

 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																																																		
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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 Update the WLAN calculation and Simultaneous transmission table
04/08/2025	D	Update Table 6 and section 15.3 Simultaneous transmission

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1.0 Introduction

This report details the test setup, test equipment and test results of Maximum Permissible Exposure (MPE) performed at Motorola Solutions' test site for product model M37TSS9PW1CN (PHUW2000D). This device is electrically and mechanically identical to the approved FCC ID: AZ492FT7089/ ISED: 109U-92FT7089, except for the software enhancement to enable the WIFI 5GHz. The results of previous evaluations from FCC ID: AZ492FT7089 / ISED: 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, Motorcycle configuration (G138 option), 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)

2.0 FCC MPE Summary

Table 1

Equipment Class	Frequency band (MHz)	Operator		Bystander	
		Power Density (mW/cm ²)	Percentage of Limit (%)	Power Density (mW/cm ²)	Percentage of Limit (%)
TNB	150.8 – 173.4 (LMR VHF)	0.37	38.06	0.08	40.86
	406.1 – 470 (LMR UHF1)	0.17	13.36	0.08	25.96
	450 – 512 (LMR UHF2)	0.17	11.36	0.09	30.36
	769-775; 799-824; 851-869 (LMR 7/800)	0.32	11.76	0.09	16.86
DTS	2402 – 2480 (Bluetooth)	0.005	0.53	0.005	0.53
DTS	2412 – 2462 (WLAN 2.4GHz)	0.007	0.66	0.007	0.66
NII	5180 – 5825 (WLAN 5GHz)	0.006	0.63	0.006	0.63
Simultaneous (Highest Combined Percentage of Limit)			38.06		40.86

3.0 Abbreviations / Definitions

CNR: Calibration Not Required
CW: Continuous Wave
DUT: Device Under Test
EME: Electromagnetic Energy
FHSS: Frequency Hopping Spread Spectrum
FM: Frequency Modulation
MPE: Maximum Permissible Exposure
GPS: Global Positioning System
LMR: Land Mobile Radio
SAR: Specific Absorption Rate
NA: Not Applicable
BS: Bystander
OP: Operator
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

5.0 Power Density Limits

Table 2 – Occupational / Controlled Exposure Limits

Frequency Range (MHz)	FCC OET Bulletin 65	ICNIRP	IEEE C95.1 1992/1999	IEEE C95.1 2005	RSS-102 Issue 6
	Mw/cm ²	W/m ²	Mw/cm ²	W/m ²	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					$3.33 \times 10^{-4} f$

Table 3 – General Population / Uncontrolled Exposure Limits

Frequency Range (MHz)	FCC OET Bulletin 65	ICNIRP	IEEE C95.1 1992/1999	IEEE C95.1 2005	RSS-102 Issue 6
	Mw/cm ²	W/m ²	Mw/cm ²	W/m ²	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					$6.67 \times 10^{-5} f$

6.0 N_c Test Channels

The number of test channels are 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

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

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

7.0 Measurement Equipment

Table 4 – Equipment

Equipment Type	Model #	SN	Calibration Date	Calibration Due Date
Motorcycle	Honda CBX750-2003	NA	NA	NA
Survey Meter	ETS Model HI-2200	00206805	02/13/2024	02/13/2025
Probe – H-Field	ETS Model H200	00084225		
Probe – E-Field	ETS Model E100	00237161		
Survey Meter	ETS Model HI-2200	00249839	11/29/2023	11/29/2024
Probe – H-Field	ETS Model H200	00086316		
Probe – E-Field	ETS Model E100	00206767		

E-field measurements are in Mw/cm².

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	50% (PTT)	18
	380 – 470 (LMR UHF1) 450 – 520 (LMR UHF2)	380 - 485			
		485 - 512			
		512 - 520			
	769 – 775; 799 – 824, 851 – 869 (LMR 7/800)	764 - 806			
806 - 870					
Bluetooth	2402 - 2480		FHSS	100	0.010
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			

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

Not available.

11.0 Test Set-Up Description

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

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

12.0 Method of Measurement for motorcycle mounted antenna(s)

12.1 Bystander vehicle MPE measurements

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

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

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

12.2 Operator vehicle MPE measurements

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

MPE measurements for operator (OP) conditions are determined by taking the average of the (3) measurements (Head, Chest and Lower Trunk) at the test distance of 37.5cm (for VHF and UHF band) and 20cm (for 7/800 and BT/WLAN band) from the operators' seat area to antennas.

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

13.0 MPE Calculations

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

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

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

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

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

Therefore;

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

$$\text{Calc._P.D.} = (\text{Avg_over_body}) * (\text{probe_frequency_cal_factor}) * (\text{duty_cycle})$$

$$\text{Calc._P.D.} = (\text{Avg_TopPortion_body}) * \frac{2}{3} * (\text{probe_frequency_cal_factor}) * (\text{duty_cycle})$$

Note1: 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/cm²) 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"/ "Avg_TopPortion_body" A/m results were converted to power density (mW/cm²) using the equation 3. H-field measurements are only applicable to frequencies below 300MHz.

Note 4: For operator position, 2/3 factor is implying that exposure on top portion of the body is much closer to antenna than the leg.

Equation 3 – Converting A/m to mW/cm²

$$mW/cm^2 = (A/m)^2 * 37.699$$

Equation 4 – Power Density Maximum Calculation

$$Max_Calc._P.D. = P.D._calc * \frac{max_output_power}{initial_output_power}$$

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

14.0 Antenna Summary

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

Table 7

Antenna No.	Antenna Model	Frequency Range (MHz)	Physical Length (cm)	Gain (dBi)	Remarks	Overlap FCC Bands (MHz)	FCC N _c	Actual N _c
VHF (136-174 MHz)								
1	AN000197A01 (HAD4023A)	136-144	55.2	2.15	1/4 wave	NA	0	3
2	AN000197A02 (HAD4024A)	144-150.8	52	2.15	1/4 wave	150.8	1	3
3	AN000197A03 (HAD4025A)	150.8-162	48	2.15	1/4 wave	150.8-162	3	3
4	AN000197A04 (HAD4026A)	162-174	44.5	2.15	1/4 wave	162-173.4	3	3
UHF 1 (380-470 MHz)								
5	AN000197A05 (HAE6014A)	380-433	44.5	2.15	1/4 wave	406.1-433	3	5
6	AN000197A06 ⁽¹⁾ (HAE6032A)	425-470	15.5	2.15	1/4 wave	425-470	4	4
7	AN000197A07 ⁽¹⁾ (HAE6033A)	450-482	14.7	2.15	1/4 wave	450-470	3	3
8	AN000197A09 ⁽¹⁾ (HAE6035A)	450-512	8.2	2.15	1/4 wave	450-470	3	3
UHF 2 (450-520 MHz)								
6	AN000197A06 ⁽¹⁾ (HAE6032A)	425-470	15.5	2.15	1/4 wave	450-470	3	3
7	AN000197A07 ⁽¹⁾ (HAE6033A)	450-482	14.7	2.15	1/4 wave	450-482	4	4
8	AN000197A09 ⁽¹⁾ (HAE6035A)	450-512	8.2	2.15	1/4 wave	450-512	6	6
9	AN000197A08 (HAE6034A)	482-520	13.8	2.15	1/4 wave	482-512	3	4
7/800 (764-870 MHz)								
10	AN000197A10 (HAF4015A)	764-870	39.8	5.15	1/4 wave	769-775; 799-824; 851-869	7	9
11	AN000197A11 (HAF4018A)	764-870	4.5	4.65	1/4 wave	769-775; 799-824; 851-869	7	9
BT/WiFi / GPS								
12	AN000163A02	2400 - 2500 4900 - 5900	7	5.0/5.25	Monopole	2412-2462 5180-5825	N/A	N/A

Note (1): Antennas support UHF1 & UHF2 frequency range.

15.0 Test Results Summary

15.1 MPE Test Results Summary for LMR

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

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										
MC	BS	E	AN000197A03 (HAD4025A), 1/4 wave, 150.8-162 MHz	18.0	17.6	156.4000	0.11	0.20	56.50	Reference Configuration
					17.3		0.08	0.20	40.20	Measured
Spot Check - Highest Configuration Operator										
MC	OP	E	AN000197A04 (HAD4026A), 1/4 wave, 162-174 MHz	18.0	17.7	173.0125	0.66	1.00	65.80	Reference Configuration
					17.2		0.37	1.00	37.40	Measured
UHF1 (406.1 - 470MHz)										
Spot Check - Highest Configuration ByStander										
MC	BS	E	AN000197A09 (HAE6035A), 1/4 wave, 450-512 MHz	18.0	17.9	469.9875	0.10	0.31	32.80	Reference Configuration
					17.5		0.08	0.31	25.30	Measured
Spot Check - Highest Configuration Operator										
MC	OP	E	AN000197A05 (HAE6014A), 1/4 wave, 380-433 MHz	18.0	17.7	406.5000	0.19	1.36	14.30	Reference Configuration
					17.5		0.17	1.36	12.70	Measured
UHF2 (450 - 512MHz)										
Spot Check - Highest Configuration ByStander										
MC	BS	E	AN000197A09 (HAE6035A), 1/4 wave, 450-512 MHz	18.0	18.0	481.9875	0.11	0.32	33.00	Reference Configuration
					17.4		0.10	0.32	29.70	Measured
Spot Check - Highest Configuration Operator										
MC	OP	E	AN000197A09 (HAE6035A), 1/4 wave, 450-512 MHz	18.0	18.0	481.9875	0.24	1.61	14.70	Reference Configuration
					17.4		0.17	1.61	10.70	Measured
7/800 (769 - 775MHz; 799 - 824MHz; 851 - 869MHz)										
Spot Check - Highest Configuration ByStander										
MC	BS	E	AN000197A11 (HAF4018A), 1/4 wave, 764-870 MHz	18.0	18.0	868.8875	0.12	0.57	21.60	Reference Configuration
					17.2		0.09	0.57	16.20	Measured
Spot Check - Highest Configuration Operator										
MC	OP	E	AN000197A10 (HAF4015A), 1/4 wave, 764-870 MHz	18.0	18.0	794.0875	0.23	2.90	8.00	Reference Configuration
					17.3		0.32	2.90	11.10	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										
MC	BS	E	AN000197A03 (HAD4025A), 1/4 wave, 150.8-162 MHz	18.0	17.6	156.4000	0.11	0.13	87.50	Reference Configuration
					17.3		0.08	0.13	62.30	Measured
Spot Check - Highest Configuration Operator										
MC	OP	E	AN000197A04 (HAD4026A), 1/4 wave, 162-174 MHz	18.0	17.7	173.0125	0.66	0.85	77.50	Reference Configuration
					17.2		0.37	0.85	44.10	Measured
UHF1 (406.1 - 430MHz, 450 - 470MHz)										
Spot Check - Highest Configuration ByStander										
MC	BS	E	AN000197A09 (HAE6035A), 1/4 wave, 450-512 MHz	18.0	17.9	469.9875	0.10	0.18	58.50	Reference Configuration
					17.5		0.08	0.18	45.30	Measured
Spot Check - Highest Configuration Operator										
MC	OP	E	AN000197A05 (HAE6014A), 1/4 wave, 380-433 MHz	18.0	17.7	406.5000	0.19	1.30	14.90	Reference Configuration
					17.5		0.17	1.30	13.30	Measured
UHF2 (450 - 470MHz)										
Spot Check - Highest Configuration ByStander										
MC	BS	E	AN000197A09 (HAE6035A), 1/4 wave, 450-512 MHz	18.0	17.9	469.9875	0.10	0.18	58.50	Reference Configuration
					17.5		0.08	0.18	43.70	Measured
Spot Check - Highest Configuration Operator										
MC	OP	E	AN000197A09 (HAE6035A), 1/4 wave, 450-512 MHz	18.0	17.9	469.9875	0.19	1.40	13.60	Reference Configuration
					17.5		0.17	1.40	11.80	Measured
7/800 (768 - 776MHz; 798 - 824MHz; 851 - 869MHz)										
Spot Check - Highest Configuration ByStander										
MC	BS	E	AN000197A11 (HAF4018A), 1/4 wave, 764-870 MHz	18.0	18.0	868.8875	0.12	0.27	46.80	Reference Configuration
					17.2		0.09	0.27	35.00	Measured
Spot Check - Highest Configuration Operator										
MC	OP	E	AN000197A10 (HAF4015A), 1/4 wave, 764-870 MHz	18.0	18.0	794.0875	0.23	1.90	12.10	Reference Configuration
					17.3		0.32	1.90	16.80	Measured

15.2 MPE Test Results for Bluetooth and WLAN

Antennas AN000163A02 support Bluetooth / WLAN 2.4GHz / WLAN 5GHz should be installed at enclosure of the motorcycle. 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, calculations can be made to predict RF

field strength and power density levels around typical RF sources. Equation (5) is generally accurate in far-field of an antenna.

Equation 5 – Power Density Calculation

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

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/cm²)

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 operator and 60cm for bystander.

L = cable loss (dB), 0.77 dB with 6' PFP240 cable (attenuation 12.9 dB/100ft)

F = Enhancement factor

BT/WLAN was subject to the General Population/ Uncontrolled Exposure limits.

Table 10

Antenna #	Max Power (W)	Duty Cycle (%)	Tx Frequency (MHz)	Antenna Gain (dBi)	Cable Loss, L (dB)	Dist., d (cm)	Enhance Factor, F	Max Calc. MPE (mW/cm ²)	MPE Spec Limit (mW/cm ²)				
									FCC	% of FCC Spec Limit	ISED limit	% of ISED Spec Limit	
Bluetooth													
AN000163A02	0.010	100.00%	2402.0000	5.00	0.77	20	1.00	0.003	1.00	0.33	0.54	0.98	
AN000163A02	0.010	100.00%	2441.0000	5.00	0.77	20	1.00	0.005	1.00	0.53	0.54	0.97	
AN000163A02	0.010	100.00%	2480.0000	5.00	0.77	20	1.00	0.005	1.00	0.53	0.55	0.96	
Bluetooth LE													
AN000163A02	0.002	100.00%	2402.0000	5.00	0.77	20	1.00	0.001	1.00	0.10	0.54	0.19	
AN000163A02	0.002	100.00%	2441.0000	5.00	0.77	20	1.00	0.001	1.00	0.10	0.54	0.19	
AN000163A02	0.002	100.00%	2480.0000	5.00	0.77	20	1.00	0.001	1.00	0.10	0.55	0.19	
WLAN2.4GHz 802.11b / n(20MHz)													
AN000163A02	0.008	100.00%	2412.0000	5.00	0.77	20	1.00	0.004	1.00	0.42	0.54	0.78	
AN000163A02	0.008	100.00%	2442.0000	5.00	0.77	20	1.00	0.004	1.00	0.42	0.54	0.77	
AN000163A02	0.008	100.00%	2472.0000	5.00	0.77	20	1.00	0.004	1.00	0.42	0.55	0.77	
WLAN2.4GHz 802.11g													
AN000163A02	0.013	100.00%	2412.0000	5.00	0.77	20	1.00	0.007	1.00	0.66	0.54	1.24	
AN000163A02	0.013	100.00%	2442.0000	5.00	0.77	20	1.00	0.007	1.00	0.66	0.54	1.23	
AN000163A02	0.013	100.00%	2472.0000	5.00	0.77	20	1.00	0.007	1.00	0.66	0.55	1.22	
WLAN5GHz 802.11a/n/ac													
AN000163A02	0.011	100.00%	5180.0000	5.25	0.77	20	1.00	0.006	1.00	0.63	0.90	0.69	
AN000163A02	0.011	100.00%	5502.5000	5.25	0.77	20	1.00	0.006	1.00	0.63	0.94	0.66	
AN000163A02	0.011	100.00%	5825.0000	5.25	0.77	20	1.00	0.006	1.00	0.63	0.98	0.64	

15.3 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 WLAN 2.4GHz transmit power is higher than Bluetooth power, thus Bluetooth is excluded 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 Operator (OP)						
Simultaneous transmission conditions	LMR				WLAN 2.4GHz	Highest Combined Percentage Of Limit (%)
	VHF	UHF1	UHF2	7/800		
VHF + WLAN 2.4GHz	37.40	-	-	-	0.66	38.06
UHF1 + WLAN 2.4GHz	-	12.70	-	-	0.66	13.36
UHF2 + WLAN 2.4GHz	-	-	10.70	-	0.66	11.36
7/800 + WLAN 2.4GHz	-	-	-	11.10	0.66	11.76
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	40.20	-	-	-	0.66	40.86
UHF1 + WLAN 2.4GHz	-	25.30	-	-	0.66	25.96
UHF2 + WLAN 2.4GHz	-	-	29.70	-	0.66	30.36
7/800 + WLAN 2.4GHz	-	-	-	16.20	0.66	16.86

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

ISED Operator (OP)						
Simultaneous transmission conditions	LMR				WLAN 2.4GHz	Highest Combined Percentage Of Limit (%)
	VHF	UHF1	UHF2	7/800		
VHF + WLAN 2.4GHz	44.10	-	-	-	1.24	45.34
UHF1 + WLAN 2.4GHz	-	13.30	-	-	1.24	14.54
UHF2 + WLAN 2.4GHz	-	-	11.80	-	1.24	13.04
7/800 + WLAN 2.4GHz	-	-	-	16.80	1.24	18.04
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	62.30	-	-	-	1.24	63.54
UHF1 + WLAN 2.4GHz	-	45.30	-	-	1.24	46.54
UHF2 + WLAN 2.4GHz	-	-	43.70	-	1.24	44.94
7/800 + WLAN 2.4GHz	-	-	-	35.00	1.24	36.24

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

Table 14

Simultaneous Transmission	Highest Combined Percentage Of Limit (%)	
	Operator (OP)	Bystander (BS)
FCC		
LMR VHF and WLAN	38.06	40.86
LMR UHF1 and WLAN	13.36	25.96
LMR UHF2 and WLAN	11.36	30.36
LMR 7/800 and WLAN	11.76	16.86
ISED		
LMR VHF and WLAN	45.34	63.54
LMR UHF1 and WLAN	14.54	46.54
LMR UHF2 and WLAN	13.04	44.94
LMR 7/800 and WLAN	18.04	36.24

16.0 Conclusion

The assessments for this device were performed with an output power range as indicated in section 15.0. The maximum allowable output power is equal to the upper limit of the final test factory transmit power specification of 18W. The highest power density results for the mobile device scaled to the maximum allowable power output are indicated in Table below for operator and bystander to the motorcycle and the wireless networks.

Table 15 Maximum MPE RF Exposure Summary (LMR)

Designator	Transmitters	Frequency Band (MHz)	Operator (mW/cm ²)	Bystander (mW/cm ²)
FCC	LMR VHF	150.8 - 173.4	0.37	0.08
	LMR UHF1	406.1 - 470	0.17	0.08
	LMR UHF2	450 - 512	0.17	0.09
	LMR 7/800	769-775; 799-824; 851-869	0.32	0.09
ISED Canada	LMR VHF	138 - 174	0.37	0.08
	LMR UHF1	406.1 – 430; 450 -470	0.17	0.08
	LMR UHF2	450 -470	0.17	0.09
	LMR 7/800	768-775; 798-824; 851-869	0.32	0.09

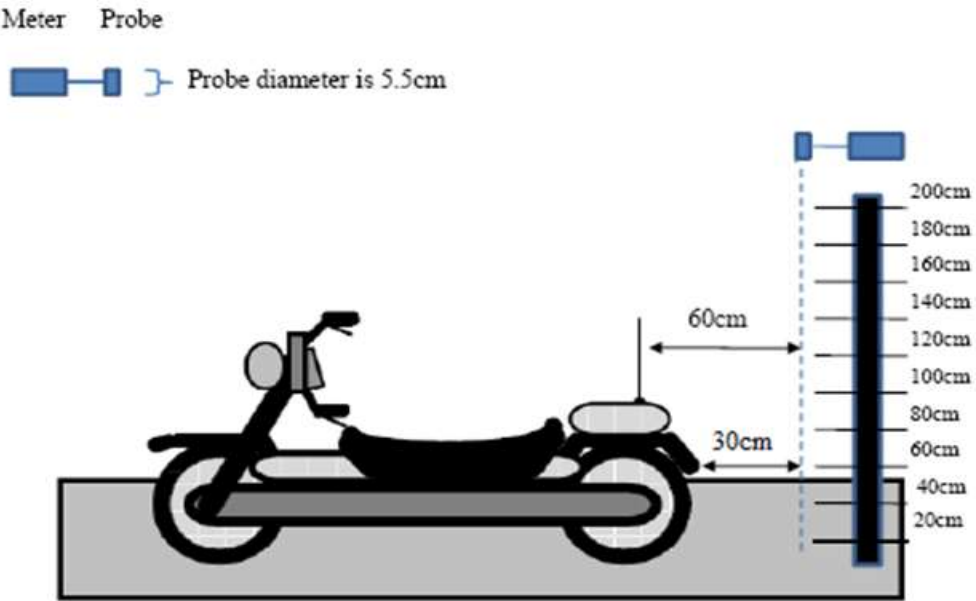
Table 16 Maximum MPE RF Exposure Summary (Bluetooth/WLAN)

Designator	Transmitters	Frequency Band (MHz)	Operator (mW/cm ²)	Bystander (mW/cm ²)
FCC / ISED Canada	Bluetooth	2402 – 2480	0.005	0.005
	WLAN 2.4GHz	2412 – 2462	0.007	0.007
	WLAN 5GHz	5180 – 5825	0.006	0.006

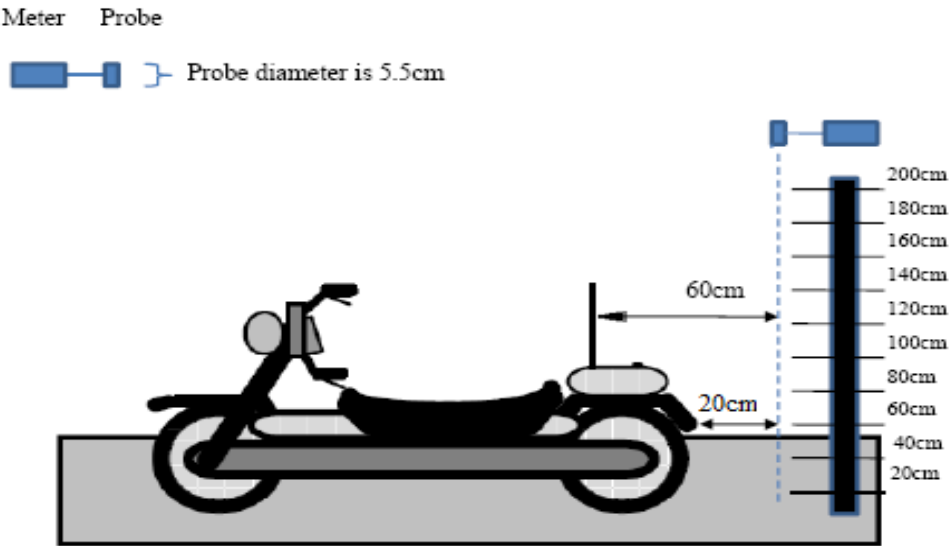
These MPE results herein demonstrate compliance to the FCC/ISED Canada Occupational/Controlled Exposure limit. FCC/ISED Canada rules require compliance for Bystanders to the FCC General Population/Uncontrolled limits.

Appendix A - Illustration of Antenna Location and Test Distances

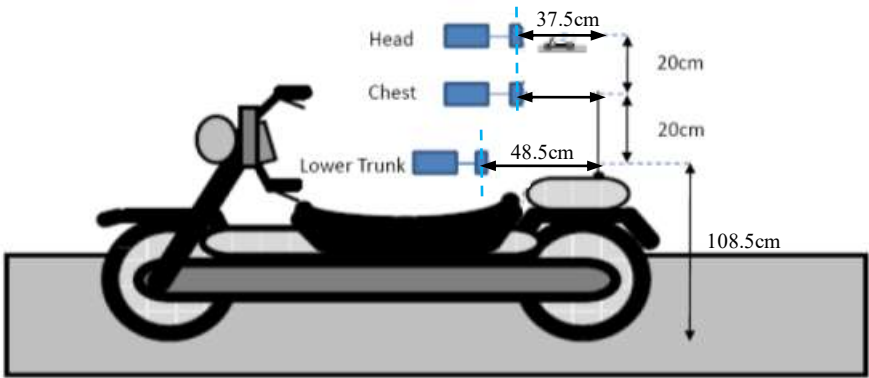
Bystander Illustration
(For VHF and UHF)



Bystander Illustration
(For 7/800 and BT/WLAN)

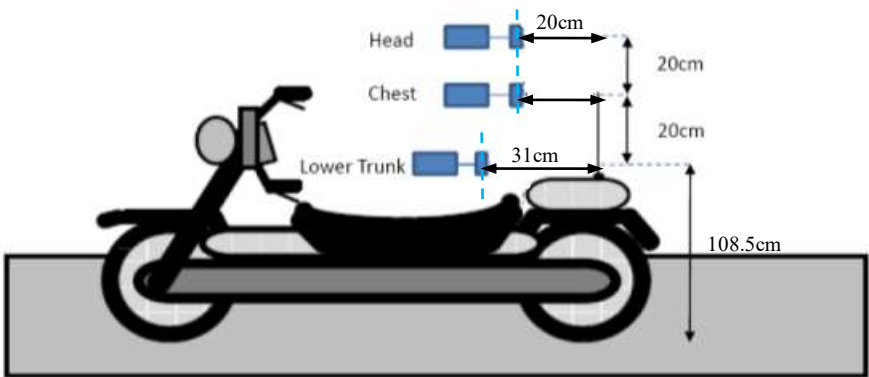


Operator Illustration
(For VHF and UHF)



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

Operator Illustration
(For 7/800 and BT/WLAN)



Note: Lower Trunk measurement distance 31cm from the antenna is to maintain minimum 20cm separation distance between the probe sensor and reradiating objects (motorcycle’s enclosure)

Appendix B - Probe Calibration Certificates



Certificate of Calibration

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

Certificate Number 231127-121041-b67867



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	F17000	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.



Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994
Certificate Number 231127-121041-b67867



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

Issue Date 29 Nov 2023


Brandt Langer Iowa Service Center Manager

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Certificate of Calibration

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

Certificate Number 231127-121041-b67867



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	
	Multiplier	20V/m 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

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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

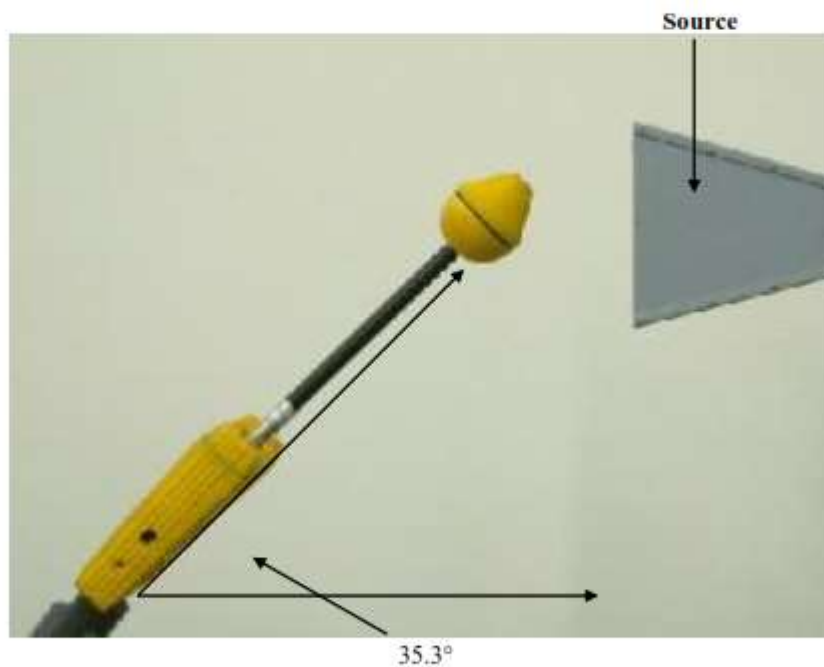
Freq MHz	Applied Field V/m	Indicated Field V/m	Max Dev dB
27.12	0.50	0.66	-2.41
27.12	1.01	0.98	0.26
27.12	2.01	1.77	1.10
27.12	4.04	3.40	1.50
27.12	8.05	6.99	1.23
27.12	15.12	13.40	1.05
27.12	20.08	17.70	1.10
27.12	30.30	26.70	1.10
27.12	50.00	43.60	1.19
27.12	65.02	56.90	1.16
27.12	100.20	88.40	1.09
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

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

ISO/IEC 17025:2017 and ANSI/NCCL Z540.1-1994
Certificate Number 231113-155252-a521af



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/NCCL 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
Issue Date 29 Nov 2023


Brandt Langer Iowa Service Center Manager

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Certificate of Calibration

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

Certificate Number 231113-155252-a521af



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	HB-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

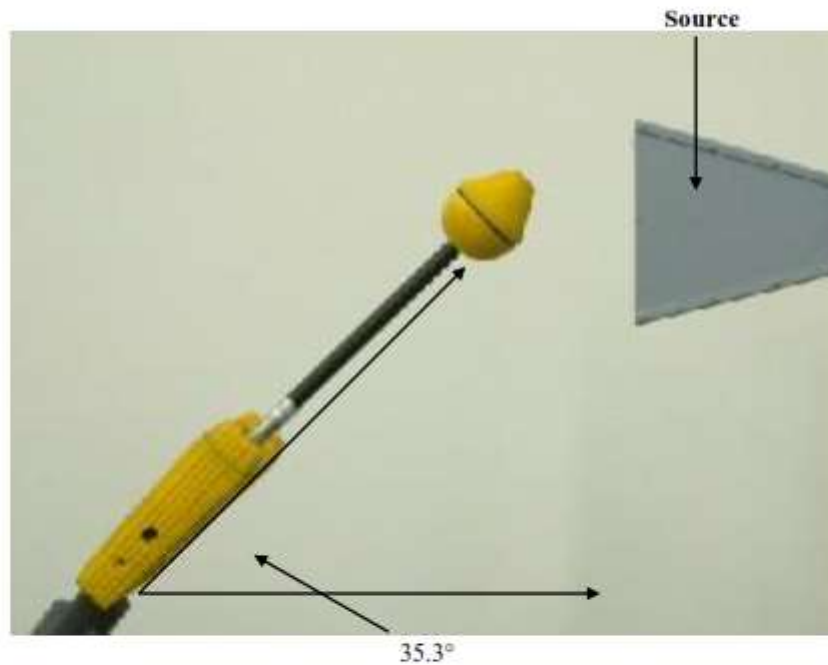
Freq	Applied Field	Indicated Field	Max Dev
MHz	A/m	A/m	dB
27.12	0.04	0.037	0.62
27.12	0.05	0.050	0.52
27.12	0.08	0.076	0.42
27.12	0.13	0.128	0.33
27.12	0.17	0.167	0.30
27.12	0.27	0.262	0.12
27.12	0.33	0.326	0.17
27.12	0.53	0.526	0.09
27.12	0.67	0.664	0.03
27.12	0.80	0.802	-0.01
27.12	0.93	0.935	-0.02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

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
ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994
Certificate Number 240209-131305-3f1df5



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 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
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

Issue Date 13 Feb 2024


Brandt Langer Iowa Service Center Manager

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Certificate of Calibration

ISO/IEC 17025:2017 and ANSI/NC SL Z540.1-1994
Certificate Number 240209-131305-3f1df5



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	510I	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	230629-130030-5Cda1
Hewlett-Packard	8487A	Power Sensor	10577	02/28/2025	240130-103045-c70fd
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	231026-132817-4Ddc83
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.



Certificate of Calibration

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

Certificate Number 240209-131305-3f1df5



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	
	Multiplier	20V/m 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

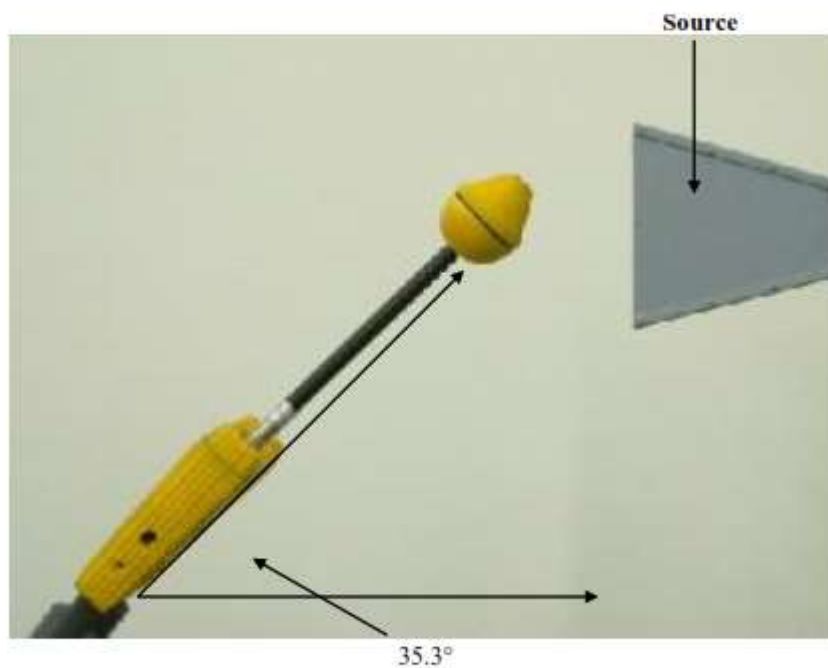
Freq	Applied Field	Indicated Field	Max Dev
MHz	V/m	V/m	dB
27.12	0.51	0.70	-2.75
27.12	1.02	1.11	-0.73
27.12	2.08	1.96	0.52
27.12	4.07	3.84	0.51
27.12	8.05	7.46	0.66
27.12	15.15	13.83	0.79
27.12	20.12	18.34	0.80
27.12	30.15	27.30	0.86
27.12	50.27	45.50	0.87
27.12	65.60	59.66	0.82
27.12	100.40	91.95	0.76
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

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
ISO/IEC 17025:2017 and ANSI/NCSL Z540.1-1994
Certificate Number 240209-131101-f21e01



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)	Calibration Method(s)	Calibration Procedure(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	Substitution	28733()

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
Issue Date 13 Feb 2024


Brandt Langer Iowa Service Center Manager
Page 1 of 5



Certificate of Calibration

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

Certificate Number 240209-131101-f21e01



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

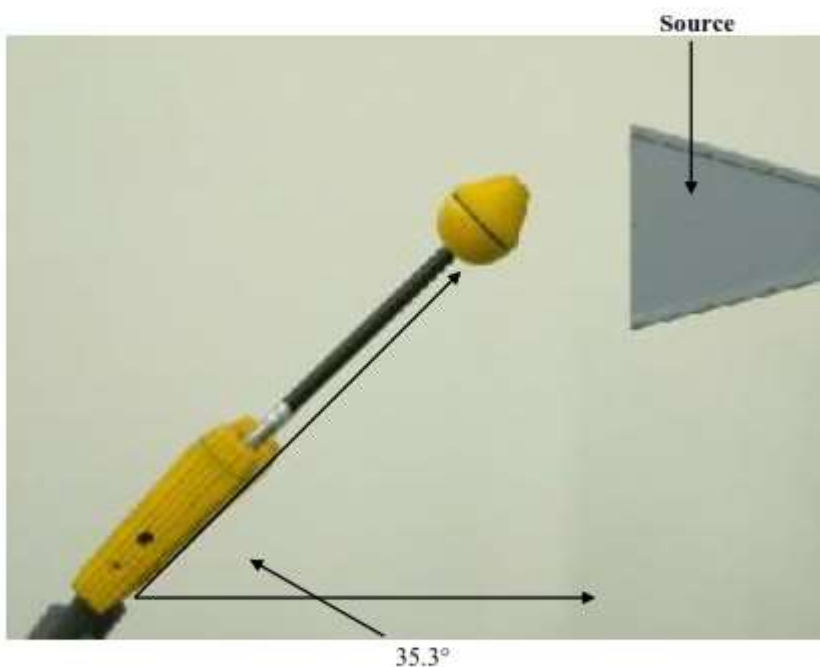
Freq	Applied Field	Indicated Field	Max Dev
MHz	A/m	A/m	dB
27.12	0.04	0.035	1.11
27.12	0.05	0.050	0.52
27.12	0.08	0.070	1.13
27.12	0.13	0.130	0.24
27.12	0.17	0.170	0.15
27.12	0.27	0.260	0.20
27.12	0.33	0.330	0.07
27.12	0.54	0.530	0.08
27.12	0.67	0.670	0.00
27.12	0.80	0.800	0.03
27.12	0.94	0.940	-0.04
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

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)