MOTOROLA SOLUTIONS

SAMM 826

CERTIFICATE 2518.05

DECLARATION OF COMPLIANCE: MPE ASSESSMENT Part 1 of 2

Motorola Solutions Inc.
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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:	3/8/2017-3/20/2017; 07/28/2024-07/31/2024, 08/02/2024, 08/16/2024, 08/20/2024
Manufacturer:	Futurecom System Group
Manufacturer Location:	Futurecom Systems Group, ULC. 3277 Langstaff Rd, Concord, ON L4K 5P8, Canada.
Date submitted for test:	01/13/2017; 05/10/2024
DUT Description:	DVR 800 (806-870MHz), Digital Vehicular Repeater Companion Mobile:APX 8500 mobile All Bands (VHF, UHF, 7/800)
Test TX mode(s):	CW, 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:	DVR: MOBEXCOM DVRS 800 (DQPMDVR8000P) Companion Mobile: M37TSS9PW1CN (PHUW2000D)
Model(s) Certified: (HVIN/PMN)	Refer Section 1.0 Introduction
Serial Number(s):	17010530 (DVR), 681IZN6305(Companion Mobile)
Classification:	Occupational/Controlled Environment
Firmware Version (FVIN):	D32.50.27 (Companion Mobile)
Applicant Name:	Motorola Solutions Inc.
Applicant Address:	Plot 2A, Medan Bayan Lepas Mukim, 12 SWD, 11900 Bayan Lepas, Penang, Malaysia
FCC ID:	DVR: LO6-DVRS800 (806-824MHz, 851-869MHz) Companion Mobile: AZ492FT7180 (150.8-173.4 MHz, 406.1-512 MHz, 769-775 MHz, 799-824 MHz, 851-869 MHz, 2402-2480 MHz, 2412-2462 MHz & 5180 – 5825) This report contains results that are immaterial for FCC equipment approval, which are clearly identified.
FCC Test Firm Registration Number:	823256
IC:	DVR:2098B-DVRS800 (806-824MHz, 851-869MHz) Companion Mobile: 109U-92FT7180 (138-174 MHz, 406.1 – 430 MHz, 450-470MHz, 768-775 MHz, 799-824 MHz, 851-869 MHz, 2402-2480 MHz, 2412-2462 MHz & 5180 – 5825) 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
01/24/2025	A	Initial release
02/04/2025	B	Update report FCC/IC ID
02/13/2025	C	Update radio model name, FVIN, WLAN calculation and Simultaneous transmission table
04/08/2025	D	Update Table 6 and section 16.3 Simultaneous transmission

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Appendices

Appendix D – MPE Test Results Summary for DVR VHF
Appendix E – MPE Test Results Summary for Companion Mobile LMR VHF, UHF R1, UHF R2 and 7/800 MHz

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 DVRS 800 (FCC ID: LO6-DVRS800) and Companion Mobile radio M37TSS9PW1CN(PHUW2000D) (FCC ID: AZ492FT7180 / IC: 109U-92FT7180). For companion mobile radio model M37TSS9PW1CN (PHUW2000D) is applying sport check on the highest configurations from reference model with M37TSS9PW1AN (FCC ID: AZ492FT7089 / IC: 109U-92FT7089).

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)
MOBEXCOM DVRS 800 with APX 8500 MP	MOBEXCOM DVRS 800 with APX 8500 MP	DVRS 800	MOBEXCOM DigitalVehicular Repeater (DVR)800 work with APX 8500 MP

2.0 FCC MPE Summary

Table 1

DVRS 800 (FCC ID: LO6-DVRS800)					
Equipment Class	Frequency Band (MHz)	Passenger		Bystander	
		Power Density (mW/cm^2)	Highest % of Limit	Power Density (mW/cm^2)	Highest % of Limit
TNB	800 (806-824, 851-869)	0.060	11.1%	0.028	4.9%
Companion Mobile APX 8500 MP (FCC ID: AZ492FT7180) Roof Mounted Antenna					
Equipment Class	Frequency Band (MHz)	Passenger		Bystander	
		Power Density (mW/cm^2)	Highest % of Limit	Power Density (mW/cm^2)	Highest % of Limit
TNB	VHF (150.8-173.4 MHz)	0.139	69.50%	0.062	30.80%
	UHF1 (406.1-470 MHz)	0.047	18.60%	0.076	24.90%
	UHF2 (450-512 MHz)	0.046	15.20%	0.076	24.90%
	7/800 (769-775 MHz; 799-824 MHz; 851-869 MHz)	0.032	6.00%	0.032	6.20%
DTS	Bluetooth (2402 – 2480 MHz)	0.003	0.27%	0.003	0.27%
	WLAN 2.4GHz (2412 – 2462 MHz)	0.003	0.34%	0.003	0.34%
NII	WLAN 5GHz (5180-5825 MHz)	0.002	0.21%	0.002	0.21%
Simultaneous Transmission					
Simultaneous Transmission Conditions		Passenger		Bystander	
		Highest % of Limit		Highest % of Limit	
DVRS 800 + WLAN + Companion Mobile VHF		80.94%		33.94%	
DVRS 800 + WLAN + Companion Mobile UHF1		28.54%		26.24%	
DVRS 800 + WLAN + Companion Mobile UHF2		26.64%		26.24%	
DVRS 800 + WLAN + Companion Mobile 7/800		17.44%		8.84%	

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

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

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

7.0 Measurement Equipment

Table 4 – Equipment

Equipment Type	Model #	SN	Calibration Date	Calibration Due Date
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

MOBEXCOM DVRS 800 (FCC ID: LO6-DVRS800) is Digital Vehicular Repeater (DVR) manufactured by Futurecom System Group. At standalone the DVR operates at a maximum power up to 20W, but when the DVR is interfaced to the APX 8500 Mobile radio, the maximum power is 10W as listed in Table 6. For more detailed information refer to the Product Safety and RF Energy Exposure Booklet.

Companion mobile APX 8500 MP All Bands (FCC ID: AZ492FT7180) operates in 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

Devices	Technology	Transmit Band (MHz)		Transmission	Duty Cycle (%)	Conducted (Average Detector) Maximum Power (W)
DVR 800 (FCC ID: LO6-DVRS800)	LMR	806-824, 851-869 (800)		FM	100% (Repeater)	10
Companion Mobile APX 8500 MP All Bands (FCC ID: AZ492FT7180)	LMR	136 - 174 (VHF)		FM	50% (PTT)	60
		380 - 470 (UHF1) 450 - 520 (UHF2)	380 - 485			54
			485 - 512			48
			512 - 520			30
		769 - 775; 799 - 824, 851 - 869 (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

In addition to standalone operation, is capable of interfacing to a companion mobile radio using serial data protocol for audio and control. The DVRS can operate in the following modes: OFF mode– DVRS repeat is not required; LOCAL mode–with portable-to-portable repeat and network monitoring capabilities; and SYSTEM mode – outbound calls received by mobile radio are repeated by DVRS. Inbound calls received by DVRS are repeated locally (portable-to-portable) as well as to the system users (by keying up the mobile radio).

This test report covers the RF exposure performance of the DVR FCC ID: LO6-DVRS800 interfaced with, and transmitting simultaneously with Companion Mobile radio FCC ID: AZ492FT7180. DVR operate in repeater; transmit with duty cycle up to 100%. A duty factor of 50% applies for companion mobile with PTT operating mode.

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 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 DVR and Companion 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 8 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 DVR antenna mounted at center of the trunk (for external/bystander measurement) or toward the center of the trunk at a minimum 85 cm from backseat passenger (for Internal/passenger measurement), and the Companion mobile antennas are mounted at the side of the roof (20 cm from the center of the roof).

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 for DVR with trunk mounted antenna(s)

12.1 External/Bystander vehicle MPE measurements

Initially the DVR 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 (5) bystander test locations indicated in Appendix A with 20 cm height increments, with the distance of 90cm from the test vehicle's body, as stated in the user manual. The measurement probe is positioned orthogonal to antenna (typically parallel to ground with a vertically mounted antenna) and aimed directly at the antenna's axis. These measurements are representative of persons other than the operator standing next to the vehicle.

12.2 Internal/Passenger vehicle MPE measurements

The DVR antenna is located toward the center of the trunk at a minimum 85 cm from backseat passenger. 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 trunk 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 for Companion Mobile with roof mounted antenna(s)

Introduction

The installation requirements for this radio indicate that in multiple single-band antenna configurations the antennas should be installed along a transverse line bisecting the roof, with one of the antennas in the center and the remaining two at 8" (20 cm) on each side. We tested all the antennas at one of the lateral positions (8" from the center along the mentioned bisecting line) in order to be closer to the edge of the roof. Additional measurements with antennas placed in the center of the roof are not needed because that placement would increase the distance to bystanders.

13.1 External/Bystander vehicle MPE measurements

Antenna is located at the side of the roof (20 cm from the center of the roof, along the width of the vehicle, driver side). 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 each of the (5) bystander test locations indicated in Appendix A with 20 cm height increments at the test distance of 90cm from the test vehicle body.

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 side of the roof (20 cm from the center of the roof, along the width of the vehicle, driver side). 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 Calculations

The final MPE results for DVR and Companion Mobile are presented in section 16.0. These results are based on 50% duty cycle for Companion Mobile (PTT operation) and 100% duty cycle for DVR (repeater operation).

Below is an explanation of how the MPE results are calculated. Refer to Appendix D for DVR VHF; Appendix E for Companion Mobile LMR bands VHF, UHF1, UHF2 and 7/800 MHz.

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

15.0 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
DVR 800									
1	HAF4016A	764-870	9	2.15	1/4 wave	Trunk	806-824; 851-869	6	6
Companion Mobile									
VHF (136 – 174MHz)									
2	HAD4016A	136 - 162	51.3	2.15	¼ wave	R	150.8 - 162	3	5
3	HAD4017A	146 - 174	46.2	2.15	¼ wave	R	150.8 - 173.4	4	5
4	HAD4021A	136 - 174	51.7	2.15	¼ wave	R	150.8 - 173.4	4	6
5	HAD4006A	136 - 144	52	2.15	¼ wave	R	-	-	2
6	HAD4007A	144 - 150.8	49	2.15	¼ wave	R	150.8	1	2
7	HAD4008A	150.8 - 162	45.6	2.15	¼ wave	R	150.8 - 162	3	3
8	HAD4009A	162 - 174	43	2.15	¼ wave	R	162 - 173.4	3	3
9	*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
10	*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

Note:* Antenna length trimmed to frequency.

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)									
14	HAE6010A	380 - 433	63.5	5.65	1/2 wave	R/T	406.1-433	3	5
15	HAE6011A	380 - 433	91.0	7.15	5/8 wave	R/T	406.1-433	3	5
16	HAE6012A	380 - 433	18.2	2.15	1/4 wave	R	406.1-433	3	5
17	HAE6013A(1)	380 - 470	29	4.15	1/2 wave	R/T	406.1-470	6	8
18	HAE6031A(1)	380 - 520	28	4.15	1/2 wave	R/T	406.1-470	5	7
19	HAE4003A(1)	450 - 470	16	2.15	1/4 wave	R	450-470	3	3
20	HAE4011A(1)	450 - 470	73.2	5.65	1/2 wave	R/T	450-470	3	3
21	HAE6015A(1)	450 - 520	26.2	4.15	1/2 wave	R/T	450-470	3	3
22	HAE6016A(1)	450 - 512	8.3	2.15	1/4 wave	R	450-470	3	3
23	*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)									
24	HAE6013A(1)	380 - 470	29	4.15	1/2 wave	R/T	450-470	3	3
25	HAE6031A(1)	380 - 520	28	4.15	1/2 wave	R/T	450-512	5	6
26	HAE4003A(1)	450 - 470	16	2.15	1/4 wave	R	450-470	3	3
27	HAE4004A	470 - 512	14.7	2.15	1/4 wave	R	470-512	4	4
28	HAE4011A(1)	450 - 470	73.2	5.65	1/2 wave	R/T	450-470	3	3
29	HAE4012A	470 - 495	68.6	5.65	1/2 wave	R/T	470-495	3	3
30	HAE4013A	494 - 512	64.3	5.65	1/2 wave	R/T	494-512	3	3
31	HAE6015A(1)	450 - 520	26.2	4.15	1/2 wave	R/T	450-512	5	7
32	HAE6016A(1)	450 - 512	8.3	2.15	1/4 wave	R	450-512	5	6
33	*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
34	*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
35	*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)									
36	HAF4013A	764 - 870	6.1	5.15	1/4 wave	R/T	769-775; 799-824; 851-869	8	9
37	HAF4014A	764 - 870	57.7	5.15	1/4 wave	R/T	769-775; 799-824; 851-869	8	9
38	HAF4016A	764 - 870	9	2.15	1/4 wave	R/T	769-775; 799-824; 851-869	8	9
39	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)									
40	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
41	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									
42	AN000163A01	2400 - 2500 4900 - 5900	7	3.5 / 3.3	-	Glass Mount	2412 - 2462	3	3
43	PMAN5100A	2400 - 2500	5.7 (L) x 1.9 (W)	3	-	Glass Mount	2412 - 2462	3	3
44	PMAN5101A	2400 - 2500 4900 - 5900	5.4 (L) x 1.32 (W)	2.7 / 0.2	Monopole	Trunk	2412 - 2462 5180 - 5825	3	3
45	AN000163A05	2400 - 2500 4900 - 5900	7	2.5 / 1.6	Monopole	Roof / Trunk	2412 - 2462 5180 - 5825	3	3

Note:* Antenna length trimmed to frequency.

16.0 Test Results Summary

16.1 MPE Test Results Summary for DVR and Companion Mobile (LMR)

Refer to the following appendices for MPE test results for each test configuration: antenna location, test positions (BS1-Bystander test location #1, BS2-Bystander test location #2, BS3-Bystander test location #3, BS4-Bystander test location #4, BS5-Bystander test location #5, PB-Passenger Backseat, PF-Passenger Front seat), E/H field measurements, antenna model & freq. range, maximum output power, initial power, TX frequency, max calculated power density results, applicable FCC/ ISED Canada specification limits and % of the applicable specification limits.

- Appendix D for DVR 800 (part 2 of 2)
- Appendix E for Companion Mobile (part 2 of 2)

Table 8 summarized the highest maximum calculated power density and highest % of the applicable specification limit for each standalone transmitter (DVR, Companion Mobile)

Table 8

Test Position	DVRS 800		Companion Mobile APX8500 MP							
	806 - 825; 851 - 870		VHF(136 - 174MHz)		UHF1(380-470MHz)		UHF2(450-520MHz)		7/800(764-870MHz)	
	Power Density (mW/cm²)	Highest % of Limit	Power Density (mW/cm²)	Highest % of Limit	Power Density (mW/cm²)	Highest % of Limit	Power Density (mW/cm²)	Highest % of Limit	Power Density (mW/cm²)	Highest % of Limit
FCC										
Passenger, Front Seat (PF)	0.034	5.80%	0.037	18.30%	0.047	18.60%	0.029	9.60%	0.017	3.10%
Passenger, Back Seat (PB)	0.060	11.10%	0.139	69.50%	0.046	17.10%	0.046	15.20%	0.032	6.00%
ByStander #1, BS1	0.006	1.00%	0.062	30.80%	0.076	24.90%	0.076	24.90%	0.032	6.20%
ByStander #2, BS2	0.016	2.90%	0.061	30.70%	0.049	15.80%	0.049	15.80%	0.029	5.50%
ByStander #3, BS3	0.016	3.00%	0.057	28.70%	0.022	8.10%	0.035	10.90%	0.018	3.40%
ByStander #4, BS4	0.028	4.90%	0.052	26.00%	0.019	6.10%	0.019	6.10%	0.019	3.60%
ByStander #5, BS5	0.016	3.00%	0.031	15.60%	0.02	6.20%	0.02	6.20%	0.011	2.00%
ISED Canada										
Passenger, Front Seat (PF)	0.034	12.70%	0.037	28.40%	0.047	22.60%	0.029	16.80%	0.017	6.50%
Passenger, Back Seat (PB)	0.060	23.50%	0.139	**107.60%**	0.046	29.20%	0.046	26.80%	0.032	12.80%
ByStander #1, BS1	0.006	2.20%	0.062	47.60%	0.076	44.10%	0.076	44.10%	0.032	12.90%
ByStander #2, BS2	0.016	6.10%	0.061	62.30%	0.049	28.10%	0.049	28.10%	0.029	11.50%
ByStander #3, BS3	0.016	6.40%	0.057	44.50%	0.022	13.90%	0.035	19.60%	0.018	7.10%
ByStander #4, BS4	0.028	10.50%	0.052	40.20%	0.019	10.80%	0.019	10.80%	0.019	7.60%
ByStander #5, BS5	0.016	6.40%	0.031	24.10%	0.020	11.20%	0.020	11.20%	0.011	4.20%

16.2 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 WLAN 2.4GHz transmit power is higher than Bluetooth power, thus Bluetooth is exclude from simultaneous transmission.

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

Table 9

Antenna #	Max Power (W)	Duty Cycle (%)	Tx Frequency (MHz)	Antenna Gain (dBi)	Cable Loss, L (dB)	Dist., d (cm)	[4]Enhance Factor, F	Max Calc. MPE (mW/cm²)	MPE Spec Limit (mW/cm²)			
									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

16.3 Simultaneous Transmission

DVR will transmit simultaneously with Companion mobile; refer to Table 10 for all simultaneous transmission conditions. Companion mobile 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 WLAN 2.4GHz transmit power is higher than Bluetooth power, thus Bluetooth is exclude from simultaneous transmission.

Table 10 – Simultaneous transmission conditions

Simultaneous transmission conditions	DVRS 800	Companion Mobile APX 8500 All bands (VHF, UHF, 7/800)						
	800 [806-825 MHz; 851-870MHz]	VHF [136-174 MHz]	UHF1 [380-470 MHz)	UHF2 [450-520 MHz]	7/800 [764-805 MHz; 806-870 MHz]	Bluetooth	WLAN 2.4GHz	WLAN 5GHz
1	x	x				x		
2	x	x					x	
3	x	x						x
4	x		x			x		
5	x		x				x	
6	x		x					x
8	x			x		x		
9	x			x			x	
10	x			x				x
13	x				x	x		
14	x				x		x	
15	x				x			x

Table 11 – Highest Percentage of limit for Simultaneous transmission conditions
(DVRS + Companion Mobile VHF)

FCC				
Test Position	DVRS 800 (806-824, 851-869)	Companion Mobile APX8500 MP		Simultaneous Transmission
		WLAN 2.4GHz	VHF (150.8 - 173.4MHz)	DVRS + WLAN 2.4GHz + VHF
	[1] Highest of Limit (%)	[2] Highest of Limit (%)	[3] Highest of Limit (%)	[1 + 2 + 3] Combine of Limit (%)
FCC				
Passenger, Front Seat (PF)	5.80	0.34	18.30	24.44
Passenger, Back Seat (PB)	11.10	0.34	69.50	80.94
ByStander #1, BS1	1.00	0.34	30.80	32.14
ByStander #2, BS2	2.90	0.34	30.70	33.94
ByStander #3, BS3	3.00	0.34	28.70	32.04
ByStander #4, BS4	4.90	0.34	26.00	31.24
ByStander #5, BS5	3.00	0.34	15.60	18.94
ISED				
Test Position	DVRS 800 (806-824, 851-869)	Companion Mobile APX8500 MP		Simultaneous Transmission
		WLAN 2.4GHz	VHF (138 - 174MHz)	DVRS + WLAN 2.4GHz + VHF
	[1] Highest of Limit (%)	[2] Highest of Limit (%)	[3] Highest of Limit (%)	[1 + 2 + 3] Combine of Limit (%)
Passenger, Front Seat (PF)	12.70	0.63	28.40	41.73
Passenger, Back Seat (PB)	23.50	0.63	107.60	131.73
ByStander #1, BS1	2.20	0.63	47.60	50.43
ByStander #2, BS2	6.10	0.63	62.30	69.03
ByStander #3, BS3	6.40	0.63	44.50	51.53
ByStander #4, BS4	10.50	0.63	40.20	51.33
ByStander #5, BS5	6.40	0.63	24.10	31.13

Table 12 – Highest Percentage of limit for Simultaneous transmission conditions
(DVRS + Companion Mobile UHF1)

FCC				
Test Position	DVRS 800 (806-824, 851-869)	Companion Mobile APX8500 MP		Simultaneous Transmission
		WLAN 2.4GHz	UHF1 (406.1-470MHz)	DVRS + WLAN 2.4GHz + UHF1
	[1] Highest of Limit (%)	[2] Highest of Limit (%)	[3] Highest of Limit (%)	[1 + 2 + 3] Combine of Limit (%)
FCC				
Passenger, Front Seat (PF)	5.80	0.34	18.60	24.74
Passenger, Back Seat (PB)	11.10	0.34	17.10	28.54
ByStander #1, BS1	1.00	0.34	24.90	26.24
ByStander #2, BS2	2.90	0.34	15.80	19.04
ByStander #3, BS3	3.00	0.34	8.10	11.44
ByStander #4, BS4	4.90	0.34	6.10	11.34
ByStander #5, BS5	3.00	0.34	6.20	9.54
ISED				
Test Position	DVRS 800 (806-824, 851-869)	Companion Mobile APX8500 MP		Simultaneous Transmission
		WLAN 2.4GHz	UHF1 (406.1-430, 450-470)	DVRS + WLAN 2.4GHz + UHF1
	[1] Highest of Limit (%)	[2] Highest of Limit (%)	[3] Highest of Limit (%)	[1 + 2 + 3] Combine of Limit (%)
Passenger, Front Seat (PF)	12.70	0.63	22.60	35.93
Passenger, Back Seat (PB)	23.50	0.63	29.20	53.33
ByStander #1, BS1	2.20	0.63	44.10	46.93
ByStander #2, BS2	6.10	0.63	28.10	34.83
ByStander #3, BS3	6.40	0.63	13.90	20.93
ByStander #4, BS4	10.50	0.63	10.80	21.93
ByStander #5, BS5	6.40	0.63	11.20	18.23

Table 13 – Highest Percentage of limit for Simultaneous transmission conditions
(DVRS + Companion Mobile UHF2)

FCC				
Test Position	DVRS 800 (806-824, 851-869)	Companion Mobile APX8500 MP		Simultaneous Transmission
		WLAN 2.4GHz	UHF2 (450-512)	DVRS + WLAN 2.4GHz + UHF2
	[1] Highest of Limit (%)	[2] Highest of Limit (%)	[3] Highest of Limit (%)	[1 + 2 + 3] Combine of Limit (%)
FCC				
Passenger, Front Seat (PF)	5.80	0.34	9.60	15.74
Passenger, Back Seat (PB)	11.10	0.34	15.20	26.64
ByStander #1, BS1	1.00	0.34	24.90	26.24
ByStander #2, BS2	2.90	0.34	15.80	19.04
ByStander #3, BS3	3.00	0.34	10.90	14.24
ByStander #4, BS4	4.90	0.34	6.10	11.34
ByStander #5, BS5	3.00	0.34	6.20	9.54
ISED				
Test Position	DVRS 800 (806-824, 851-869)	Companion Mobile APX8500 MP		Simultaneous Transmission
		WLAN 2.4GHz	UHF2 (450-470)	DVRS + WLAN 2.4GHz + UHF2
	[1] Highest of Limit (%)	[2] Highest of Limit (%)	[3] Highest of Limit (%)	[1 + 2 + 3] Combine of Limit (%)
Passenger, Front Seat (PF)	12.70	0.63	16.80	30.13
Passenger, Back Seat (PB)	23.50	0.63	26.80	50.93
ByStander #1, BS1	2.20	0.63	44.10	46.93
ByStander #2, BS2	6.10	0.63	28.10	34.83
ByStander #3, BS3	6.40	0.63	19.60	26.63
ByStander #4, BS4	10.50	0.63	10.80	21.93
ByStander #5, BS5	6.40	0.63	11.20	18.23

Table 14 – Highest Percentage of limit for Simultaneous transmission conditions
(DVRS + Companion Mobile 7/800)

FCC				
Test Position	DVRS 800 (806-824, 851-869)	Companion Mobile APX8500 MP		Simultaneous Transmission
		WLAN 2.4GHz	7/800 (769-775; 799-824; 851-869)	DVRS + WLAN 2.4GHz + 7/800
	[1] Highest of Limit (%)	[2] Highest of Limit (%)	[3] Highest of Limit (%)	[1 + 2 + 3] Combine of Limit (%)
FCC				
Passenger, Front Seat (PF)	5.80	0.34	3.10	9.24
Passenger, Back Seat (PB)	11.10	0.34	6.00	17.44
ByStander #1, BS1	1.00	0.34	6.20	7.54
ByStander #2, BS2	2.90	0.34	5.50	8.74
ByStander #3, BS3	3.00	0.34	3.40	6.74
ByStander #4, BS4	4.90	0.34	3.60	8.84
ByStander #5, BS5	3.00	0.34	2.00	5.34
ISED				
Test Position	DVRS 800 (806-824, 851-869)	Companion Mobile APX8500 MP		Simultaneous Transmission
		WLAN 2.4GHz	7/800 (768-775; 798-824; 851-869)	DVRS + WLAN 2.4GHz + 7/800
	[1] Highest of Limit (%)	[2] Highest of Limit (%)	[3] Highest of Limit (%)	[1 + 2 + 3] Combine of Limit (%)
Passenger, Front Seat (PF)	12.70	0.63	6.50	19.83
Passenger, Back Seat (PB)	23.50	0.63	12.80	36.93
ByStander #1, BS1	2.20	0.63	12.90	15.73
ByStander #2, BS2	6.10	0.63	11.50	18.23
ByStander #3, BS3	6.40	0.63	7.10	14.13
ByStander #4, BS4	10.50	0.63	7.60	18.73
ByStander #5, BS5	6.40	0.63	4.20	11.23

The combine MPE results for DVR and Companion Mobile were calculate based on the percent of MPE limit for each applicable test channels according to the table below. The highest combined power density percentage of the applicable specification limits are indicating in table 15 & 16.

Table 15: Maximum MPE RF Exposure Summary (FCC)

DVRS 800 (FCC ID: LO6-DVRS800)					
Equipment Class	Frequency Band (MHz)	Passenger		Bystander	
		Power Density (mW/cm^2)	Highest % of Limit	Power Density (mW/cm^2)	Highest % of Limit
TNB	800 (806-824, 851-869)	0.060	11.1%	0.028	4.9%
Companion Mobile APX 8500 MP (FCC ID: AZ492FT7180) Roof Mounted Antenna					
Equipment Class	Frequency Band (MHz)	Passenger		Bystander	
		Power Density (mW/cm^2)	Highest % of Limit	Power Density (mW/cm^2)	Highest % of Limit
TNB	VHF (150.8-173.4)	0.139	69.50%	0.062	30.80%
	UHF1 (406.1-470)	0.047	18.60%	0.076	24.90%
	UHF2 (450-512)	0.046	15.20%	0.076	24.90%
	7/800 (769-775; 799-824; 851-869)	0.032	6.00%	0.032	6.20%
DTS	Bluetooth (2402 – 2480)	0.003	0.27%	0.003	0.27%
	WLAN 2.4GHz (2412 – 2462)	0.003	0.34%	0.003	0.34%
NII	WLAN 5GHz (5180-5825)	0.002	0.21%	0.002	0.21%
Simultaneous Transmission					
Simultaneous Transmission Conditions		Passenger		Bystander	
		Highest % of Limit		Highest % of Limit	
DVRS 800 + WLAN + Companion Mobile VHF		80.94%		33.94%	
DVRS 800 + WLAN + Companion Mobile UHF1		28.54%		26.24%	
DVRS 800 + WLAN + Companion Mobile UHF2		26.64%		26.24%	
DVRS 800 + WLAN + Companion Mobile 7/800		17.44%		8.84%	

Table 16: Maximum MPE RF Exposure Summary (ISED Canada)

DVRS 800 (IC: 2098B-DVRS800)					
Equipment Class	Frequency Band (MHz)	Passenger		Bystander	
		Power Density (mW/cm²)	Highest % of Limit	Power Density (mW/cm²)	Highest % of Limit
TNB	800 (806-824, 851-869)	0.060	23.5%	0.028	10.5%
Companion Mobile APX 8500 MP (IC: 109U-92FT7180) Roof Mounted Antenna					
Equipment Class	Frequency Band (MHz)	Passenger		Bystander	
		Power Density (mW/cm²)	Highest % of Limit	Power Density (mW/cm²)	Highest % of Limit
TNB	VHF (138-174)	0.139	****107.60%**	0.062	62.30%
	UHF1 (406.1-430, 450-470)	0.047	29.20%	0.076	44.10%
	UHF2 (450-470)	0.046	26.80%	0.076	44.10%
	7/800 (768-775; 799-824; 851-869)	0.032	12.80%	0.032	12.90%
DTS	Bluetooth (2402 – 2480)	0.003	0.50%	0.003	0.50%
	WLAN 2.4GHz (2412 – 2462)	0.003	0.63%	0.003	0.63%
NII	WLAN 5GHz (5180-5825)	0.002	0.24%	0.002	0.24%
Simultaneous Transmission					
Simultaneous Transmission Conditions		Passenger		Bystander	
		Highest % of Limit		Highest % of Limit	
DVRS 800 + WLAN + Companion Mobile VHF		****131.73%**		69.03%	
DVRS 800 + WLAN + Companion Mobile UHF1		53.33%		46.93%	
DVRS 800 + WLAN + Companion Mobile UHF2		50.93%		46.93%	
DVRS 800 + WLAN + Companion Mobile 7/800		36.93%		18.73%	

** SAR simulation result refer to DVR (FCC ID: LO6-DVRS800 / IC: 2098B-DVRS800) + Companion radio (FCC ID: AZ492FT7089 / IC: 109U-92FT7089) SAR simulation report.

17.0 Conclusion

The assessment for DVR and Companion mobile were performed as indicate in section 16.1 with an output power range listed in Table 6 and wireless networks (BT, WLAN 2.4 GHz and WLAN 5.0 GHz) MPE calculation in section 16.2. 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 DVR and Companion Mobile scaled to maximum allowable power output are indicated in Table 15 (FCC) and Table 16 (ISED Canada) for internal/passenger of to the vehicle, and external/bystander to the vehicle.

These MPE results herein demonstrate compliance to FCC / ISED Canada Occupation/Controlled Exposure limit. However, FCC / Canada rules required compliance for Passengers and Bystanders to FCC / ISED Canada General Population / Uncontrolled limits. Maximum Combined MPE percentage in bold exceed General Population / Uncontrolled limit.

Although MPE is a convenient method of demonstrating RF Exposure requirements, SAR is recognized as the "basic restriction". For those configurations in Table 16 with '**', compliance to the General Population / Uncontrolled SAR 1g limit of 1.6 W/kg is demonstrated through SAR computational analysis.

The computational results show that this DVR 800 device, when used with Companion Mobile radio APX8500 and specified antennas, exhibit a maximum combine SAR are indicate in the Table 17.

Table 17

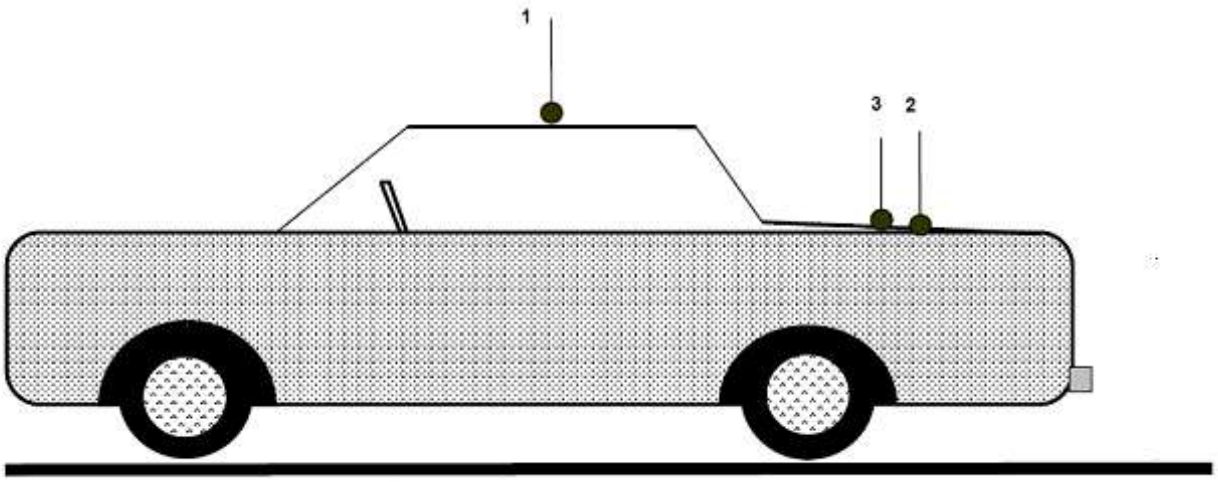
Designator	Exposure Condition	Combined SAR (W/kg)	
		1-g	WB
FCC	Passenger Back	0.41	0.014
ISED Canada	Passenger Back	0.77	0.019

18.0 User Instructions Considerations

In order to facilitate the requirements for Occupational exposure limits, the Safety Manual for this radio requires that bystanders to maintain at least 3 ft. (90 cm) in all directions between the vehicle and external persons while transmitting.

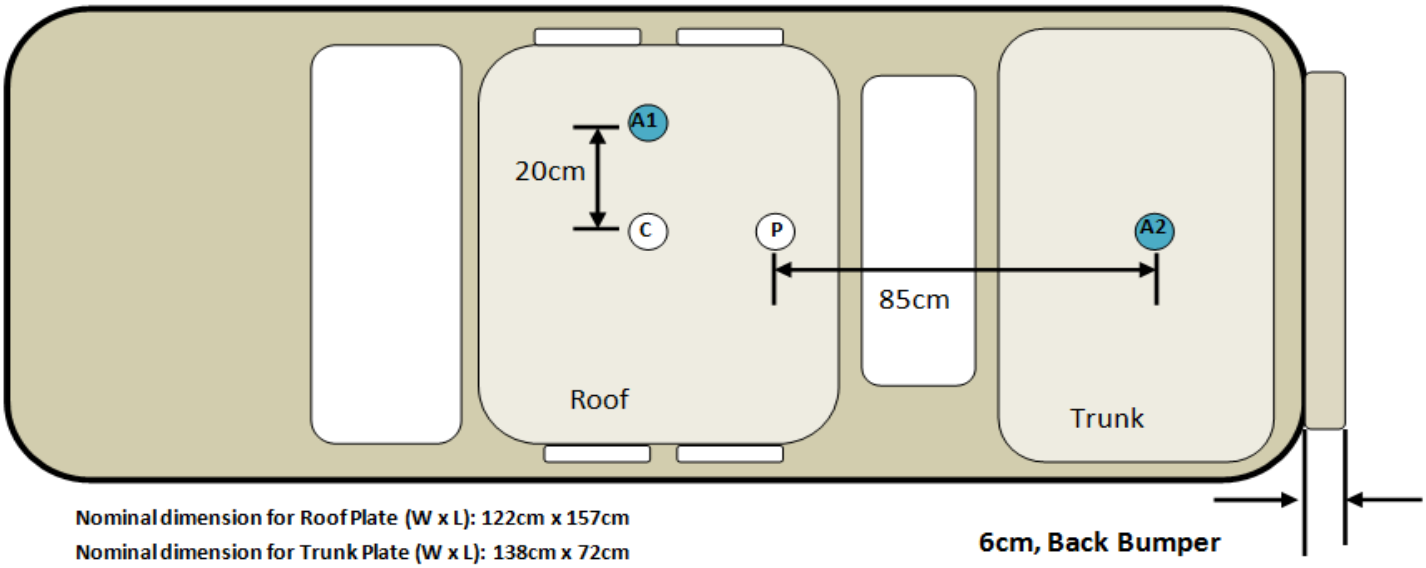
Appendix A - Antenna Locations, Test Distances, and Cable Losses

Antenna locations



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

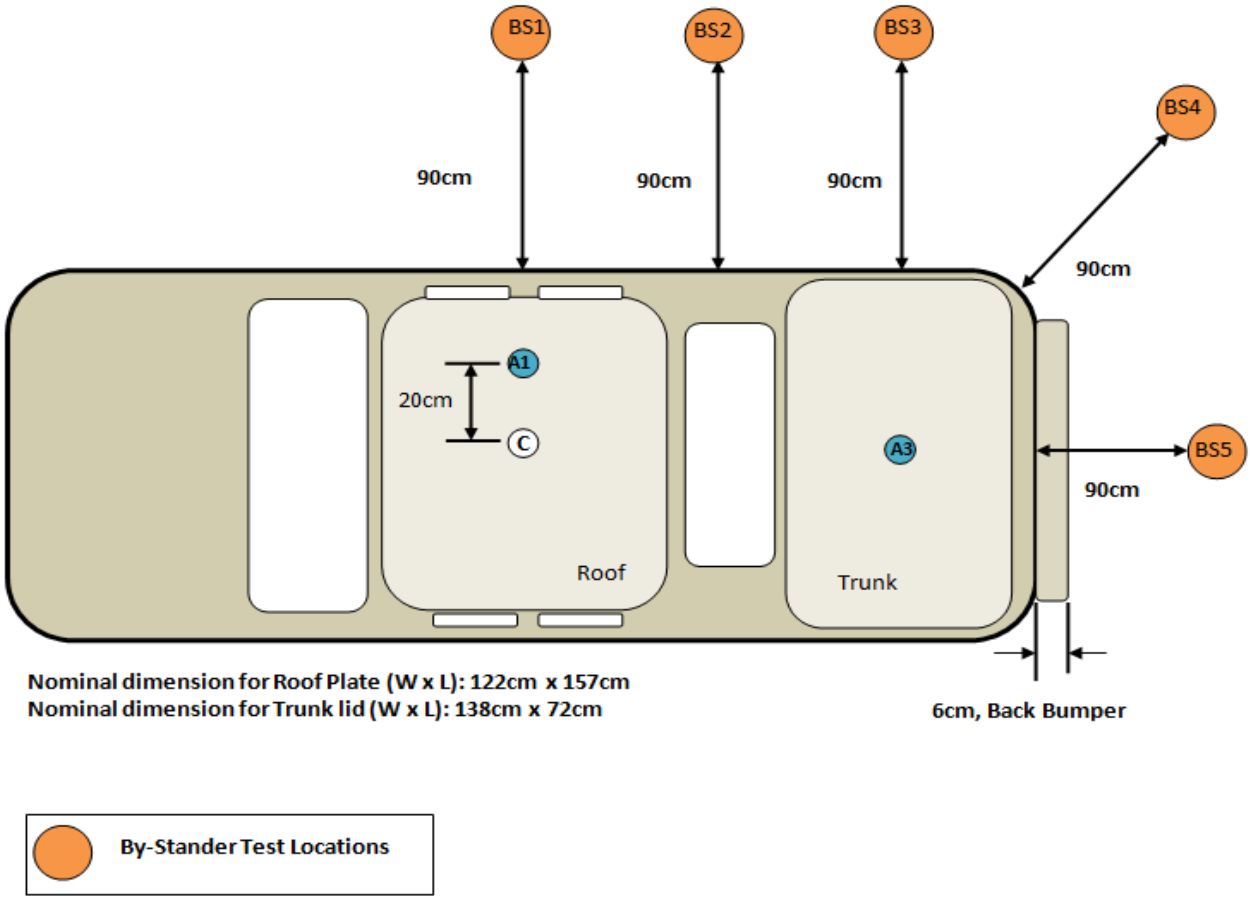
Passenger Antenna mounting
(LMR VHF, UHF R1, UHF R2 and 7/800 band)



Notes:

1.) Antenna location A1: APX mobile radio roof antenna mounting locations for passenger and bystander testing
2.) Antenna location A2: DVR trunk antenna mounting locations for passenger back testing
3.) Total distance between trunk mount antenna and rear passenger is 85cm

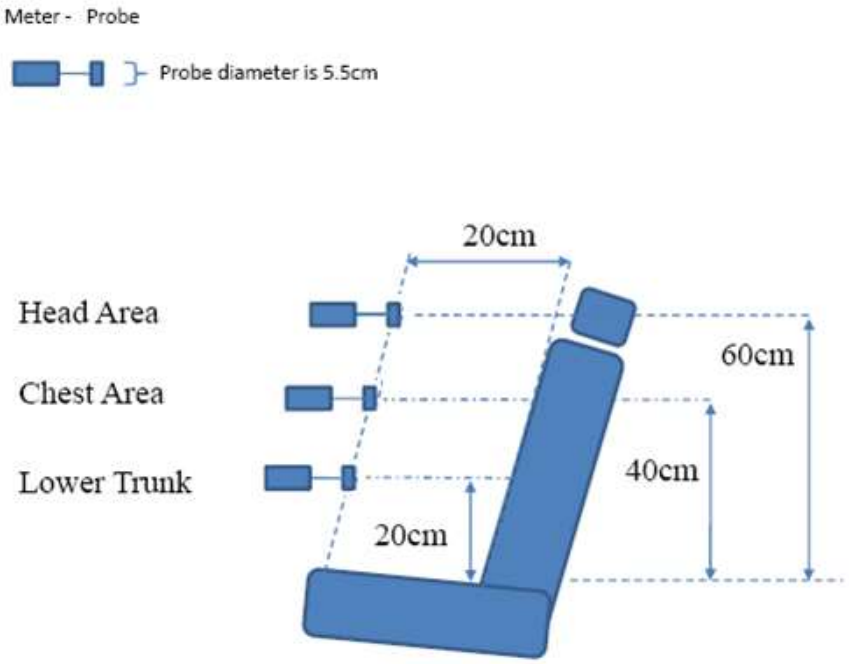
Bystander Antenna mounting and test locations for distance 90cm (LMR VHF, UHF R1and UHF R2 bands)



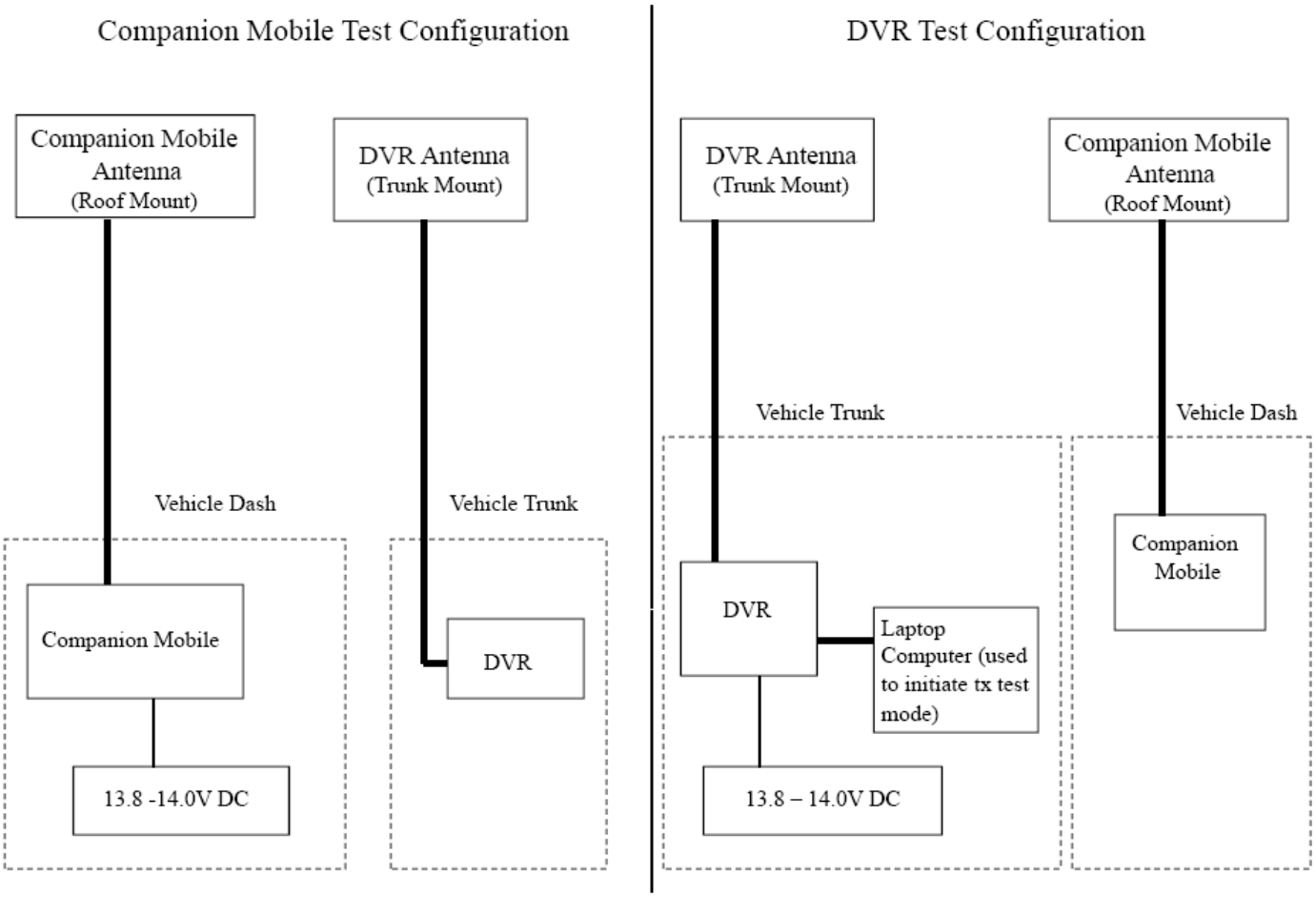
Notes:

1.) Antenna location A1: APX mobile radio roof antenna mounting locations for passenger and bystander testing
2.) Antenna location A3: DVR trunk antenna mounting locations for bystander testing
3.) Bystander location BS2: Center point of the bystander test location BS1 and test location BS3
4.) Bystander location BS (1-5): 90cm away from the vehicle body. Apply for both roof and trunk testing

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



MPE Test Configuration



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	PADD2000501800B	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

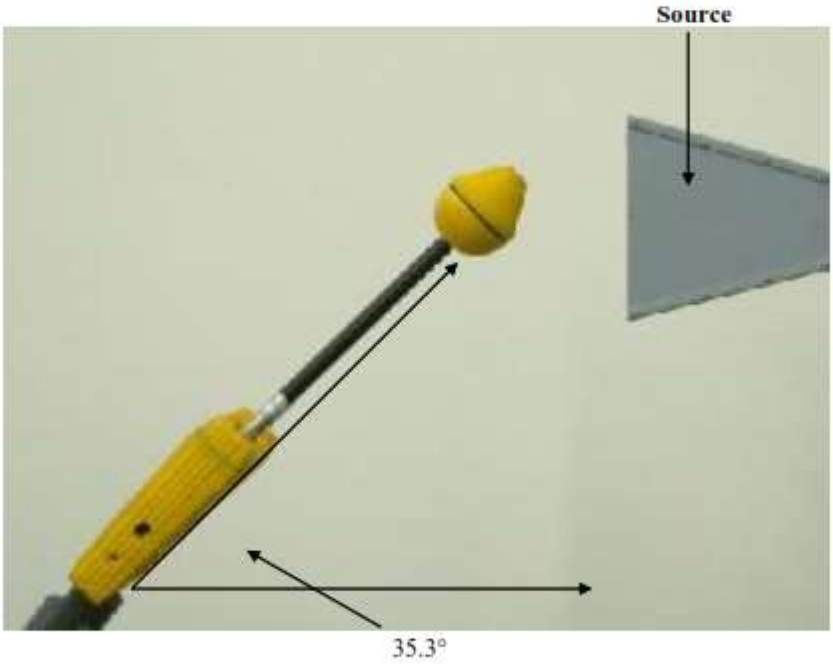
W&G_critical_angle.doc

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

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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

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

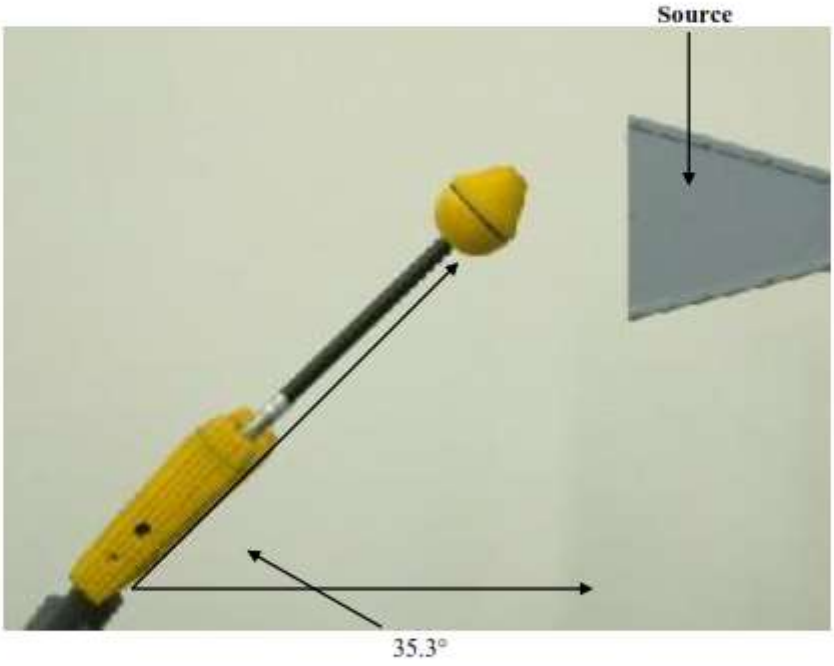
Freq	Applied Field	Indicated Field	Max Dev
MHz	A/m	A/m	dB
27.12	0.04	0.037	0.62
27.12	0.05	0.050	0.52
27.12	0.08	0.076	0.42
27.12	0.13	0.128	0.33
27.12	0.17	0.167	0.30
27.12	0.27	0.262	0.12
27.12	0.33	0.326	0.17
27.12	0.53	0.526	0.09
27.12	0.67	0.664	0.03
27.12	0.80	0.802	-0.01
27.12	0.93	0.935	-0.02
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

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

ilac-MRA ANAB 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

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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	PADD2000501800B	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

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

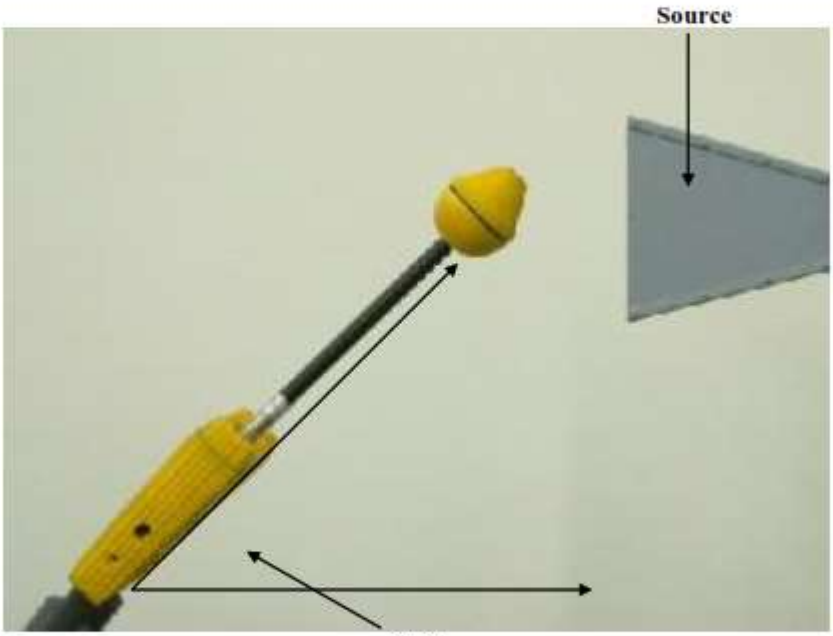
W&G_critical_angle.doc

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



Certificate of Calibration

KEYSIGHT TECHNOLOGIES

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	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

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

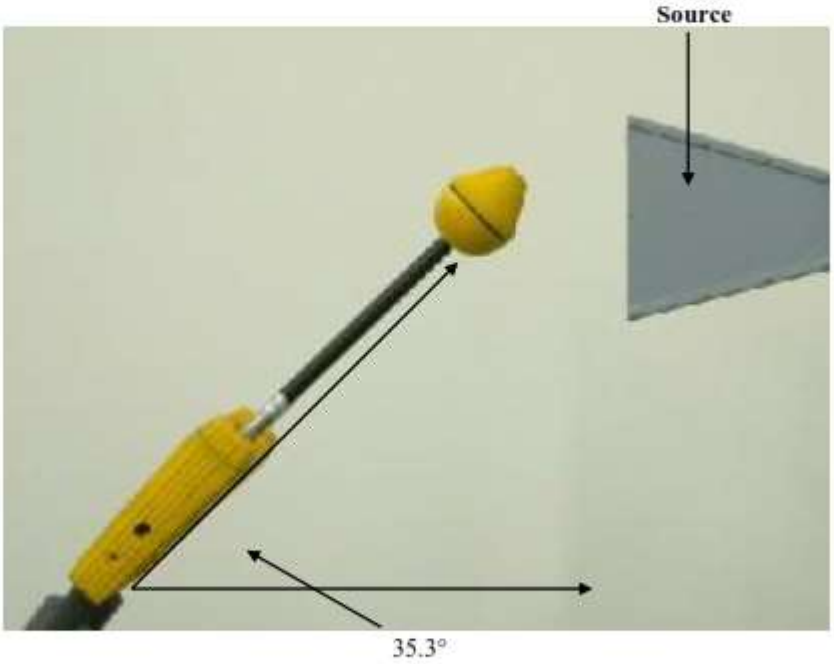
W&G_critical_angle.doc

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

(All antennas mounted to the vehicle with magnetic mount base)

DVR

Antenna kit number
HAF4016A

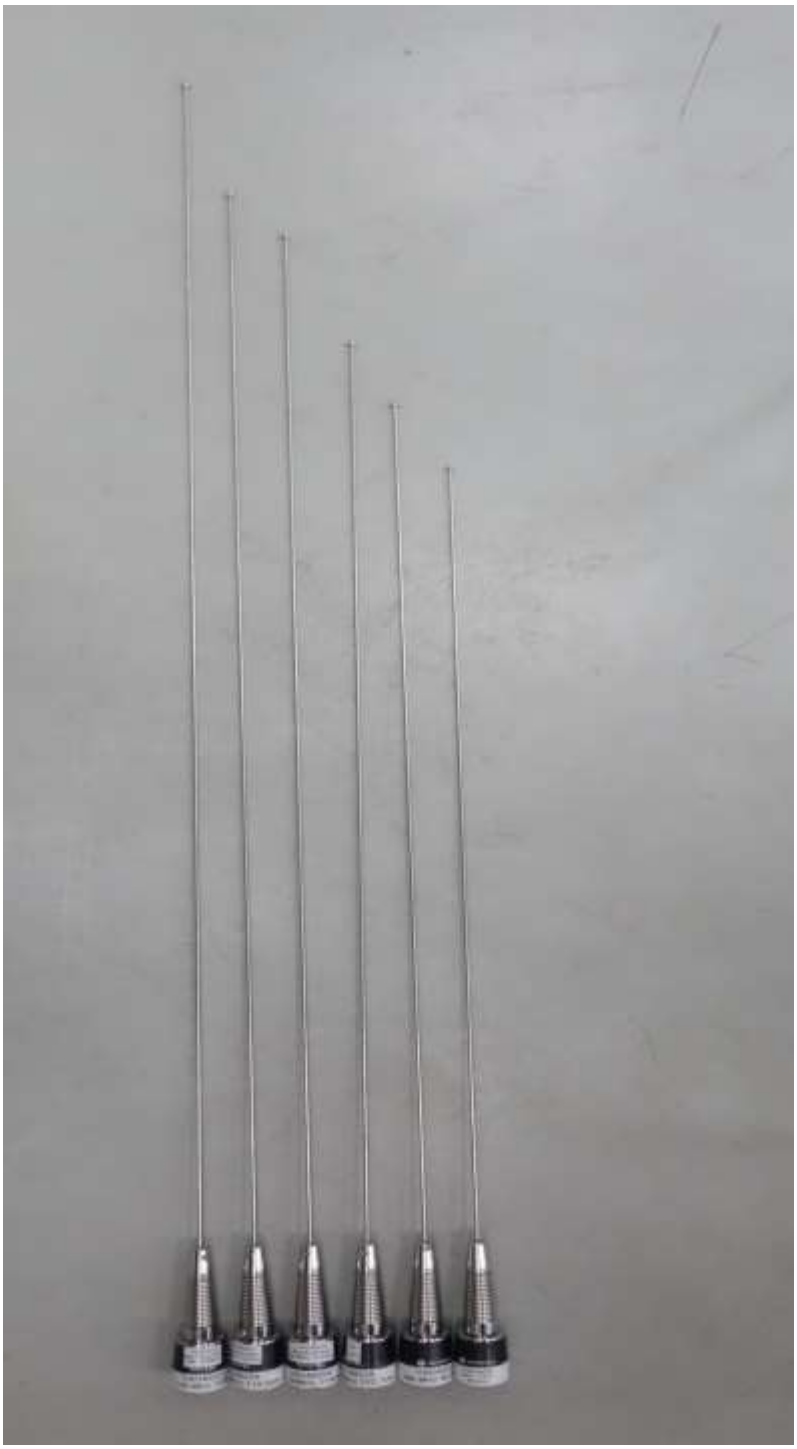
Companion Mobile

Antenna kit number (left to right):

AN000131A02 & AN000131A01

VHF Antenna kit numbers:
RAD4010ARB (6 pcs)

Note: Antennas were trimmed per test frequency.



VHF Antenna kit numbers:
HAD4022A (6 pcs)

Note: Antennas were trimmed per test frequency.

VHF Antenna kit numbers, from left to right;
HAD4016A, HAD4017A and HAD4021A

VHF Antenna kit numbers, from left to right;
HAD4009A, HAD4006A, HAD4007A and HAD4008A

UHF Antenna kit numbers, from left to right;
RAE4014ARB (3 pcs), RAE4015ARM (3 pcs)

Note: Antennas were trimmed per test frequency (3 each).

UHF Antenna kit numbers:
RAE4016ARB (3 pcs)

Note: Antennas were trimmed per test frequency.

UHF Antenna kit numbers, from left to right;
HAE4011A, HAE4012A, HAE4013A, HAE6011A and HAE6010A

UHF Antenna kit numbers, from left to right;
HAE6013A, HAE6031A and HAE6015A

UHF Antenna kit numbers, from left to right;
HAE6016A, HAE4004A, HAE4003A and HAE6012A

7/800 Antenna kit numbers, from left to right;
HAF4014A, HAF4017A, HAF4013A and HAF4016A