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Date: 02 November 2022

I.T.L. Product Testing Ltd.
FCC Part 15.247 Test Report

for

Magos Systems Ltd.

Equipment under test:

**Radar-Based, Outdoor Perimeter
Security Sensor**

SR150F

Tested by:

M. Zohar

Approved by: I. Mansky

pp. I. Cohen:

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Measurement/Technical Report for **Magos Systems Ltd.**

Radar-Based, Outdoor Perimeter Security Sensor SR150F

FCC ID: 2AFHU-SR150F

This report concerns: Original Grant

Equipment type: FCC: DSS Part 15 Spread Spectrum Transmitter

Limits used: 47CFR15 Section 15.247

Measurement procedures used are KDB 558074 D01 v05, and ANSI C63.10: 2013.

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1 General Information

1.1 Administrative Information

Manufacturer:	Magos Systems Ltd.
Manufacturer's Address:	13 Gad Feinstein St., Rehovot 7638517 Israel Tel: +972-77-414-0155
Manufacturer's Representative:	Amit Isseroff
Equipment Under Test (E.U.T):	Radar-Based, Outdoor Perimeter Security Sensor
Equipment Serial No.:	Not designated
Date of Receipt of E.U.T:	7 June, 2022
Start of Test:	7 June, 2022
End of Test:	30 August, 2022
Test Laboratory Location:	I.T.L. Product Testing Ltd. 1 Bat Sheva St., Lod 7120101 Israel
Test Specifications:	FCC, Subpart C, Section 15.247

1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation No. IL1005.
3. Department of Innovation, Science and Economic Development (ISED) Canada, CAB identifier: IL1002

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

1.3 Product Description

DC-supplied, outdoor Radar used as a perimeter protection security sensor.
The EUT is powered from an Ethernet line using power over Ethernet (PoE),
with a voltage level up to 60 V DC.

Type of Equipment							
☒	Stand Alone (Equipment with/without its own control provisions)						
☐	Combined (Equipment where radio part is fully integrated with another type of equipment)						
☐	Plug in card (Equipment intended for a variety of host systems)						
Intended Use				Condition of use			
☒	Fixed			Always of distance >2m from the people			
☐	Mobile						
☐	Portable						
Assigned frequency band				5725-5850MHz			
Operational frequencies				5726-5849Mhz			
Maximum rated output power				At transmitter 50Ω RF output connector [dBm]			
				Effective Radiated Power (for equipment without RF connector)		~10dBm	
Antenna Connection							
☐	Unique Coupling	☐	Standard Connection	☒	Integral	☐	With temporary RF connector
						☒	Without temporary RF connector
Antenna Gain(peak)				9dBi			
Operating channel bandwidth				N/A(CW)			
Type of modulation				N/A(CW)			
Bit rate				N/A			
Maximum transmitter duty cycle				100%			
Transmitter power source							
☐	AC			Nominal rated voltage			
☒	DC			Nominal rated voltage		48V DC (PoE)	
☐	Battery			Nominal rated voltage			

1.4 Test Methodology

Radiated testing was performed according to the procedures in KDB 558074 D01 v05 and ANSI C63.10: 2013, at an antenna-to-EUT distance of three meters.

1.5 Test Facility

Emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.



1.6 Measurement Uncertainty

Conducted Emission

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)
0.15 – 30 MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 3.6 dB

Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)
for open site:
30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.96 dB

1 GHz to 6 GHz

Expanded Uncertainty (95% Confidence, K=2):

± 5.19 dB

>6 GHz

Expanded Uncertainty (95% Confidence, K=2):

± 5.51 dB

2 System Test Configuration

2.1 Justification

1. The E.U.T contains a 5.7GHz transceiver.
2. Some evaluations were performed in hopping mode and some in non-hopping mode, in the low channel (5726MHz), mid channel (5800MHz) and high channel (5849MHz).
3. Testing was performed with the E.U.T in installation orientation position.

2.2 EUT Exercise Software

No special exercise software was used.

2.3 Special Accessories

Equipment	Manufacturer	Part Number	Serial Number
Laptop	Lenovo	2518-R8G	R8-0YHG8
AC/DC Laptop Charger	Lenovo	ADLX90NLT3A	N/A
POE Injector	TP-Link Technologies CO, LTD.	TL-POE150S	2166533000679
AC/DC Power Supply	TP-Link Technologies CO, LTD.	T480050-2C1	N/A

2.4 Equipment Modifications

No modifications were needed in order to achieve compliance.

2.5 Configuration of Tested System

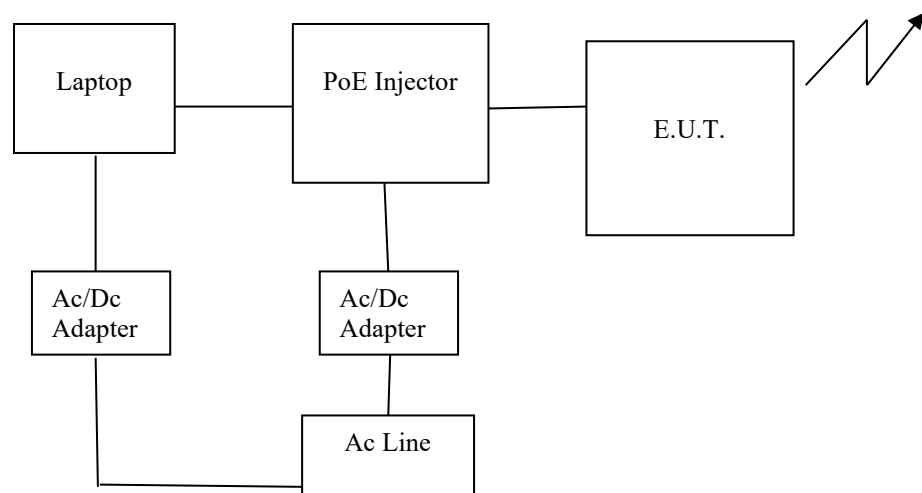


Figure 1. Configuration of Tested System



3 Test Setup Photos

See a separate file.

4 Conducted Emission from AC Mains

4.1 Test Specification

FCC Part 15, Subpart C, Section 15.207

4.2 Test Procedure

(Temperature (22°C)/ Humidity (55%RH))

The E.U.T operation mode and test setup are as described in Section 2 of this report. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room, with the E.U.T placed on a 0.8 meter high wooden table, 0.4 meter from the room's vertical wall. In the case of a floor-standing E.U.T., it was placed on the horizontal ground plane.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50 μ Hn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T.

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission.

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying with CISPR 16 requirements. The specification limits are loaded to the receiver and are displayed on the receiver's spectrum display.

The E.U.T was evaluated in TX operation mode.

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

4.3 Test Limit

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

4.4 Test Results

JUDGEMENT: Passed by 6.9 dB

The margin between the emission levels and the specification limit is, in the worst case- 2.98 dB for the phase line at 518 kHz, and 3.36 dB at 526 kHz for the neutral line.

The EUT met the FCC Part 15, Subpart C specification requirements.

The details of the highest emissions are given in *Figure 2* to *Figure 5*.

Conducted Emission

E.U.T Description: Radar-Based, Outdoor
Perimeter Security Sensor
Type: SR150F
Serial Number: Not designated

Specification: FCC Part 15, Subpart C
Lead: Phase
Detectors: : Peak, Quasi-peak, Average
Power Operation: POE

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CE22BQP			
Trace2:	CE22BAP			
Trace3:	---			
TRACE	FREQUENCY	LEVEL dBμV	DELTA LIMIT dB	
1 Quasi Peak	150 kHz	45.41	-20.58	
2 Average	154 kHz	29.73	-26.04	
2 Average	170 kHz	28.26	-26.69	
2 Average	518 kHz	43.01	-2.98	
1 Quasi Peak	526 kHz	49.27	-6.72	
1 Quasi Peak	874 kHz	38.61	-17.38	
2 Average	878 kHz	32.90	-13.09	
2 Average	1.246 MHz	32.94	-13.05	
1 Quasi Peak	1.286 MHz	37.31	-18.68	
2 Average	1.578 MHz	32.76	-13.23	
2 Average	1.898 MHz	32.87	-13.12	
1 Quasi Peak	1.938 MHz	37.75	-18.24	
2 Average	2.202 MHz	32.15	-13.85	
1 Quasi Peak	2.21 MHz	37.59	-18.40	
2 Average	2.622 MHz	31.74	-14.25	
2 Average	2.914 MHz	31.43	-14.56	
1 Quasi Peak	8.146 MHz	33.39	-26.60	
1 Quasi Peak	20.382 MHz	26.42	-33.57	
1 Quasi Peak	21.662 MHz	26.79	-33.20	
1 Quasi Peak	23.13 MHz	26.70	-33.29	

Figure 2. Detectors: Peak, Quasi-peak, Average

Note: QP Delta/Av Delta refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Conducted Emission

E.U.T Description: Radar-Based, Outdoor Perimeter Security Sensor
Type: SR150F
Serial Number: Not designated

Specification: FCC Part 15, Subpart C
Lead: Phase
Detectors: Peak, Quasi-peak, Average
Power Operation: POE

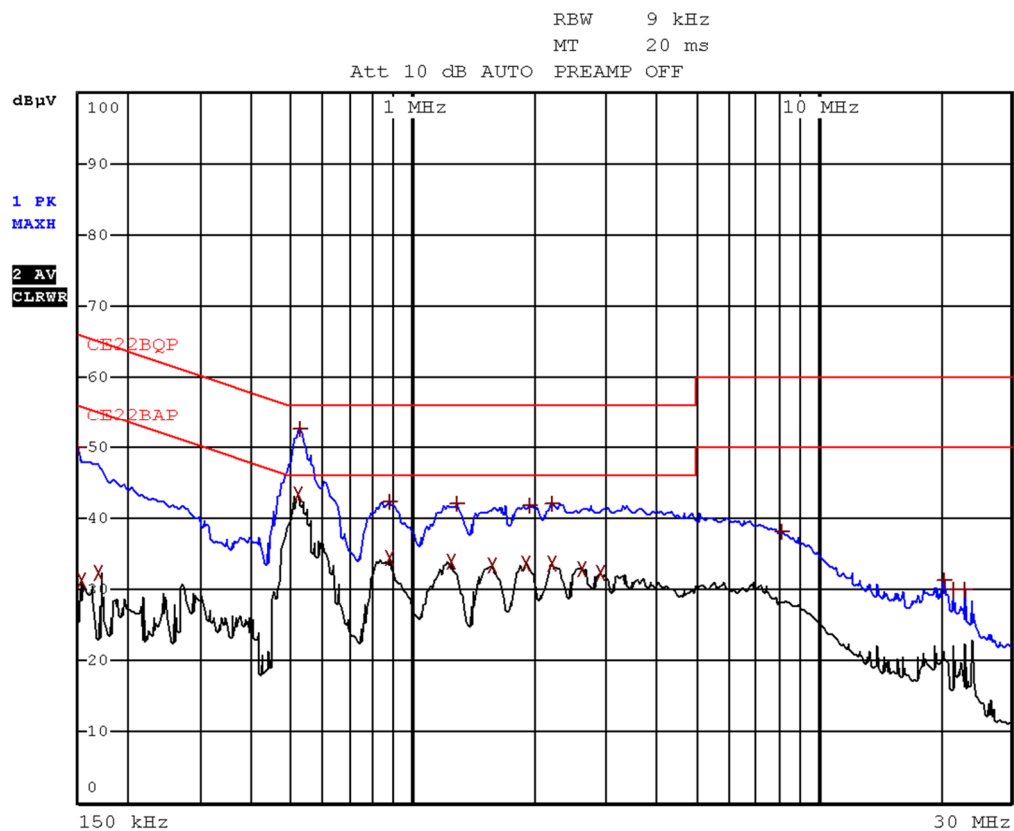


Figure 3. Detectors: Peak, Quasi-peak, Average

Conducted Emission

E.U.T Description: Radar-Based, Outdoor Perimeter Security Sensor
Type: SR150F
Serial Number: Not designated

Specification: FCC Part 15, Subpart C
Lead: Neutral
Detectors: Peak, Quasi-peak, Average
Power Operation: POE

EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CE22BQP			
Trace2:	CE22BAP			
Trace3:	---			
	TRACE	FREQUENCY	LEVEL dBμV	DELTA LIMIT dB
2	Average	150 kHz	29.75	-26.24
1	Quasi Peak	154 kHz	45.47	-20.30
1	Quasi Peak	522 kHz	49.13	-6.87
2	Average	526 kHz	42.63	-3.36
2	Average	854 kHz	33.23	-12.76
1	Quasi Peak	862 kHz	38.38	-17.61
2	Average	1.234 MHz	32.75	-13.24
1	Quasi Peak	1.274 MHz	37.13	-18.86
2	Average	1.554 MHz	32.53	-13.46
1	Quasi Peak	1.65 MHz	36.34	-19.65
2	Average	1.894 MHz	32.54	-13.46
1	Quasi Peak	1.922 MHz	37.51	-18.48
2	Average	2.262 MHz	32.22	-13.77
2	Average	2.554 MHz	31.79	-14.20
2	Average	2.946 MHz	31.32	-14.67
2	Average	3.238 MHz	30.66	-15.33
1	Quasi Peak	3.37 MHz	36.81	-19.18
1	Quasi Peak	8.11 MHz	34.03	-25.96
1	Quasi Peak	20.258 MHz	26.14	-33.85
1	Quasi Peak	23.13 MHz	26.08	-33.91

Figure 4. Detectors: Peak, Quasi-peak, Average

Note: QP Delta/Av Delta refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Conducted Emission

E.U.T Description Radar-Based, Outdoor Perimeter Security Sensor
Type SR150F
Serial Number: Not designated

Specification: FCC Part 15, Subpart C
Lead: Neutral
Detectors: Peak, Quasi-peak, Average
Power Operation POE

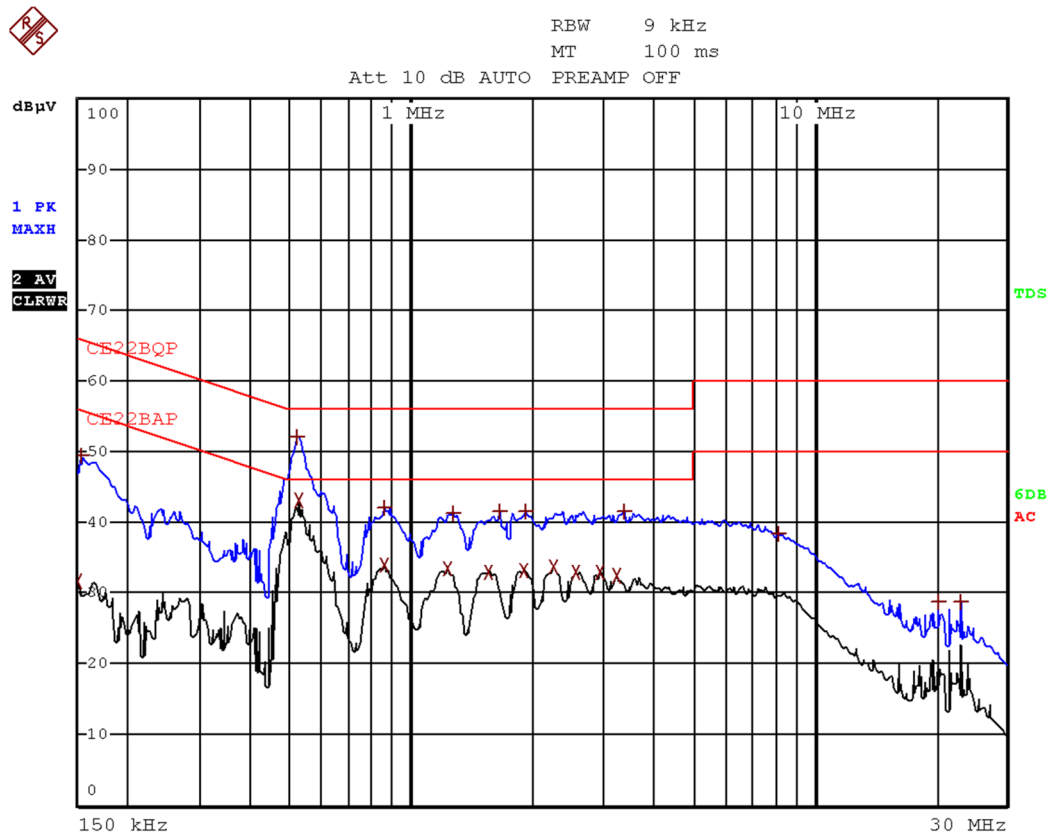


Figure 5 Detectors: Peak, Quasi-peak, Average



4.5 Test Equipment Used; Conducted Emission from AC Mains

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
LISN	Fischer	FCC-LISN-25A	127	November 4, 2022	November 4, 2023
Transient Limiter	HP	11947A	3107A03041	September 14, 2021	September 14, 2022
EMI Receiver	Rohde & Schwarz	ESCI7	100724	February 20, 2022	February 20, 2023
Cable CE Chamber 5m	Testline 18 + RJ214	11556	-	June 7, 2022	June 7, 2023

Figure 6 Test Equipment Used

5 20dB Minimum Bandwidth

5.1 Test Specification

FCC Part 15, Subpart C, section 15.247(a)(1)

5.2 Test Procedure

(Temperature (22°C)/ Humidity (58%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report. The E.U.T was tested in the chamber and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground at three-meter distance from the testing antenna.

The spectrum analyzer was set to the following parameters:

- Span = ~ 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
- RBW $\geq$ 1% of the 20 dB bandwidth
- Detector Function: Peak, Trace: Maximum Hold.

5.3 Test Limit

The maximum 20 dB bandwidth of the hopping channel is 1 MHz

5.4 Test Results

Operation Frequency (MHz)	Bandwidth Reading (kHz)
5,726.0	27.1
5,800.0	27.1
5,849.0	27.5

Figure 7 Test Results

JUDGEMENT: Passed

For additional information see *Figure 8* to *Figure 10*.

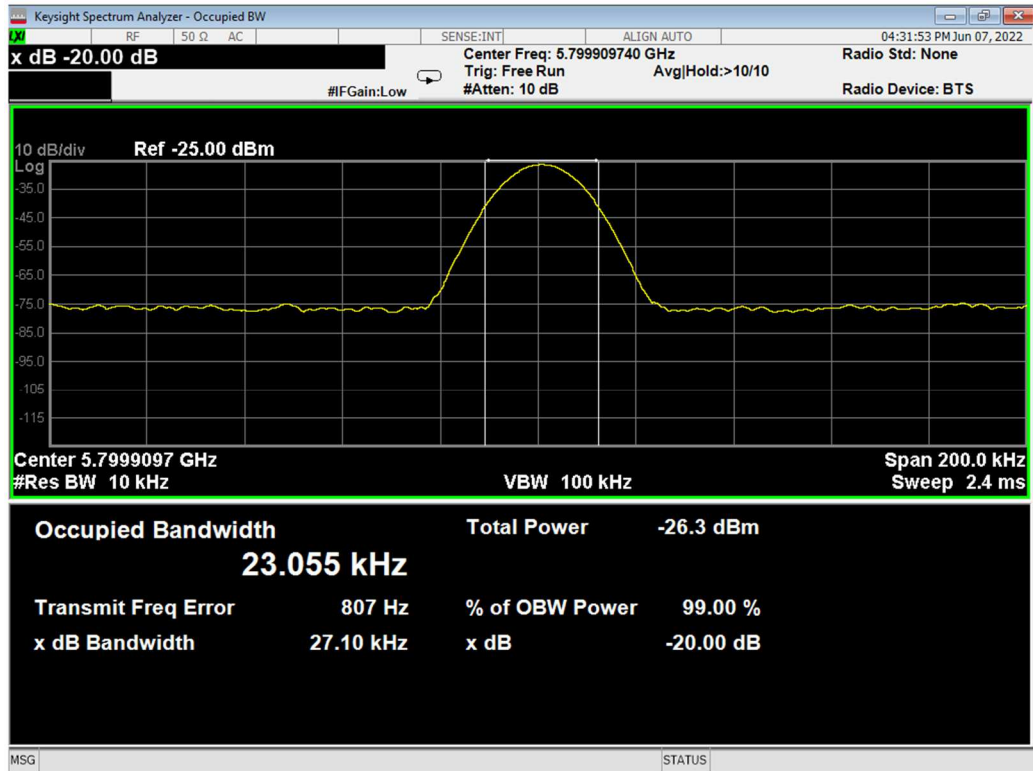


Figure 8. Low Channel

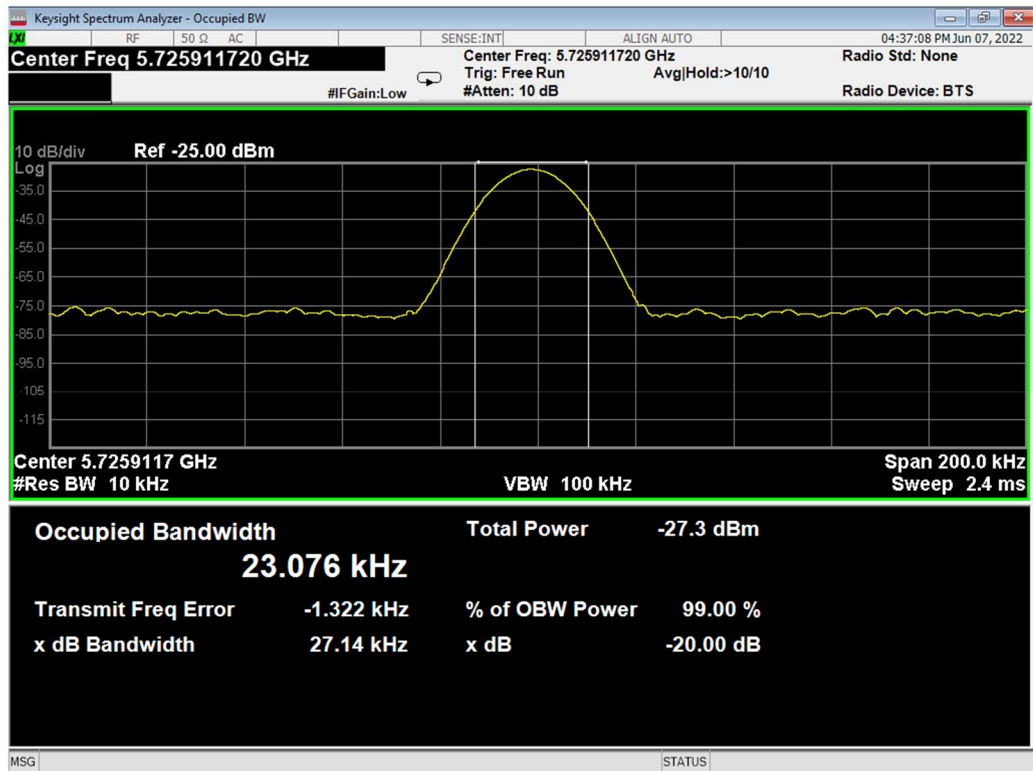


Figure 9. Mid Channel

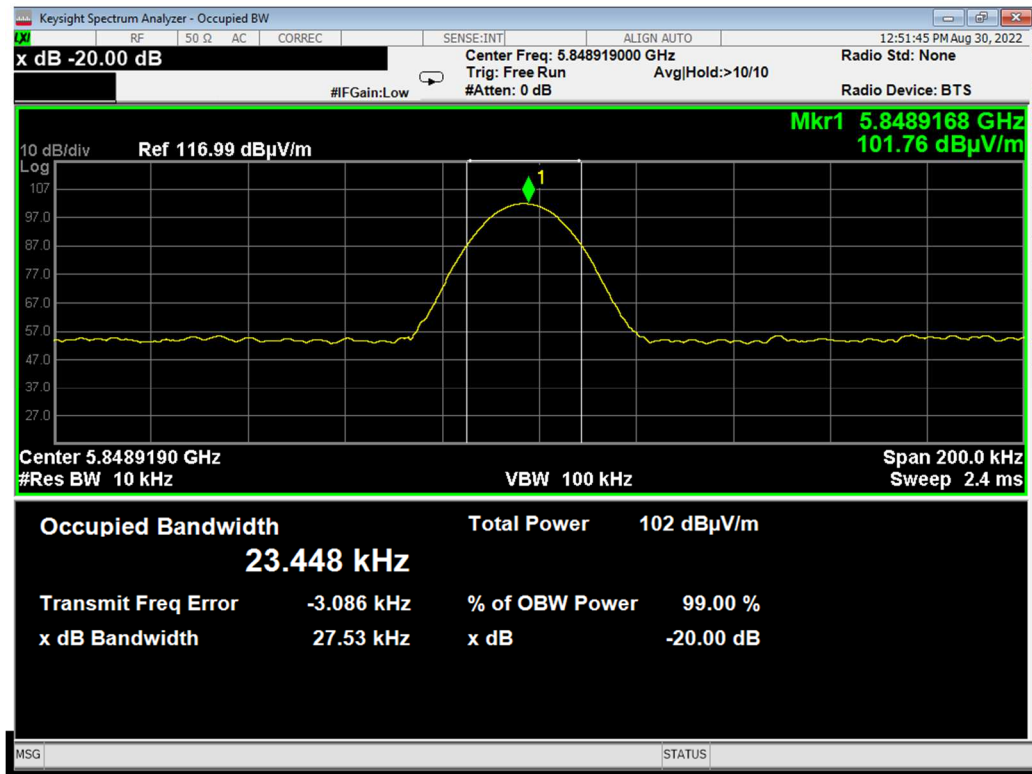


Figure 10. High Channel

5.5 Test Equipment Used, 20 dB Minimum Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 20, 2022	February 20, 2023
Horn Antenna	ETS	3115	6142	May 25, 2021	May 25, 2024
RF Cable	Commscope ORS	0623 WBC-400	G020133	May 16, 2022	May 16, 2023
Full Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 11 Test Equipment Used



6 Occupied Bandwidth

6.1 Test Specification

FCC Part 15, Subpart C: section 2.1048

6.2 Test Procedure

(Temperature (22°C)/ Humidity (55%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report. The E.U.T was tested in the chamber and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground at three-meter distance from testing antenna. The spectrum analyzer was set to the following parameters:

Span = ~ 2 to 3 times the occupied bandwidth, centered on a hopping channel

Detector Function: Peak, Trace: Maximum Hold.

99% Occupied bandwidth function was turn on.

6.3 Test Limit

N/A

6.4 Test Results

Operation Frequency (MHz)	Bandwidth Reading (kHz)
5,726.0	23.0
5,800.0	23.0
5,849.0	23.4

Figure 12 Test Results

JUDGEMENT: Passed

For additional information see *Figure 8* to *Figure 10*.

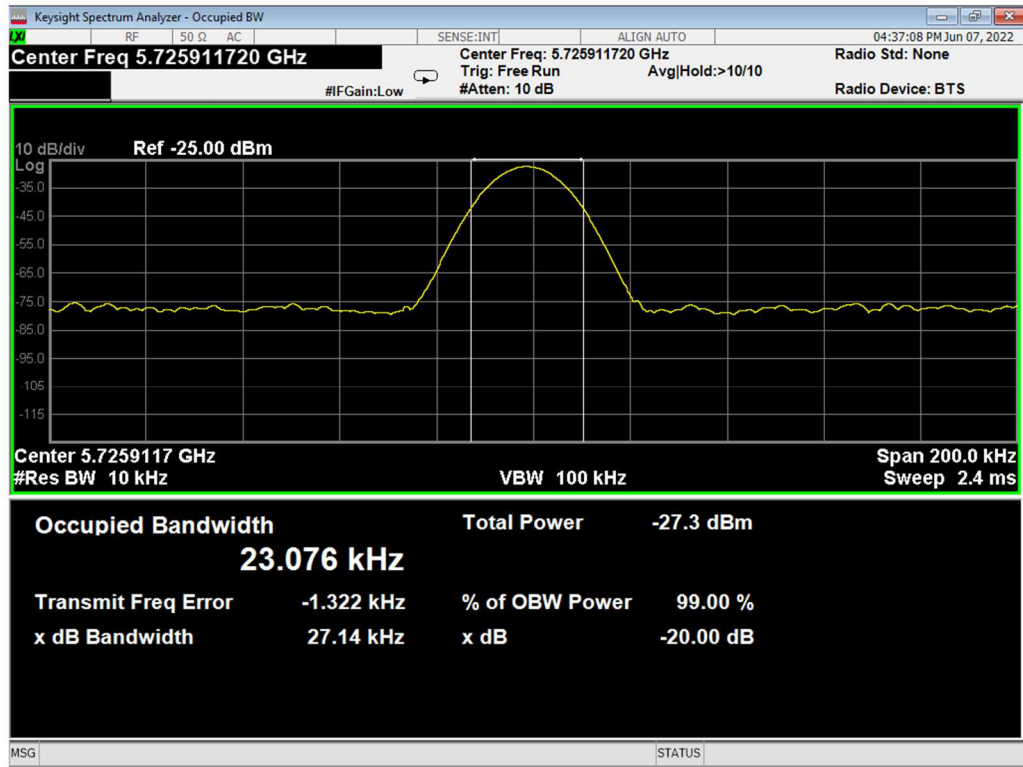


Figure 13. Low Channel

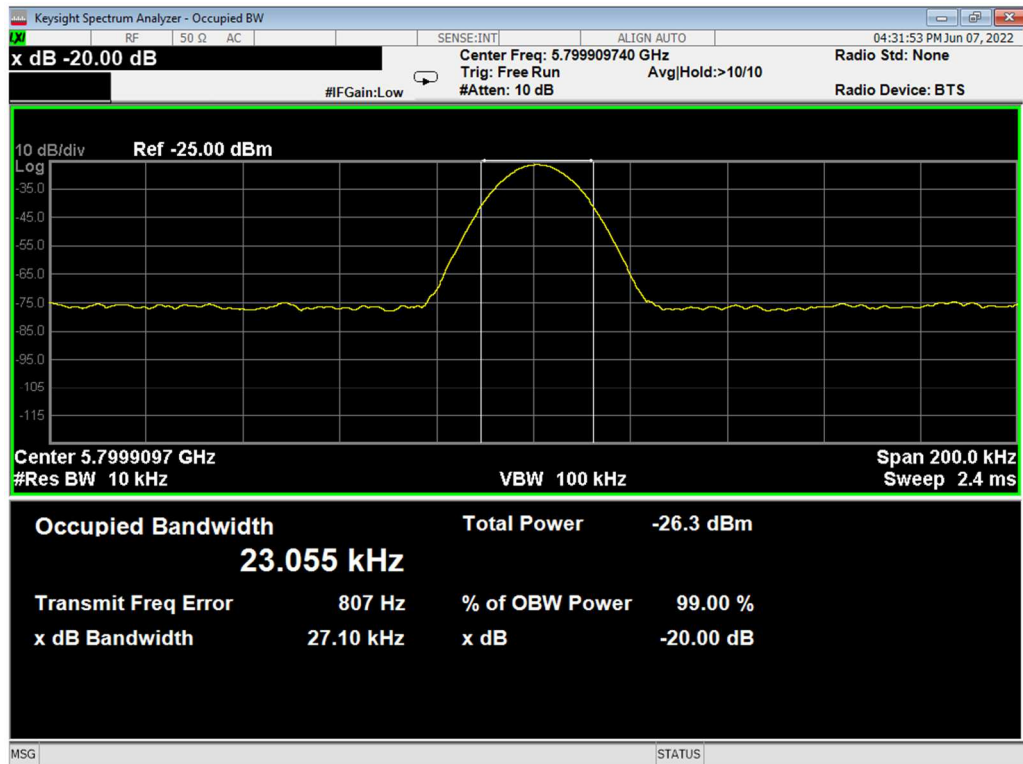


Figure 14. Mid Channel

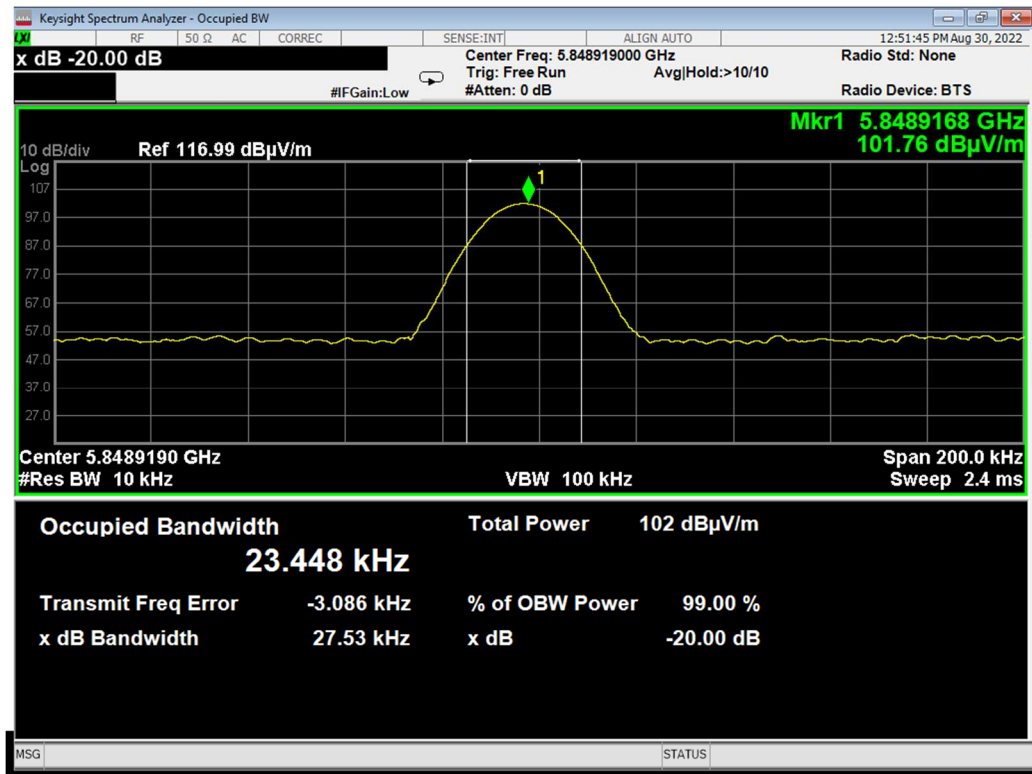


Figure 15. High Channel

6.5 Test Equipment Used, Occupied Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 20, 2022	February 20, 2023
Horn Antenna	ETS	3115	6142	May 25, 2021	May 25, 2024
RF Cable	Commscope ORS	0623 WBC-400	G020133	May 16, 2022	May 16, 2023
Ful Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 16 Test Equipment Used

7 Hopping Frequencies Number

7.1 Test Specification

FCC Part 15, Subpart C Section 15.247(a)(1)(ii)

7.2 Test Procedure

(Temperature (22°C)/ Humidity (62%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report. The E.U.T was tested in the chamber, placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground and a 3 meter distance from testing antenna.

The E.U.T. was set to hopping mode. The spectrum analyzer was set to the following parameters:

- RBW: 30 kHz, VBW: 100 kHz
- Detector Function: Peak, Trace: Maximum Hold.

7.3 Test Limit

“Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies.”

7.4 Test Results

Number of Hopping Frequencies	Specification
247	≥ 75

Figure 17 Test Results

JUDGEMENT: Passed

For additional information see *Figure 18* to *Figure 23*.

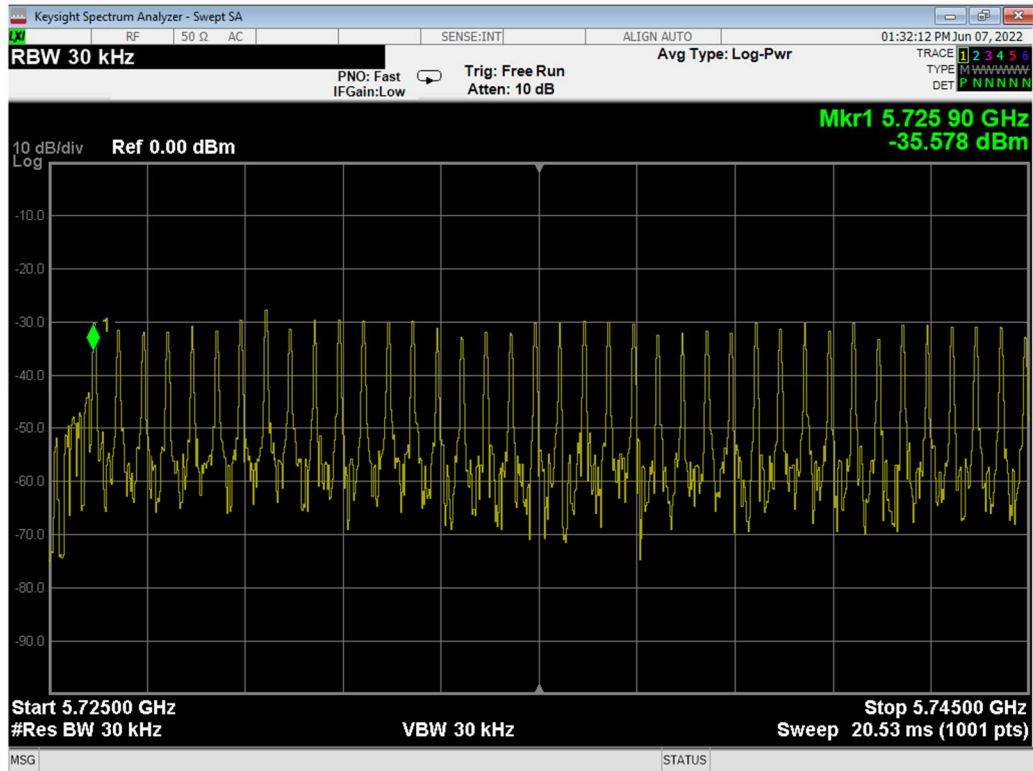


Figure 18. Number of Channels 5725-5745MHz band

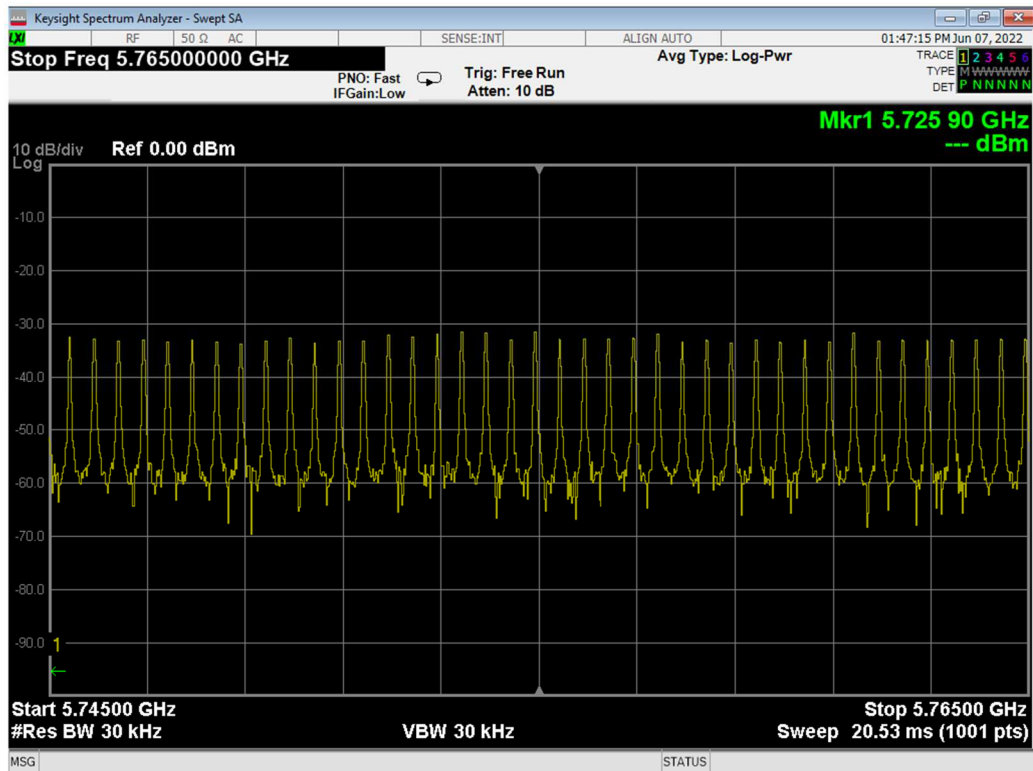


Figure 19. Number of Channels 5745-5765MHz band

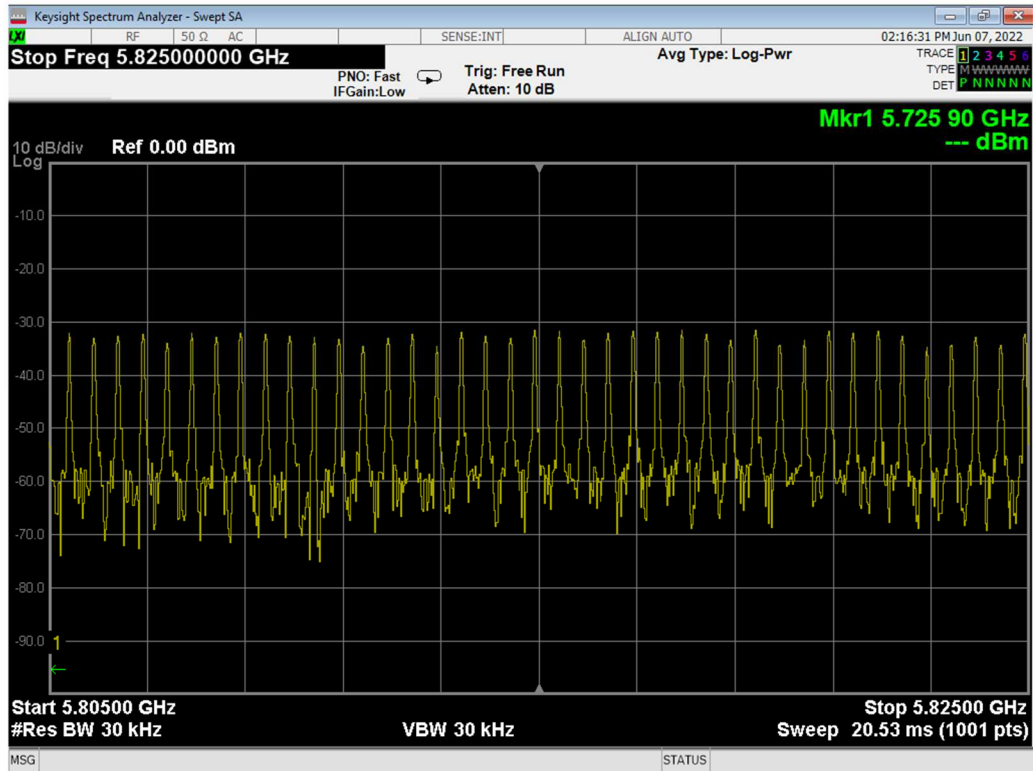


Figure 22. Number of Channels 5805-5825MHz band

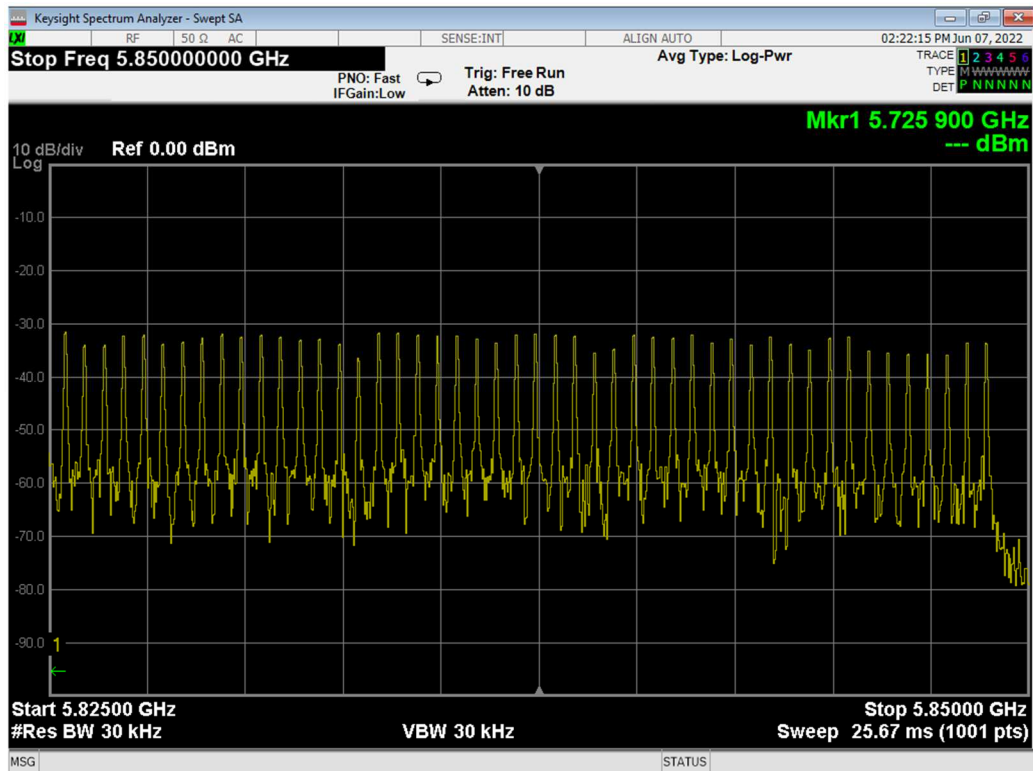


Figure 23. Number of Channels 5825-5850MHz band



7.5 Test Equipment Used, Number of Hopping Frequencies

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 20, 2022	February 20, 2023
Horn Antenna	ETS	3115	6142	May 25, 2021	May 25, 2024
RF Cable	Commscope ORS	0623 WBC-400	G020133	May 16, 2022	May 16, 2023
Full Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 24 Test Equipment Used

8 Channel Frequency Separation

8.1 Test Specification

FCC Part 15, Subpart C, Section 15.247(a) (1)

RSS 247. Issue 2, Section 5.1(b)

8.2 Test Procedure

(Temperature (22°C)/ Humidity (55%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T was tested in the chamber, placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground and a 3 meter distance from testing antenna.

The E.U.T. was set to hopping mode.

The spectrum analyzer was set to the following parameters:

Span = wide enough to capture two adjacent channels, RBW $\geq$ 1% of the span

Detector Function: Peak, Trace: Maximum Hold.

8.3 Test Limit

“Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.”

8.4 Test Results

Channel Frequency Separation (kHz)	Limit (kHz)
1,500.0	27.0

Figure 25 Test Results

JUDGEMENT: Passed

For additional information see *Figure 26*.

Channel Frequency Separation

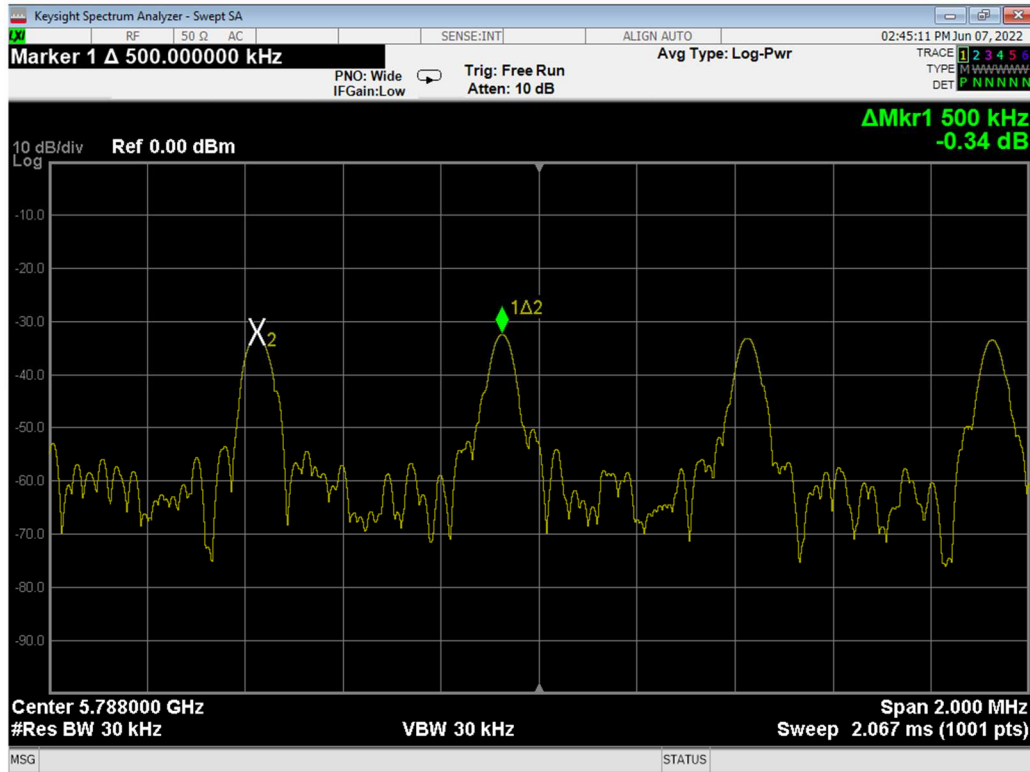


Figure 26. Channel Frequency Separation

8.5 Test Equipment Used, Channel Frequency Separation

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 20, 2022	February 20, 2023
Horn Antenna	ETS	3115	6142	May 25, 2021	May 25, 2024
RF Cable	Commscope ORS	0623 WBC-400	G020133	May 16, 2022	May 16, 2023
Full Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 27 Test Equipment Used

9 Peak Output Power

9.1 Test Specification

FCC Part 15, Subpart C, Section 15.247(b)(1)
RSS, Issue 2, Section 5.4(c)

9.2 Test Procedure

(Temperature (22°C)/ Humidity (55%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T was tested in the chamber, placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground and a 3 meter distance from testing antenna.

The spectrum analyzer was set to the following parameters:

Span = ~5 times the 20 dB bandwidth, centered on a hopping channel RBW $\geq$ of the 20 dB bandwidth of the emission being measured.

Detector Function: Peak, Trace: Maximum Hold.

Radiated output power levels were measured at selected operation frequencies and the results were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \quad [\text{W}]$$

- E - Field Strength (V/m)
- d – Distance from transmitter (m)
- G – Antenna gain
- P – Peak power (W)

9.3 Test Limit

The maximum peak conducted output power for all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

9.4 Test Results

Operation Frequency (MHz)	Pol. (V/H)	Field Strength (dBuV/m)	EIRP (dBm)	Antenna Gain (dBi)	Conducted Power (dBm)	Conducted Power (mW)	Limit*	Margin
5726.0	V	104.5	9.3	9.0	0.3	1.0	500.0	-499.0
	H	95.6	0.4	9.0	-8.6	0.1	500.0	-499.9
5800.0	V	103.8	8.6	9.0	-0.4	0.9	500.0	-499.1
	H	96.2	1.0	9.0	-8.0	0.1	500.0	-499.9
5849.0	V	103.0	7.8	9.0	-1.2	0.7	500.0	-499.3
	H	95.2	0.0	9.0	-9.0	0.1	500.0	-499.9

*Note: the limit value is reduced by 3 dBi because the antenna gain exceeds 6 dBi by 3 dB.

Figure 28 Radiated Power Output Test Results

JUDGEMENT: Passed by 419 mW

For additional information see *Figure 29 to Figure 34*.