MOTOROLA SOLUTIONS

SAMM 826

CERTIFICATE 2518.05

DECLARATION OF COMPLIANCE: MPE ASSESSMENT

Motorola Solutions Inc.
EME Test Laboratory
Motorola Solutions Malaysia Sdn Bhd
Plot 2A, Medan Bayan Lepas,
Mukim 12 SWD 11900 Bayan Lepas Penang, Malaysia.

Date of Report: 04/08/2025
Report Revision: D

Responsible Engineer:	Alfred Hoe (EME Senior Engineer)
Report author:	Alfred Hoe (EME Senior Engineer)
Date(s) Tested:	04/17/2024, 07/28/2024 - 07/29/2024, 08/21/2024
Manufacturer:	Motorola Solutions Inc.
Manufacturer Location:	1301 E. ALGONQUIN ROAD, BLDG IL02 ROOM 3035, SCHAUMBURG, IL 60196
Date submitted for test:	04/10/2024
DUT Description:	APX 8500 ALL Band, GNSS, BT/WiFi DASH/REMOTE
Test TX mode(s):	CW (PTT), Bluetooth, Bluetooth LE, WLAN 2.4GHz & WLAN 5GHz
Max. Power output:	Refer to Table 6
TX Frequency Bands:	Refer to Table 6
Signaling type:	FM, TDMA, FHSS(Bluetooth), WLAN 2.4GHz 802.11b/g/n & WLAN 5GHz 802.11a/n/ac
Model(s) Tested:	M37TSS9PW1CN (PHUW2000D)
Model(s) Certified: (HVIN/PMN)	Refer Section 1.0 Introduction
Serial Number(s):	681IZN6305
Classification:	Occupational/Controlled Environment
Firmware Version (FVIN):	D32.50.27
Applicant Name:	Motorola Solutions Inc.
Applicant Address:	Plot 2A, Medan Bayan Lepas Mukim, 12 SWD, 11900 Bayan Lepas, Penang, Malaysia
FCC ID:	AZ492FT7180 This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
FCC Test Firm Registration Number:	823256
IC:	109U-92FT7180 This report contains results that are immaterial for ISED Canada equipment approval, which are clearly identified.
ISED Test Site registration:	24843

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. The results and statements contained in this report pertain only to the device(s) evaluated herein.

Saw Sun Hock (Approval Signatory)
Approved Date: 04/09/2025

Document Revision History

Date	Revision	Comments
12/23/2024	A	Initial release
02/04/2025	B	Update cover page FCC/IC ID
03/14/2025	C	Update radio model name, FVIN, WLAN calculation and Simultaneous transmission table
04/08/2025	D	Update Table 6 and section 17.3 Simultaneous transmission

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' test site for product model M37TSS9PW1CN (PHUW2000D). This device is electrically and mechanically identical to the approved FCC ID: AZ492FT7089/ IC: 109U-92FT7089, except for the software enhancement to enable the WIFI 5GHz. The results of previous evaluations from FCC ID: AZ492FT7089 / IC: 109U-92FT7089 were taken into consideration when developing the test plan for this device applying spot check on the highest configurations.

Model	Hardware Version ID Number (HVIN)	Product Marketing Name (PMN)	Description
M37TSS9PW1CN	M37TSS9PW1CN	APX 8500	APX 8500 ALL Band, GNSS, BT/WiFi DASH/REMOTE(VHF 136-174MHz 1-25W; UHF1 380-485MHz 1-25W; UHF2 485-512MHz 1-25W, 512-520MHz 1-25W & 800MHz 806-870MHz 1-25W)
L37TSS9PW1CN	L37TSS9PW1CN	APX CONSOLETTE	APX 8500 ALL Band, GNSS, WiFi ,REMOTE(VHF 136-174MHz 1-100W; UHF1 380-485MHz 1-100W; UHF2 485-512MHz 1-40W, 512-520MHz 1-25W ; 762-806MHz 1-30W; 806-870MHz 1-35W)

2.0 FCC MPE Summary

Table 1

Equipment Class	Frequency band (MHz)	Trunk/Roof Mounted Antennas			
		Passenger		Bystander	
		Power Density (mW/cm^2)	Percentage of Limit (%)	Power Density (mW/cm^2)	Percentage of Limit (%)
TNB	150.8-173.4 (LMR VHF)	0.50	248.84	0.13	67.74
	406.1 – 470 (LMR UHF1)	0.30	101.84	0.20	75.14
	450 – 512 (LMR UHF2)	0.30	101.84	0.14	47.94
	769 – 775; 799 – 824, 851 – 869 (LMR 7/800)	0.16	30.44	0.17	29.64
DTS	2402 – 2480 (Bluetooth)	0.003	0.27	0.003	0.27
	2412 – 2462 (WLAN 2.4GHz)	0.002	0.34	0.002	0.34
NII	5180 – 5825 (WLAN 5GHz)	0.002	0.21	0.002	0.21
Simultaneous (Highest Combined Percentage of Limit)			248.84		75.14

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
NA: Not Applicable
BS: Bystander
PB: Passenger Back seat
PF: Passenger Front seat
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 6) – 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 6 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 6 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 – H-Field Probe – E-Field	ETS Model HI-2200 ETS Model H200 ETS Model E100	00206805 00084225 00237161	02/13/2024	02/13/2025
Survey Meter Probe – H-Field Probe – E-Field	ETS Model HI-2200 ETS Model H200 ETS Model E100	00249839 00086316 00206767	11/29/2023	11/29/2024

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

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 frequency modulation (FM) and TDMA signals incorporating traditional simplex two-way radio transmission protocol.

The LMR bands in this device operate in a half duplex system. A half duplex system only allows the user to transmit or receive. This device cannot transmit and receive simultaneously. The user must stop transmitting in order to receive a signal or listen for a response, regardless of PTT button or use of voice activated audio accessories. This type of operation which instructs the user to transmit no more than 50% of the time, justifies the use of 50% duty factor for this device.

This device also contains WLAN technology for data capabilities over WLAN 2.4 GHz (802.11b/g/n), WLAN 5 GHz (802.11 a/n/ac) wireless networks and Bluetooth technology for short range wireless devices.

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

Technology	Transmit Band (MHz)		Transmission	Duty Cycle (%)	Conducted (Average Detector) Maximum Power (W)
LMR	136-174 (LMR VHF)		FM/TDMA	*50 / *25	60
	380 – 470 (LMR UHF1) 450 – 520 (LMR UHF2)	380 - 485			54
		485 - 512			48
		512 - 520			30
	769 – 775; 799 – 824, 851 – 869 (LMR 7/800)	764 - 806			36
		806 - 870			42
Bluetooth	2402 - 2480		FHSS	100	0.0100
Bluetooth LE					0.00198
WLAN 2.4GHz	2412 – 2462	802.11b	DSSS, OFDM	100	0.00794
		802.11g			0.01259
		802.11n (HT20)			0.00794
WLAN 5GHz	5180 - 5825	802.11a	OFDM	100	0.0112
		802.11n			
		802.11ac			

Note - * includes 50% PTT operation

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/ISED Canada 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

Below is additional antenna kits that electrically identical to the tested antenna.

AN000131A03 – Identical to tested antenna AN000131A02

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
VHF (136 – 174MHz)									
1	HAD4016A	136 - 162	51.3	2.15	¼ wave	R	150.8 - 162	3	5
2	HAD4017A	146 - 174	46.2	2.15	¼ wave	R	150.8 - 173.4	4	5
3	HAD4021A	136 - 174	51.7	2.15	¼ wave	R	150.8 - 173.4	4	6
4	HAD4006A	136 - 144	52	2.15	¼ wave	R	-	-	2
5	HAD4007A	144 - 150.8	49	2.15	¼ wave	R	150.8	1	2
6	HAD4008A	150.8 - 162	45.6	2.15	¼ wave	R	150.8 - 162	3	3
7	HAD4009A	162 - 174	43	2.15	¼ wave	R	162 - 173.4	3	3
8	*HAD4022A	132 - 174	130(136MHz) 118.5(144MHz) 114(150.8MHz) 102.7(150.0125MHz) 96.5(165.0125MHz) 89.9(173.0125MHz)	5.15	5/8 wave	R/T	150.8 – 173.4	4	6
9	*RAD4010ARB	136 - 174	143.5(136MHz) 130.5(146MHz) 126.8(150.8MHz) 116.5(158.0125MHz) 112.5(165.0125MHz) 103.7(173.0125MHz)	5.15	½ wave	R/T	150.8 – 173.4	4	6

Table 7 (Continued)

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
UHF1 (380 - 470MHz)									
10	HAE6010A	380 - 433	63.5	5.65	1/2 wave	R/T	406.1-433	3	5
11	HAE6011A	380 - 433	91.0	7.15	5/8 wave	R/T	406.1-433	3	5
12	HAE6012A	380 - 433	18.2	2.15	1/4 wave	R	406.1-433	3	5
13	HAE6013A(1)	380 - 470	29	4.15	1/2 wave	R/T	406.1-470	6	8
14	HAE6031A(1)	380 - 520	28	4.15	1/2 wave	R/T	406.1-470	5	7
15	HAE4003A(1)	450 - 470	16	2.15	1/4 wave	R	450-470	3	3
16	HAE4011A(1)	450 - 470	73.2	5.65	1/2 wave	R/T	450-470	3	3
17	HAE6015A(1)	450 - 520	26.2	4.15	1/2 wave	R/T	450-470	3	3
18	HAE6016A(1)	450 - 512	8.3	2.15	1/4 wave	R	450-470	3	3
19	*RAE4014ARB(1)	445 - 470	92.7(450.0125 MHz) 90.5(460 MHz) 89.0(469.9875 MHz)	7.15	5/8 wave	R/T	450-470	3	3
UHF2 (450-520 MHz)									
20	HAE6013A(1)	380 - 470	29	4.15	1/2 wave	R/T	450-470	3	3
21	HAE6031A(1)	380 - 520	28	4.15	1/2 wave	R/T	450-512	5	6
22	HAE4003A(1)	450 - 470	16	2.15	1/4 wave	R	450-470	3	3
23	HAE4004A	470 - 512	14.7	2.15	1/4 wave	R	470-512	4	4
24	HAE4011A(1)	450 - 470	73.2	5.65	1/2 wave	R/T	450-470	3	3
25	HAE4012A	470 - 495	68.6	5.65	1/2 wave	R/T	470-495	3	3
26	HAE4013A	494 - 512	64.3	5.65	1/2 wave	R/T	494-512	3	3
26	HAE6015A(1)	450 - 520	26.2	4.15	1/2 wave	R/T	450-512	5	7
27	HAE6016A(1)	450 - 512	8.3	2.15	1/4 wave	R	450-512	5	6
28	*RAE4014ARB(1)	445 - 470	92.7(450.0125 MHz) 90.5(460 MHz) 89.0(469.9875 MHz)	7.15	5/8 wave	R/T	450-470	3	3
29	*RAE4016ARB	494 - 512	85.7(494.9875 MHz) 83.6(503 MHz) 83.3(511.9875 MHz)	7.15	5/8 wave	R/T	494-512	3	3
30	*RAE4015ARM	470 - 494	89(470.0125 MHz) 86.4(482.5 MHz) 85(493.9875 MHz)	7.15	5/8 wave	R/T	470-494	3	3

Note:* Antenna length trimmed to frequency.
(1): Antennas support UHF1 & UHF2 frequency range.

Table 7 (Continued)

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
7/800 (764-870 MHz)									
30	HAF4013A	764 - 870	6.1	5.15	1/4 wave	R/T	769-775; 799-824; 851-869	8	9
31	HAF4014A	764 - 870	57.7	5.15	1/4 wave	R/T	769-775; 799-824; 851-869	8	9
32	HAF4016A	764 - 870	9	2.15	1/4 wave	R/T	769-775; 799-824; 851-869	8	9
33	HAF4017A	764 - 870	34.5	5.15	1/4 wave	R/T	769-775; 799-824; 851-869	8	9
All Bands (136-870 MHz)									
34	AN000131A01(1)	136 - 870	55.7	2.15	1/4 wave	R	150.8-173.4 (VHF)	4	6
						R	406.1- 470 (UHF1)	5	7
						R	450-512 (UHF2)	5	6
						R/T	764-775; 799-824; 851-869 (7/800)	8	9
35	AN000131A02(1)	136 - 870	56.4	2.15	1/4 wave	R	150.8-173.4 (VHF)	4	6
						R	406.1- 470 (UHF1)	5	7
						R	450-512 (UHF2)	5	6
						R/T	764-775; 799-824; 851-869 (7/800)	8	9
BT / WiFi / GPS									
37	AN000163A01	2400 - 2500 4900 - 5900	7	3.5 / 3.3	-	Glass Mount	2412 - 2462	3	3
38	PMAN5100A	2400 - 2500	5.7 (L) x 1.9 (W)	3	-	Glass Mount	2412 - 2462	3	3
39	PMAN5101A	2400 - 2500 4900 - 5900	5.4 (L) x 1.32 (W)	2.7 / 0.2	Monopole	Trunk	2412 - 2462 5180 - 5825	3	3
40	AN000163A05	2400 - 2500 4900 - 5900	7	2.5 / 1.6	Monopole	Roof / Trunk	2412 - 2462 5180 - 5825	3	3

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 the table below for internal/passenger to the vehicle, and external/bystander to the vehicle.

The previous highest configuration from reference model M37TSS9PW1AN with FCC ID: AZ492FT7089/ IC ID: 109U-92FT7089 has been performed spot check. Table below indicated the reference model and spot check results.

Table 8 (FCC)

VHF (150.8 - 173.4MHz)										
Trunk/ Roof	**Test Position**	**E/H Field**	**Antenna Model**	**Max Pwr (W)**	**Initial Pwr (W)**	**Tx Freq (MHz)**	**Max Calc. P.D. (mW/ cm^2)**	**FCC Limit**	**% To FCC Spec Limit**	**Remark**
Spot Check - Highest Configuration ByStander										
Roof	BS	H	HAD4016A, 1/4 Wave (136-162MHz)	60.0	58.6	150.8000	0.17	0.20	85.5	Reference Configuration
					58.9		0.13	0.20	67.4	Measured
Spot Check - Highest Configuration Passenger Back										
Trunk	PB	E	HAD4022A, 5/8 Wave (132-174MHz)	60.0	59.0	165.0125	0.50	0.20	250.1	Reference Configuration
					59.6		0.50	0.20	248.5	Measured
Spot Check - Highest Configuration Passenger Front										
Roof	PF	E	HAD4017A, 1/4 Wave (146-174MHz)	60.0	59.0	165.0125	0.09	0.20	42.9	Reference Configuration
					59.6		0.04	0.20	22.0	Measured
UHF1 (406.1 - 470MHz)										
Spot Check - Highest Configuration ByStander										
Trunk	BS	E	HAE6031A, 1/2 Wave (380-520MHz)	54.0	53.4	406.5000	0.20	0.27	74.7	Reference Configuration
					53.9		0.20	0.27	74.8	Measured
Spot Check - Highest Configuration Passenger Back										
Trunk	PB	E	HAE6031A, 1/2 Wave (380-520MHz)	54.0	53.2	450.0125	0.42	0.30	140.1	Reference Configuration
					53.4		0.30	0.30	***101.5**	Measured
Spot Check - Highest Configuration Passenger Front										
Roof	PF	E	HAE6015A, 1/2 Wave (450-520MHz)	54.0	53.3	469.9875	0.09	0.31	27.4	Reference Configuration
					52.6		0.10	0.31	30.6	Measured

Table 8 Continued (FCC)

UHF2 (450 - 512MHz)										
Trunk/ Roof	Test Position	E/H Field	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To FCC Spec Limit	Remark
Spot Check - Highest Configuration ByStander										
Trunk	BS	E	HAE6015A, 1/2 Wave (450-520MHz)	54.0	53.2	450.0125	0.15	0.30	51.1	Reference Configuration
					53.4		0.14	0.30	47.6	Measured
Spot Check - Highest Configuration Passenger Back										
Trunk	PB	E	HAE6031A, 1/2 Wave (380-520MHz)	54.0	53.2	450.0125	0.42	0.30	140.1	Reference Configuration
					53.4		0.30	0.30	101.5	Measured
Spot Check - Highest Configuration Passenger Front										
Trunk	PF	E	HAE6031A, 1/2 Wave (380-520MHz)	48.0	47.5	511.9875	0.10	0.34	29.2	Reference Configuration
					46.2		0.10	0.34	29.1	Measured
7/800 (769 - 775MHz; 799 - 824MHz; 851 - 869MHz)										
Spot Check - Highest Configuration ByStander										
Trunk	BS	E	HAF4014A, 1/4 Wave (764-870MHz)	42.0	40.3	851.0125	0.22	0.57	38.7	Reference Configuration
					42.0		0.17	0.57	29.3	Measured
Spot Check - Highest Configuration Passenger Back										
Trunk	PB	E	HAF4017A, 1/4 Wave (764-870MHz)	42.0	41.6	806.0125	0.17	0.54	31.7	Reference Configuration
					41.2		0.16	0.54	30.1	Measured
Spot Check - Highest Configuration Passenger Front										
Trunk	PF	E	HAF4017A, 1/4 Wave (764-870MHz)	42.0	41.0	823.9875	0.12	0.55	22.3	Reference Configuration
					40.3		0.09	0.55	15.5	Measured

Table 9 (ISED)

VHF (138 - 174MHz)										
Trunk/ Roof	Test Position	E/H Field	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	ISED Limit	% To ISED Spec Limit	Remark
Spot Check - Highest Configuration ByStander										
Roof	BS	H	HAD4016A, 1/4 Wave (136-162MHz)	60.0	58.4	144.0000	0.18	0.13	138.6	Reference Configuration
					59.4		0.14	0.13	105	Measured
Spot Check - Highest Configuration Passenger Back										
Trunk	PB	E	HAD4022A, 5/8 Wave (132-174MHz)	60.0	59.0	165.0125	0.50	0.13	387.5	Reference Configuration
					59.6		0.50	0.13	385	Measured
Spot Check - Highest Configuration Passenger Front										
Roof	PF	E	HAD4017A, 1/4 Wave (146-174MHz)	60.0	59.0	165.0125	0.09	0.13	66.4	Reference Configuration
					59.6		0.04	0.13	34.0	Measured
UHF1 (406.1 - 430MHz, 450 - 470MHz)										
Spot Check - Highest Configuration ByStander										
Trunk	BS	E	HAE6031A, 1/2 Wave (380-520MHz)	54.0	53.4	406.5000	0.20	0.16	127.4	Reference Configuration
					53.9		0.20	0.16	127.5	Measured
Spot Check - Highest Configuration Passenger Back										
Trunk	PB	E	HAE6031A, 1/2 Wave (380-520MHz)	54.0	53.2	450.0125	0.42	0.17	246.6	Reference Configuration
					53.4		0.30	0.17	178.8	Measured
Spot Check - Highest Configuration Passenger Front										
Roof	PF	E	HAE6015A, 1/2 Wave (450-520MHz)	54.0	53.3	469.9875	0.09	0.18	48.8	Reference Configuration
					52.6		0.10	0.18	54.6	Measured

Table 9 Continued (ISED)

UHF2 (450 - 470MHz)										
Trunk/ Roof	**Test Position**	**E/H Field**	**Antenna Model**	**Max Pwr (W)**	**Initial Pwr (W)**	**Tx Freq (MHz)**	**Max Calc. P.D. (mW/ cm^2)**	**ISED Limit**	**% To ISED Spec Limit**	**Remark**
Spot Check - Highest Configuration ByStander										
Trunk	BS	E	HAE6015A, 1/2 Wave (450-520MHz)	54.0	53.2	450.0125	0.15	0.17	90.0	Reference Configuration
					53.4		0.14	0.17	83.8	Measured
Spot Check - Highest Configuration Passenger Back										
Trunk	PB	E	HAE6031A, 1/2 Wave (380-520MHz)	54.0	53.2	450.0125	0.42	0.17	246.6	Reference Configuration
					53.4		0.30	0.17	178.8	Measured
Spot Check - Highest Configuration Passenger Front										
Trunk	PF	E	HAE6015A, 1/2 Wave (450-520MHz)	54.0	53.3	469.9875	0.09	0.18	48.8	Reference Configuration
					52.6		0.10	0.18	54.6	Measured
7/800 (768 - 776MHz; 798 - 824MHz; 851 - 869MHz)										
Spot Check - Highest Configuration ByStander										
Trunk	BS	E	HAF4014A, 1/4 Wave (764-870MHz)	42.0	40.3	851.0125	0.22	0.26	83.4	Reference Configuration
					42.0		0.17	0.26	63.0	Measured
Spot Check - Highest Configuration Passenger Back										
Trunk	PB	E	HAF4017A, 1/4 Wave (764-870MHz)	42.0	41.6	806.0125	0.17	0.25	67.2	Reference Configuration
					41.2		0.16	0.25	63.7	Measured
Spot Check - Highest Configuration Passenger Front										
Trunk	PF	E	HAF4017A, 1/4 Wave (764-870MHz)	42.0	41.0	823.9875	0.12	0.26	47.5	Reference Configuration
					40.3		0.09	0.26	33.0	Measured

17.2 MPE Test Results for Bluetooth and WLAN

Antenna PMAN5100A support Bluetooth & WLAN 2.4GHz only, was intended for mounting on the windshield of the vehicle. This antenna should be installed closed to the top and on the front windshield only. Antennas AN000163A01, AN000163A05 and PMAN5101A support Bluetooth / WLAN 2.4GHz / WLAN 5GHz should be installed at roof or trunk of the vehicle. WLAN 2.4GHz and WLAN 5GHz will not transmit simultaneously. WLAN 2.4GHz and Bluetooth are sharing the same antenna and they are in the same frequency range, thus only WLAN 2.4GHz is selected for simultaneous transmission as the Bluetooth transmit power is higher than Bluetooth power, thus Bluetooth is exclude from simultaneous transmission.

Bluetooth has higher source-based-time-averaging output power compare to Bluetooth LE and will be used for the MPE assessment.

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, calculation can be made to predict RF field strength and power density level around typical RF source. Equation (5) is generally accurate in far-field of an antenna.

Equation 5 – Power Density Calculation

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

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 (mW/cm^2)
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 (dBi)
d = distance from antenna (cm), *20 cm for more conservative estimation.*
L = cable loss (dB), *2.2 dB with 17' PFP240 cable (attenuation 12.9 dB/100ft)*
F = Enhancement factor

Table 10 summarized the MPE calculation for each standalone transmitter bands, Bluetooth and WLAN.

Table 10

Antenna #	Max Power (W)	Duty Cycle (%)	Tx Frequency (MHz)	Antenna Gain (dBi)	Cable Loss, L (dB)	Dist., d (cm)	[2]Enhance Factor, F	Max Calc. MPE (mW/cm^2)	MPE Spec Limit (mW/cm^2)			
									FCC	% of FCC Spec Limit	ISED limit	% of ISED Spec Limit
Bluetooth												
AN000163A01	0.010	100.00%	2402.0000	3.50	2.20	20	1.00	0.003	1.00	0.27	0.54	0.50
AN000163A01	0.010	100.00%	2441.0000	3.50	2.20	20	1.00	0.003	1.00	0.27	0.54	0.50
AN000163A01	0.010	100.00%	2480.0000	3.50	2.20	20	1.00	0.003	1.00	0.27	0.55	0.49
AN000163A05	0.010	100.00%	2402.0000	2.50	3.47	20	1.00	0.002	1.00	0.16	0.54	0.30
AN000163A05	0.010	100.00%	2441.0000	2.50	3.47	20	1.00	0.002	1.00	0.16	0.54	0.29
AN000163A05	0.010	100.00%	2480.0000	2.50	3.47	20	1.00	0.002	1.00	0.16	0.55	0.29
PMAN5100A	0.010	100.00%	2402.0000	3.00	2.20	20	1.00	0.002	1.00	0.24	0.54	0.45
PMAN5100A	0.010	100.00%	2441.0000	3.00	2.20	20	1.00	0.002	1.00	0.24	0.54	0.44
PMAN5100A	0.010	100.00%	2480.0000	3.00	2.20	20	1.00	0.002	1.00	0.24	0.55	0.44
PMAN5101A	0.010	100.00%	2402.0000	2.70	3.00	20	1.00	0.002	1.00	0.19	0.54	0.35
PMAN5101A	0.010	100.00%	2441.0000	2.70	3.00	20	1.00	0.002	1.00	0.19	0.54	0.34
PMAN5101A	0.010	100.00%	2480.0000	2.70	3.00	20	1.00	0.002	1.00	0.19	0.55	0.34
Bluetooth LE												
AN000163A01	0.002	100.00%	2402.0000	3.50	2.20	20	1.00	0.001	1.00	0.05	0.54	0.10
AN000163A01	0.002	100.00%	2441.0000	3.50	2.20	20	1.00	0.001	1.00	0.05	0.54	0.10
AN000163A01	0.002	100.00%	2480.0000	3.50	2.20	20	1.00	0.001	1.00	0.05	0.55	0.10
AN000163A05	0.002	100.00%	2402.0000	2.50	3.47	20	1.00	0.000	1.00	0.03	0.54	0.06
AN000163A05	0.002	100.00%	2441.0000	2.50	3.47	20	1.00	0.000	1.00	0.03	0.54	0.06
AN000163A05	0.002	100.00%	2480.0000	2.50	3.47	20	1.00	0.000	1.00	0.03	0.55	0.06
PMAN5100A	0.002	100.00%	2402.0000	3.00	2.20	20	1.00	0.000	1.00	0.05	0.54	0.09
PMAN5100A	0.002	100.00%	2441.0000	3.00	2.20	20	1.00	0.000	1.00	0.05	0.54	0.09
PMAN5100A	0.002	100.00%	2480.0000	3.00	2.20	20	1.00	0.000	1.00	0.05	0.55	0.09
PMAN5101A	0.002	100.00%	2402.0000	2.70	3.00	20	1.00	0.000	1.00	0.04	0.54	0.07
PMAN5101A	0.002	100.00%	2441.0000	2.70	3.00	20	1.00	0.000	1.00	0.04	0.54	0.07
PMAN5101A	0.002	100.00%	2480.0000	2.70	3.00	20	1.00	0.000	1.00	0.04	0.55	0.07
WLAN2.4GHz 802.11b / n(20MHz)												
AN000163A01	0.008	100.00%	2412.0000	3.50	2.20	20	1.00	0.002	1.00	0.21	0.54	0.40
AN000163A01	0.008	100.00%	2437.0000	3.50	2.20	20	1.00	0.002	1.00	0.21	0.54	0.39
AN000163A01	0.008	100.00%	2462.0000	3.50	2.20	20	1.00	0.002	1.00	0.21	0.54	0.39
AN000163A05	0.008	100.00%	2412.0000	2.50	3.47	20	1.00	0.001	1.00	0.13	0.54	0.24
AN000163A05	0.008	100.00%	2437.0000	2.50	3.47	20	1.00	0.001	1.00	0.13	0.54	0.23
AN000163A05	0.008	100.00%	2462.0000	2.50	3.47	20	1.00	0.001	1.00	0.13	0.54	0.23
PMAN5100A	0.008	100.00%	2412.0000	3.00	2.20	20	1.00	0.002	1.00	0.19	0.54	0.35
PMAN5100A	0.008	100.00%	2437.0000	3.00	2.20	20	1.00	0.002	1.00	0.19	0.54	0.35
PMAN5100A	0.008	100.00%	2462.0000	3.00	2.20	20	1.00	0.002	1.00	0.19	0.54	0.35
PMAN5101A	0.008	100.00%	2412.0000	2.70	3.00	20	1.00	0.001	1.00	0.15	0.54	0.27
PMAN5101A	0.008	100.00%	2437.0000	2.70	3.00	20	1.00	0.001	1.00	0.15	0.54	0.27
PMAN5101A	0.008	100.00%	2462.0000	2.70	3.00	20	1.00	0.001	1.00	0.15	0.54	0.27
WLAN2.4GHz 802.11g												
AN000163A01	0.013	100.00%	2412.0000	3.50	2.20	20	1.00	0.003	1.00	0.34	0.54	0.63
AN000163A01	0.013	100.00%	2437.0000	3.50	2.20	20	1.00	0.003	1.00	0.34	0.54	0.63
AN000163A01	0.013	100.00%	2462.0000	3.50	2.20	20	1.00	0.003	1.00	0.34	0.54	0.62
AN000163A05	0.013	100.00%	2412.0000	2.50	3.47	20	1.00	0.002	1.00	0.20	0.54	0.37
AN000163A05	0.013	100.00%	2437.0000	2.50	3.47	20	1.00	0.002	1.00	0.20	0.54	0.37
AN000163A05	0.013	100.00%	2462.0000	2.50	3.47	20	1.00	0.002	1.00	0.20	0.54	0.37
PMAN5100A	0.013	100.00%	2412.0000	3.00	2.20	20	1.00	0.003	1.00	0.30	0.54	0.56
PMAN5100A	0.013	100.00%	2437.0000	3.00	2.20	20	1.00	0.003	1.00	0.30	0.54	0.56
PMAN5100A	0.013	100.00%	2462.0000	3.00	2.20	20	1.00	0.003	1.00	0.30	0.54	0.55
PMAN5101A	0.013	100.00%	2412.0000	2.70	3.00	20	1.00	0.002	1.00	0.23	0.54	0.44
PMAN5101A	0.013	100.00%	2437.0000	2.70	3.00	20	1.00	0.002	1.00	0.23	0.54	0.43
PMAN5101A	0.013	100.00%	2462.0000	2.70	3.00	20	1.00	0.002	1.00	0.23	0.54	0.43
WLAN5GHz 802.11a/n/ac												
AN000163A01	0.011	100.00%	5180.0000	3.30	3.47	20	1.00	0.002	1.00	0.21	0.90	0.24
AN000163A01	0.011	100.00%	5502.5000	3.30	3.47	20	1.00	0.002	1.00	0.21	0.94	0.23
AN000163A01	0.011	100.00%	5825.0000	3.30	3.47	20	1.00	0.002	1.00	0.21	0.98	0.22
AN000163A05	0.011	100.00%	5180.0000	1.60	3.47	20	1.00	0.001	1.00	0.15	0.90	0.16
AN000163A05	0.011	100.00%	5502.5000	1.60	3.47	20	1.00	0.001	1.00	0.15	0.94	0.15
AN000163A05	0.011	100.00%	5825.0000	1.60	3.47	20	1.00	0.001	1.00	0.15	0.98	0.15
PMAN5101A	0.011	100.00%	5180.0000	0.20	4.00	20	1.00	0.001	1.00	0.09	0.90	0.10
PMAN5101A	0.011	100.00%	5502.5000	0.20	4.00	20	1.00	0.001	1.00	0.09	0.94	0.10
PMAN5101A	0.011	100.00%	5825.0000	0.20	4.00	20	1.00	0.001	1.00	0.09	0.98	0.09

17.3 Simultaneous Transmission

LMR bands can transmit simultaneously with Bluetooth or WLAN 2.4GHz or WLAN 5GHz. WLAN 2.4GHz and WLAN 5GHz cannot transmit at the same time. WLAN 2.4GHz and Bluetooth are sharing the same antenna and they are in the same frequency range, thus only WLAN 2.4GHz is selected for simultaneous transmission as the Bluetooth transmit power is higher than Bluetooth power, thus Bluetooth is exclude from simultaneous transmission. Table 11 lists all the simultaneous transmission conditions.

Table 11 – Simultaneous transmission conditions

Simultaneous transmission conditions	LMR				Bluetooth	WLAN 2.4GHz	WLAN 5GHz
	VHF	UHF1	UHF2	7/800			
1	x				x		
2	x					x	
3	x						x
4		x			x		
5		x				x	
6		x					x
7			x		x		
8			x			x	
9			x				x
10				x	x		
11				x		x	
12				x			x

Table 12 – Highest Percentage of limit for Simultaneous transmission conditions (FCC)

FCC Passenger, Front Seat (PF)						
Simultaneous transmission conditions	LMR				WLAN 2.4GHz	Highest Combined Percentage Of Limit (%)
	VHF	UHF1	UHF2	7/800		
VHF + WLAN 2.4GHz	22.00	-	-	-	0.34	22.27
UHF1 + WLAN 2.4GHz	-	30.60	-	-	0.34	30.87
UHF2 + WLAN 2.4GHz	-	-	29.10	-	0.34	29.37
7/800 + WLAN 2.4GHz	-	-	-	15.50	0.34	15.77
FCC Passenger, Back Seat (PB)						
Simultaneous transmission conditions	LMR				WLAN 2.4GHz	Highest Combined Percentage Of Limit (%)
	VHF	UHF1	UHF2	7/800		
VHF + WLAN 2.4GHz	248.50	-	-	-	0.34	248.77
UHF1 + WLAN 2.4GHz	-	101.50	-	-	0.34	101.77
UHF2 + WLAN 2.4GHz	-	-	101.50	-	0.34	101.77
7/800 + WLAN 2.4GHz	-	-	-	30.10	0.34	30.37
FCC By-Stander (BS)						
Simultaneous transmission conditions	LMR				WLAN 2.4GHz	Highest Combined Percentage Of Limit (%)
	VHF	UHF1	UHF2	7/800		
VHF + WLAN 2.4GHz	67.40	-	-	-	0.34	67.67
UHF1 + WLAN 2.4GHz	-	74.80	-	-	0.34	75.07
UHF2 + WLAN 2.4GHz	-	-	47.60	-	0.34	47.87
7/800 + WLAN 2.4GHz	-	-	-	29.30	0.34	29.57

Table 13 – Highest Percentage of limit for Simultaneous transmission conditions (ISED)

ISED Passenger, Front Seat (PF)						
Simultaneous transmission conditions	LMR				WLAN 2.4GHz	Highest Combined Percentage Of Limit (%)
	VHF	UHF1	UHF2	7/800		
VHF + WLAN 2.4GHz	34.00	-	-	-	0.63	34.50
UHF1 + WLAN 2.4GHz	-	54.60	-	-	0.63	55.10
UHF2 + WLAN 2.4GHz	-	-	30.60	-	0.63	31.10
7/800 + WLAN 2.4GHz	-	-	-	33.00	0.63	33.50
ISED Passenger, Back Seat (PB)						
Simultaneous transmission conditions	LMR				WLAN 2.4GHz	Highest Combined Percentage Of Limit (%)
	VHF	UHF1	UHF2	7/800		
VHF + WLAN 2.4GHz	385.00	-	-	-	0.63	385.50
UHF1 + WLAN 2.4GHz	-	178.80	-	-	0.63	179.30
UHF2 + WLAN 2.4GHz	-	-	178.80	-	0.63	179.30
7/800 + WLAN 2.4GHz	-	-	-	63.70	0.63	64.20
ISED By-Stander (BS)						
Simultaneous transmission conditions	LMR				WLAN 2.4GHz	Highest Combined Percentage Of Limit (%)
	VHF	UHF1	UHF2	7/800		
VHF + WLAN 2.4GHz	104.40	-	-	-	0.63	104.90
UHF1 + WLAN 2.4GHz	-	127.50	-	-	0.63	128.00
UHF2 + WLAN 2.4GHz	-	-	83.80	-	0.63	84.30
7/800 + WLAN 2.4GHz	-	-	-	63.00	0.63	63.50

The highest combined power density percentage for simultaneous transmission indicated in Table 14.

Table 14

Simultaneous Transmission	Highest Percentage of Limit (%)		
	Passenger, Front Seat (PF)	Passenger, Back Seat (PB)	By-Stander (BS)
FCC			
LMR VHF and WLAN	22.34	**248.84	67.74
LMR UHF1 and WLAN	30.94	**101.84	75.14
LMR UHF2 and WLAN	29.44	**101.84	47.94
LMR 7/800 and WLAN	15.84	30.44	29.64
ISED Canada			
LMR VHF and WLAN	34.63	**385.63	**105.03
LMR UHF1 and WLAN	55.23	**179.43	**128.13
LMR UHF2 and WLAN	31.23	**179.43	84.43
LMR 7/800 and WLAN	33.63	64.33	63.63

** SAR simulation result refer to FCC ID: AZ492FT7089/ IC: 109U-92FT7089 SAR simulation report

18.0 Conclusion

The assessments for this device were performed with an output power range as indicated in section 17.1 (for LMR) and 17.2 (for Bluetooth/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 transmitter scaled to maximum allowable power output are indicated in Table below for internal/passenger to the vehicle, and external/bystander to the vehicle and the wireless networks.

Table 15: Maximum MPE RF Exposure Summary (LMR)

Designator	Transmitters	Frequency Band (MHz)	Passenger (mW/cm^2)	By-Stander (mW/cm^2)
FCC	LMR VHF	150.8-173.4	0.50	0.13
	LMR UHF1	406.1-470	0.30	0.20
	LMR UHF2	450-470	0.30	0.14
	LMR 7/800	769-775; 799-824; 851-869	0.16	0.17
ISED Canada	LMR VHF	138-174	0.50	0.14
	LMR UHF1	406.1-430; 450-470	0.30	0.20
	LMR UHF2	450-470	0.30	0.14
	LMR 7/800	768-775; 798-824; 851-869	0.16	0.17

Table 16: Maximum MPE RF Exposure Summary (Bluetooth/WLAN)

Designator	Transmitters	Frequency Band (MHz)	Passenger (mW/cm^2)	By-Stander (mW/cm^2)
FCC / ISED Canada	Bluetooth	2402 – 2480	0.003	0.003
	WLAN 2.4GHz	2412 – 2462	0.002	0.002
	WLAN 5GHz	5180 – 5825	0.002	0.002

Although MPE is a convenient method of demonstrating RF Exposure requirements, SAR is recognized as the "basic restriction". For those configurations in Table 14 with '*', compliance to the General Population / Uncontrolled SAR 1g limit of 1.6 W/kg is demonstrated through SAR computational analysis.

The highest power density results for the transmitter scaled to maximum allowable power output are indicated in Table 17 for internal/passenger to the vehicle, and external/bystander to the vehicle

Table 17

Designator	Frequency Band (MHz)	Passenger (mW/cm^2)	By-Stander (mW/cm^2)
FCC	150.8-173.4	1.25	NA
	406.1-470	1.39	NA
	450-512	0.96	NA
ISED Canada	138-174	1.25	0.85
	406.1-430	1.39	0.46
	450-470	0.96	NA

NA: not applicable

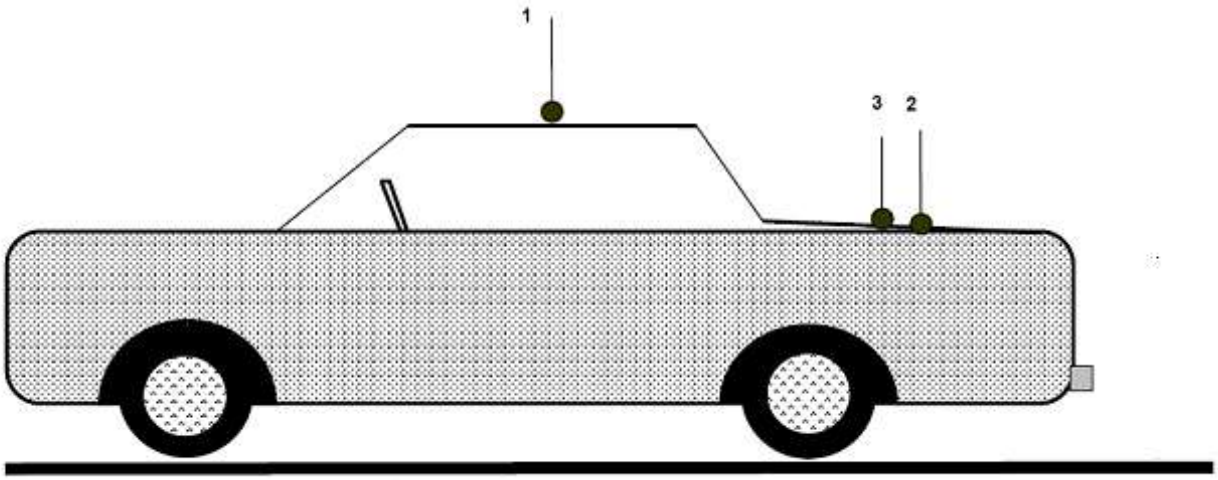
These MPE results herein demonstrate compliance to the FCC and ISED Canada Occupational/Controlled Exposure limit. FCC/ISED rules require compliance for Passengers and Bystanders to the FCC/ISED General Population/Uncontrolled limits.

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 during radio use, even though the reported MPE tests data demonstrates compliance at 2 ft. (60cm) from the vehicle in the 700/800MHz band.

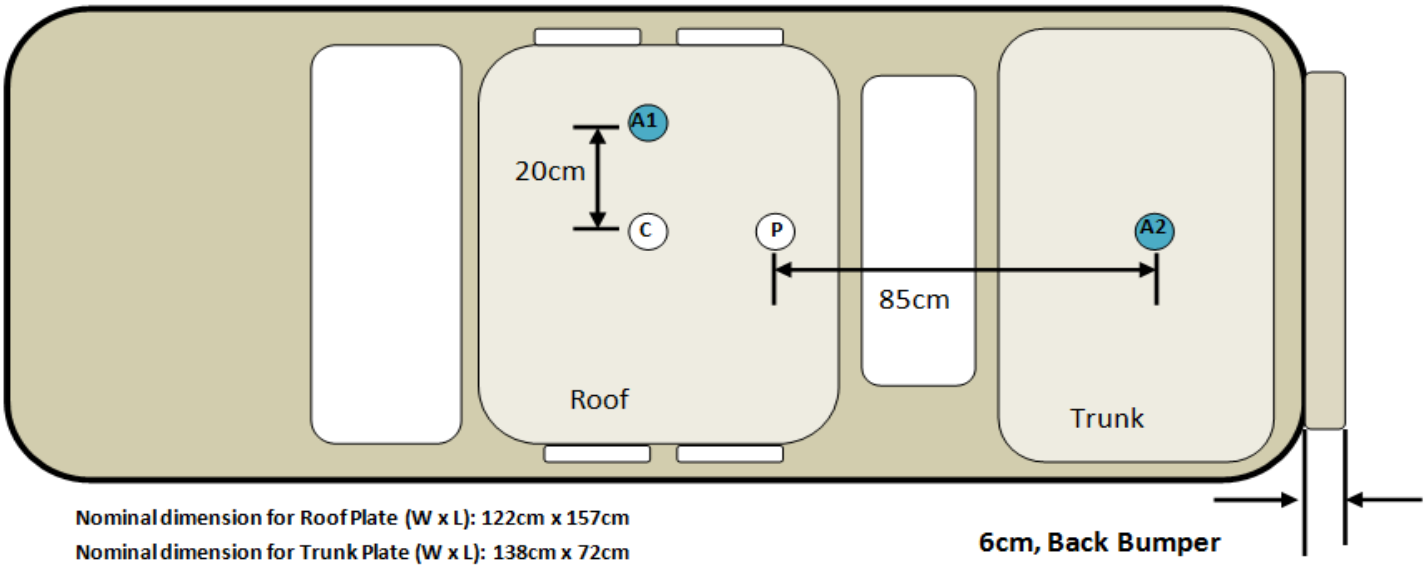
Appendix A - Antenna Locations, Test Distances, and Cable Losses

Antenna locations



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

Passenger Antenna mounting
(LMR VHF, UHF R1, UHF R2 and 7/800 band)



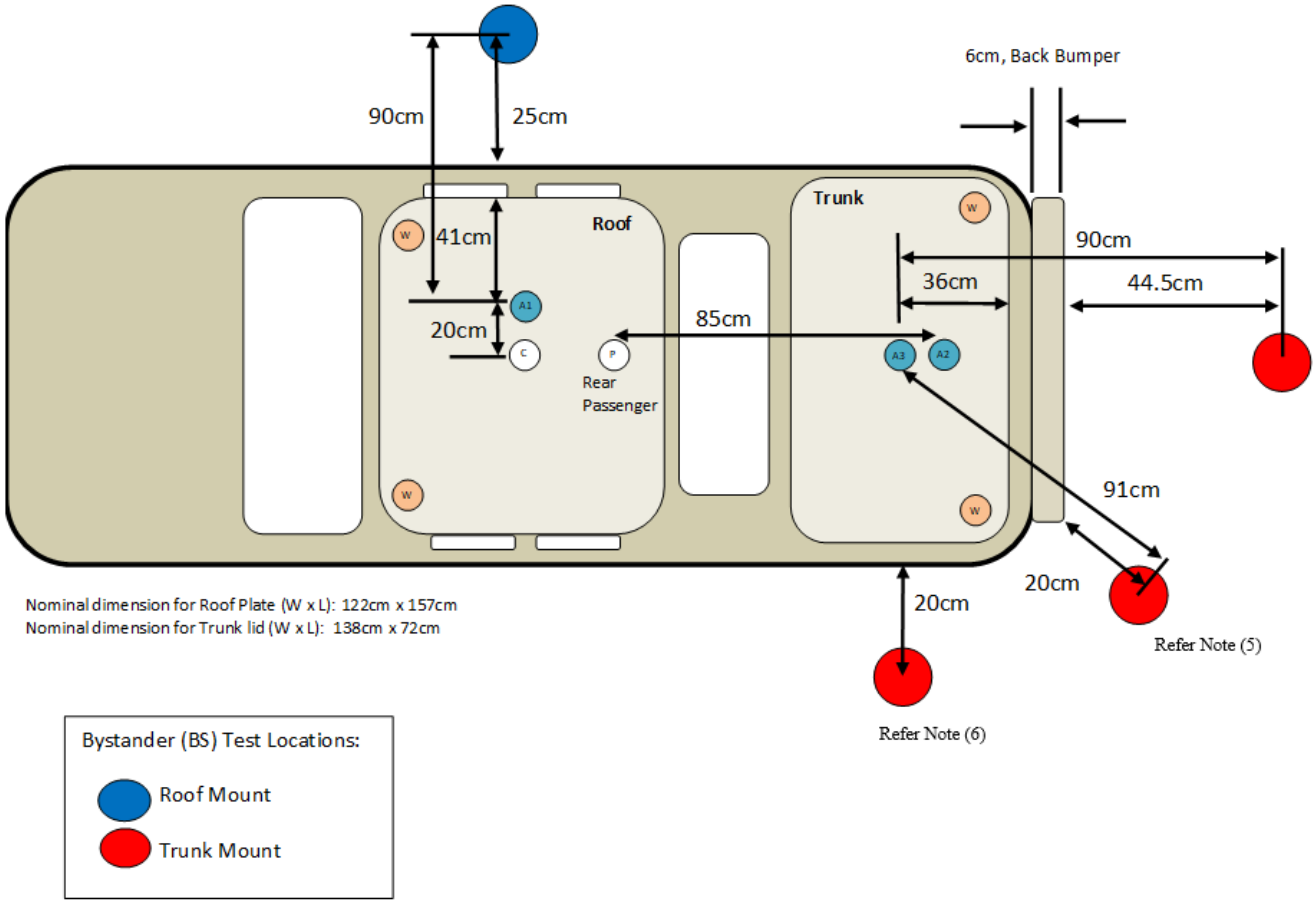
Notes:

1.) Antenna location A1: APX mobile radio roof antenna mounting locations for passenger back and front testing (for LMR VHF, UHF R1, UHF R2 and 7/800 bands)

2.) Antenna location A2: APX mobile trunk antenna mounting locations for passenger back and front testing (for LMR 7/800 band only).

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

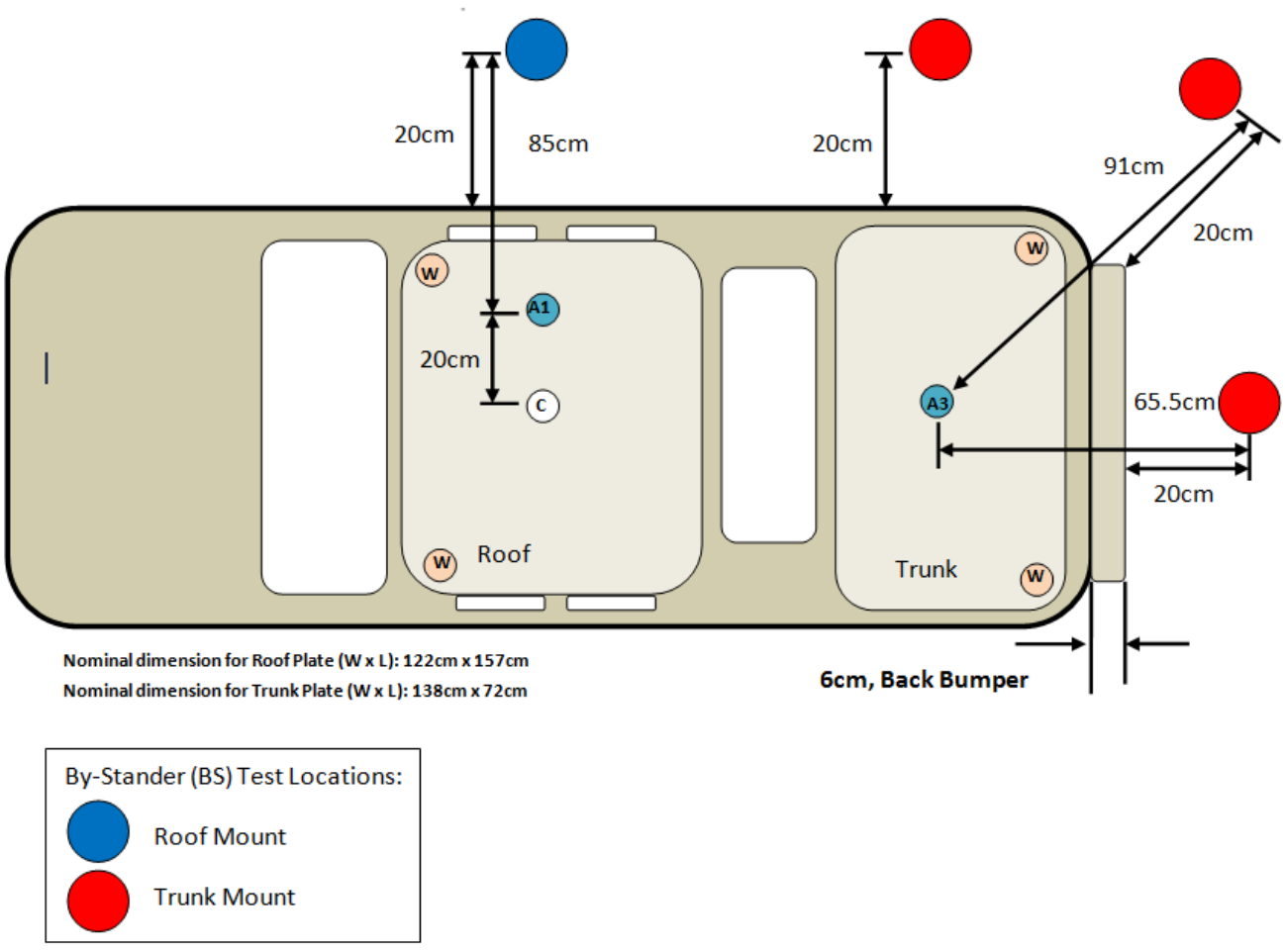
Bystander Antenna mounting and test locations for distance 90cm (LMR VHF, UHF R1and UHF R2 bands)



Notes:

1.) Antenna location A1: LMR antennas roof mount for bystander testing (20cm offset from center)
2.) Antenna location A2: LMR antennas trunk mount for passenger, back seat testing.
3.) Antenna location A3: LMR antennas trunk mount for bystander testing
4.) Antenna location W: Total 4 locations identified for WLAN antenna mounting. (If LMR antennas installed at trunk, WLAN antenna should installed at roof and vice versa)
5.) Total distance between Bystander 45 degree angle from the centered-trunk mount antenna is 91cm to maintain a minimum 20cm separation between probe sensor to the vehicle body.
6.) Total distance between Bystander 90 degree angle from the centered-trunk mount antenna is 90cm (by moving antenna location A3 12cm from center of the trunk)

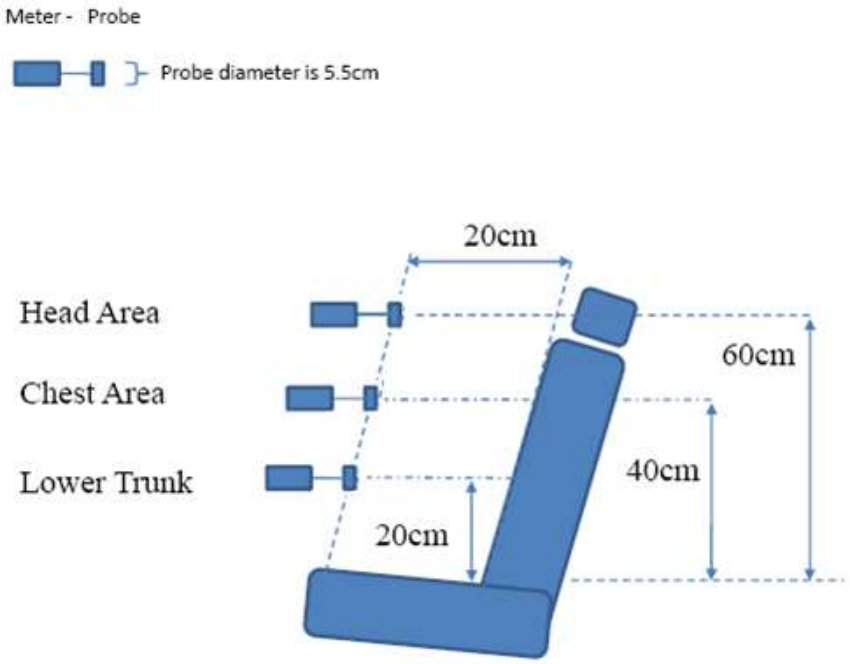
Bystander Antenna mounting and test locations for distance 60cm (LMR 7/800 band)



Notes:

1.) Antenna location A1: LMR antennas roof mount for bystander testing (20cm offset from center)
2.) Antenna location A2: LMR antennas trunk mount for passenger, back seat testing.
3.) Antenna location A3: LMR antennas trunk mount for bystander testing
4.) Antenna location W: Total 4 locations identified for WLAN antenna mounting. (If LMR antennas installed at trunk, WLAN antenna should installed at roof and vice versa)
5.) Total distance between Bystander from roof mount antenna is 85cm. This is the closet distance to maintain minimum 20cm separation between probe sensor and vehicle body.
6.) Total distance between Bystanders from the centered-trunk mount antenna is 60cm and 65.5cm at bumper to maintain a minimum 20cm separation between probe sensor to the vehicle body.
7.) Total distance between Bystander 45 degree angle from the centered-trunk mount antenna is 91cm to maintain a minimum 20cm separation between probe sensor to the vehicle body.
8.) Total distance between Bystander 90 degree angle from the centered-trunk mount antenna is 60cm (by moving antenna location A3 42cm from center of the trunk)

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



Cable Losses

Test Cable

Teflon RG58A/U Loss Per 100 Feet

160 MHz - 5 dB

450 MHz - 9 dB

1 GHz - 13.8 dB

Customer Cable

RG-58A/U Loss Per 100 Feet (For LMR)

136 MHz – 5.5 dB

450 MHz – 9.6 dB

900 MHz – 13.9 dB

PFP 240 Loss Per 100 Feet (For BT/WLAN)

2500 MHz - 12.9 dB

5800 MHz -20.4 dB

Appendix B - Probe Calibration Certificates

KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 231127-121041-b67867

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1498.20

This calibration report shall not be reproduced, except in full. The documented results relate to the equipment calibrated only.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

Traceability Information

Technician Name Dennis Bissen

Measurements are traceable to the International System of Units (SI) via national metrology institutes (www.keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement.

Calibration Equipment Used

Manufacturer	Model Number	Model Description	Equipment ID	Cal Due Date	Certificate Number
AR	100W1000B	Amp	11546	NA	
AR	15T4G18	Amp	10888	NA	NA
EMCO	5101	TEM Cell	10420	NA	2003121920
EMCO	5302	G/TEM	10223	NA	2003121915
AR	600A400	Amplifier, 10KHz-400 MHz, 600W	624658	NA	
AR	75A250	Amp	10560	NA	N/A
AR	80S1G4	Amp	11728	NA	
Agilent Technologies, Inc.	83650B	Synthesized Swept Signal Generator	1354	11/30/2024	231026-132122-02ee89
Hewlett-Packard	8481A	Power Sensor	10449	06/30/2024	230629-130030-5f3da1
Hewlett-Packard	8487A	Power Sensor	10577	01/31/2024	221208-065953-dc1c28
Agilent Technologies, Inc.	8648D	Signal Generator	10307	12/31/2023	221208-065704-d68280
Schwarzbeck Mess-Elektronik	BBHA 9120D	Horn	10194	10/31/2024	231026-132817-d3dc83
Agilent Technologies, Inc.	E4419B	EPM Series Power Meter	10458	10/31/2024	231026-130607-a4620d
AR	FI7000	Interface	11015	NA	700516
AR	FL7006	Isotropic Probe	10946	03/08/2024	2023010355-1
Holaday	HI-4422	Isotropic Probe	10022	01/21/2025	2022100146-1
dbwave	PADD200050180 0B	Dual Directional Coupler	20522	03/31/2024	230301-141152-7ab616

Compliance with Specification

Unless otherwise noted, the calibration results are reported without factoring in the effect of uncertainty on the assessment of compliance/specification.

KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 231127-121041-b67867

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1498.20

Model Number	E100; HI-2200
Manufacturer	ETS - Lindgren
Description	Field Probe
Serial Number	00206767; 00086316
Customer Asset No.	N/A

Customer
Motorola Solutions Malaysia Sdn Bhd
Plot 2A Medan Bayan Lepas Technoplex
Industrial Park Mukim 12 SWD
Bayan Lepas, Penang 11900
MALAYSIA

Date of Calibration	11/29/2023
Temperature	21°C
Humidity	36% RH

Location of Calibration
Keysight Technologies Inc.
1346 Yellowwood Road
Kimballton, IA 51543
United States

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures and in compliance with ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994 (R2002). The quality management system is registered to ISO 9001:2015.

Calibration Standard(s)
IEEE Std 1309-2013 Section 4.1
IEEE Std 1309-2013 Section 5
IEEE Std 1309-2013 Section 8.2
IEEE Std 1309-2013 Section Annex A
IEEE Std 1309-2013 Section A.3
IEEE Std 1309-2013 Section 7.3
IEEE Std 1309-2013 Section 8.3.3.3

Calibration Method(s)
Calculated, Substitution

Calibration Procedure(s)
287330

Calibration Software
Probe Cal 3.6.2
Probe Calculated Method 3.14
Probe Calculated Method 3.14
Probe Chamber Site Validation 1.0
Probe Comparison 1.5.2

As Received Conditions
The measured values of the equipment were observed in specification at the points tested.

Action Taken
No action was taken.

As Completed Conditions
The measured values of the equipment were observed in specification at the points tested.

Calibration Due
Based on the customer's request, the next calibration is due on 29 Nov 2024

Remarks or Special Requirements
A probe position document is included with this certificate. This calibration is valid only for the alignment/mounting position specified in this report.

Keysight Technologies, Inc.
1346 Yellowwood Road
Kimballton, IA 51543
United States

Brandt Langer Iowa Service Center Manager

Issue Date 29 Nov 2023

Page 1 of 7

KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 231127-121041-b67867

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1498.20

In Specification/Out of Specification Explanation

The standard criteria to determine the "In Specification/Out of Specification" status is based on one or more of the following conditions, as requested by the client:

1. If the manufacturer has a specified specification for the item being calibrated, then the calibration values are compared to this specification, and the values must fall within the manufacturer's specification. The specification may be obtained from the manufacturer's web site, data sheets, equipment manuals, etc.
2. Where specifications are called out in a published standard, the calibration results are compared to this specification, and the measured values must fall within the standard's specification.
3. In cases where the manufacturer, standard, or client does not identify any relevant specifications, applicable calibration results are compared to historical data with a +/- 3 dB specification.

Uncertainty of Measurement

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008(GUM). The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95%. This probability corresponds to a coverage factor of k=2 for a normal distribution.

Parameter	Range	MU (+/-)
RF Isotropic E-Field Probes - GTEM Cell - Isotropic	10 kHz to 1000 MHz	0.97 dB
RF Isotropic E-Field Probes - TEM Cell - Linearity	5 kHz to 800 MHz	0.91 dB
RF Isotropic E-Field Probes - Anechoic Chamber - Frequency Response	(450 to 18,000) MHz	1.1 dB
RF Isotropic E-Field Probes - GTEM Cell - Frequency Response	10 kHz to 1000 MHz	0.79 dB

2023_Frequency Response.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: E100; HI-2200
Probe Serial No.: 00206767; 00086316
Notes:
CAL CERT #: 231127-121041-b67867

Frequency in MHz	Correction Factors 20V/m Multiplier	dB
0.1	1.38	2.81
0.5	1.24	1.88
1	1.17	1.34
3	1.05	0.46
15	1.05	0.46
27.12	1.05	0.45
30	1.06	0.49
75	1.08	0.63
100	1.08	0.65
150	1.08	0.67
200	1.09	0.72
250	1.11	0.91
300	1.16	1.31
400	0.87	-1.17
500	1.08	0.69
600	1.13	1.07
700	1.18	1.43
800	0.85	-1.44
900	1.02	0.20
1000	0.91	-0.83
2000	0.98	-0.21
2450	0.92	-0.71
3000	0.84	-1.50
3500	0.88	-1.13
4000	0.95	-0.42
5000	1.04	0.35
5500	1.00	-0.04
6000	1.01	0.09

2023_Isotropic Response.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: E100; HI-2200
Probe Serial No.: 00206767; 00086316
Notes:
CAL CERT # 231127-121041-b67867

Isotropic Response at 400 MHz at 20V/m

Deg	Response dB
0	0.00
45	-0.09
90	0.04
135	-0.13
180	-0.21
225	-0.17
270	-0.26
315	-0.13
360	-0.09

Max Dev. 0.30

2023_Linearity.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: E100; HI-2200
Probe Serial No.: 00206767; 00086316
Notes:
CAL CERT #: 231127-121041-b67867

Linearity

Freq	Applied Field	Indicated Field	Max Dev
MHz	V/m	V/m	dB
27.12	0.50	0.66	-2.41
27.12	1.01	0.98	0.26
27.12	2.01	1.77	1.10
27.12	4.04	3.40	1.50
27.12	8.05	6.99	1.23
27.12	15.12	13.40	1.05
27.12	20.08	17.70	1.10
27.12	30.30	26.70	1.10
27.12	50.00	43.60	1.19
27.12	65.02	56.90	1.16
27.12	100.20	88.40	1.09
27.12	125.20	110.60	1.08
27.12	201.30	178.70	1.03
27.12	250.00	223.30	0.98
27.12	300.30	268.80	0.96
27.12	353.60	317.10	0.95
27.12	400.40	359.40	0.94
27.12	450.80	403.20	0.97
27.12	500.20	449.70	0.92
27.12	552.00	499.80	0.86
27.12	602.30	550.20	0.79

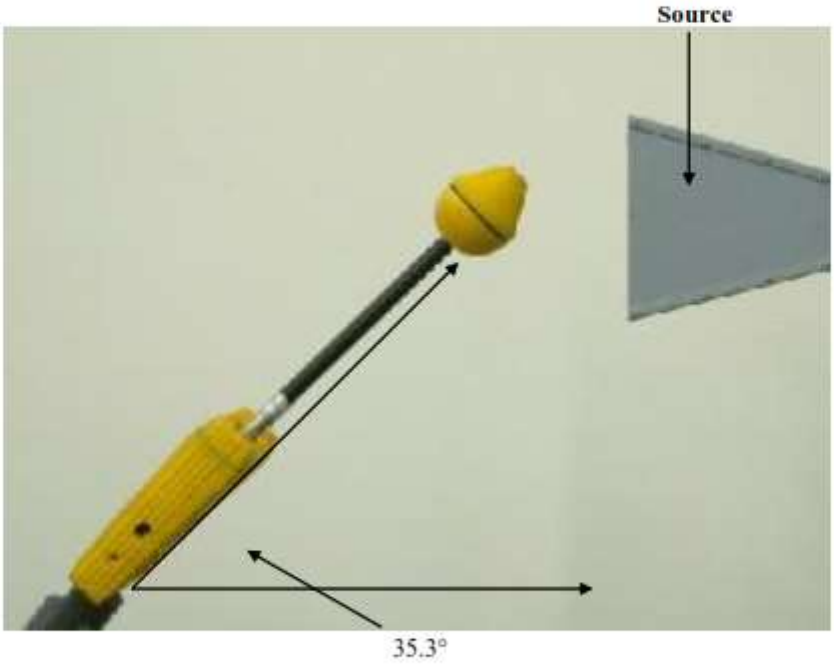
W&G_critical_angle.doc

Probe Alignment/Mounting Position

The alignment/mounting position of the probe is critical. The correction factors given with calibration are valid only for the indicated alignment/mounting position. Deviation from indicated alignment/mounting position of calibration can produce errors in excess of 6 dB.

The probe was positioned with the probe wand at a 35.3° angle position with the probe head centered in front of the field source. The picture below is for probe positioning reference only. The equipment shown does not necessarily indicate the equipment used for calibration.

Side View



KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 231113-155252-a521af

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1498.20

Model Number	H200; HI-2200
Manufacturer	ETS - Lindgren
Description	Field Probe
Serial Number	0024839; 00086316
Customer Asset No.	N/A

Customer
Motorola Solutions Malaysia Sdn Bhd
Plot 2A Medan Bayan Lepas Technoplex
Industrial Park Mukim 12 SWD
Bayan Lepas, Penang 11900
MALAYSIA

Date of Calibration	11/29/2023
Temperature	22°C
Humidity	38% RH

Location of Calibration
Keysight Technologies Inc.
1346 Yellowwood Road
Kimballton, IA 51543
United States

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures and in compliance with ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994 (R2002). The quality management system is registered to ISO 9001:2015.

Calibration Standard(s)
IEEE Std 1309-2013 Section 4.1
IEEE Std 1309-2013 Section 5
IEEE Std 1309-2013 Section 8.2
IEEE Std 1309-2013 Section Annex A
IEEE Std 1309-2013 Section A.3

Calibration Method(s)
Substitution

Calibration Procedure(s)
287330

Calibration Software
Probe Comparison 1.5.2

As Received Conditions
The measured values of the equipment were observed in specification at the points tested.

Action Taken
No action was taken.

As Completed Conditions
The measured values of the equipment were observed in specification at the points tested.

Calibration Due
Based on the customer's request, the next calibration is due on 29 Nov 2024

Remarks or Special Requirements
A probe position document is included with this certificate. This calibration is valid only for the alignment/mounting position specified in this report.

This calibration report shall not be reproduced, except in full. The documented results relate to the equipment calibrated only.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

Keysight Technologies, Inc.
1346 Yellowwood Road
Kimballton, IA 51543
United States

Brandt Langer Iowa Service Center Manager

Issue Date 29 Nov 2023

Page 1 of 5

KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 231113-155252-a521af

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1498.20

Traceability Information

Technician Name Dennis Bissen

Measurements are traceable to the International System of Units (SI) via national metrology institutes (www.keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement.

Calibration Equipment Used

Manufacturer	Model Number	Model Description	Equipment ID	Cal Due Date	Certificate Number
AR	100W1000B	Amp	11546	NA	
EMCO	5101	TEM Cell	10420	NA	2003121920
EMCO	5302	G/TEM	10223	NA	2003121915
AR	600A400	Amplifier, 10KHz-400 MHz, 600W	624658	NA	
Agilent Technologies, Inc.	8648D	Signal Generator	10307	12/31/2023	221208-065704-d68280
AR	FL7006	Isotropic Probe	10946	03/08/2024	2023010355-1
Holaday	HI-4422	Isotropic Probe	10022	01/21/2025	2022100146-1

Compliance with Specification

Unless otherwise noted, the calibration results are reported without factoring in the effect of uncertainty on the assessment of compliance/specification.

In Specification/Out of Specification Explanation

The standard criteria to determine the "In Specification/Out of Specification" status is based on one or more of the following conditions, as requested by the client:

1. If the manufacturer has a specified specification for the item being calibrated, then the calibration values are compared to this specification, and the values must fall within the manufacturer's specification. The specification may be obtained from the manufacturer's web site, data sheets, equipment manuals, etc.
2. Where specifications are called out in a published standard, the calibration results are compared to this specification, and the measured values must fall within the standard's specification.
3. In cases where the manufacturer, standard, or client does not identify any relevant specifications, applicable calibration results are compared to historical data with a +/- 3 dB specification.

Uncertainty of Measurement

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008(GUM). The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95%. This probability corresponds to a coverage factor of k=2 for a normal distribution.

Parameter	Range	MU (+/-)
RF Isotropic E-Field Probes - TEM Cell - Linearity	5 kHz to 800 MHz	0.91 dB
RF Isotropic E-Field Probes - GTEM Cell - Frequency Response	10 kHz to 1000 MHz	0.79 dB

2023_Frequency Response.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: H200; HI-2200
Probe Serial No.: 0024839; 00086316
Notes:
CAL CERT #: 231113-155252-a521af

Correction Factors

Freq in MHz	Mult	dB
5	1.81	5.17
6	1.76	4.91
7	1.73	4.77
8	1.72	4.72
9	1.72	4.69
10	1.73	4.77
13.6	1.74	4.82
15	1.75	4.85
20	1.73	4.74
27.1	1.68	4.49
30	1.65	4.37
40	1.56	3.84
50	1.43	3.13
60	1.32	2.39
70	1.20	1.57
75	0.99	-0.13
80	1.08	0.65
90	0.96	-0.32
100	0.88	-1.09
150	0.71	-2.95
175	0.70	-3.06
200	0.70	-3.05
250	0.71	-3.01
300	0.68	-3.30

2023_Linearity.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: H200; HI-2200
Probe Serial No.: 0024839; 00086316
Notes:
CAL CERT #: 231113-155252-a521af

Linearity

Freq	Applied Field	Indicated Field	Max Dev
MHz	A/m	A/m	dB
27.12	0.04	0.037	0.62
27.12	0.05	0.050	0.52
27.12	0.08	0.076	0.42
27.12	0.13	0.128	0.33
27.12	0.17	0.167	0.30
27.12	0.27	0.262	0.12
27.12	0.33	0.326	0.17
27.12	0.53	0.526	0.09
27.12	0.67	0.664	0.03
27.12	0.80	0.802	-0.01
27.12	0.93	0.935	-0.02
27.12	1.07	1.077	-0.02
27.12	1.20	1.210	-0.05
27.12	1.33	1.341	-0.10
27.12	1.47	1.497	-0.16
27.12	1.60	1.629	-0.17

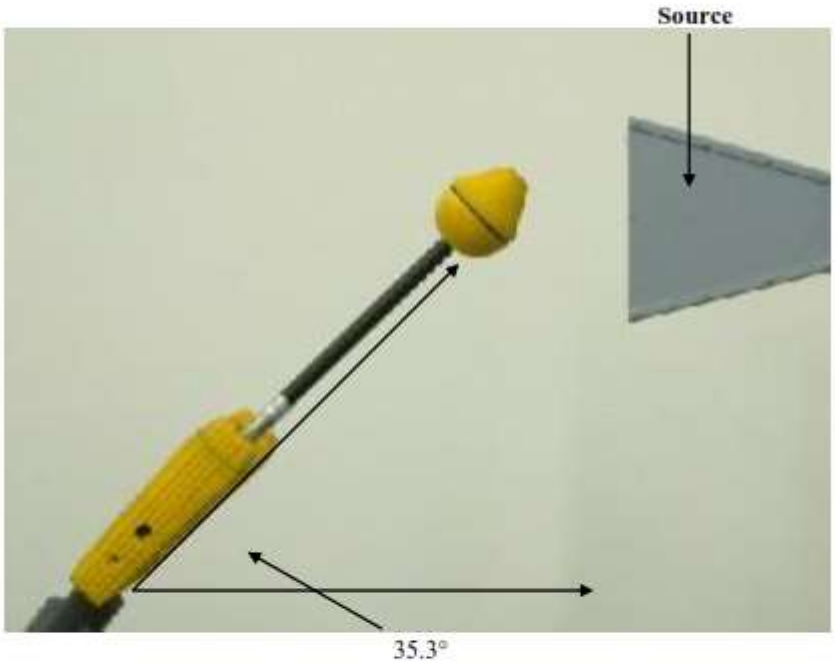
W&G_critical_angle.doc

Probe Alignment/Mounting Position

The alignment/mounting position of the probe is critical. The correction factors given with calibration are valid only for the indicated alignment/mounting position. Deviation from indicated alignment/mounting position of calibration can produce errors in excess of 6 dB.

The probe was positioned with the probe wand at a 35.3° angle position with the probe head centered in front of the field source. The picture below is for probe positioning reference only. The equipment shown does not necessarily indicate the equipment used for calibration.

Side View



KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 240209-131305-3f1df5

ACCREDITED CALIBRATION LABORATORY AC-1498.20

Model Number	E100; HI-2200
Manufacturer	ETS - Lindgren
Description	Field Probe
Serial Number	00237361; 00206805
Customer Asset No.	N/A

Customer
Motorola Solutions Malaysia Sdn Bhd
Plot 2A Medan Bayan Lepas Technoples
Industrial Park Mukim 12 SWD
Bayan Lepas, Penang 11900
MALAYSIA

Date of Calibration	02/13/2024
Temperature	23°C
Humidity	39% RH

Location of Calibration
Keysight Technologies Inc.
1346 Yellowwood Road
Kimballton, IA 51543
United States

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures and in compliance with ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994 (R2002). The quality management system is registered to ISO 9001:2015.

Calibration Standard(s)
IEEE Std 1309-2013 Section 4.1
IEEE Std 1309-2013 Section 5
IEEE Std 1309-2013 Section 8.2
IEEE Std 1309-2013 Section Annex A
IEEE Std 1309-2013 Section A.3
IEEE Std 1309-2013 Section 7.3
IEEE Std 1309-2013 Section 8.3.3.3

Calibration Method(s)
Calculated, Substitution

Calibration Procedure(s)
287330

Calibration Software
Probe Calculated Method 3.14
Probe Comparison 1.5.2

As Received Conditions
The measured values of the equipment were observed in specification at the points tested.

Action Taken
No action was taken.

As Completed Conditions
The measured values of the equipment were observed in specification at the points tested.

Calibration Due
Based on the customer's request, the next calibration is due on 13 Feb 2025

Remarks or Special Requirements
A probe position document is included with this certificate. This calibration is valid only for the alignment/mounting position specified in this report.

Keysight Technologies, Inc.
1346 Yellowwood Road
Kimballton, IA 51543
United States

Brandt Langer Iowa Service Center Manager

Issue Date 13 Feb 2024

KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 240209-131305-3f1df5

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1498.20

This calibration report shall not be reproduced, except in full. The documented results relate to the equipment calibrated only.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

Traceability Information

Technician Name Dennis Bissen

Measurements are traceable to the International System of Units (SI) via national metrology institutes (www.keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement.

Calibration Equipment Used

Manufacturer	Model Number	Model Description	Equipment ID	Cal Due Date	Certificate Number
AR	100W1000B	Amp	11546	NA	
AR	15T4G18	Amp	10888	NA	NA
EMCO	5101	TEM Cell	10420	NA	2003121920
EMCO	5302	G/TEM	10223	NA	2003121915
AR	600A400	Amplifier, 10KHz-400 MHz, 600W	624658	NA	
AR	75A250	Amp	10560	NA	N/A
AR	80S1G4	Amp	11728	NA	
Agilent Technologies, Inc.	83650B	Synthesized Swept Signal Generator	1354	11/30/2024	231026-132122-02ee89
Hewlett-Packard	8481A	Power Sensor	10449	06/30/2024	230629-130030-5f3da1
Hewlett-Packard	8487A	Power Sensor	10577	02/28/2025	240130-103045-c70ffd
Agilent Technologies, Inc.	8648D	Signal Generator	10307	12/31/2024	231026-134816-25ae97
Agilent Technologies, Inc.	8648D	Signal Generator	11028	02/29/2024	230113-115008-67a419
Schwarzbeck Mess-Elektronik	BBHA 9120D	Horn	10194	10/31/2024	231026-132817-d3dc83
Agilent Technologies, Inc.	E4419B	EPM Series Power Meter	10458	10/31/2024	231026-130607-a4620d
AR	FI7000	Interface	11015	NA	700516
AR	FL7006	Isotropic Probe	10946	03/08/2024	2023010355-1
Holaday	HI-4422	Isotropic Probe	10022	01/21/2025	2022100146-1
dbwave	PADD200050180 0B	Dual Directional Coupler	20522	03/31/2024	230301-141152-7ab616

Compliance with Specification

Unless otherwise noted, the calibration results are reported without factoring in the effect of uncertainty on the assessment of compliance/specification.

KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 240209-131305-3f1df5

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1498.20

In Specification/Out of Specification Explanation

The standard criteria to determine the "In Specification/Out of Specification" status is based on one or more of the following conditions, as requested by the client:

1. If the manufacturer has a specified specification for the item being calibrated, then the calibration values are compared to this specification, and the values must fall within the manufacturer's specification. The specification may be obtained from the manufacturer's web site, data sheets, equipment manuals, etc.
2. Where specifications are called out in a published standard, the calibration results are compared to this specification, and the measured values must fall within the standard's specification.
3. In cases where the manufacturer, standard, or client does not identify any relevant specifications, applicable calibration results are compared to historical data with a +/- 3 dB specification.

Uncertainty of Measurement

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008(GUM). The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95%. This probability corresponds to a coverage factor of k=2 for a normal distribution.

Parameter	Range	MU (+/-)
RF Isotropic E-Field Probes - GTEM Cell - Isotropic	10 kHz to 1000 MHz	0.97 dB
RF Isotropic E-Field Probes - TEM Cell - Linearity	5 kHz to 800 MHz	0.91 dB
RF Isotropic E-Field Probes - Anechoic Chamber - Frequency Response	(450 to 18,000) MHz	1.1 dB
RF Isotropic E-Field Probes - GTEM Cell - Frequency Response	10 kHz to 1000 MHz	0.79 dB

2024_Frequency Response.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: E100; HI-2200
Probe Serial No.: 00237361; 00206805
Notes:
CAL CERT #: 240209-131305-3f1df5

Frequency in MHz	Correction Factors 20V/m Multiplier	dB
0.1	1.17	1.37
0.5	1.23	1.79
1	1.10	0.79
3	1.05	0.41
15	1.00	0.01
27.12	1.00	0.02
30	1.00	-0.03
75	1.06	0.50
100	1.07	0.57
150	1.08	0.67
200	1.08	0.71
250	1.10	0.87
300	1.17	1.37
400	0.91	-0.81
500	1.07	0.60
600	1.09	0.77
700	1.18	1.46
800	0.95	-0.46
900	1.03	0.25
1000	0.97	-0.26
2000	1.04	0.35
2450	0.92	-0.71
3000	0.90	-0.94
3500	0.84	-1.47
4000	0.91	-0.78
5000	1.04	0.37
5500	1.07	0.62
6000	1.21	1.63

2024_Isotropic Response.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: E100; HI-2200
Probe Serial No.: 00237361; 00206805
Notes:
CAL CERT #: 240209-131305-3f1df5

Isotropic Response at 400 MHz at 20V/m

Deg	Response dB
0	0.00
45	-0.03
90	-0.04
135	-0.10
180	-0.16
225	-0.10
270	0.00
315	-0.01
360	-0.01

Max Dev. 0.16

2024_Linearity.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: E100; HI-2200
Probe Serial No.: 00237361; 00206805
Notes:
CAL CERT #: 240209-131305-3f1df5

Linearity

Freq	Applied Field	Indicated Field	Max Dev
MHz	V/m	V/m	dB
27.12	0.51	0.70	-2.75
27.12	1.02	1.11	-0.73
27.12	2.08	1.96	0.52
27.12	4.07	3.84	0.51
27.12	8.05	7.46	0.66
27.12	15.15	13.83	0.79
27.12	20.12	18.34	0.80
27.12	30.15	27.30	0.86
27.12	50.27	45.50	0.87
27.12	65.60	59.66	0.82
27.12	100.40	91.95	0.76
27.12	125.00	114.40	0.77
27.12	200.70	184.60	0.73
27.12	252.90	233.60	0.69
27.12	300.10	277.90	0.67
27.12	350.40	324.90	0.66
27.12	403.30	373.90	0.66
27.12	454.00	421.20	0.65
27.12	501.40	466.00	0.64
27.12	551.60	518.80	0.53
27.12	603.90	568.80	0.52

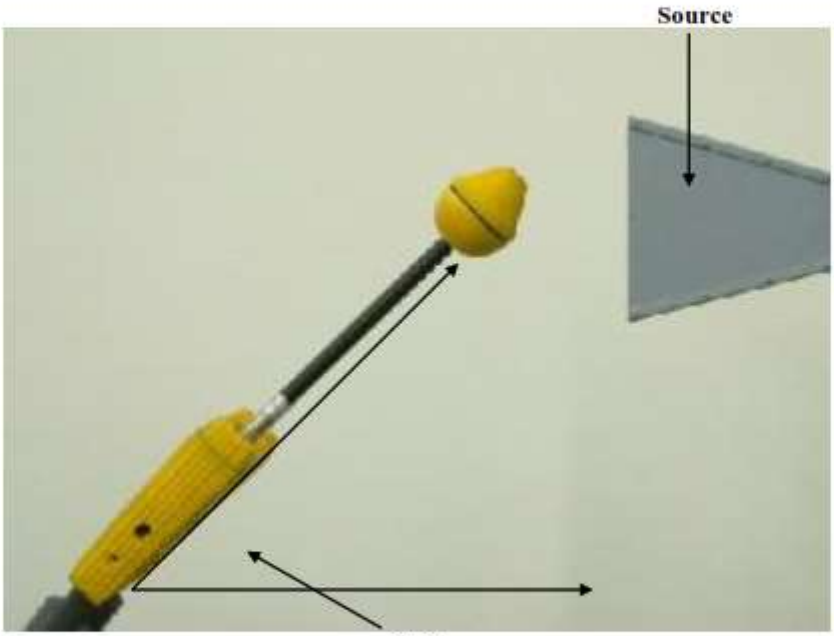
W&G_critical_angle.doc

Probe Alignment/Mounting Position

The alignment/mounting position of the probe is critical. The correction factors given with calibration are valid only for the indicated alignment/mounting position. Deviation from indicated alignment/mounting position of calibration can produce errors in excess of 6 dB.

The probe was positioned with the probe wand at a 35.3° angle position with the probe head centered in front of the field source. The picture below is for probe positioning reference only. The equipment shown does not necessarily indicate the equipment used for calibration.

Side View



KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 240209-131101-f21e01

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1498.20

Model Number	H200; HI-2200
Manufacturer	ETS - Lindgren
Description	Field Probe
Serial Number	00084225; 00206805
Customer Asset No.	N/A

Customer
Motorola Solutions Malaysia Sdn Bhd
Plot 2A Medan Bayan Lepas Technoplex
Industrial Park Mukim 12 SWD
Bayan Lepas, Penang 11900
MALAYSIA

Date of Calibration	02/13/2024
Temperature	23°C
Humidity	39% RH

Location of Calibration
Keysight Technologies Inc.
1346 Yellowwood Road
Kimballton, IA 51543
United States

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures and in compliance with ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994 (R2002). The quality management system is registered to ISO 9001:2015.

Calibration Standard(s)
IEEE Std 1309-2013 Section 4.1
IEEE Std 1309-2013 Section 5
IEEE Std 1309-2013 Section 8.2
IEEE Std 1309-2013 Section Annex A
IEEE Std 1309-2013 Section A.3

Calibration Method(s)
Substitution

Calibration Procedure(s)
287330

Calibration Software
Probe Comparison 1.5.2

As Received Conditions
The measured values of the equipment were observed in specification at the points tested.

Action Taken
No action was taken.

As Completed Conditions
The measured values of the equipment were observed in specification at the points tested.

Calibration Due
Based on the customer's request, the next calibration is due on 13 Feb 2025

Remarks or Special Requirements
A probe position document is included with this certificate. This calibration is valid only for the alignment/mounting position specified in this report.

This calibration report shall not be reproduced, except in full. The documented results relate to the equipment calibrated only.

The test limits stated in the report correspond to the published specifications of the equipment, at the points tested.

Keysight Technologies, Inc.
1346 Yellowwood Road
Kimballton, IA 51543
United States

Brandt Langer Iowa Service Center Manager

Issue Date 13 Feb 2024

Page 1 of 5

KEYSIGHT TECHNOLOGIES

Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994

Certificate Number 240209-131101-f21e01

ilac-MRA ANAB ACCREDITED CALIBRATION LABORATORY AC-1498.20

Traceability Information

Technician Name Dennis Bissen

Measurements are traceable to the International System of Units (SI) via national metrology institutes (www.keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement.

Calibration Equipment Used

Manufacturer	Model Number	Model Description	Equipment ID	Cal Due Date	Certificate Number
AR	100W1000B	Amp	11546	NA	
EMCO	5101	TEM Cell	10420	NA	2003121920
EMCO	5302	G/TEM	10223	NA	2003121915
AR	600A400	Amplifier, 10KHz-400 MHz, 600W	624658	NA	
Agilent Technologies, Inc.	8648D	Signal Generator	10307	12/31/2024	231026-134816-25ae97
AR	FT7000	Interface	11015	NA	700516
AR	FL7006	Isotropic Probe	10946	03/08/2024	2023010355-1
Holaday	HI-4422	Isotropic Probe	10022	01/21/2025	2022100146-1

Compliance with Specification

Unless otherwise noted, the calibration results are reported without factoring in the effect of uncertainty on the assessment of compliance/specification.

In Specification/Out of Specification Explanation

The standard criteria to determine the "In Specification/Out of Specification" status is based on one or more of the following conditions, as requested by the client:

1. If the manufacturer has a specified specification for the item being calibrated, then the calibration values are compared to this specification, and the values must fall within the manufacturer's specification. The specification may be obtained from the manufacturer's web site, data sheets, equipment manuals, etc.
2. Where specifications are called out in a published standard, the calibration results are compared to this specification, and the measured values must fall within the standard's specification.
3. In cases where the manufacturer, standard, or client does not identify any relevant specifications, applicable calibration results are compared to historical data with a +/- 3 dB specification.

Uncertainty of Measurement

The uncertainty evaluation has been performed in accordance with ISO/IEC Guide 98-3:2008(GUM). The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k such that the coverage probability corresponds to approximately 95%. This probability corresponds to a coverage factor of k=2 for a normal distribution.

Parameter	Range	MU (+/-)
RF Isotropic E-Field Probes - TEM Cell - Linearity	5 kHz to 800 MHz	0.91 dB
RF Isotropic E-Field Probes - GTEM Cell - Frequency Response	10 kHz to 1000 MHz	0.79 dB

2024_Frequency Response.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: H200; HI-2200
Probe Serial No.: 00084225; 00206805
Notes:
CAL CERT #: 240209-131101-f21e01

Correction Factors

Freq in MHz	Mult	dB
5	1.85	5.36
6	1.78	5.01
7	1.76	4.90
8	1.74	4.79
9	1.73	4.76
10	1.72	4.74
13.6	1.73	4.76
15	1.73	4.77
20	1.72	4.71
27.1	1.67	4.43
30	1.63	4.26
40	1.52	3.63
50	1.38	2.83
60	1.26	2.01
70	1.16	1.26
75	1.10	0.81
80	1.05	0.45
90	0.96	-0.32
100	0.89	-0.97
150	0.72	-2.85
175	0.72	-2.89
200	0.75	-2.46
250	0.76	-2.42
300	0.67	-3.48

2024_Linearity.txt

Customer Name: Motorola Solutions Malaysia Sdn Bhd
Probe Manufacturer: ETS - Lindgren
Probe Model: H200; HI-2200
Probe Serial No.: 00084225; 00206805
Notes:
CAL CERT #: 240209-131101-f21e01

Linearity

Freq	Applied Field	Indicated Field	Max Dev
MHz	A/m	A/m	dB
27.12	0.04	0.035	1.11
27.12	0.05	0.050	0.52
27.12	0.08	0.070	1.13
27.12	0.13	0.130	0.24
27.12	0.17	0.170	0.15
27.12	0.27	0.260	0.20
27.12	0.33	0.330	0.07
27.12	0.54	0.530	0.08
27.12	0.67	0.670	0.00
27.12	0.80	0.800	0.03
27.12	0.94	0.940	-0.04
27.12	1.06	1.070	-0.04
27.12	1.21	1.210	-0.01
27.12	1.33	1.350	-0.11
27.12	1.47	1.490	-0.14
27.12	1.60	1.670	-0.36

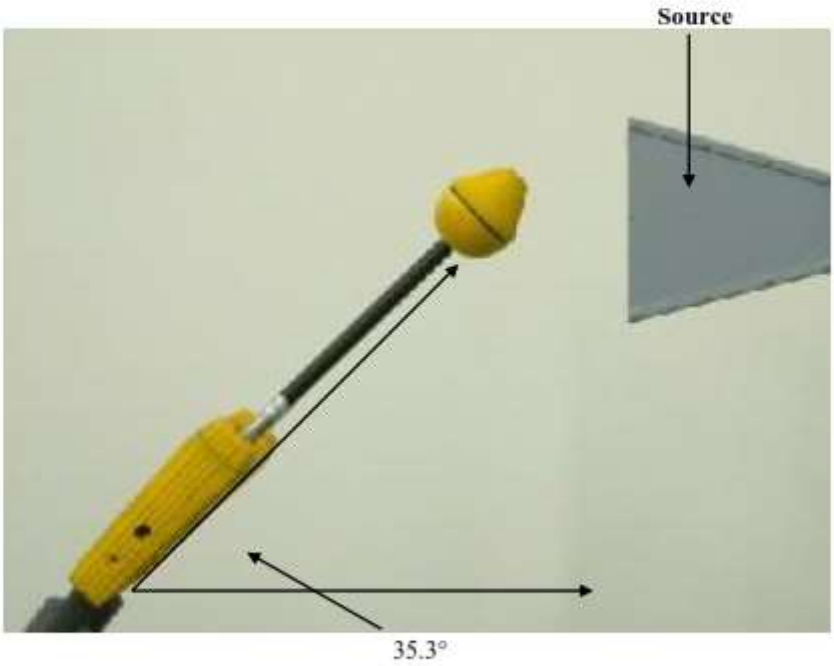
W&G_critical_angle.doc

Probe Alignment/Mounting Position

The alignment/mounting position of the probe is critical. The correction factors given with calibration are valid only for the indicated alignment/mounting position. Deviation from indicated alignment/mounting position of calibration can produce errors in excess of 6 dB.

The probe was positioned with the probe wand at a 35.3° angle position with the probe head centered in front of the field source. The picture below is for probe positioning reference only. The equipment shown does not necessarily indicate the equipment used for calibration.

Side View



Appendix C - Photos of Assessed Antennas

(Refer to Exhibit 7B)

LMR MPE Variability Test (FCC)

Note:

Bystander measurement at initial mounting location
Bystander measurement at 10cm antenna offset from initial mounting location

Trunk / Roof	Test Post.	E/H Field	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/cm^2)	FCC Limit	% To FCC Spec Limit	MPE Variability (%)
Roof	BS (0deg)	H	HAD4016A, 1/4 Wave (136-162MHz)	60	58.9	150.8000	0.13	0.20	67.4	
					58.9	150.8000	0.14	0.20	68.3	1.34
Trunk	BS (45deg)	E	HAE6031A, 1/2 Wave (380-520MHz)	54	53.9	406.5000	0.2	0.27	74.8	
					53.9	406.5000	0.18	0.27	66.5	-11.10