

TEST REPORT

ACCORDING TO: FCC 47CFR part 15 subpart C §15.247 (DTS),
RSS-247 Issue 2:2017, RSS-Gen Issue 5, ICES-003 Issue 7:2020

FOR:

Vayyar Imaging LTD.

Walabot DIY2

Models: VMPRO19FB4BAT

FCC ID: 2AHIS-VMAKERPROW

IC: 21498-VMAKERPROW

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1 Applicant information

Client name: Vayyar Imaging LTD.
Address: 26 Shabazi street, Yehud, 5623000, Israel
Telephone: +972 54 333 9670
E-mail: miroslav.baryakh@vayyar.com
Contact name: Mr. Miro Baryakh

2 Equipment under test attributes

Product name: Walabot DIY2
Product type: UWB handheld device with wireless communication
Model(s): VMPRO19FB4BAT
Hardware version: Rev. F
Software release: ESP_RF_Test_Tool_V2.5
Receipt date 14-Aug-23

3 Manufacturer information

Manufacturer name: Vayyar Imaging LTD.
Address: 26 Shabazi street, Yehud, 5623000, Israel
Telephone: +972 54 333 9670
E-Mail: miroslav.baryakh@vayyar.com
Contact name: Mr. Miro Baryakh

4 Test details





Project ID: 51758
Location: Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel
Test started: 05-Sep-23
Test completed: 06-Dec-23
Test specification(s): FCC 47CFR part 15 subpart C §15.247 (FHSS) and subpart B, RSS-247 Issue 2:2017, RSS-Gen Issue 5, ICES-003 Issue 7:2020



5 Tests summary

Test	Status
Transmitter characteristics	
FCC Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth	Pass
FCC Section 15.247(b)3/ RSS-247 section 5.4(4), Peak output power	Pass
FCC section 15.247(i) / RSS-102 section 2.5.1, RF exposure	Pass, the exhibit to the application of certification is provided
FCC Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions at Wi-Fi mode	Pass
FCC Section 15.31(k), Combined radiated spurious emissions at UWB and Wi-Fi mode	Pass
FCC Section 15.247(d)/ RSS-247 section 5.5, Emissions at band edges	Pass
FCC Section 15.247(e) / RSS-247 section 5.2(2), Peak power density	Pass
FCC section 15.203 / RSS-Gen section 8.3, Antenna requirement	Pass
FCC section 15.207(a) / RSS-Gen section 8.8, Conducted emission	Pass

Testing was completed against all relevant requirements of the test standard. However, results obtained indicate that the product under test complies in full with the requirements tested.
The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer, EMC & Radio Mr. S. Sugatov, test engineer, EMC & Radio	05-Sep-23 – 06-Dec-23	 
Reviewed by:	Mrs. S. Peysahov Sheynin, certification specialist, EMC & Radio	25-Dec-23	
Approved by:	Mr. M. Nikishin, group leader, EMC & Radio	01-Feb-24	

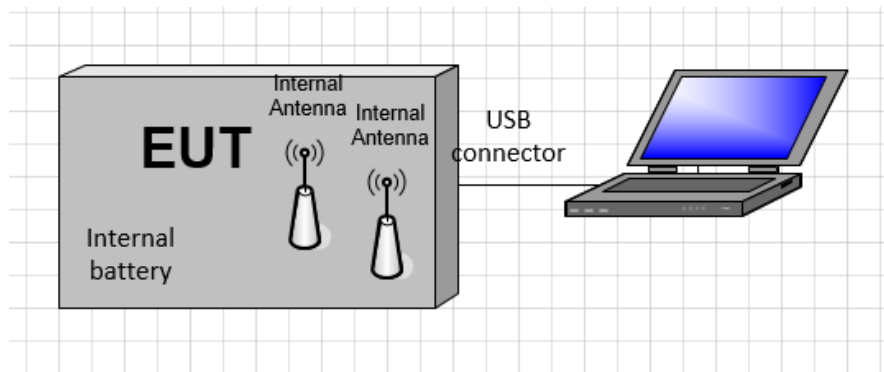
6 EUT description

Note: The following data in this clause is provided by the customer and represents his sole responsibility

6.1 General information

The WalabotDIY2 products are using VMKAERPROUWB UWB module to characterize the environment in the vicinity of the sensor and are connected to a hosting device by WiFi/BLE communication. Utilizing the UWB module, those products are collecting and analyzing propagation information between the antennas, which is affected by the environment. The information is gathered by sequentially transmitting from the available antennas and collecting the received information at the rest of the antennas. The response information is then transmitted by WiFi to a hosting device and processed to obtain spatial information about the environment. The acquisition is controlled by the hosting device. The hosting device may ask WalabotDIY2 to acquire multiple snapshots, so as to integrate the data into information about larger spatial extent, or to detect changes in the environment.

6.2 Test configuration



6.3 Changes made in EUT

No changes were performed in the EUT during testing.



6.4 Transmitter characteristics

Type of equipment					
V	Stand-alone (Equipment with or without its own control provisions)				
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)				
	Plug-in card (Equipment intended for a variety of host systems)				
Assigned frequency range		2400 -2483.5 MHz			
Operating frequencies		2412-2462 MHz			
Maximum rated output power		Peak output power @ CCK 8.51 dBm at 20 MHz channel bandwidth			
		Peak output power @ BPSK 8.28 dBm at 20 MHz channel bandwidth			
		Peak output power @ BPSK 8.07 dBm at 40 MHz channel bandwidth			
		Peak output power @ 64-QAM 7.08 dBm at 20 MHz channel bandwidth			
		Peak output power @ 64-QAM 7.64 dBm at 40 MHz channel bandwidth			
Is transmitter output power variable?		V	No		
			continuous variable		
			stepped variable with stepsize		
			minimum RF power	dB	
			maximum RF power	dBm	
Antenna connection					
unique coupling	standard connector	V	Integral	with temporary RF connector	
				without temporary RF connector	
Antenna/s technical characteristics					
Type	Manufacturer / Design	Model number		Gain	
PCB printed antenna	Design: Vayyar Imaging Ltd. Manufacturing: PCB fabricator	NA		Typ peak gain: 1.5 dBi	
Transmitter aggregate data rate/s		1 / 2 / 5.5 / 11 / 6 / 54 / 6.5 / 65 Mbps			
Type of modulation		CCK / BPSK / 64-QAM			
Modulating test signal (baseband)					
Transmitter power source					
V	Battery	Nominal rated voltage	3.85 V	Battery type	
V	DC	Nominal rated voltage	5.0 VDC		
	AC mains	Nominal rated voltage		Frequency	Hz



Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

7 Transmitter tests according to 47CFR part 15 subpart C and RSS-247 requirements

7.1 Minimum 6 dB bandwidth

7.1.1 General

This test was performed to measure 6 dB bandwidth of the EUT carrier frequency. Specification test limits are given in Table 7.1.1.

Table 7.1.1 6 dB bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Minimum bandwidth, kHz
2400.0 – 2483.5	6.0	500.0

* - Modulation envelope reference points provided in terms of attenuation below the peak of modulated carrier.

Table 7.1.2 The 99% bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points	Limit, kHz
2400.0 – 2483.5	99%	NA

7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was set to transmit modulated carrier.

7.1.2.3 The transmitter minimum 6 dB bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.1.3 and associated plot.

Figure 7.1.1 6 dB bandwidth test setup





Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Table 7.1.3 6 dB bandwidth test results

ASSIGNED FREQUENCY BAND: 2400.0 – 2483.5 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
MODULATION: CCK
CHANNEL BANDWIDTH: 20 MHz
BITRATE: 1 Mbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	9980	500.0	9480	Pass
2442.0	10010	500.0	9510	Pass
2462.0	9980	500.0	9480	Pass

CHANNEL BANDWIDTH: 20 MHz
BITRATE: 11 Mbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	10100	500.0	9600	Pass
2442.0	9321	500.0	8821	Pass
2462.0	9351	500.0	8851	Pass

MODULATION: BPSK
CHANNEL BANDWIDTH: 20 MHz
BITRATE: 6 Mbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	16304	500.0	15804	Pass
2442.0	16334	500.0	15834	Pass
2462.0	16274	500.0	15774	Pass

MODULATION: 64-QAM
CHANNEL BANDWIDTH: 20 MHz
BITRATE: 54 Mbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	16424	500.0	15924	Pass
2442.0	16424	500.0	15924	Pass
2462.0	16454	500.0	15954	Pass



Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Table 7.1.4 6 dB bandwidth test results (continuation)

ASSIGNED FREQUENCY BAND: 2400.0 – 2483.5 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
MODULATION: BPSK
CHANNEL BANDWIDTH: 20 MHz
BITRATE: 6.5 Mbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	17532	500.0	17032	Pass
2442.0	17502	500.0	17002	Pass
2462.0	17502	500.0	17002	Pass

MODULATION: 64-QAM
CHANNEL BANDWIDTH: 20 MHz
BITRATE: 65 Mbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	17652	500.0	17152	Pass
2442.0	17682	500.0	17182	Pass
2462.0	17682	500.0	17182	Pass

MODULATION: BPSK
CHANNEL BANDWIDTH: 40 MHz
BITRATE: 6.5 Mbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2422	35730	500.0	35230	Pass
2437	34440	500.0	33940	Pass
2452	34440	500.0	33940	Pass

MODULATION: 64-QAM
CHANNEL BANDWIDTH: 40 MHz
BITRATE: 65Mbps

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2422.0	35790	500.0	35290	Pass
2442.0	34500	500.0	34000	Pass
2462.0	34400	500.0	33900	Pass



Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Table 7.1.5 99% bandwidth test results

ASSIGNED FREQUENCY BAND: 2400.0 – 2483.5 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 300 kHz
VIDEO BANDWIDTH: 1000 kHz
MODULATION: CCK
CHANNEL BANDWIDTH: 20 MHz
MODULATION/BITRATE: 1 Mbps

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	13217	NA	NA	Pass
2442.0	13397	NA	NA	Pass
2462.0	13337	NA	NA	Pass

CHANNEL BANDWIDTH: 20 MHz
MODULATION/BITRATE: 11 Mbps

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	13067	NA	NA	Pass
2442.0	13307	NA	NA	Pass
2462.0	13157	NA	NA	Pass

MODULATION: BPSK
CHANNEL BANDWIDTH: 20 MHz
MODULATION/BITRATE: 6 Mbps

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	16603	NA	NA	Pass
2442.0	16573	NA	NA	Pass
2462.0	16573	NA	NA	Pass

MODULATION: 64-QAM
CHANNEL BANDWIDTH: 20 MHz
MODULATION/BITRATE: 54 Mbps

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	16454	NA	NA	Pass
2442.0	16454	NA	NA	Pass
2462.0	16454	NA	NA	Pass



Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Table 7.1.6 99% bandwidth test results (continuation)

ASSIGNED FREQUENCY BAND: 2400.0 – 2483.5 MHz
DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 300 kHz
VIDEO BANDWIDTH: 1000 kHz
MODULATION: BPSK
CHANNEL BANDWIDTH: 20 MHz
BITRATE: 6.5 Mbps

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	17772	NA	NA	Pass
2442.0	17772	NA	NA	Pass
2462.0	17742	NA	NA	Pass

MODULATION: 64-QAM
CHANNEL BANDWIDTH: 20 MHz
BITRATE: 65 Mbps

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2412.0	17652	NA	NA	Pass
2442.0	17682	NA	NA	Pass
2462.0	17682	NA	NA	Pass

MODULATION: BPSK
CHANNEL BANDWIDTH: 40 MHz
BITRATE: 6.5 Mbps

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2422	36279	NA	NA	Pass
2437	36016	NA	NA	Pass
2452	36142	NA	NA	Pass

MODULATION: 64-QAM
CHANNEL BANDWIDTH: 40 MHz
BITRATE: 65Mbps

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
2422	36208	NA	NA	Pass
2437	35996	NA	NA	Pass
2452	36119	NA	NA	Pass

Reference numbers of test equipment used

HL 4135	HL 4355	HL 4938	HL 5838					
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Full description is given in Appendix A.



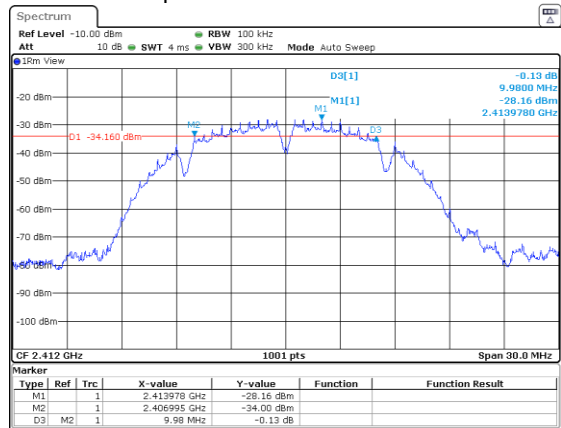
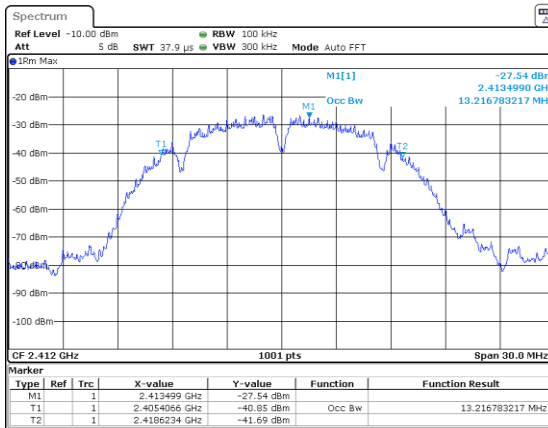
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Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.1 6 dB bandwidth test result at low frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

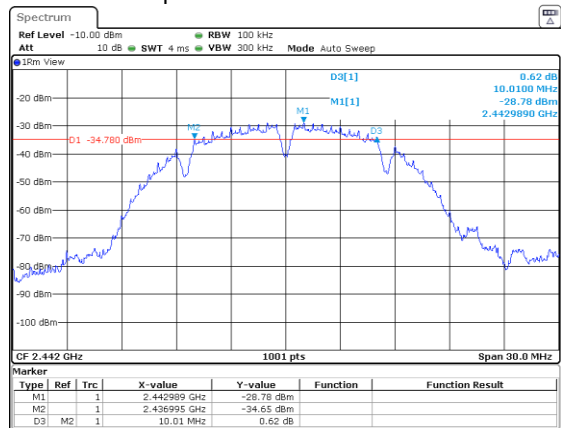
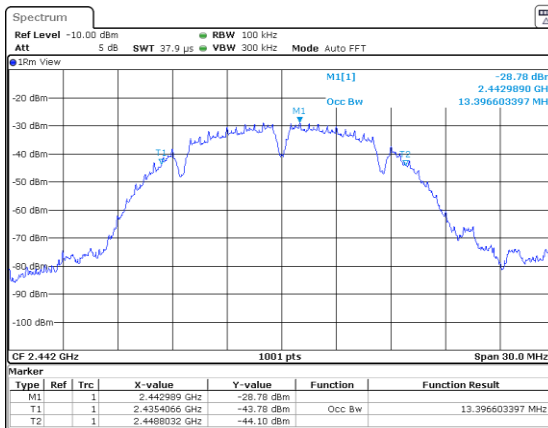
20 MHz
CCK / 1 Mbps



Plot 7.1.2 6 dB bandwidth test result at mid frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

20 MHz
CCK / 1 Mbps





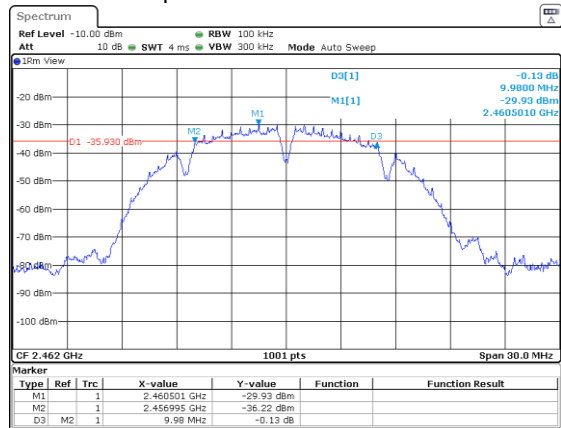
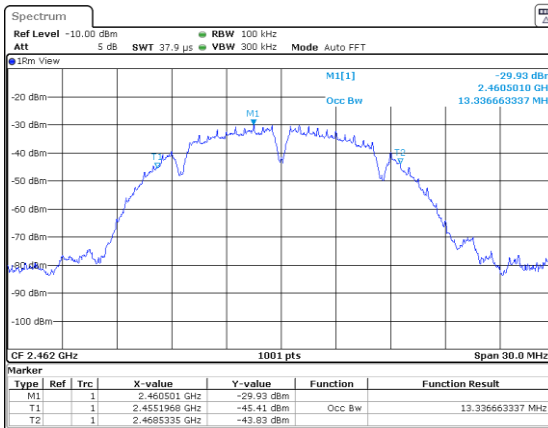
HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.3 6 dB bandwidth test result at high frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

20 MHz
CCK / 1 Mbps

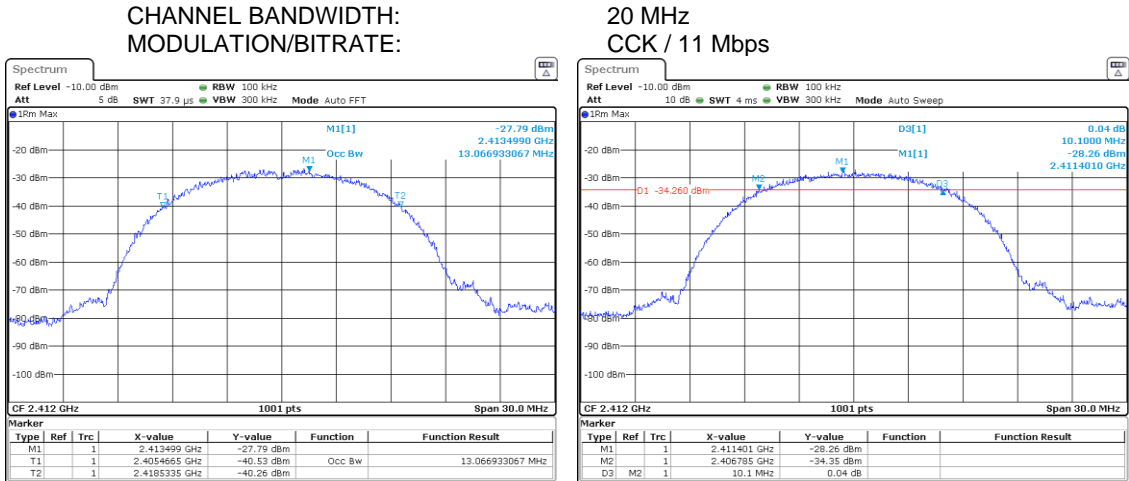




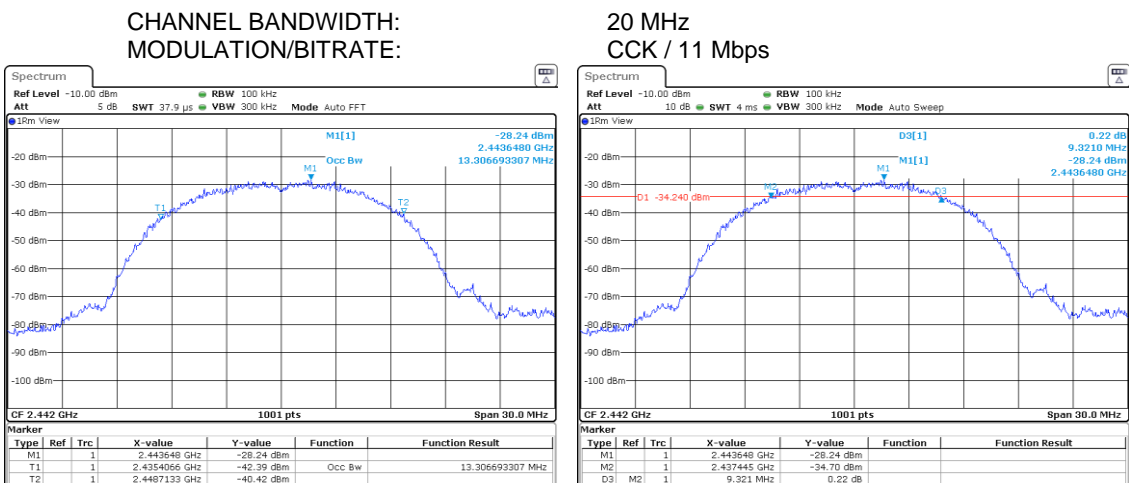
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Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.4 6 dB bandwidth test result at low frequency



Plot 7.1.5 6 dB bandwidth test result at mid frequency





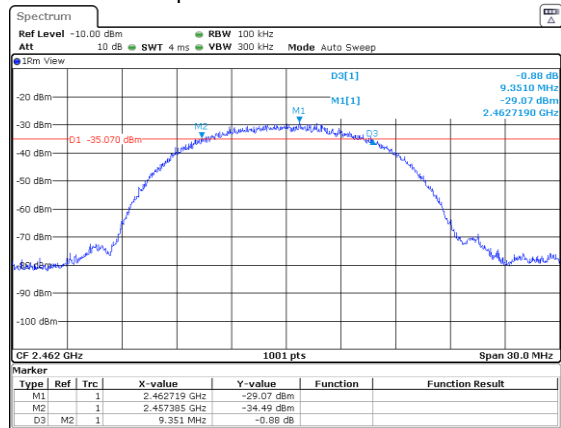
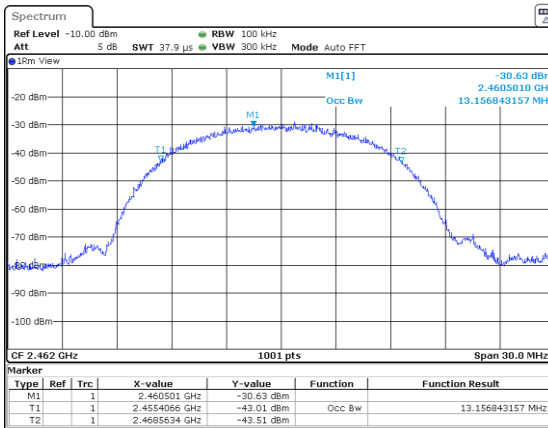
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Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.6 6 dB bandwidth test result at high frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

20 MHz
CCK / 11 Mbps

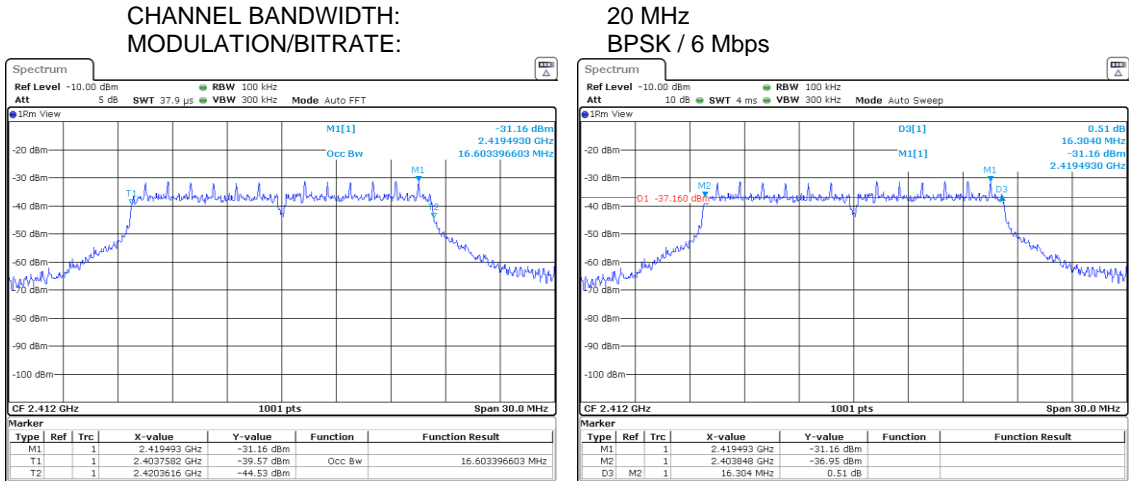




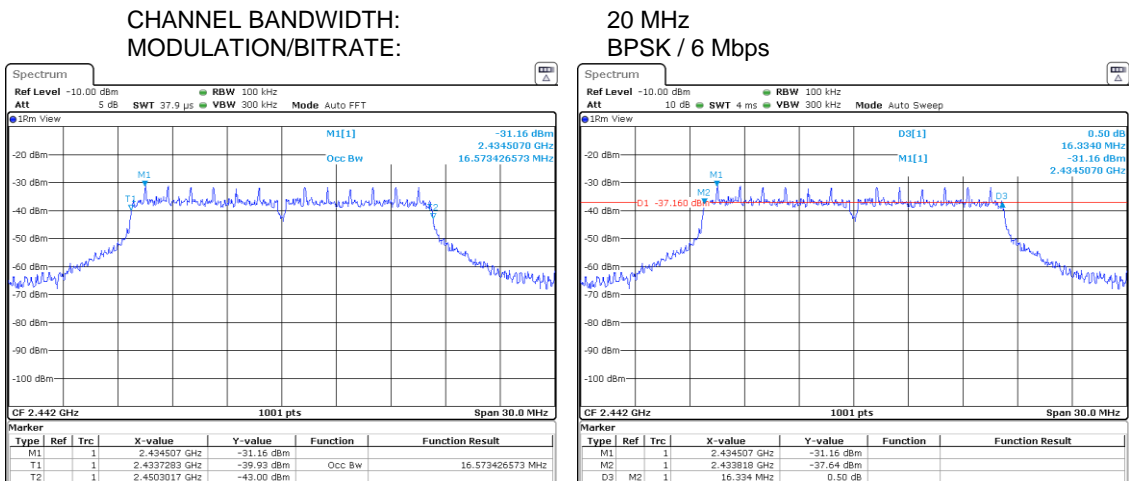
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Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.7 6 dB bandwidth test result at low frequency



Plot 7.1.8 6 dB bandwidth test result at mid frequency





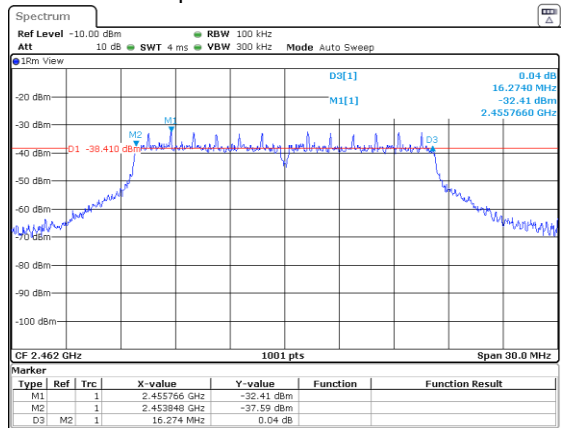
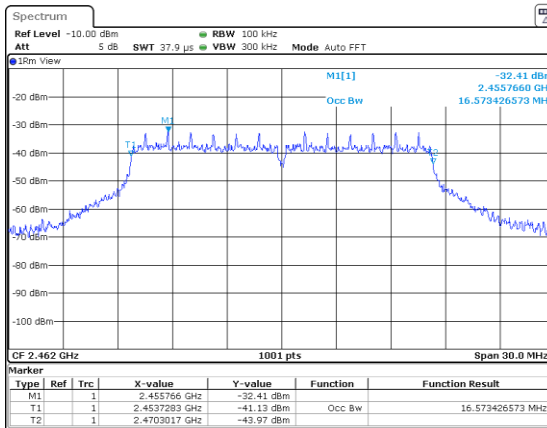
HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.9 6 dB bandwidth test result at high frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

20 MHz
BPSK / 6 Mbps

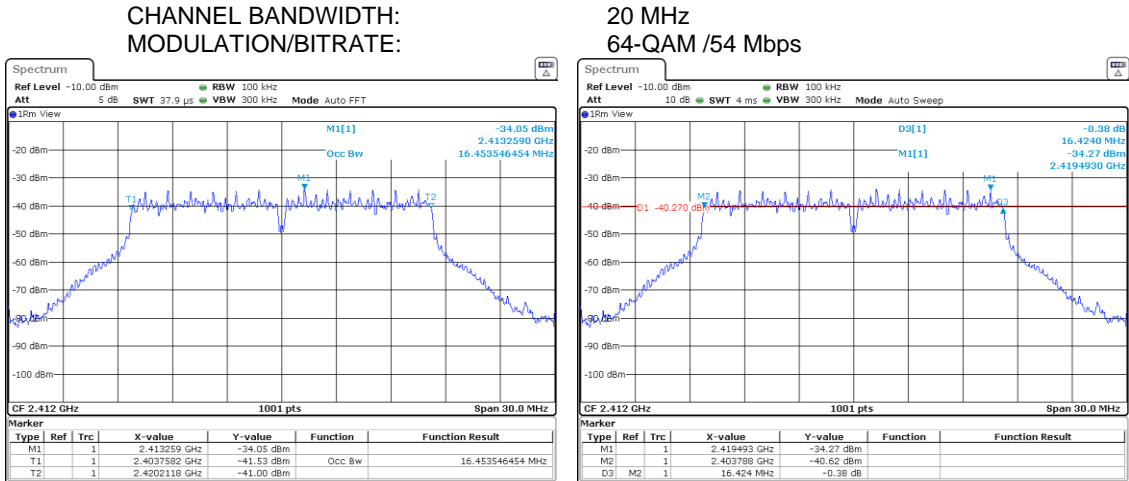




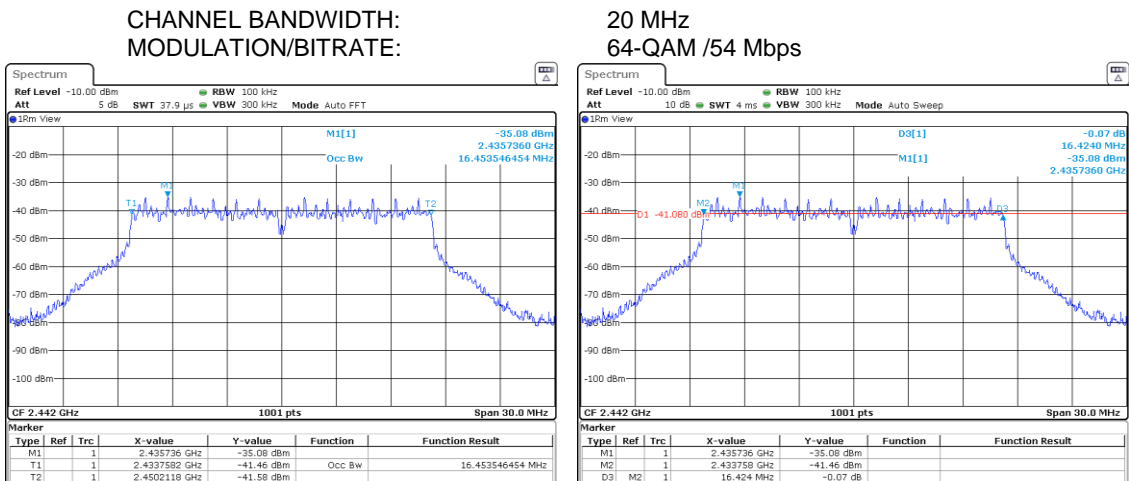
HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.10 6 dB bandwidth test result at low frequency



Plot 7.1.11 6 dB bandwidth test result at mid frequency





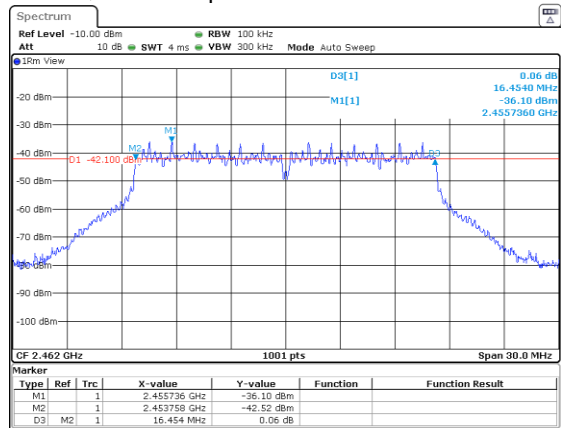
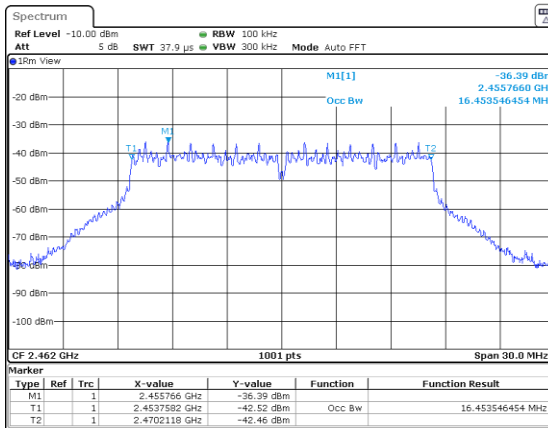
HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.12 6 dB bandwidth test result at high frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

20 MHz
64-QAM /54 Mbps





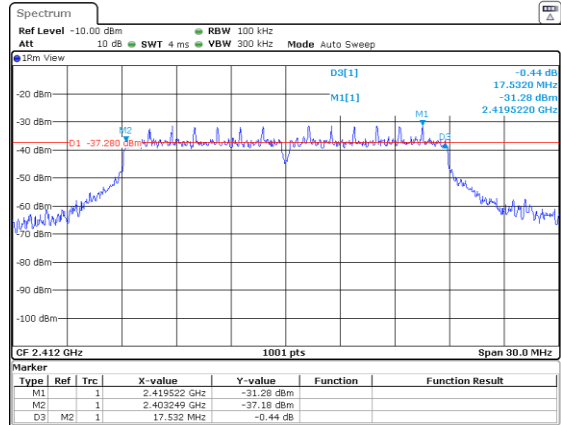
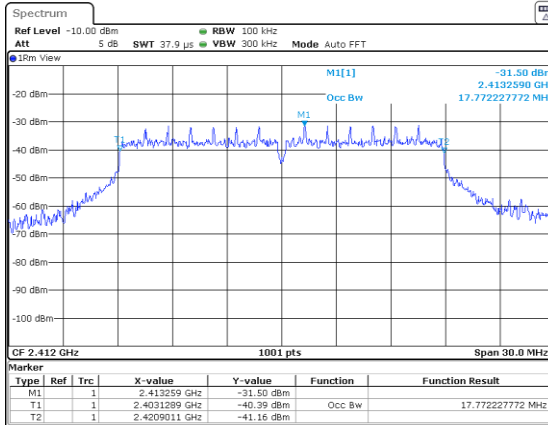
HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.13 6 dB bandwidth test result at low frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

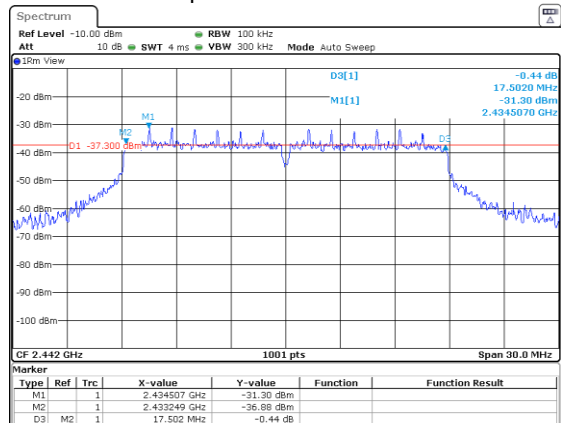
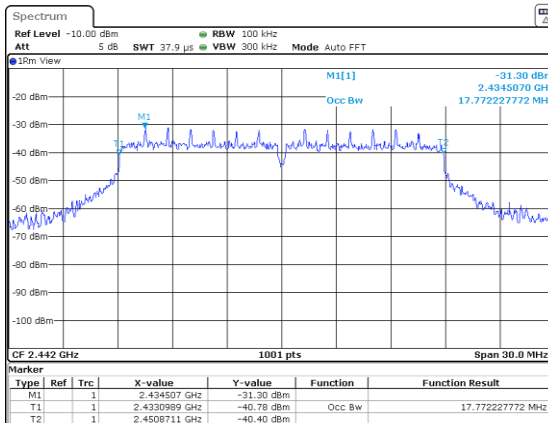
20 MHz
BPSK /6.5 Mbps



Plot 7.1.14 6 dB bandwidth test result at mid frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

20 MHz
BPSK /6.5 Mbps





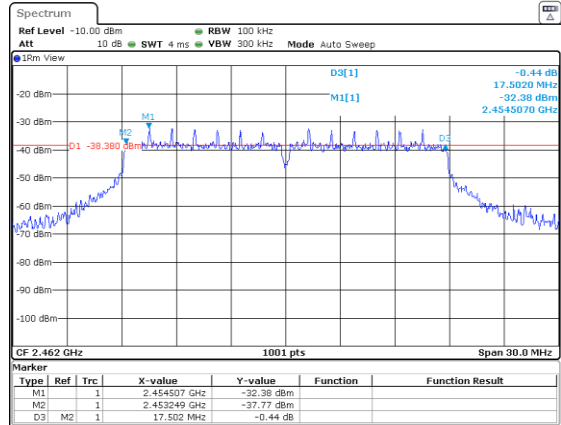
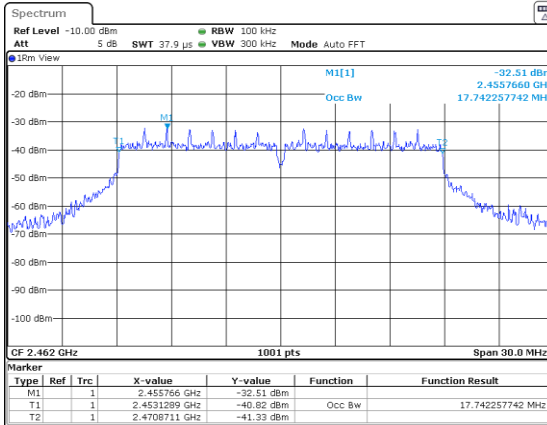
HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.15 6 dB bandwidth test result at high frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

20 MHz
BPSK /6.5 Mbps

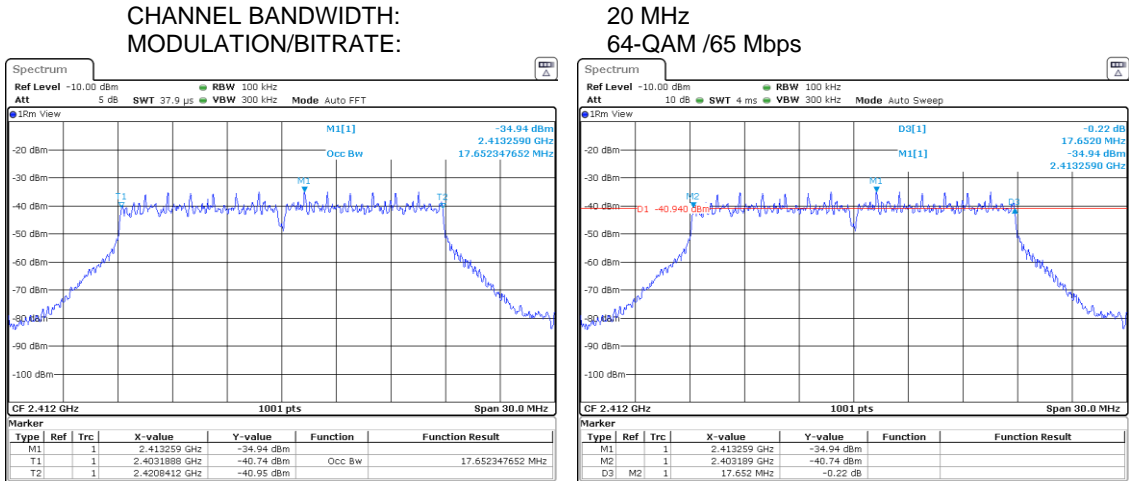




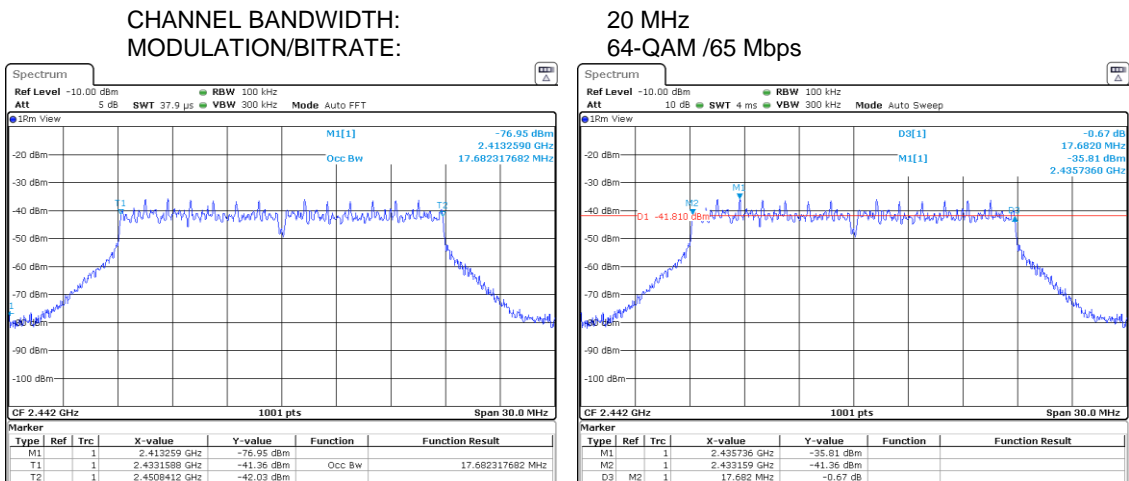
HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.16 6 dB bandwidth test result at low frequency



Plot 7.1.17 6 dB bandwidth test result at mid frequency





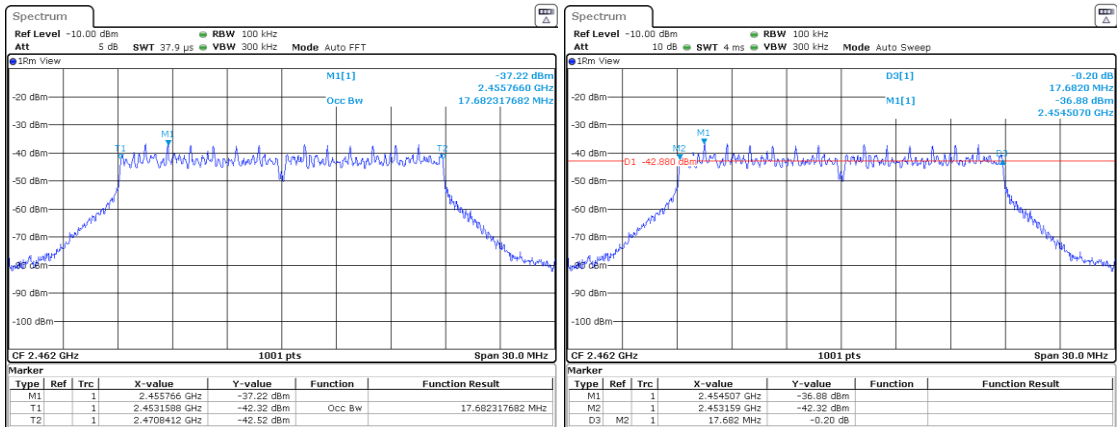
HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.18 6 dB bandwidth test result at high frequency

CHANNEL BANDWIDTH:
MODULATION/BITRATE:

20 MHz
64-QAM /65 Mbps

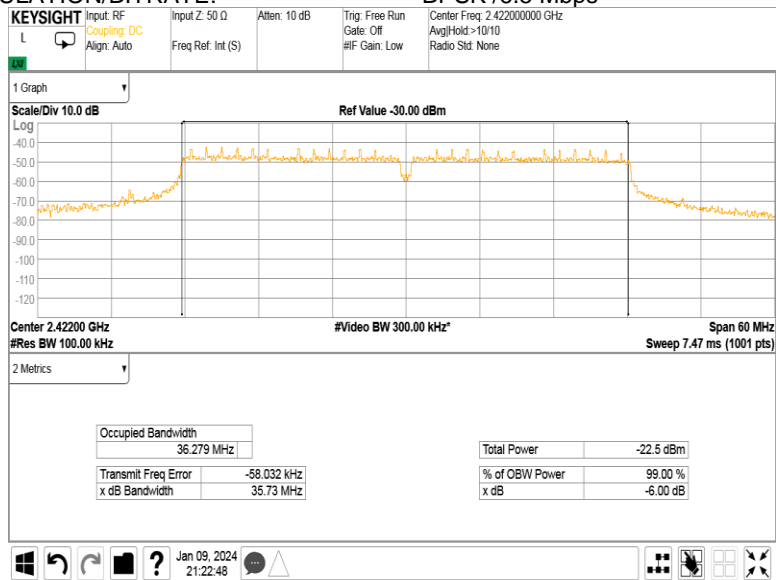




Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

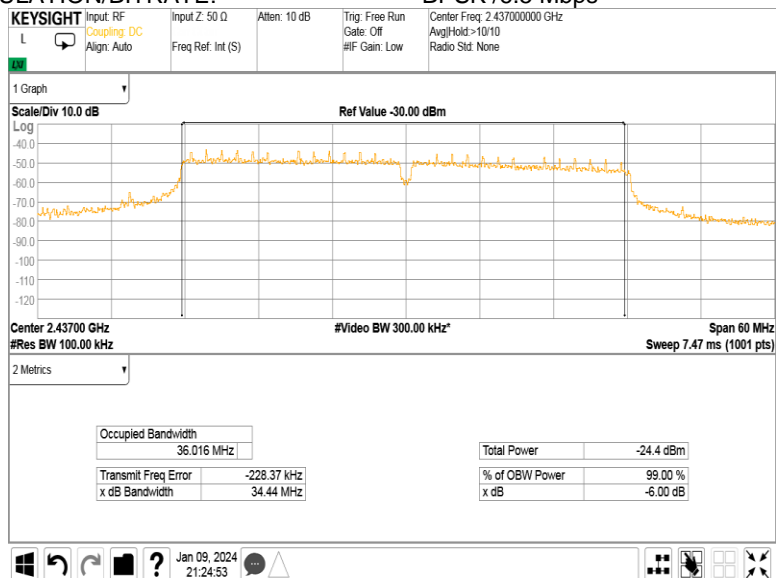
Plot 7.1.19 6 dB bandwidth test result at low frequency

CHANNEL BANDWIDTH: 40 MHz
MODULATION/BITRATE: BPSK /6.5 Mbps



Plot 7.1.20 6 dB bandwidth test result at mid frequency

CHANNEL BANDWIDTH: 40 MHz
MODULATION/BITRATE: BPSK /6.5 Mbps



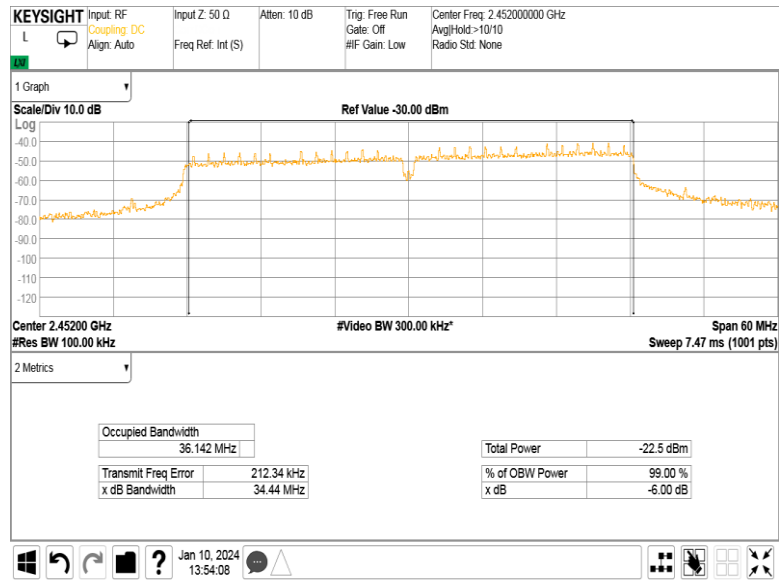


HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.21 6 dB bandwidth test result at high frequency

CHANNEL BANDWIDTH: 40 MHz
MODULATION/BITRATE: BPSK /6.5 Mbps

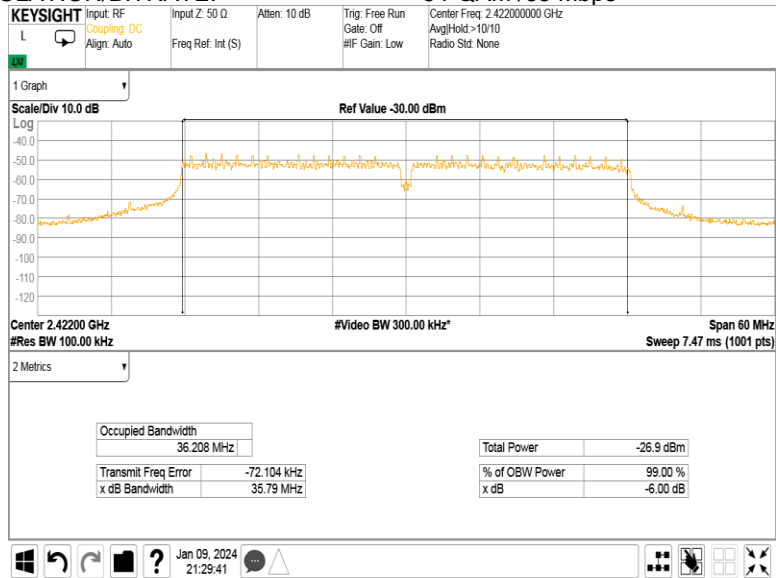




Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

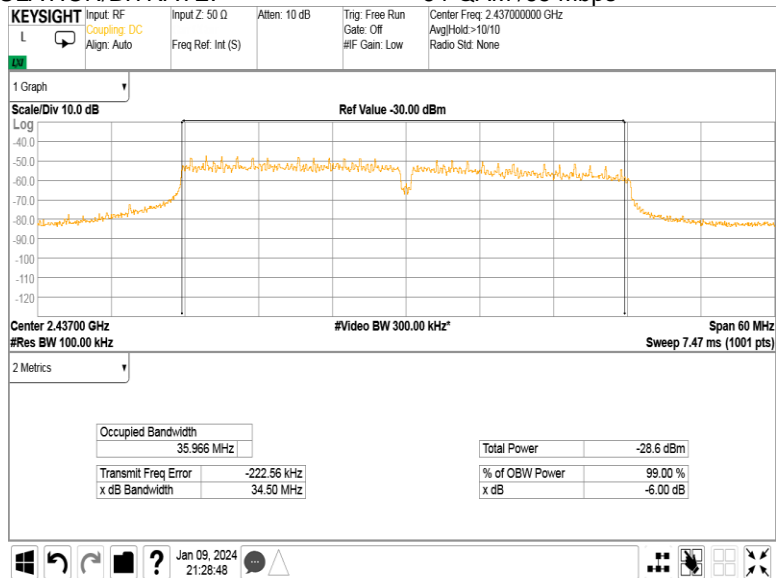
Plot 7.1.22 6 dB bandwidth test result at low frequency

CHANNEL BANDWIDTH: 40 MHz
MODULATION/BITRATE: 64-QAM /65 Mbps



Plot 7.1.23 6 dB bandwidth test result at mid frequency

CHANNEL BANDWIDTH: 40 MHz
MODULATION/BITRATE: 64-QAM /65 Mbps



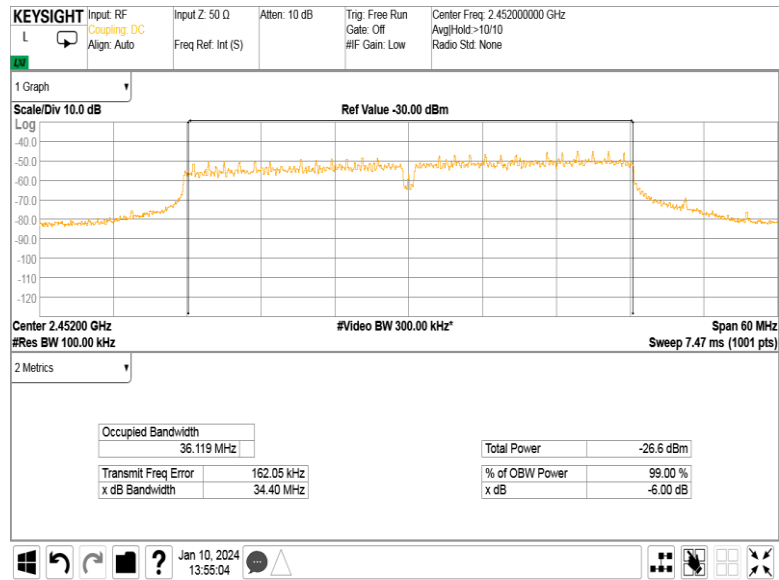


HERMON LABORATORIES

Test specification: Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth			
Test procedure: ANSI C63.10 section 11.8.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-May-22			
Temperature: 24 °C	Relative Humidity: 60 %	Air Pressure: 1008 hPa	Power: 5 VDC
Remarks:			

Plot 7.1.24 6 dB bandwidth test result at high frequency

CHANNEL BANDWIDTH: 40 MHz
MODULATION/BITRATE: 64-QAM /65 Mbps





Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

7.2 Field strength of spurious emissions at Wi-Fi mode

7.2.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m within restricted bands, dB(μ V/m)*			Attenuation of field strength of spurious versus carrier outside restricted bands, dBc***
	Peak	Quasi Peak	Average	
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	30.0
0.090 – 0.110	NA	108.5 – 106.8**	NA	
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**	
0.490 – 1.705	NA	73.8 – 63.0**	NA	
1.705 – 30.0*		69.5		
30 – 88		40.0		
88 – 216		43.5		
216 – 960		46.0		
960 - 1000		54.0		
1000 – 10 th harmonic	74.0	NA	54.0	

*- The limit for 3 m test distance was calculated using the inverse square distance extrapolation factor as follows:

$$\text{Lim}_{S_2} = \text{Lim}_{S_1} + 40 \log(S_1/S_2),$$

where S_1 and S_2 – standard defined and test distance respectively in meters.

** - The limit decreases linearly with the logarithm of frequency.

*** - The field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.

7.2.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.2.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.2.2.3 The worst test results (the lowest margins) were recorded and shown in the associated plots.

7.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.2.3.1 The EUT was set up as shown in Figure 7.2.2, Figure 1.1.3, energized and the performance check was conducted.

7.2.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.2.3.3 The worst test results (the lowest margins) were recorded and shown in the associated plots.



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Figure 7.2.1 Setup for spurious emission field strength measurements below 30 MHz

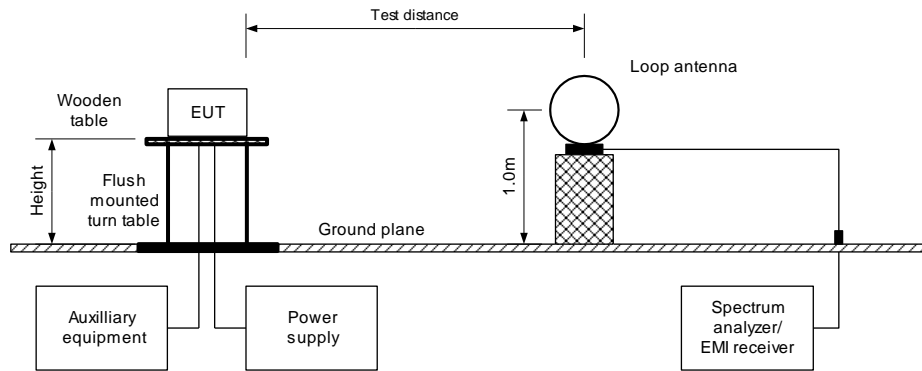
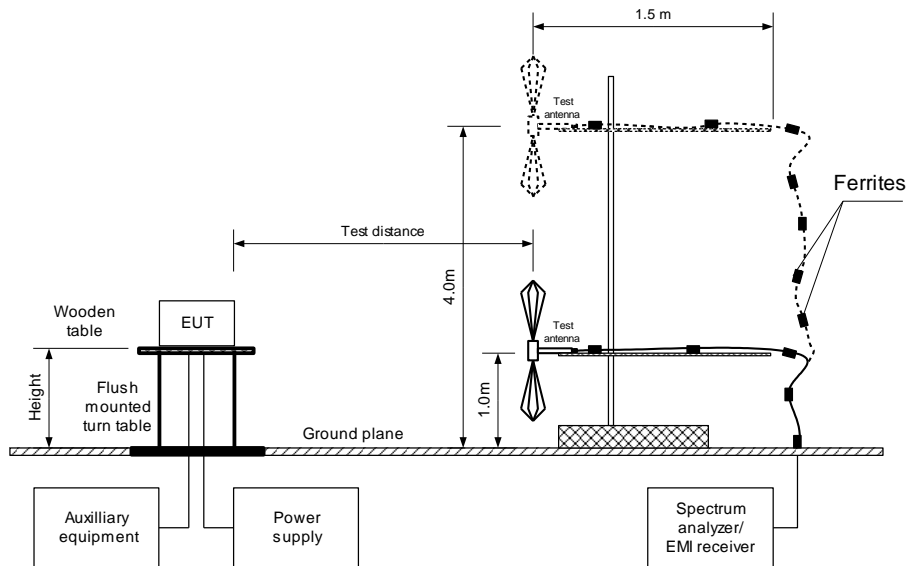


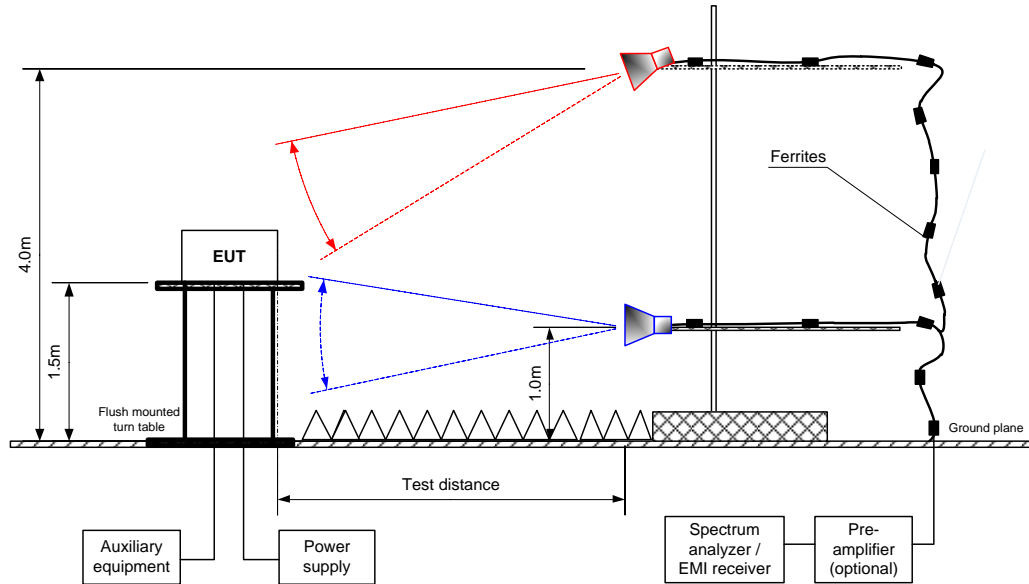
Figure 7.2.2 Setup for spurious emission field strength measurements in 30 – 1000 MHz





Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Figure 7.2.3 Setup for spurious emission field strength measurements above 1000 MHz





Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Table 7.2.2 Field strength of emissions outside restricted bands

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 - 25000 MHz
 TEST DISTANCE: 3 m
 MODULATION: CCK
 MODULATING SIGNAL: PRBS
 BIT RATE: 11 Mbps
 DUTY CYCLE: 100 %
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconilog (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength of spurious, dB(μV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	Field strength of carrier, dB(μV/m)	Attenuation below carrier, dBc	Limit, dBc	Margin, dB**	Verdict
Low carrier frequency									
36.041	41.56	Vertical	1.02	76	97.86	-56.30	20.0	-36.30	Pass
7235.11	58.26	Vertical	1.02	-169		-39.60		-19.60	
Mid carrier frequency									
35.973	43.63	Vertical	1.00	141	97.68	54.05	20.0	-34.05	Pass
38.689	41.54	Vertical	1.00	26		56.14		-36.14	
309.994	38.11	Vertical	1.00	-180		59.57		-39.57	
398.319	44.37	Vertical	1.04	-120		53.31		-33.31	
468.264	31.99	Vertical	1.00	9		65.69		-45.69	
1917.26	33.34	Vertical	3.43	52		-64.34		-44.34	
High carrier frequency									
36.014	43.54	Vertical	1.02	74	98.08	54.54	20.0	-34.54	Pass
38.946	40.17	Vertical	1.00	10		57.91		-37.91	
310.275	34.10	Vertical	1.43	-180		63.98		-43.98	
398.908	39.83	Vertical	1.02	-120		58.25		38.25	
757.682	33.28	Vertical	1.02	180		64.80		-44.80	
1281.22	38.50	Vertical	2.32	-2		-59.58		-39.58	
1794.96	39.39	Vertical	1.23	-54		-58.69		-38.69	

*- EUT front panel refers to 0 degrees position of turntable.

** - Margin = Attenuation below carrier – specification limit.



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Table 7.2.3 Field strength of spurious emissions above 1 GHz within restricted bands

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz
 INVESTIGATED FREQUENCY RANGE: 1000 - 25000 MHz
 TEST DISTANCE: 3 m
 MODULATION: CCK
 MODULATING SIGNAL: PRBS
 BIT RATE: 11 Mbps
 DUTY CYCLE: 100 %
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1000 kHz
 TEST ANTENNA TYPE: Double ridged guide

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength(VBW=3 MHz)			Average field strength(VBW=10 Hz)				Verdict
	Polarization	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Low carrier frequency											
1182.68	Vertical	1.89	-54	32.89	74.00	-41.11	20.08	N/A	54.00	-33.92	Pass
1413.22	Vertical	2.33	-55	36.54	74.00	-37.46	20.49	N/A	54.00	-33.51	
4823.90	Horizontal	2.61	-136	60.82	74.00	-13.18	47.61	N/A	54.00	-6.39	
Mid carrier frequency											
1118.75	Vertical	2.32	-9	34.49	74.00	-39.51	19.45	N/A	54.00	-34.55	Pass
1417.76	Vertical	1.02	17	32.43	74.00	-41.57	20.38	N/A	54.00	-33.62	
1605.62	Vertical	1.02	153	32.87	74.00	-41.13	20.95	N/A	54.00	-33.05	
4883.90	Horizontal	2.57	-136	61.30	74.00	-12.70	48.07	N/A	54.00	-5.93	
7325.32	Vertical	3.06	176	59.44	74.00	-14.56	44.89	N/A	54.00	-9.11	
High carrier frequency											
1594.84	Horizontal	2.77	-135	42.39	74.00	-31.61	21.22	N/A	54.00	-32.78	Pass
4923.90	Vertical	1.89	-7	61.81	74.00	-12.19	48.11	N/A	54.00	-5.89	
7385.88	Vertical	1.89	15	56.21	74.00	-17.79	43.61	N/A	54.00	-10.39	

*- EUT front panel refers to 0 degrees position of turntable.

**- Margin = Measured field strength - specification limit.



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Table 7.2.4 Field strength of spurious emissions below 1 GHz within restricted bands

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 – 1000 MHz
 TEST DISTANCE: 3 m
 MODULATION: CCK
 MODULATING SIGNAL: PRBS
 BIT RATE: 11 Mbps
 DUTY CYCLE: 100 %
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 120 kHz (30 MHz – 1000 MHz)
 VIDEO BANDWIDTH: > Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconilog (30 MHz – 1000 MHz)

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
Low carrier frequency								
399.906	43.79	27.86	46.00	18.14	Vertical	1.02	-180	Pass
Mid carrier frequency								
164.393	31.78	20.42	43.50	23.08	Vertical	1.02	-87	Pass
High carrier frequency								
119.986	29.76	25.15	43.50	18.35	Vertical	1.02	93	Pass

*- Margin = Measured emission - specification limit.
 **- EUT front panel refer to 0 degrees position of turntable.

Table 7.2.5 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
NA					

*- Average factor was calculated as follows
 for pulse train shorter than 100 ms: $Average\ factor = 20 \times \log_{10} \left(\frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{Train\ duration} \times Number\ of\ bursts\ within\ pulse\ train \right)$
 for pulse train longer than 100 ms: $Average\ factor = 20 \times \log_{10} \left(\frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{100\ ms} \times Number\ of\ bursts\ within\ 100\ ms \right)$



Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Table 7.2.6 Restricted bands according to FCC section 15.205

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2690 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.29 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.42 - 16.423	156.7 - 156.9	1660 - 1710	5350 - 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 - 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

Table 7.2.7 Restricted bands according to RSS-Gen

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.291 - 8.294	16.80425 - 16.80475	399.9 - 410	3260 - 3267	10.6 - 12.7
2.1735 - 2.1905	8.362 - 8.366	25.5 - 25.67	608 - 614	3332 - 3339	13.25 - 13.4
3.020 - 3.026	8.37625 - 8.38675	37.5 - 38.25	960 - 1427	3345.8 - 3358	14.47 - 14.5
4.125 - 4.128	8.41425 - 8.41475	73 - 74.6	1435 - 1626.5	3500 - 4400	15.35 - 16.2
4.17725 - 4.17775	12.29 - 12.293	74.8 - 75.2	1645.5 - 1646.5	4500 - 5150	17.7 - 21.4
4.20725 - 4.20775	12.51975 - 12.52025	108 - 138	1660 - 1710	5350 - 5460	22.01 - 23.12
5.677 - 5.683	12.57675 - 12.57725	156.52475 - 156.52525	1718.8 - 1722.2	7250 - 7750	23.6 - 24
6.215 - 6.218	13.36 - 13.41	156.7 - 156.9	2200 - 2300	8025 - 8500	31.2 - 31.8
6.26775 - 6.26825	16.42 - 16.423	240 - 285	2310 - 2390	9000 - 9200	36.43 - 36.5
6.31175 - 6.31225	16.69475 - 16.69525	322 - 335.4	2655 - 2900	9300 - 9500	Above 38.6

Reference numbers of test equipment used

HL 0446	HL 4360	HL 4933	HL 4956	HL 5288		
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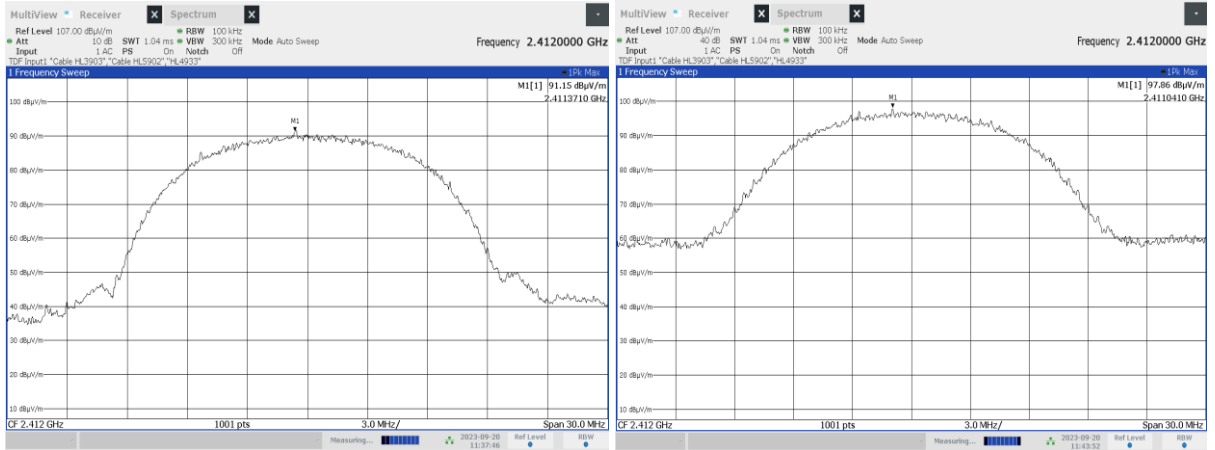
Full description is given in Appendix A.



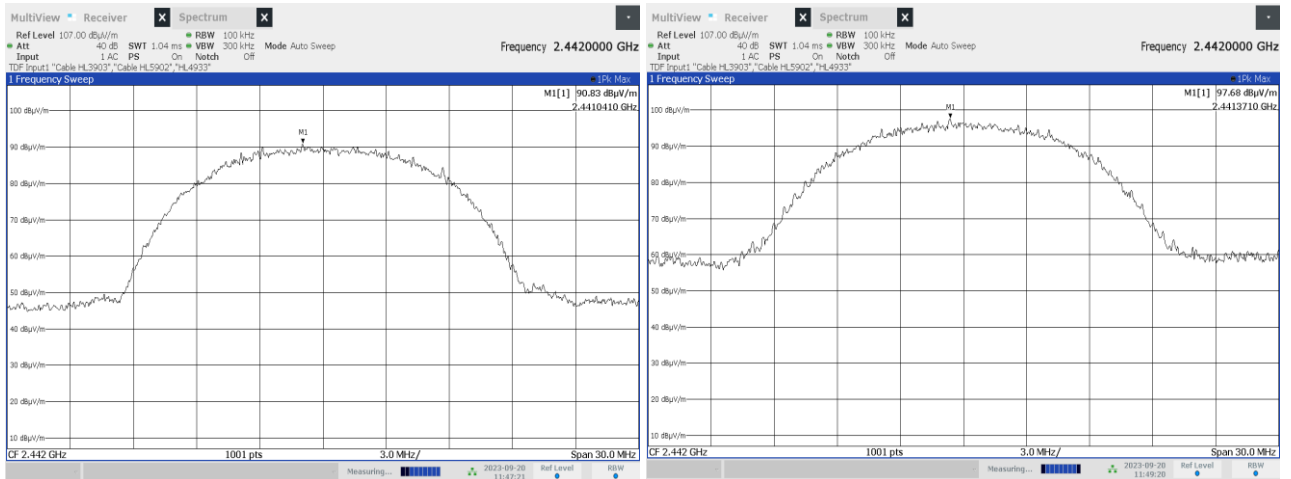
HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Plot 7.2.1 Radiated emission measurements at the low carrier frequency
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m



Plot 7.2.2 Radiated emission measurements at the mid carrier frequency
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

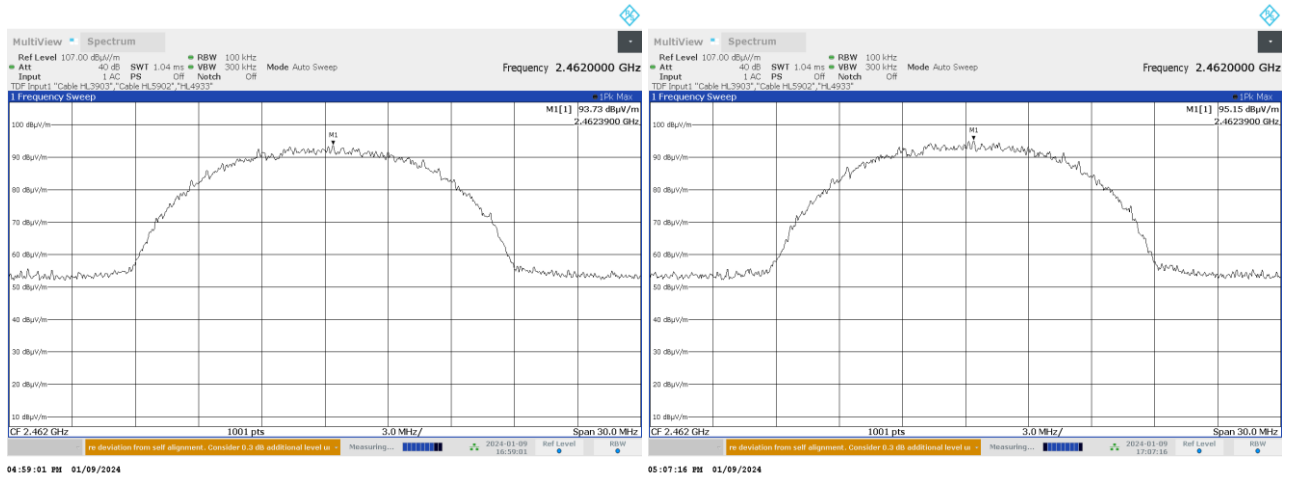




HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Plot 7.2.3 Radiated emission measurements at the high carrier frequency
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m

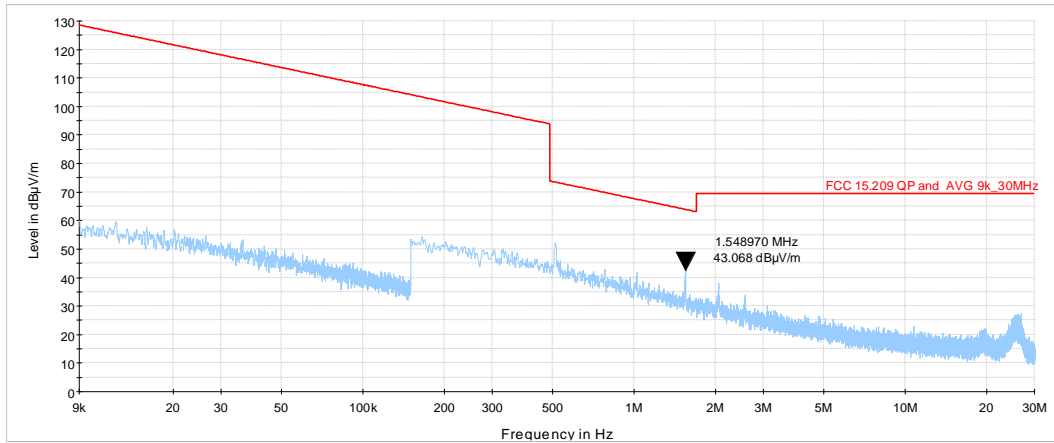




Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

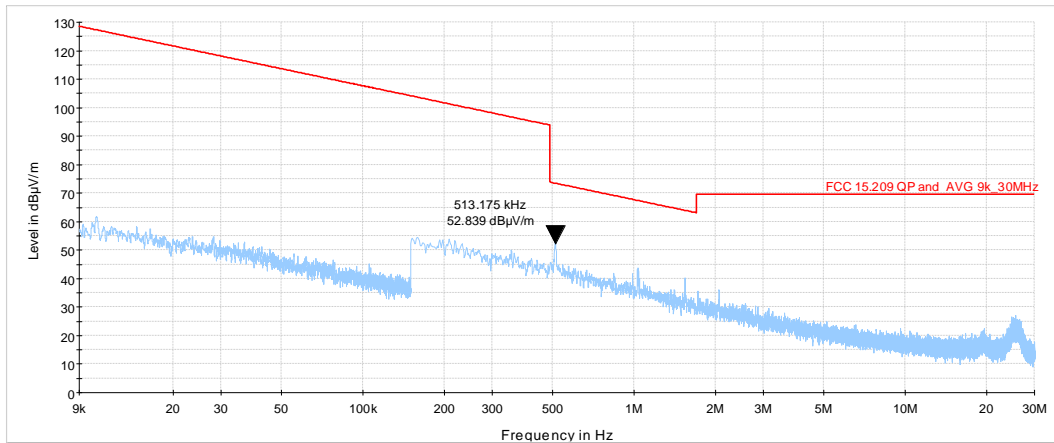
Plot 7.2.4 Radiated emission measurements from 9 kHz to 30 MHz at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



Plot 7.2.5 Radiated emission measurements from 9 kHz to 30 MHz at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical



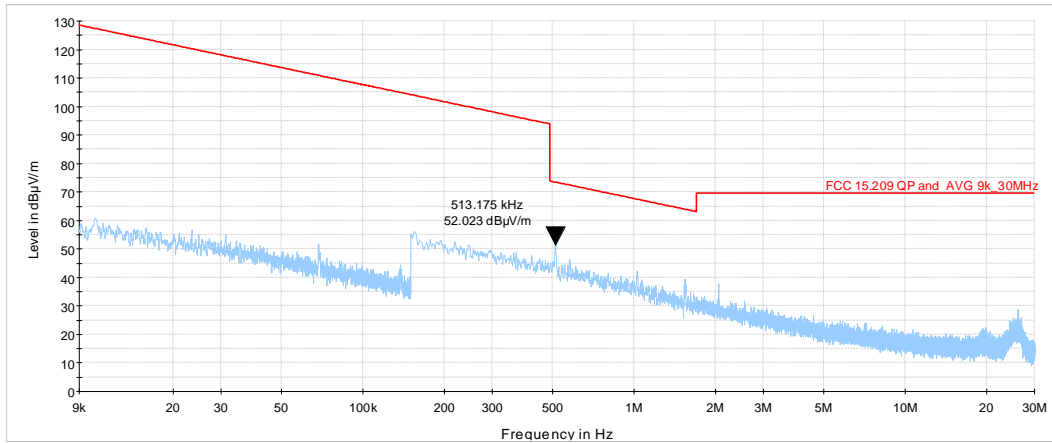


HERMON LABORATORIES

Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Plot 7.2.6 Radiated emission measurements from 9 kHz to 30 MHz at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical

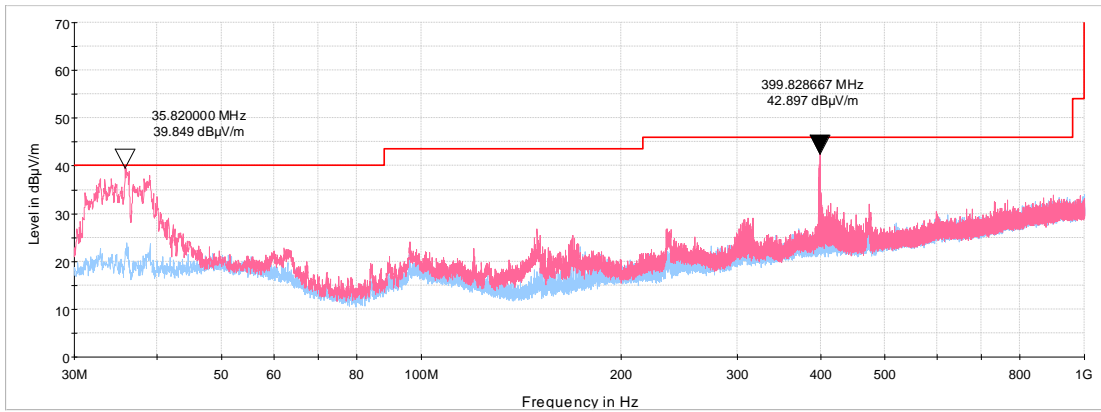




Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

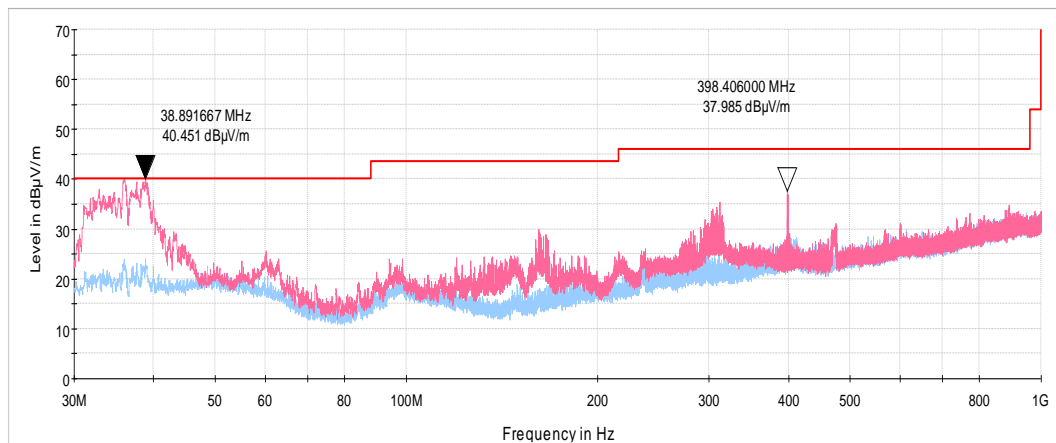
Plot 7.2.7 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal



Plot 7.2.8 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal





Test specification: Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
Test procedure: ANSI C63.10 section 11.12.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 13-Jun-22 - 15-Jun-22			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1010 hPa	Power: 5 VDC
Remarks: at Wi-Fi mode			

Plot 7.2.9 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal

