/Uncontrolled limits.

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.

Saw Sun Hock (Approved Signatory)
Approval Date: 11/16/2022

Document Revision History

Date	Revision	Comments
11/10/2022	A	Initial release
11/16/2022	B	Amend Table 9

Table of Contents

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 AAM28JQN9RA1AN-1 (PMUD3525A) (IC MODEL: PMUD3525ABUNWA).

This model is only able to operate LMR (PTT) mode, without technologies BT and WLAN. It is a depopulated version to the AMM28JQN9RA1AN (PMUD2567C) (IC MODEL: PMUD2567CBMNAA) which has been previously evaluated for MPE with the FCC ID: AZ492FT7138, IC ID: 109U-92FT7138. The results of those previous evaluations were taken into consideration when developing the AAM28JQN9RA1AN-1 (PMUD3525A) (IC MODEL: PMUD3525ABUNWA) MPE test plan.

The AAM28JQN9RA1AN-1 (PMUD3525A) (IC MODEL: PMUD3525ABUNWA) uses the same tested accessories as the AMM28JQN9RA1AN (PMUD2567C) (IC MODEL: PMUD2567CBMNAA) with the FCC ID: AZ492FT7138, IC ID: 109U-92FT7138 and these accessories were also taken consideration and/or evaluation as well, This is classified as Occupational/Controlled.

2.0 FCC MPE Summary

Table 1

Equipment Class	Frequency band (MHz)	Trunk Mounted Antennas				Roof Mounted Antennas			
		Passenger		Bystander		Passenger		Bystander	
		Power Density (mW/cm^2)	Percentage of Limit (%)	Power Density (mW/cm^2)	Percentage of Limit (%)	Power Density (mW/cm^2)	Percentage of Limit (%)	Power Density (mW/cm^2)	Percentage of Limit (%)
TNB	150.8-173.4 (LMR VHF)	0.481	240.3	0.165	82.7	0.081	40.5	0.109	54.6

3.0 Abbreviations / Definitions

CW: Continuous Wave
DUT: Device Under Test
EME: Electromagnetic Energy
FM: Frequency Modulation
MPE: Maximum Permissible Exposure
LMR: Land Mobile Radio
NA: Not Applicable
BS: Bystander
PB: Passenger Back seat
PF: Passenger Front seat
PTT: Push to Talk
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				
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

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

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
Automobile	Volvo 240-1988	NA	NA	NA
Survey Meter Probe – E-Field Probe – H-Field	ETS Model HI-2200 ETS Model E100 ETS Model H200	00206805 00237361 00084225	01/27/2022	01/27/2023

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 product contains transmit and receive circuitry for both analog and digital two way radio communications. The technology details for modes of operation employing transmitters are described below. The modulation scheme used for analog two-way radio communications is narrowband Frequency Modulation (FM). FM is a modulation technique that transmits voice information by altering a radio frequency (RF) signal. The instantaneous frequency of the RF signal is in direct proportion to changes in the amplitude of the voice signal. The rate of change of the RF signal carries the voice frequency information and the deviation of the RF signal carries the voice amplitude information. When the signal is received the change in frequency is converted back into the original voice signal. The FM modulation technique in this product uses sophisticated algorithms and a digital signal processor (DSP) to perform RF modulation/demodulation.

The modulation scheme used for digital two-way radio communications is 4 Level Frequency Shift Keying (4FSK) and Time Division Multiple Access (TDMA). 4FSK is a modulation technique that transmits information by altering the frequency of the radio frequency (RF) signal. Data is converted into complex symbols, which alter the RF signal and transmit the information. When the signal is received, the change in frequency is converted back into symbols and then into the original data. The system can accommodate 2-voice channels in a standard 12.5 kHz channel as used in two-way radio.

Time Division Multiple Access (TDMA) is used to allocate portions of the RF signal by dividing time into two slots. Time allocation enables independent units to transmit voice information without interference from each other. Transmission from a unit or base station is accommodated in time-slot lengths of 30 milliseconds and frame lengths of 60 milliseconds. The 4FSK TDMA modulation technique requires sophisticated algorithms and a digital signal processor (DSP) to perform voice compressions/decompressions and RF modulation/demodulation.

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	136-174	50 (PTT)	54

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 passengers inside the vehicle and the bystanders external to the 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

Refer to Table 7 for complete list of tested antennas.

Below are additional antenna kits that are electrically identical to the tested antennas but have a BNC connector or optional GPS Base:

No.	Antenna Models	Description	Selected for test	Tested	Comments
1	RAD4214A	COMBO GPS/VHF, 136-144 MHz, 1/4 Wave, 2.15dBi	Yes	No	By similarity to RAD4226A
2	RAD4215A	COMBO GPS/VHF, 146-150.8 MHz, 1/4 Wave, 2.15dBi	Yes	No	By similarity to RAD4225A
3	RAD4216A	COMBO GPS/VHF, 150.8-162 MHz, 1/4 Wave, 2.15dBi	Yes	No	By similarity to RAD4224A
4	RAD4217A	COMBO GPS/VHF, 162-174 MHz, 1/4 Wave, 2.15dBi	Yes	No	By similarity to RAD4223A
5	RAD4218A	COMBO GPS/VHF, 146-172 MHz, 5/8 Wave, 5.15dBi	Yes	No	By similarity to RAD4227A

11.0 Test Set-Up Description

Assessments were performed with mobile radio installed in the test vehicle, at the specified distances and test locations indicated in sections 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 appropriate mount locations (Roof / Trunk) and defined test channels.

The system was tested using a low-loss 16’ Teflon RG58A/U cable attaching the radio to the transmit antenna. This cable is shorter and lower attenuation than the 17’ RG58A/U cables supplied in the customer kits for connecting the radio to the transmit antenna. The cable used in the test setup also has lower attenuation over the test frequency range than the cable provided in the customer kits. The use of a shorter cable with lower attenuation in the test setup ensures that the test data is more conservative with regards to the actual installation. Cable losses are reported in Appendix A.

12.0 Method of Measurement with trunk mounted antenna(s)

12.1 External/Bystander vehicle MPE measurements

Initially the antenna is located at the center of the trunk. Refer to Appendix A for antenna location and distance.

MPE measurements for bystander (BS) conditions are determined by taking the average of (10) measurements in a 2 m vertical line for each of the (3) bystander test locations 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 90 cm (for VHF band). 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.

Each of the offered antennas mounted at the center of the trunk were assessed at the rear of the vehicle while maintaining a minimum of twenty (20) centimeter separation distance between the probe sensor and vehicle body. The worst case antenna was then tested at a 45º radial at the corner of the trunk, and 90º radial at the side of the trunk.

Tests for the 90º radial direction where conducted with the antenna displaced towards the "bystander on the side of the trunk" test location in order to attain 90 cm (12 cm antenna displacement) distances from that test location. In this way, the antenna is closer to the test location, and the MPE is higher, than it would be if the antenna was left at the center of the trunk

12.2 Internal/Passenger vehicle MPE measurements

Antenna is located toward the center of the trunk at a minimum 85 cm from backseat passenger. Users are instructed, per installation manual, to mount antennas on the roof only if a minimum 85cm cannot be achieved. Refer to Appendix A for antenna location and distance.

MPE measurements for passenger front seat (PF) and backseat (PB) conditions are determined by taking the average of the (3) measurements (Head, Chest, and Lower Trunk) inside the vehicle for both the front and back seats.

The backseat is a bench seat and therefore each position (Head, Chest & Lower Trunk) were scanned across (horizontally) the seat starting from the middle of the seat to the edge of the seat stopping 20 cm from the vehicle door. Similar process was used in the front bucket seat.

The probe handle is oriented parallel (horizontal) to the ground and pointed towards the back of the vehicle. The probe handle is not oriented normal to the seat surface. The probe head (incorporating the field sensors) is scanned continuously (using the max-hold function available in the meter) along three test axes which are parallel to the seat angle (intended as the line determined by the intersection of the plane of the seat and the plane of the backrest) and are 20 cm from the seat surface. One test axis is at the Head height, another is at the Chest height, and another is at the Lower Trunk height. The maximum field level value recorded for each test axis is logged. The MPE is determined by averaging these three maximum values regardless of the geometrical location where they were observed. For instance, the locations of the three maxima may lie on different vertical (relative to ground) lines.

This approach leads to results that are representative of the exposure of vehicle occupants since it is based on an average across the body portions closest to the antenna for both trunk and roof mount positions, and is conservatively biased because the highest results for each test axis are combined, e.g. the highest head exposure could be in the middle of the seat while the highest lower trunk exposure could be closer to the door.

13.0 Method of Measurement with roof mounted antenna(s)

13.1 External/Bystander vehicle MPE measurements

Antenna is located at the center of the roof. Refer to Appendix A for antenna location and distance.

MPE measurements for bystander (BS) conditions are determined by taking the average of (10) measurements in a 2m vertical line for the 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 90 cm (for VHF band). 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.

13.2 Internal/Passenger vehicle MPE measurements

Antenna is located at the center of the roof. Refer to Appendix A for antenna location and distance.

MPE measurements for passenger front seat (PF) and backseat (PB) conditions are determined by taking the average of the (3) measurements (Head, Chest, and Lower Trunk) inside the vehicle for both the front and back seats.

The backseat is a bench seat and therefore each position (Head, Chest & Lower Trunk) were scanned across (horizontally) the seat starting from the middle of the seat to the edge of the seat stopping 20 cm from the vehicle door. Similar process was used in the front bucket seat.
The probe handle is oriented parallel (horizontal) to the ground and pointed towards the back of the vehicle. The probe handle is not oriented normal to the seat surface. The probe head (incorporating the field sensors) is scanned continuously (using the max-hold function available in the meter) along three test axes which are parallel to the seat angle (intended as the line determined by the intersection of the plane of the seat and the plane of the backrest) and are 20 cm from the seat surface. One test axis is at the Head height, another is at the Chest height, and another is at the Lower Trunk height. The maximum field level value recorded for each test axis is logged. The MPE is determined by averaging these three maximum values regardless of the geometrical location where they were observed. For instance, the locations of the three maxima may lie on different vertical (relative to ground) lines.

This approach leads to results that are representative of the exposure of vehicle occupants since it is based on an average across the body portions closest to the antenna for both trunk and roof mount positions, and is conservatively biased because the highest results for each test axis are combined, e.g. the highest head exposure could be in the middle of the seat while the highest lower trunk exposure could be closer to the door.

14.0 MPE Variability Requirement for External/Bystander vehicle MPE measurement

If all the MPE bystander measurements for a particular antenna are below 50% of the FCC MPE limit, no variability testing for that antenna is required.

If one or more MPE bystander measurements for a particular is between 50-80% of the FCC MPE limit, with no results > 80%, variability testing shall be done on the single worst case for that antenna.

For any MPE bystander measurement above 80% of the MPE limit, variability testing shall be done for all of such configuration. When SAR simulation is performed for a particular antenna configuration to determine compliance, variability measurements are not required for that antenna configuration.

15.0 MPE Calculations

The final MPE results for this mobile radio are presented in section 16.0. 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.

External to vehicle (Bystander) - 10 measurements are averaged over the body (*Avg_over_body*).
Internal to vehicle (Passengers) - 3 measurements are averaged over the body (*Avg_over_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.)*

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

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

16.0 Antenna Summary

Table below summarizes the tested or evaluated antennas and their descriptions, mount location (roof/trunk), 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	Mount Location (Roof/ Trunk)	Overlap FCC Bands (MHz)	FCC N_c	Actual N_c
1	HAD4006A	136-144	52.0	2.15	1/4 wave	R	NA	0	2
2	HAD4007A	144-150.8	49.0	2.15	1/4 wave	R	150.8	1	2
3	HAD4008A	150.8-162	45.5	2.15	1/4 wave	R	150.8-162	3	3
4	HAD4009A	162-174	43.0	2.15	1/4 wave	R	162-173.4	3	3
5	RAD4223A	162-174	40.8	2.15	1/4 wave	R	162-173.4	3	3
6	RAD4224A	150.8-162	44.3	2.15	1/4 wave	R	150.8-162	3	3
7	RAD4225A	146-150.8	47.3	2.15	1/4 wave	R	150.8	1	2
8	RAD4226A	136-144	50.3	2.15	1/4 wave	R	NA	0	2
9	RAD4227A	146-172	87.1	5.15	5/8 wave	R	150.8-172	4	5
10	*HAD4022A	132-174	130.0 (138 MHz) 118.5 (144 MHz) 114.0 (150.8 MHz) 102.7 (158.0125MHz) 96.5 (165.0125MHz) 89.9 (173.0125MH	5.15	5/8 wave	R/T	150.8-173.4	4	6

Note:* Antenna length trimmed to frequency.

All quarter-wave antennas, RAD4227A (and equivalent to antenna RAD4218A) are restricted to install on the roof only.

17.0 Test Results Summary

17.1 MPE Test Results Summary for LMR

The highest power density results for LMR transmitters for each locations scaled to maximum allowable power output are indicated in table below for internal/passenger to the vehicle, and external/bystander to the vehicle.

The previous highest configuration from reference model AMM28JQN9RA1AN (PMUD2567C) (IC MODEL: PMUD2567CBMNAA) with the FCC ID: AZ492FT7138, IC ID: 109U-92FT7138 has been performed spot check. Table 8 indicated the reference model and spot check results.

Table 8

Trunk / Roof	Test Position	E/H Field	Angle (Degree)	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/cm^2)	FCC Limit	%To FCC Limit	ISED Limit	%To ISED Spec Limit	1g SAR (W/kg)	WB SAR (W/kg)	Comments
Spot Check - Highest Configuration at Trunk Mounted Antenna – Bystander															
Trunk	BS	H	90	HAD4022A, 5/8 wave (136-174MHz)	54.0	52.1	165.0125	0.207	0.20	103.4	0.13	160.2	0.43*	0.018*	Reference model
						52.9		0.165		82.7		128.1			Depopulated model
Spot Check - Highest Configuration at Trunk Mounted Antenna - Passenger Back															
Trunk	PB	E	NA	HAD4022A, 5/8 wave (136-174MHz)	54.0	52.1	173.0125	0.656	0.20	327.8	0.13	507.9	0.77*	0.032*	Reference model
						52.0		0.481		240.3		372.3			Depopulated model
Spot Check - Highest Configuration at Trunk Mounted Antenna - Passenger Front															
Trunk	PF	H	NA	HAD4022A, 5/8 wave (136-174MHz)	54.0	52.1	165.0125	0.054	0.20	27.2	0.13	42.1			Reference model
						52.9		0.025		12.3		19.1			Depopulated model
Spot Check - Highest Configuration at Roof Mounted Antenna – Bystander															
Roof	BS	H	90	HAD4008A, 1/4 wave (150.8-162MHz)	54.0	52.2	162.0000	0.126	0.20	63.0	0.13	97.6			Reference model
						53.1		0.109		54.6		84.6			Depopulated model
Spot Check - Highest Configuration at Roof Mounted Antenna – Passenger Back															
Roof	PB	H	NA	HAD4008A, 1/4 wave (150.8-162MHz)	54.0	52.2	162.0000	0.176	0.20	88.0	0.13	136.4	0.05*	0.004*	Reference model
						53.1		0.081		40.5		62.3			Depopulated model
Spot Check - Highest Configuration at Roof Mounted Antenna – Passenger Front															
Roof	PF	H	NA	RAD4224A, 1/4 wave (150.8-162MHz)	54.0	52.2	162.0000	0.084	0.20	42.0	0.13	65.1			Reference model
						53.1		0.052		25.9		40.2			Depopulated model

* The SAR values in this table are for the configurations that require SAR simulations based on corresponding MPE results. The corresponding SAR simulation condition and parameters are identical to those used to simulate SAR for the Reference model. These SAR results and the simulation procedure have been previously documented in the SAR simulation report of the Reference model.

18.0 Conclusion

Spot check result indicated the depopulated version model AAM28JQN9RA1AN-1 (PMUD3525A) (IC MODEL: PMUD3525ABUNWA) is within the product variant AMM28JQN9RA1AN (PMUD2567C) (IC MODEL: PMUD2567CBMNAA) with the FCC ID: AZ492FT7138, IC ID: 109U-92FT7138. The highest power density results for LMR transmitter scaled to maximum allowable power output are indicated in Table 9 for internal/passenger to the vehicle, and external/bystander to the vehicle.

Table 9: Maximum MPE RF Exposure Summary (LMR)

Designator	Transmitters	Frequency Band (MHz)	Passenger (mW/cm^2)	Bystander (mW/cm^2)
FCC	LMR VHF	150.8-173.4	0.481	0.165
ISED Canada	LMR VHF	138-174	0.481	0.165

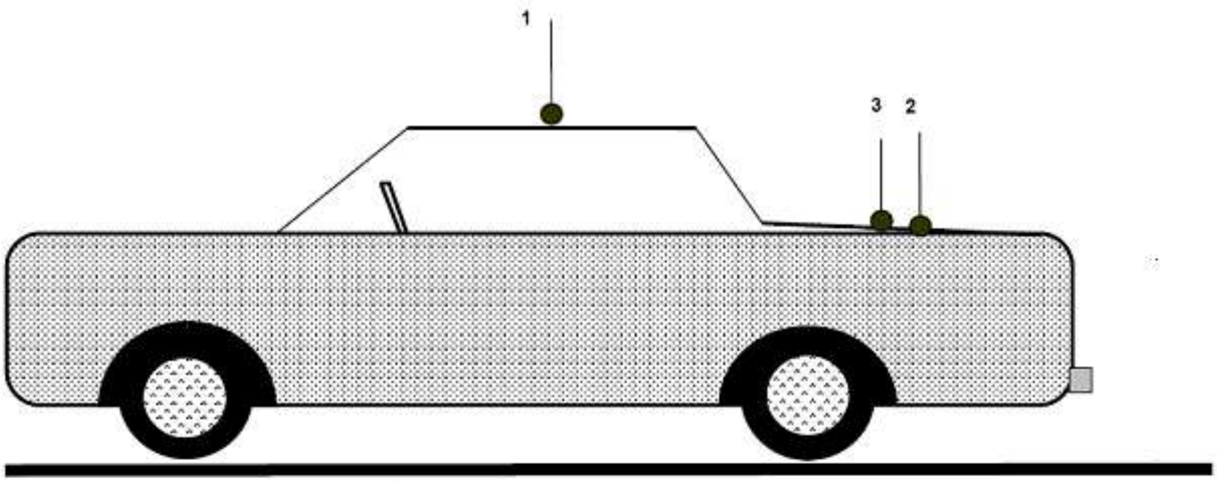
These MPE results herein demonstrate compliance to the FCC and ISED Canada Occupational/Controlled Exposure limit. FCC/ISED rules require compliance for Passengers and Bystanders to the FCC/ISED General Population/Uncontrolled limits.

19.0 User Instructions Considerations

In order to facilitate the task of professional users, the Safety Manual for this radio requires that bystanders be kept at least 3 ft (90 cm) from the vehicle Body.

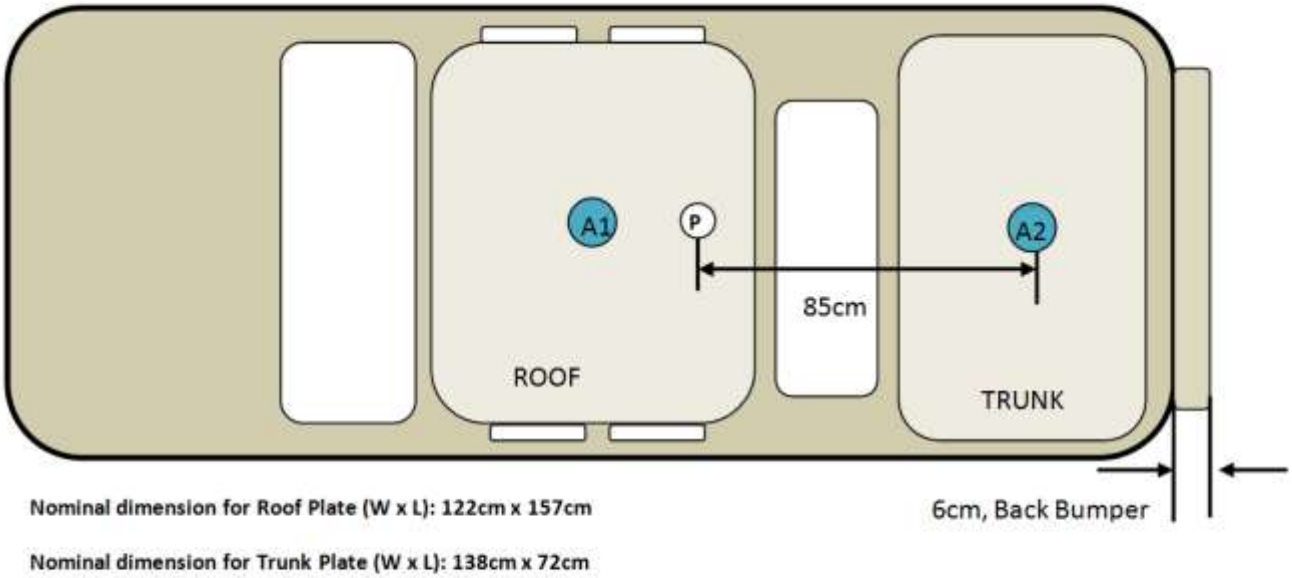
Appendix A - Antenna Locations, Test Distances, and Cable Losses

Antenna locations



1. Roof (20cm from center)
2. Trunk (85cm from back of the back seat)
3. Trunk (center)

Passenger Antenna mounting (VHF)



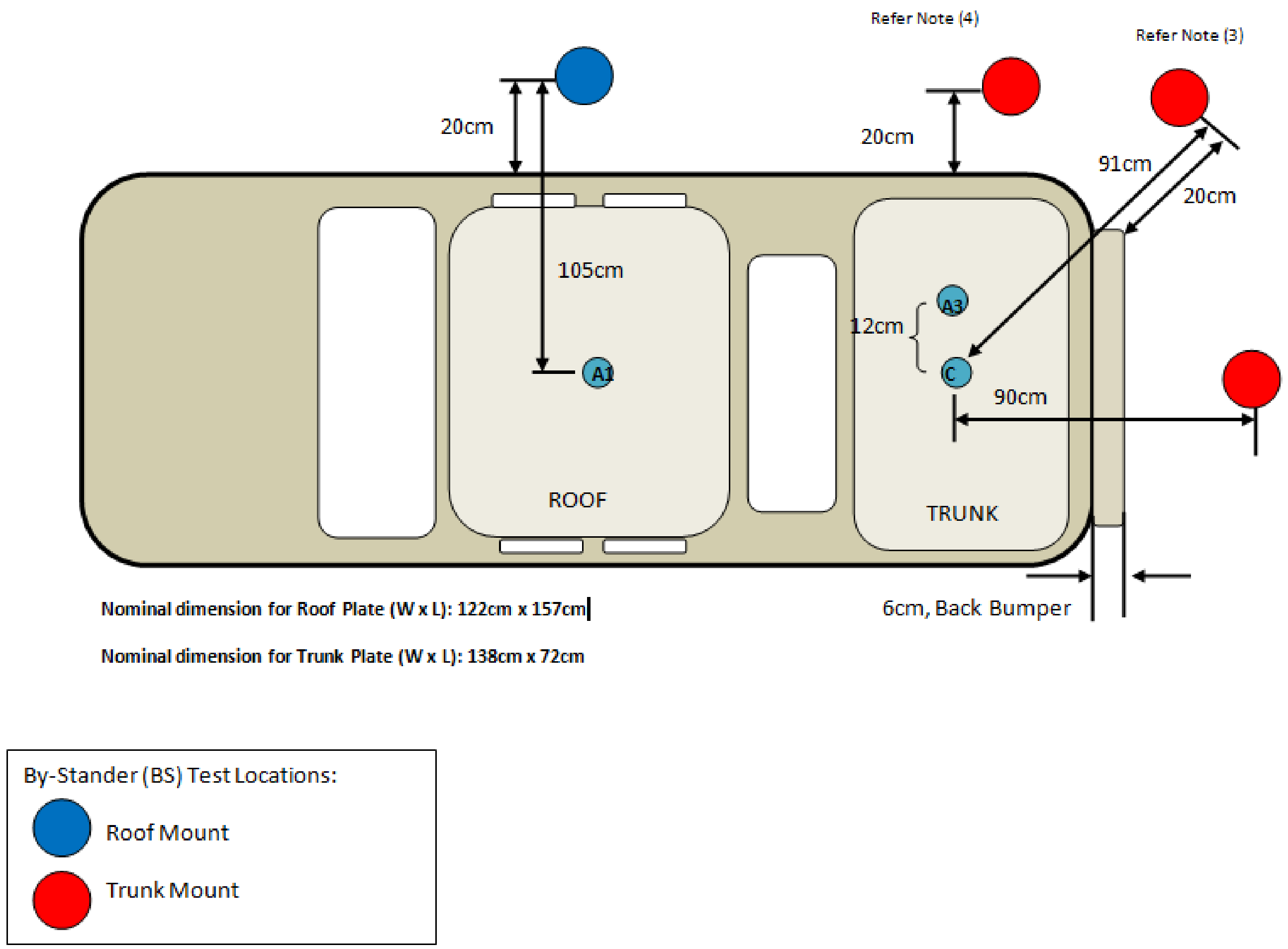
Notes:

1.) Antenna location A1: Mobile radio roof antenna mounting locations for passenger back and front testing (VHF)

2.) Antenna location A2: Mobile trunk antenna mounting locations for passenger back and front testing (VHF)

3.) Total distance between trunk mount antenna and rear passenger is 85cm

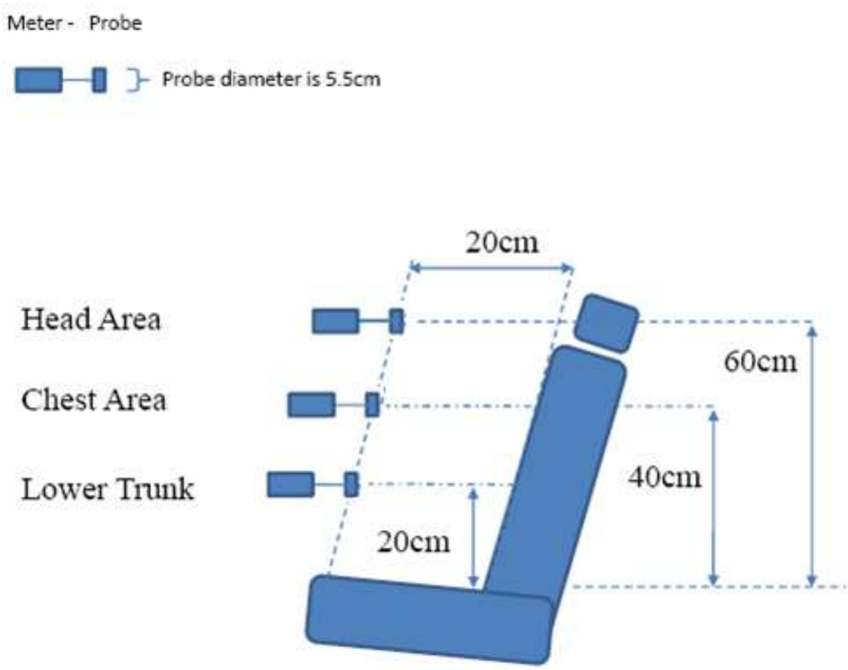
Bystander Antenna mounting (VHF)



Notes:

1) Antenna location A1: Mobile radio roof antenna mounting location
2) Antenna location A3: Mobile radio trunk antenna mounting location for bystander testing. (12cm away from the center)
3) Total distance between Bystander 45 degree angles from the centered-trunk mount antenna is 91cm to maintain a minimum 20cm separation between probe sensor and vehicle body.
4) Total distance between Bystander 90 degree angle from the centered-trunk mount antenna is 90cm (by moving antenna location A3 12 cm from center of the trunk)

Seat scan areas
(Applicable to both front and back seats)



Cable Losses

Test Cable	**Customer Cable**
Teflon RG58A/U Loss Per 100 Feet	RG-58A/U Loss Per 100 Feet (For LMR)
160 MHz - 5 dB	136 MHz – 5.5 dB
450 MHz - 9 dB	450 MHz – 9.6 dB
1 GHz - 13.8 dB	900 MHz – 13.9 dB

Appendix B - Probe Calibration Certificates

ilac-MRA A2LA ACCREDITED Calibration Laboratory Certificate 1007.01

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

ETS·LINDGREN Track# S000053304 Ltd Cal By SB Date 27-Jan-22 Next Cal Due www.ets-lindgren.com

Cert I.D.: 143584

Certificate of Calibration Conformance

Page 1 of 3

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:	*00237361*	**Date Code:**	
Tracking Number:	S 000053304	**Alternate ID:**	
Date Completed:	27-Jan-22	**Customer:**	Motorola Solutions Malaysia Sdn Bhd - Plot 2A, Medan Bayan Lepas, Mukim 12 S.W.D. - 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. Additional frequency data provided per customer. Functional test performed with customer's HI-2200 S/N: 00206805.

Calibration Traceability: This document provides traceability of measurements to recognized national standards to using controlled processes. Any uncertainties listed are derived from the methods described in NIST Tech Note 1297 and other guides to the uncertainty of measurement. This certificate and any reported data may not be reproduced, except in ful, without the written approval of ETS-Lindgren Calibration Laboratory in accordance with ISO/IEC 17025-2017 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 populations unless otherwise noted.

Standards and Equipment Used:
Make / Model / Name / S/N / Calibration Date

Make	Model	Name	S/N	Calibration Date
HP	8648C	Signal Generator	3836U02236	07-May-22
Keysight	E9304A	Power Sensor	MY56100039	15-Apr-22
Rohde & Schwarz	SMB 100A	Signal Generator	101558	16-Nov-22
Agilent	N5181B	MXG Signal Generator	MY51350051	07-Apr-22
Agilent	E9304A	Power Sensor	MY41499013	15-Apr-22
Agilent	E9304A	Power Sensor	MY41499012	15-Apr-22
Rohde & Schwarz	NRP-Z91	Power Sensor	100734	21-Oct-22
Rohde & Schwarz	NRP-Z91	Power Sensor	100246	06-Aug-22
Rohde & Schwarz	NRP-Z91	Power Sensor	100732	06-Aug-22
Agilent	E4419B	Power Meter	MY40510693	04-Aug-22
Agilent	E4419B	Power Meter	GB40202754	08-Apr-22
ETS-Lindgren	Probe Chamber	Probe Chamber	CL504	05-Nov-22
Rohde & Schwarz	NRVD	Power Meter	828110/019	09-Apr-22
Keysight	E9304A	Power Sensor	MY56100005	15-Apr-22
Rohde & Schwarz	NRV-Z55	Thermal Power Sensor	100352	21-Oct-22
Rohde & Schwarz	NRV-Z55	Thermal Power Sensor	100362	06-Aug-22
Agilent	N5181A	Signal Generator	MY50140851	06-Aug-22
Keysight	N5183B	MXG Analog Signal Gener	MY53270789	16-Apr-22

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

On Release:
In Tolerance to Internal Quality Standards

Calibration Completed By
Shane Bennett, Calibration Technician

Attested and Issued on 27-Jan-22
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 17025-2017 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). A binary statement for simple acceptance is used per ILAC G8 09/2019

CALIBRATION REPORT

Electric Field Sensor

Model	S/N
E100	00237361
HI-2200	00206805

Date: 27 Jan 2022

New Instrument
_ Other
_ Out of Tolerance
X Within Tolerance

Frequency Response

Frequency Response	MHz	Nominal Field V/m	Cal Factor* (Eapplied/Eindicated)	Deviation dB
1	1	20	1.04	-0.33
2	15	20	1.02	-0.16
3	30	20	1.02	-0.13
4	75	20	1.02	-0.21
5	100	20	1.03	-0.26
6	150	20	1.03	-0.27
7	200	20	1.02	-0.18
8	250	20	1.02	-0.19
9	300	20	1.01	-0.07
10	400	20	1.04	-0.38
11	500	20	0.94	0.50
12	600	20	0.94	0.55
13	700	20	0.99	0.07
14	800	20	1.00	0.02
15	900	20	1.03	-0.28
16	1000	20	1.02	-0.14
17	2000	20	0.97	0.28
18	2450	20	0.97	0.29
19	3000	20	1.01	-0.11
20	3500	20	0.96	0.38
21	4000	20	0.96	0.33
22	5000	20	1.08	-0.66
23	5500	20	1.25	-1.91
24	6000	20	1.36	-2.69

* 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 0.23 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	00237361
Report	S000053304
Date	Date of Calibration 27 January 2022
Isotropy *	+ 0.1 dB/ -0.1 dB

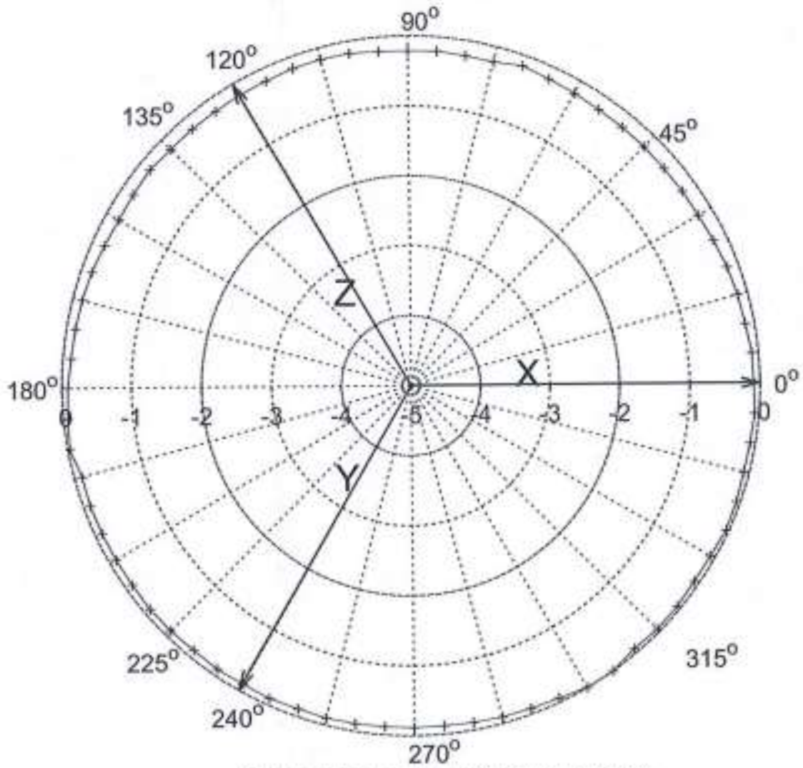


Figure 1: Probe Isotropic Response Chart.

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.

Page 3 of 3

ilac-MRA ACCREDITED Calibration Laboratory Certificate 1207.01

Cert I.D.: 143585

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

ETS·LINDGREN
An ESCO Technologies Company
Track# S000053304 Ltd Cal
By SB Date 27-Jan-22
Next Cal Due
www.ets-lindgren.com

Certificate of Calibration Conformance

Page 1 of 2

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:**	5-300MHz / 30mA/m-10A/m
Model Number:	H200	**Instrument Type:**	Isotropic Magnetic Field Probe (2)
Serial Number/ ID:	00084225	**Date Code:**	
Tracking Number:	S 000053304	**Alternate ID:**	
Date Completed:	27-Jan-22	**Customer:**	Motorola Solutions Malaysia Sdn Bhd - Plot 2A, Medan Bayan Lepas, Mukim 12 S.W.D. - Bayan Lepas - Penang 11900 - Malaysia
Test Type:	Standard Field, Field Strength		
Calibration Uncertainty:	Direct Field Method 1.15dB		

k=2, (95% Confidence Level)

Test Remarks: Probe received in tolerance thus before and after data are the same. Additional frequency data provided per customer. Functional test performed with customer's HI-2200 S/N: 00206805.

Calibration Traceability: This document provides traceability of measurements to recognized national standards to using controlled processes. Any uncertainties listed are derived from the methods described in NIST Tech Note 1297 and other guides to the uncertainty of measurement. This certificate and any reported data may not be reproduced, except in ful, without the written approval of ETS-Lindgren Calibration Laboratory in accordance with ISO/IEC 17025-2017 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 populations unless otherwise noted.

Standards and Equipment Used:
Make / Model / Name / S/N / Calibration Date

HP	8648C	Signal Generator	3836U02236	07-May-22
Keysight	E9304A	Power Sensor	MY56100039	15-Apr-22
Rohde & Schwarz	SMB 100A	Signal Generator	101558	16-Nov-22
Agilent	N5181B	MXG Signal Generator	MY51350051	07-Apr-22
Agilent	E9304A	Power Sensor	MY41499013	15-Apr-22
Agilent	E9304A	Power Sensor	MY41499012	15-Apr-22
Rohde & Schwarz	NRP-Z91	Power Sensor	100734	21-Oct-22
Rohde & Schwarz	NRP-Z91	Power Sensor	100246	06-Aug-22
Rohde & Schwarz	NRP-Z91	Power Sensor	100732	06-Aug-22
Agilent	E4419B	Power Meter	MY40510693	04-Aug-22
Agilent	E4419B	Power Meter	GB40202754	08-Apr-22

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

On Release:
In Tolerance to Internal Quality Standards

Calibration Completed By
Shane Bennett, Calibration Technician

Attested and Issued on 27-Jan-22
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 17025-2017 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). A binary statement for simple acceptance is used per ILAC G8:09/2019.

CALIBRATION REPORT

Magnetic Field Sensor

Model	*S/N*
H200	00084225
HI-2200	00206805

Date: 27 Jan 2022

New Instrument
_ Other
_ Out of Tolerance
X Within Tolerance

Frequency Response

Frequency Response	*MHz*	*Nominal Field* *A/m*	*Cal Factor** (Eapplied/Eindicated)	*Deviation* *dB*
1	10	30	1.05	-0.40
2	15	30	1.01	-0.12
3	30	30	0.99	0.10
4	50	30	0.98	0.20
5	75	30	0.96	0.39
6	100	30	0.93	0.68
7	150	30	0.86	1.32
8	175	30	0.82	1.74
9	200	30	0.77	2.27
10	250	30	0.65	3.79
11	300	30	0.53	5.49

* Corrected magnetic field values (A/m) can be obtained by multiplying the Cal Factor with the indicated H field readings.

Linearity

maximum linearity deviation is 0.24 dB

(measurements taken from 30 mA/m to 9 A/m at 27.12 MHz)

Test Conditions

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

The above sensor was calibrated to factory specifications. This calibration is performed per IEEE 1309 standard. All equipment used are traceable to US National Institute of Standards and Technology (NIST).

Page 2 of 2

Appendix C - Photos of Assessed Antennas

(Refer to Exhibit 7B)