

Test Report

Product	Telematics unit for mounting on forklifts		
Name and address of the applicant	Toyota Material Handling, Inc. 5559 Inwood Drive, Columbus IN 47201, USA		
Name and address of the manufacturer	Toyota Material Handling, Inc. 5559 Inwood Drive, Columbus IN 47201, USA		
Model	DHUnx		
Rating	External DC supply (12-48 V _{DC})		
Trademark	TOYOTA		
Serial number	2117000000251		
Additional information	WiFi, BT Classic, BLE, WCDMA, LTE		
Tested according to	Parts of FCC Part 15.407 Unlicensed National Information Infrastructure Devices (U-NII) Parts of Industry Canada RSS-247, Issue 2 Licence-Exempt Local Area Network (LE-LAN) Devices		
Order number	433049		
Tested in period	2021-09-15 to 2021-10-26		
Issue date	2022-02-24		
Name and address of the testing laboratory	 Instituttveien 6 Kjeller, Norway www.nemko.com CAB Number FCC: NO0001 ISSED: NO0470  NORWEGIAN ACCREDITATION TEST 033		
An accredited technical test executed under the Norwegian accreditation scheme			
 Prepared by [Frode Sveinsen]		 Approved by [G.Suhanthakumar]	
This report shall not be reproduced except in full without the written approval of Nemko. Opinions and interpretations expressed within this report are not part of the current accreditation. This report was originally distributed electronically with digital signatures. For more information contact Nemko.			

Revision history

Revision	Date	Comment	Sign
00	2022-02-24	First edition	FS

CONTENTS

1	INFORMATION	4
1.1	Test Item	4
1.2	Normal test conditions	5
1.3	Test Engineer	5
1.4	Antenna Requirement.....	5
1.5	Worst-Case Configuration	5
1.6	EUT Operating Modes.....	5
1.7	Radio Modules	5
1.8	EUT Power Levels.....	6
1.9	Comments	6
2	TEST REPORT SUMMARY	7
2.1	General	7
2.2	Test Summary	8
3	TEST RESULTS.....	9
3.1	Maximum Output Power, EIRP	9
3.2	Unwanted Emissions	16
3.3	Restricted Bands of operation.....	21
3.4	Radiated Emissions, 30 – 1000 MHz	22
3.5	Radiated Emissions, 1 – 40 GHz	24
4	Measurement Uncertainty.....	32
5	LIST OF TEST EQUIPMENT.....	33
6	BLOCK DIAGRAM	34
6.1	Test Site Radiated Emission.....	34

1 INFORMATION

1.1 Test Item

Name	Toyota
Model	DHUnx
FCC ID	2A226-TELETMH01
ISED ID	27732-TELETMH01
Serial number	2117000000251
Hardware identity and/or version	Rev. B
Software identity and/or version	dv_b1_2021-05-05
Frequency Ranges	U-NII 1 : 5180 – 5240 MHz: 4 channels U-NII 2A : 5260 – 5320 MHz: 4 channels U-NII 2C : 5500 – 5720 MHz: 12 channels U-NII 3 : 5745 – 5825 MHz: 5 channels
Operating Modes	802.11a 802.11n (20/40 MHz BW) 802.11ac (40/80 MHz BW)
Type of Modulation	Digital (OFDM - Orthogonal frequency-division multiplexing)
Conducted Output Power	5180 – 5240 MHz: 16.4 mW 5260 – 5320 MHz: 16.6 mW 5500 – 5720 MHz: 12.9 mW 5745 – 5825 MHz: 13.3 mW
Antenna Connector	Quad MiniFakra
Antenna Type	Molex Antenna, P/N: 2144500750 (P/N is for version with 750mm cable length, longer cables may also be used) Antenna element LTE1: Rx/Tx Antenna element LTE2: Rx Only Antenna element WiFi/BT: Rx/Tx 2.4GHz WiFi/BT/BLE and 5GHz WiFi Antenna element GNSS: Rx Only GNSS/GPS
Antenna Diversity Supported	Not for WiFi
Smart Antennas Supported	No
TPC Supported	Not implemented. Not required when EIRP is below 500 mW
DFS Supported	Client Device without Radar Detection
Ad-hoc Mode	EUT does not support Ad-hoc Mode in DFS bands
Hotspot Mode	EUT does not support Hotspot Mode in DFS bands
Power Source	External DC Supply (12-48V _{DC} , supplied through MX23 connector)
Interfaces	MX23 Connector HSD Connector (100TX Ethernet)

Description of Test Item

The EUT is a telematics unit with radio modules for BT/BLE/WiFi and Mobile (WCDMA and LTE). Both radio modules are certified radio modules. The EUT also contains a GPS receiver.

This test report covers only additional radiated tests for the new antennas.

1.2 Normal test conditions

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	24V DC (2x 12V lead acid batteries, Fiamm FG20451)

The EUT was powered from two fully charged batteries during all tests.

The values are the limit registered during the test period.

1.3 Test Engineer

Frode Sveinsen

1.4 Antenna Requirement

Does the EUT have detachable antenna(s)?	☒ YES	☐ NO
If detachable, is the antenna connector(s) non-standard?	☒ YES	☐ NO
Antenna Connector: Quad MiniFakra		

Requirement: FCC 15.203, 15.204

1.5 Worst-Case Configuration

Radiated Emissions and Power Line Conducted Emissions were performed with the EUT set to transmit at the channel with the highest output power as worst-case scenario.

1.6 EUT Operating Modes

Description of operating modes	Continuous TX, 5 GHz 20/40/80 MHz Mode
Additional information	EUT was controlled from a computer and programmed with the Qualcomm Test App.

1.7 Radio Modules

Data for radio modules				
Manufacturer	Model No	Identification	Original Test Report	Technology
Quectel	FC20	FCC ID: XMR201703FC20 IC: 10224A-201703FC20 P/N: FC20-Q73	Siemic 16050028-FCC-R3 TA R2105A0465-R2	BT Classic
			Siemic 16050028-FCC-R4 TA R2105A0465-R1	BT Low Energy
			Siemic 16050028-FCC-R1 TA R2105A0465-R1	WLAN
			Siemic 16050028-FCC-R2 TA R2105A0465-R3	UNII 2TX
			TA R2105A0465-R4V1	DFS
Quectel	EG25	FCC ID: XMR201903EG25G IC: 10224A-201903EG25G P/N: EG25GGB-256-SGNS	SGS HR/2019/1001601 SGS HR/2019/1001603	WCDMA / LTE

1.8 EUT Power Levels

The default values from the module manufacturer were used for all channels and modulations.

No power levels were modified for any of the tests.

1.9 Comments

The measurements were done with the EUT powered from fully charged batteries.

All ports were populated during spurious emission measurements.

This test report covers only selected tests for new antennas, all other tests are covered by the original Test Reports.

2 TEST REPORT SUMMARY

2.1 General

All measurements are traceable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.407 and ISSED RSS-247 Issue 2.

Tests were performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

Radiated tests were performed in a semi-anechoic chamber at measuring distances of 1m and 3m.

☒ New Submission

☐ Class II Permissive Change

NII Equipment Code

☒ Production Unit

☐ Pre-production Unit

☐ Family Listing



THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

Nemko Group authorizes the above named entity to reproduce this report provided it is reproduced in its entirety and for use by the entity's employees only. Any reproduction of parts of this report requires approval in writing from Nemko Group.

Any use that a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Group accepts no responsibility for damages suffered by any third party caused by decisions made or actions based on this report.

2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 2 RSS-GEN Issue 5 reference	Result
Supply Voltage Variations	15.31(e)	6.11 (RSS-GEN)	Complies
Antenna Requirement	15.203	6.8 (RSS-GEN)	Complies
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2 / 8.8 (RSS-GEN)	N/A
Maximum Output Power	15.407(a)	6.2	Complies
Power Spectral Density	15.407(a)	6.2	N/T
Emission Bandwidth	15.407(a)(2)	6.2	N/T
Unwanted Emissions	15.407(b)	6.2	Complies
Discontinuation of Transmission	15.407(c)	6.3	N/T ¹
6 dB Bandwidth	15.407(e)	6.2.4	N/T
Transmit Power Control	15.407(h)	6.2.3	N/A ²
Dynamic Frequency Selection	15.407(h)	6.3	N/T ³
Radiated Emissions	15.205 15.209	7.3 (RSS-GEN) 8.9 (RSS-GEN)	Complies

¹ See manufacturers declaration

² Transmit Power Control is not required when Max EIRP is below 500 mW

³ The EUT is a Client Device without Radar Detection.

3 TEST RESULTS

3.1 Maximum Output Power, EIRP

FCC 15.407 (a)

ISED RSS-247, Issue 2, Clause 6.2

Measurement procedure: ANSI C63.10-2013 Clause 12.3, method SA-1

Test Results: Complies

Measurement Data:

Ch. No.	Nominal Frequency (MHz)	Maximum Field Strength (dBµV/m)		Maximum e.i.r.p. (dBm)	
		802.11a	802.11n HT20	802.11a	802.11n HT20
36	5180	94.9	92.9	-0.3	-2.3
64	5320	98.2	96.1	3.0	0.9
100	5500	100.1	97.8	4.8	2.6
140	5700	97.8	95.6	2.6	0.3
144	5720	98.1	95.9	2.9	0.6
149	5745	99.8	97.6	4.5	2.4
165	5825	96.5	94.5	1.3	-0.8
Ch. No.	Nominal Frequency (MHz)	Maximum Field Strength (dBµV/m)		Maximum e.i.r.p. (dBm)	
		802.11n HT40	802.11ac VHT80	802.11n HT40	802.11ac VHT80
38	5190	93.3		-1.9	
62	5310	95.4		0.2	
102	5510	97.5		2.2	
134	5670	97.6		2.4	
142	5710	95.8		0.5	
151	5755	97.9		2.7	
159	5795	95.7		0.5	
42	5210		90.7		-4.5
58	5290		91.8		-3.5
106	5530		95.1		-0.2
122	5610		95.2		0.0
138	5690		94.8		-0.5
155	5775		95.4		0.2

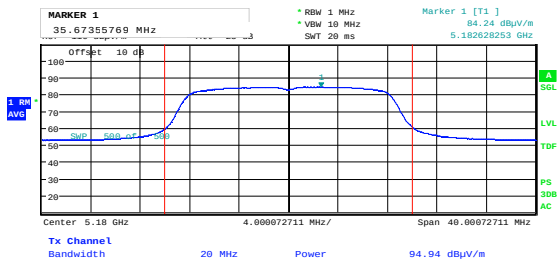
The EUT operates continuously; therefore, method SA-1 of ANSI C63.10-2013 clause 12.3 was used.

EIRP values were calculated from Field Strength values using the method described in KDB 412172 D01.

This is an indoor device with directional Antenna Gain less than 6 dBi.

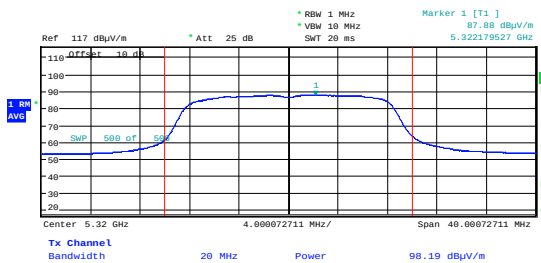
Limits for Indoor Device:

Frequency Band	FCC 15.407(a)	ISED RSS-247 Issue 2
5150 – 5250 MHz	Less than 250 mW (24 dBm) for client device Less than 1 W (30 dBm) for master device	Less than the lesser of 200 mW e.i.r.p. or $10 + 10 \log_{10} B$ dBm e.i.r.p.
5250 – 5350 MHz	Less than the lesser of 250 mW (24 dBm) or $11 + 10 \log_{10} B$ dBm	Less than the lesser of 250 mW or $11 + 10 \log_{10} B$ dBm, and Less than the lesser of 1 W e.i.r.p. or $17 + 10 \log_{10} B$ dBm e.i.r.p. Devices with e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W
5470 – 5725 MHz		
5725 – 5825 MHz	Less than 1 Watt	Less than 1 Watt If Antenna Gain is more than 6 dBi the Power Limit is reduced by the amount exceeding 6 dBi
	If Antenna Gain is more than 6 dBi the Power Limit is reduced by the amount exceeding 6 dBi	
	B is the 26dB emission bandwidth in MHz	B is the 99% emission bandwidth in MHz



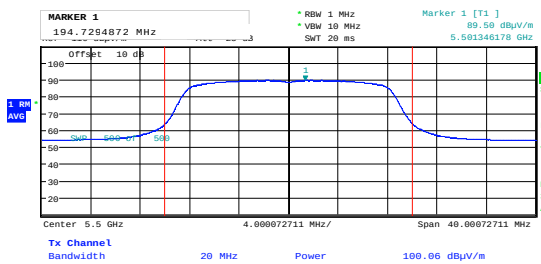
Date: 25.OCT.2021 15:38:24

Maximum EIRP, Ch036, 802.11a, 6M



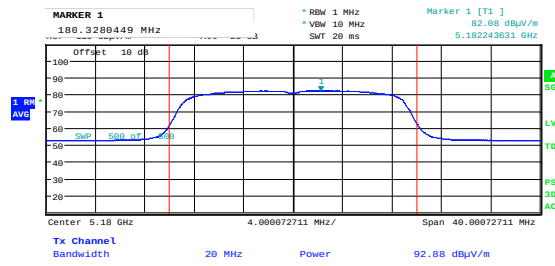
Date: 25.OCT.2021 15:22:44

Maximum EIRP, Ch064, 802.11a, 6M



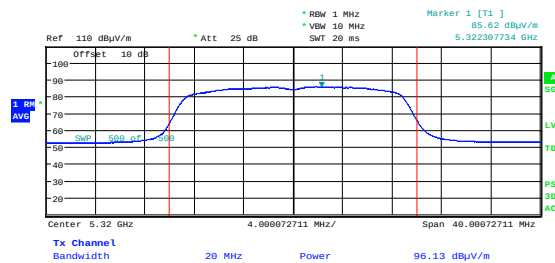
Date: 25.OCT.2021 15:34:52

Maximum EIRP, Ch100, 802.11a, 6M



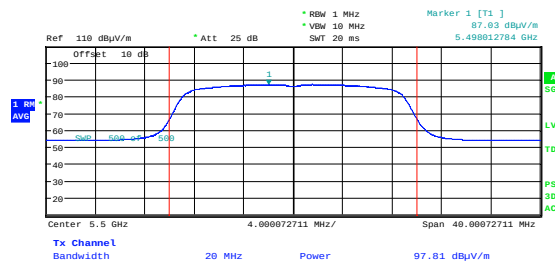
Date: 25.OCT.2021 15:41:35

Maximum EIRP, Ch036, 802.11n, HT20, MCS0



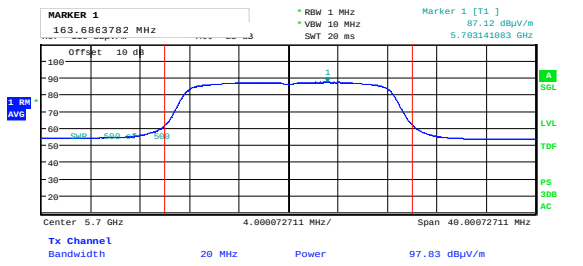
Date: 25.OCT.2021 15:25:56

Maximum EIRP, Ch064, 802.11n, HT20, MCS0



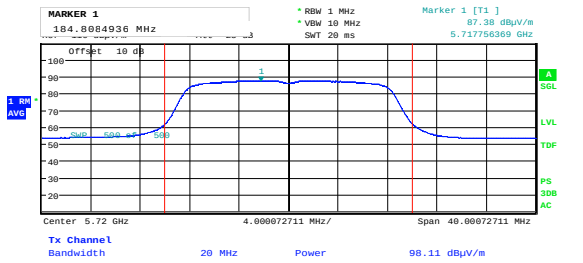
Date: 25.OCT.2021 15:28:20

Maximum EIRP, Ch100, 802.11n, HT20, MCS0



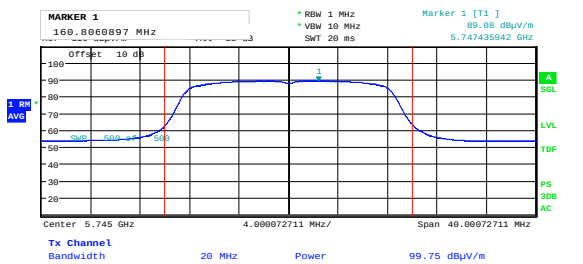
Date: 25.OCT.2021 15:48:53

Maximum EIRP, Ch140, 802.11a, 6M



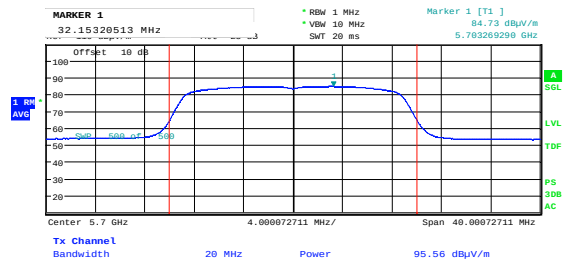
Date: 25.OCT.2021 15:51:08

Maximum EIRP, Ch144, 802.11a, 6M



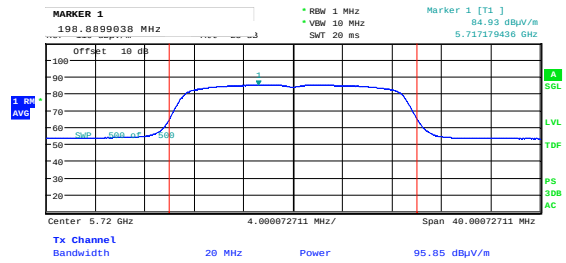
Date: 25.OCT.2021 15:54:51

Maximum EIRP, Ch149, 802.11a, 6M



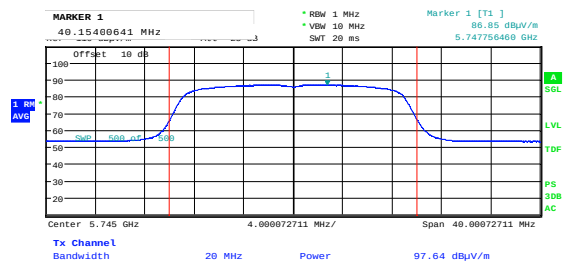
Date: 25.OCT.2021 15:47:04

Maximum EIRP, Ch140, 802.11n, HT20, MCS0



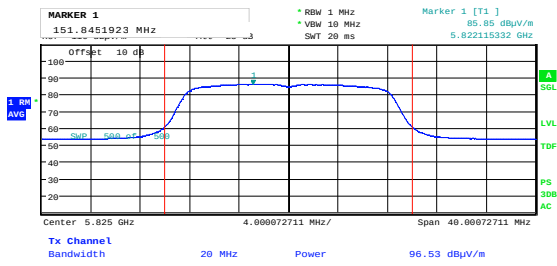
Date: 25.OCT.2021 15:52:10

Maximum EIRP, Ch144, 802.11n, HT20, MCS0



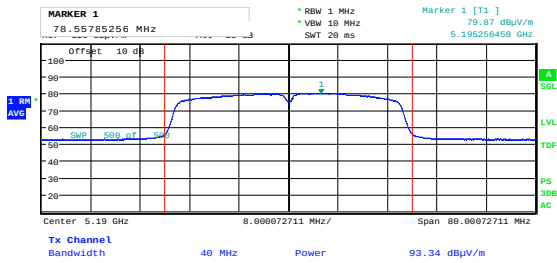
Date: 25.OCT.2021 15:53:01

Maximum EIRP, Ch149, 802.11n, HT20, MCS0



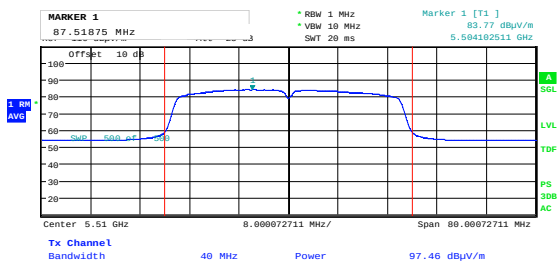
Date: 25.OCT.2021 15:56:48

Maximum EIRP, Ch165, 802.11a, 6M



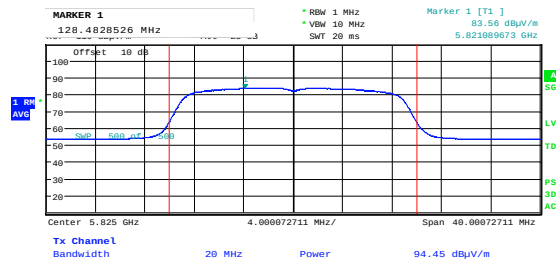
Date: 25.OCT.2021 16:03:37

Maximum EIRP, Ch038, 802.11n, HT40, MCS0



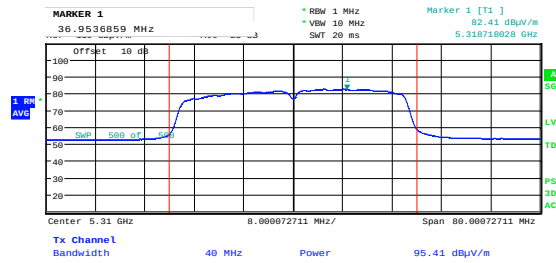
Date: 25.OCT.2021 16:12:30

Maximum EIRP, Ch102, 802.11n, HT40, MCS0



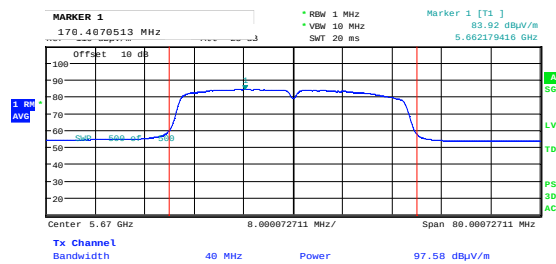
Date: 25.OCT.2021 15:58:46

Maximum EIRP, Ch165, 802.11n, HT20, MCS0



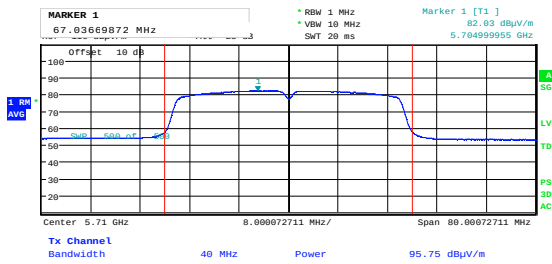
Date: 25.OCT.2021 16:08:27

Maximum EIRP, Ch062, 802.11n, HT40, MCS0



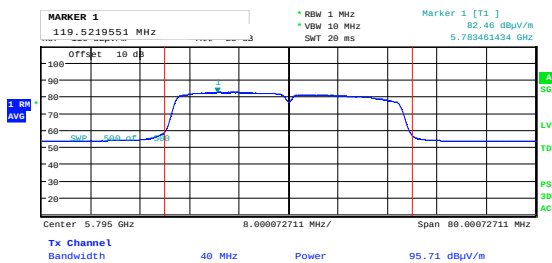
Date: 25.OCT.2021 16:15:05

Maximum EIRP, Ch134, 802.11n, HT40, MCS0



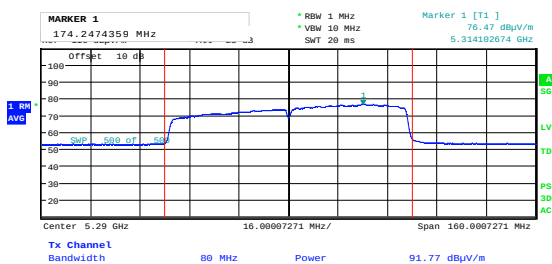
Date: 25.OCT.2021 16:17:18

Maximum EIRP, Ch142, 802.11n, HT40, MCS0



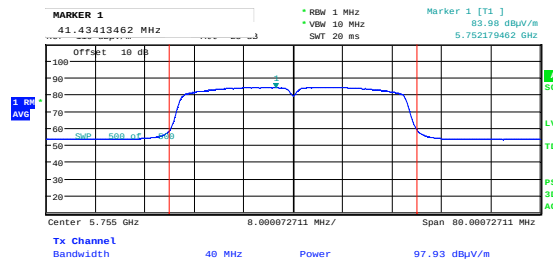
Date: 25.OCT.2021 16:20:05

Maximum EIRP, Ch159, 802.11n, HT40, MCS0



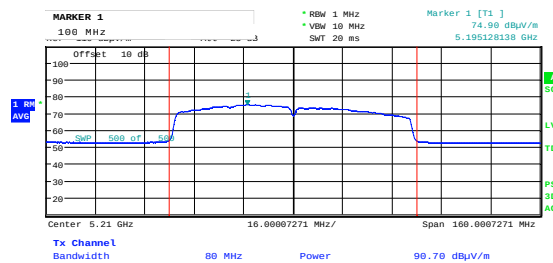
Date: 25.OCT.2021 16:26:13

Maximum EIRP, Ch058, 802.11ac, HT80, MCS0



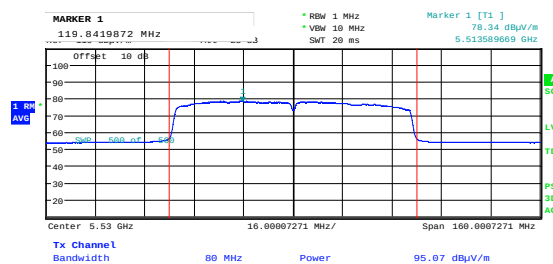
Date: 25.OCT.2021 16:18:19

Maximum EIRP, Ch151, 802.11n, HT40, MCS0



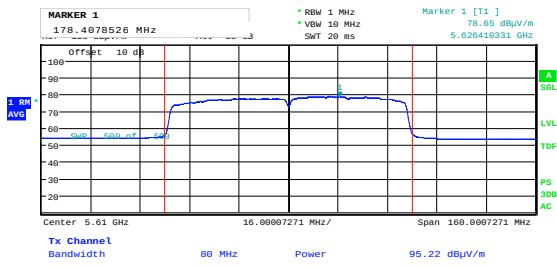
Date: 25.OCT.2021 16:22:53

Maximum EIRP, Ch042, 802.11ac, HT80, MCS0



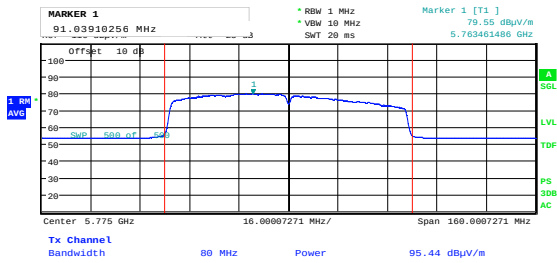
Date: 25.OCT.2021 16:28:28

Maximum EIRP, Ch106, 802.11ac, HT80, MCS0



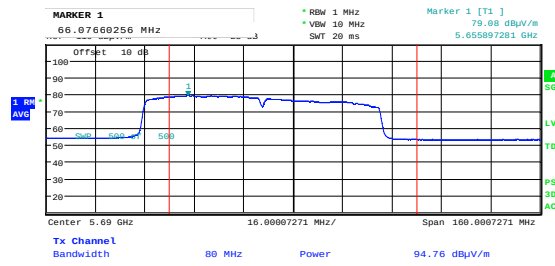
Date: 25.OCT.2021 16:38:40

Maximum EIRP, Ch122, 802.11ac, HT80, MCS0



Date: 25.OCT.2021 16:34:17

Maximum EIRP, Ch155, 802.11ac, HT80, MCS0



Date: 25.OCT.2021 16:33:10

Maximum EIRP, Ch138, 802.11ac, HT80, MCS0

3.2 Unwanted Emissions

FCC 15.407 (b)

ISED RSS-247, Issue 2, clause 6.2

Measurement procedure: ANSI C63.10-2013 Clause 12.7

Test Results: Complies

Measurement Data:

Band Edge Emissions:

Ch. No.	Carrier Freq (MHz)	Band Edge Freq (MHz)	Measured Values (dBm/MHz e.i.r.p.)			
			11a 6M	11n HT20 MCS0	11n HT40 MCS0	11ac VHT80 MCS0
36	5180	5150	-37.3	-37.9		
64	5320	5350	-37.2	-37.4		
100	5500	5470	-37.1	-37.0		
140	5700	5725	-37.1	-37.6		
149	5745	5650	<-37	<-37		
149	5745	5700	<-35	<-35		
165	5825	5875	<-35	<-35		
165	5825	5925	<-37	<-37		
38	5190	5150			-36.9	
62	5310	5350			-36.5	
102	5510	5470			-35.4	
134	5670	5725			-37.0	
151	5755	5650			<-37	
151	5755	5700			<-35	
159	5795	5875			<-35	
159	5795	5925			<-37	
42	5210	5150				-37.3
58	5290	5350				-37.2
106	5530	5470				-36.8
122	5610	5725				<-37
155	5775	5650				<-37
155	5775	5700				<-35
155	5775	5875				<-35
155	5775	5925				<-37

The measurement was performed radiated.

EIRP values were calculated from field strength using the method in KDB 412172 D01.

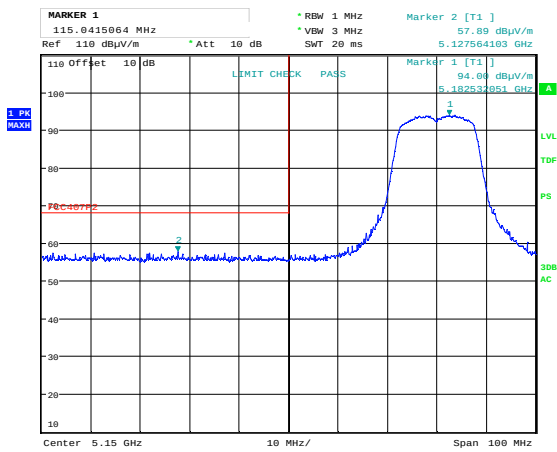
The tested equipment is for indoor use only, no band-edge requirements apply at 5250 MHz.

A 10 dB attenuator was used before the preamp for all Band Edge measurements.

Limits:

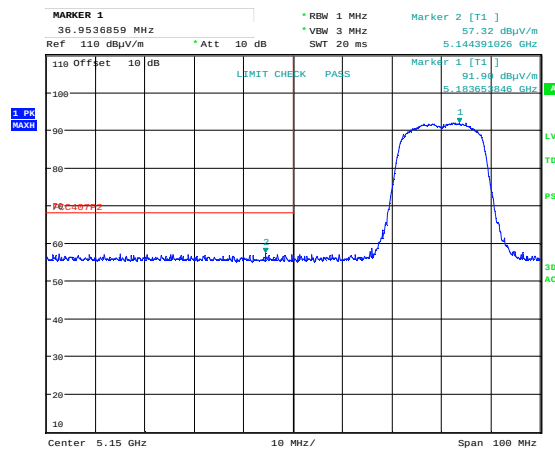
Operating Frequency band	Limit for Emissions Outside Operating Frequency Band
5150 – 5250 MHz	-27 dBm/MHz e.i.r.p.
5250 – 5350 MHz	-27 dBm/MHz e.i.r.p.
5470 – 5725 MHz	-27 dBm/MHz e.i.r.p.
5725 – 5825 MHz	See FCC 15.407(b)(4)(i) or 15.407(b)(4)(ii)

Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.



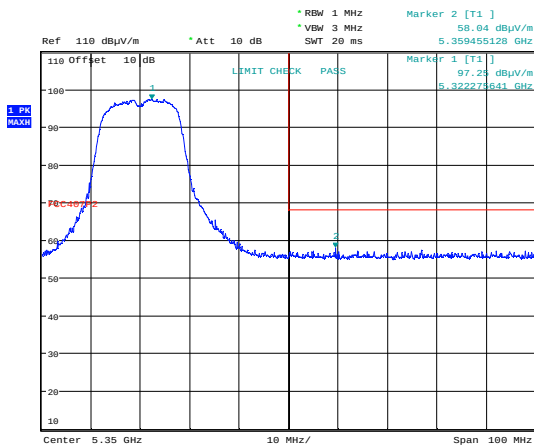
Date: 25.OCT.2021 15:39:27

Band Edge 5150MHz, ch036, 802.11a 6M, Max



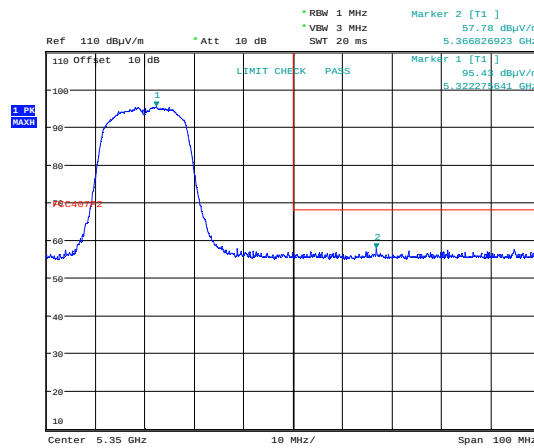
Date: 25.OCT.2021 15:43:46

Band Edge 5150MHz, ch036, 802.11n MCS0, Max



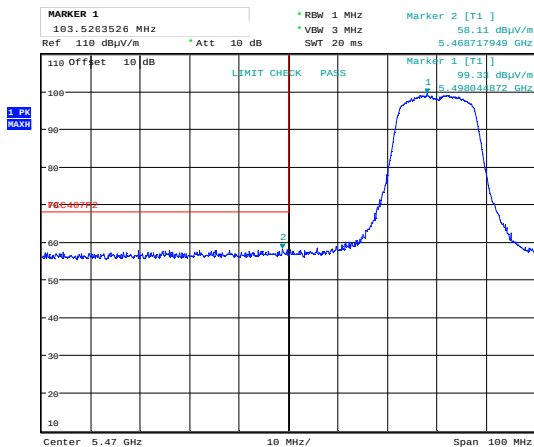
Date: 25.OCT.2021 15:23:48

Band Edge 5350MHz, ch064, 802.11a 6M, Max



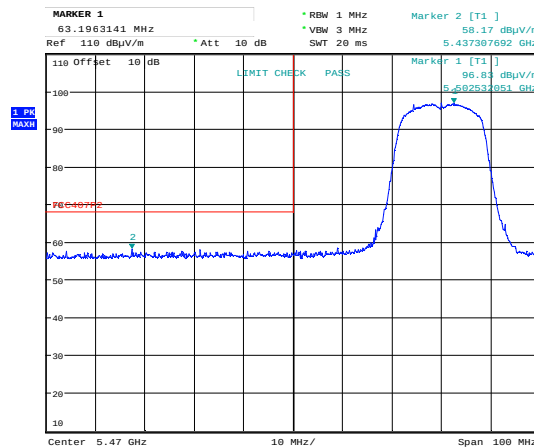
Date: 25.OCT.2021 15:26:51

Band Edge 5350MHz, ch064, 802.11n MCS0, Max



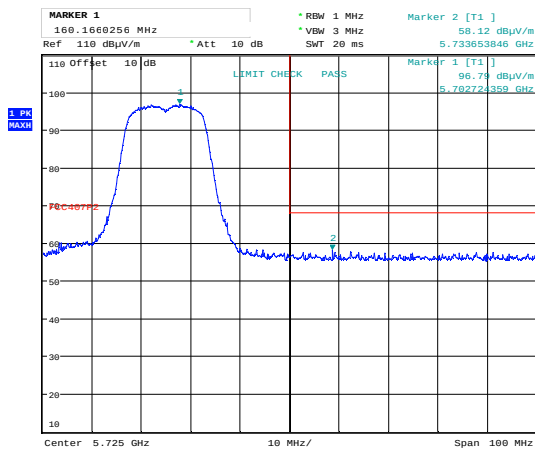
Date: 25.OCT.2021 15:36:43

Band Edge 5470MHz, ch100, 802.11a 6M, Max



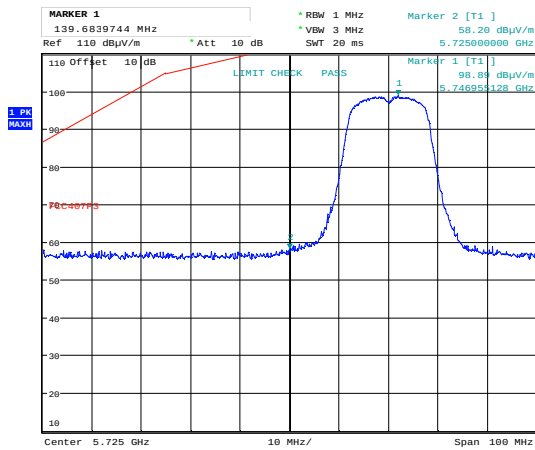
Date: 25.OCT.2021 15:30:23

Band Edge 5470MHz, ch100, 802.11n MCS0, Max



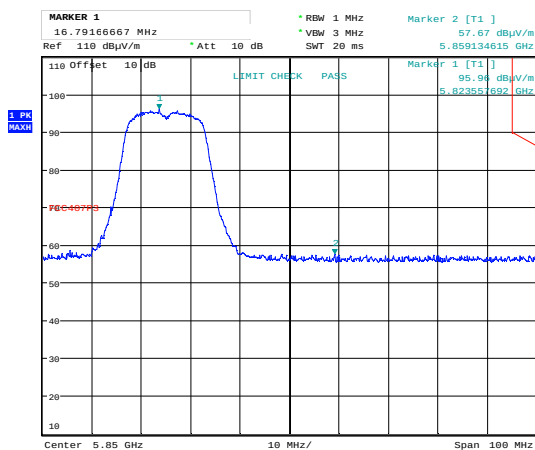
Date: 25.OCT.2021 15:50:13

Band Edge 5725MHz, ch140, 802.11a 6M, Max



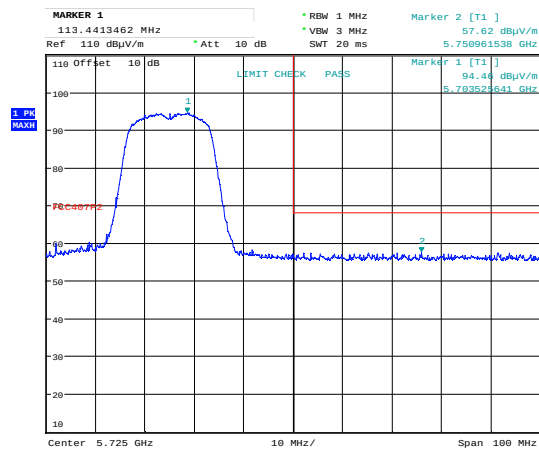
Date: 25.OCT.2021 15:55:48

Band Edge 5725MHz, ch149, 802.11a 6M, Max



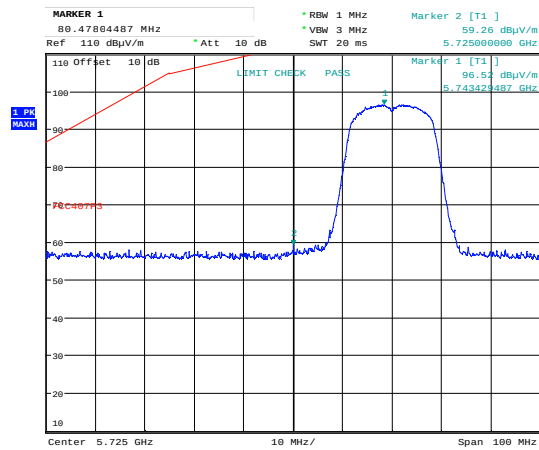
Date: 25.OCT.2021 15:57:46

Band Edge 5850MHz, ch165, 802.11a 6M, Max



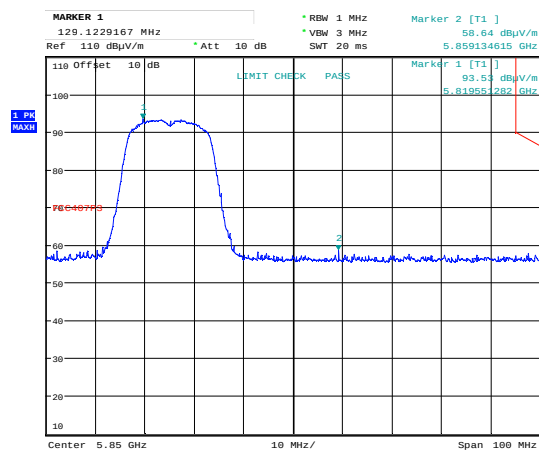
Date: 25.OCT.2021 15:48:02

Band Edge 5725MHz, ch140, 802.11n MCS0, Max



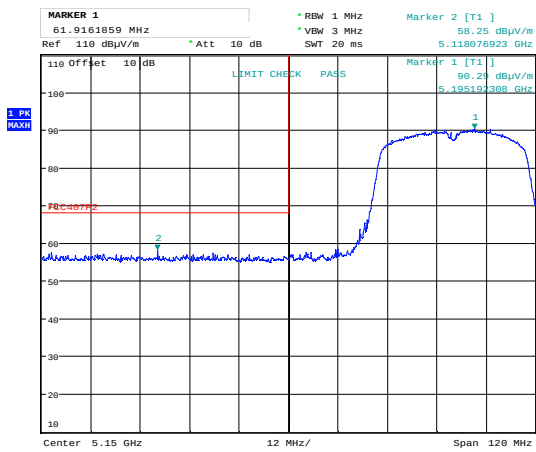
Date: 25.OCT.2021 15:53:56

Band Edge 5725MHz, ch149, 802.11n MCS0, Max



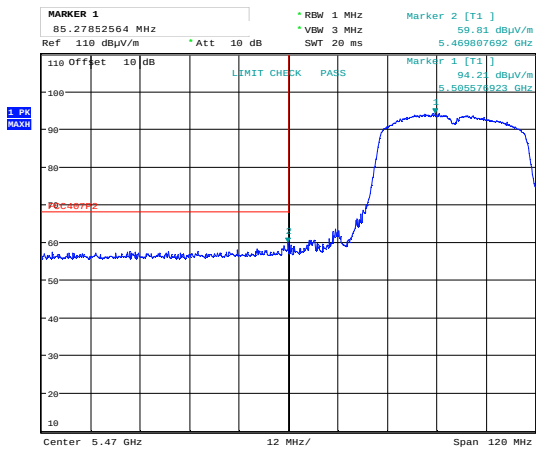
Date: 25.OCT.2021 16:01:05

Band Edge 5850MHz, ch165, 802.11n MCS0, Max



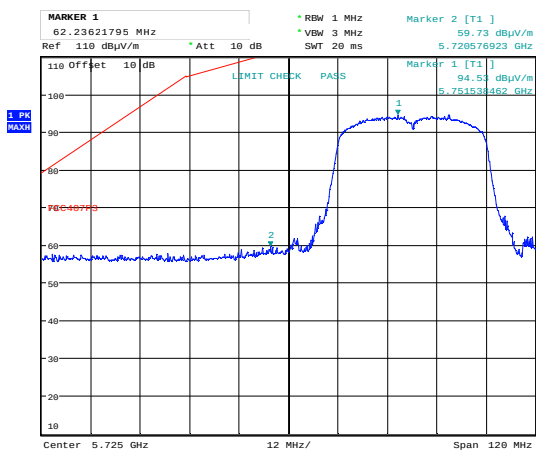
Date: 25.OCT.2021 16:05:29

Band Edge 5150 MHz, ch038, 802.11n HT40 MCS0, Max



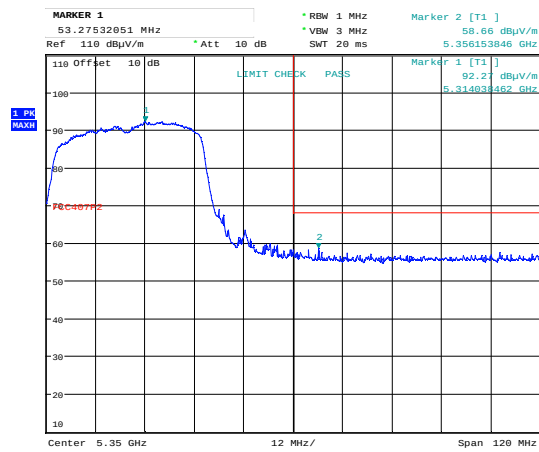
Date: 25.OCT.2021 16:13:24

Band Edge 5350 MHz, ch102, 802.11n HT40 MCS0, Max



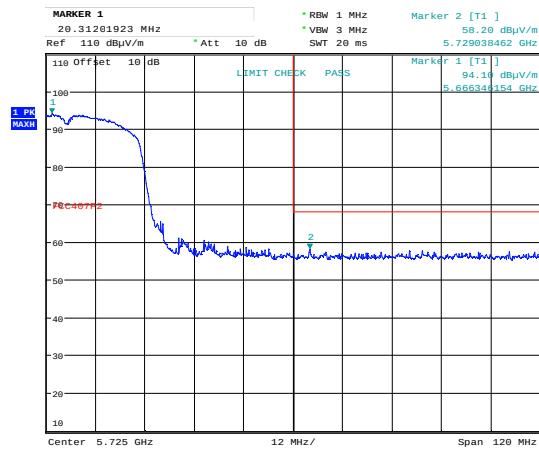
Date: 25.OCT.2021 16:19:13

Band Edge 5725 MHz, ch151, 802.11n HT40 MCS0, Max



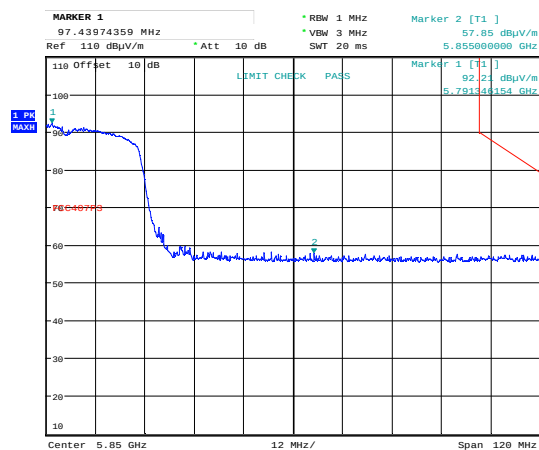
Date: 25.OCT.2021 16:09:21

Band Edge 5350 MHz, ch062, 802.11n HT40 MCS0, Max



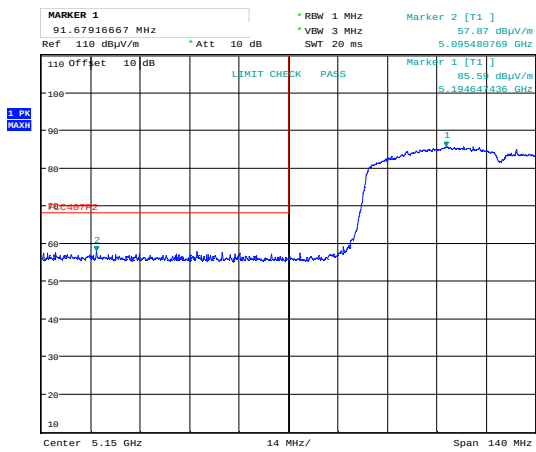
Date: 25.OCT.2021 16:15:59

Band Edge 5725 MHz, ch134, 802.11n HT40 MCS0, Max



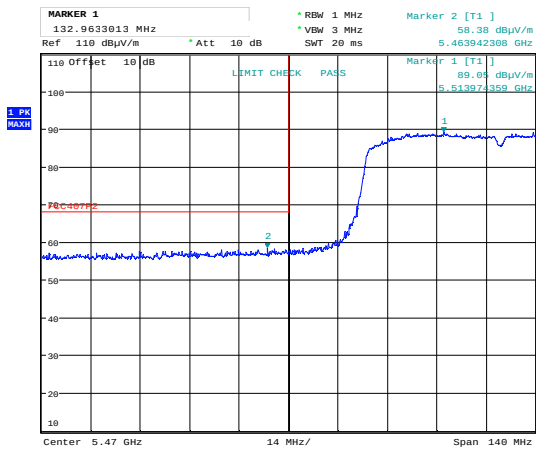
Date: 25.OCT.2021 16:21:14

Band Edge 5850 MHz, ch159, 802.11n HT40 MCS0, Max



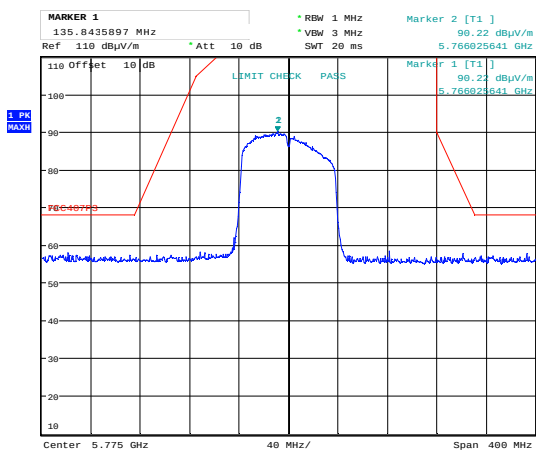
Date: 25.OCT.2021 16:23:48

Band Edge 5150 MHz, ch042, 802.11ac VHT80 MCS0, Max



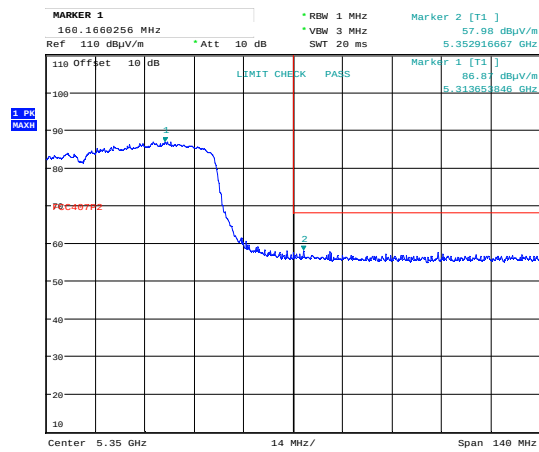
Date: 25.OCT.2021 16:29:12

Band Edge 5470 MHz, ch106, 802.11ac VHT80 MCS0, Max



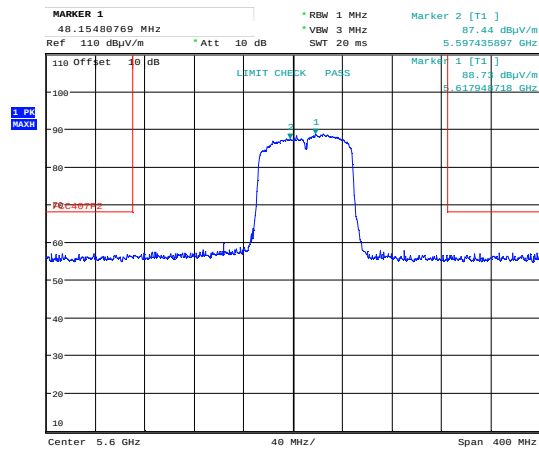
Date: 25.OCT.2021 16:35:11

Band Edge 5725/5850 MHz, ch155, 802.11ac VHT80 MCS0, Max



Date: 25.OCT.2021 16:27:02

Band Edge 5350 MHz, ch058, 802.11ac VHT80 MCS0, Max



Date: 25.OCT.2021 16:31:35

Band Edge 5725 MHz, ch122, 802.11ac VHT80 MCS0, Max

3.3 Restricted Bands of operation

Restricted Bands of operation for FCC and ISSED are defined in FCC Part 15.205 and ISSED RSS-GEN, Issue 5 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 5, clause 8.9.

FCC (MHz)	ISED (MHz)	FCC (GHz)	ISED (GHz)
0.090-0.110		0.96-1.24 1.3-1.427	0.96-1.427
0.495-0.505		1.435-1.6265	
2.1735-2.1905		1.6455-1.6465	
	3.020-3.026	1.660-1.710	
4.125-4.128		1.7188-1.7222	
4.17725-4.17775		2.2-2.3	
4.20725-4.20775		2.31-2.39	
	5.677-5.683	2.4835-2.5	
6.215-6.218		2.69-2.9	2.655-2.9
6.26775-6.26825		3.26-3.267	
6.31175-6.31225		3.332-3.339	
8.291-8.294		3.3458-3.358	
8.362-8.366		3.6-4.4	3.5-4.4
8.37625-8.38675		4.5-5.15	
8.41425-8.41475		5.35-5.46	
12.29-12.293		7.25-7.75	
12.51975-12.52025		8.025-8.5	
12.57675-12.57725		9.0-9.2	
13.36-13.41		9.3-9.5	
16.42-16.423		10.6-12.7	
16.69475-16.69525		13.25-13.4	
16.80425-16.80475		14.47-14.5	
25.5-25.67		15.35-16.2	
37.5-38.25		17.7-21.4	
73-74.6		22.01-23.12	
74.8-75.2		23.6-24.0	
108-121.94 123-138	108-138	31.2-31.8	
149.9-150.05		36.43-36.5	
156.52475-156.52525		Above 38.6	
156.7-156.9			
162.0125-167.17			
167.72-173.2			
240-285			
322-335.4			
399.9-410			
608-614			

Frequencies in **Bold** text are specific for FCC or ISSED, all other frequencies are common.

3.4 Radiated Emissions, 30 – 1000 MHz

FCC 15.205, 15.209, 15.407

ISED RSS-GEN, Issue 5, Clause 8.9

Measurement procedure: ANSI C63.10-2013 Clause 12.7

Test Results: Complies

Measurement Data:

Detector: QuasiPeak (Peak for Pre-Scan)

Measuring distance 3m

Tested in test mode with EUT transmitting on Ch 64.

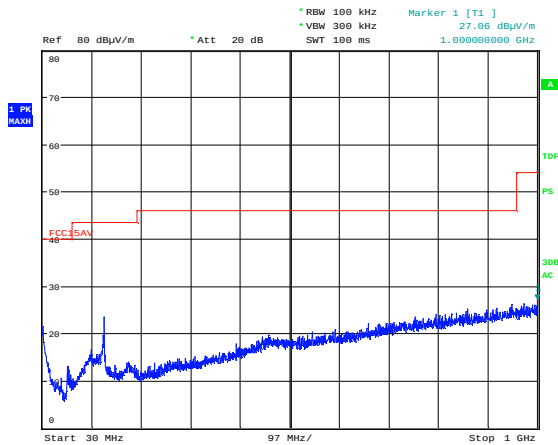
Measured Frequency (MHz)	Carrier Frequency (MHz)	Modulation	Measured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30 – 88	5300	802.11a 6Mbps	<25	40.0	>15
88 – 216	5300	802.11a 6Mbps	<20	43.5	>23.5
216 – 960	5300	802.11a 6Mbps	<25	46.0	>21
960 – 1000	5300	802.11a 6Mbps	<30	54.0	>24
150	Any	any	26.0	40.0	14.0

See attached plots.

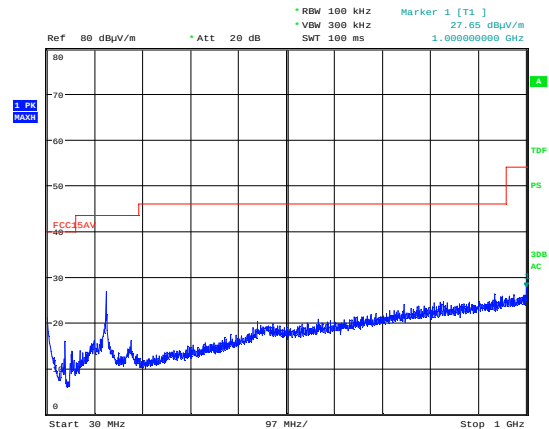
Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
Frequency	Radiated emission limit @3 meters	
30 – 88 MHz	100 μV/m	40.0 dBμV/m
88 – 216 MHz	150 μV/m	43.5 dBμV/m
216 – 960 MHz	200 μV/m	46.0 dBμV/m
960 – 1000 MHz	500 μV/m	54.0 dBμV/m
Limits above are with Quasi Peak Detector		

Molex Antenna

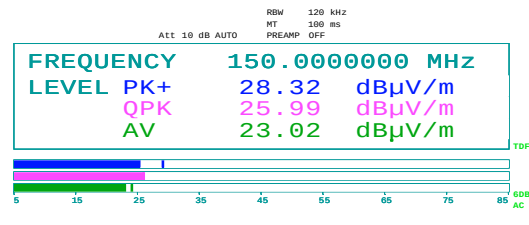


Date: 25.OCT.2021 19:31:52



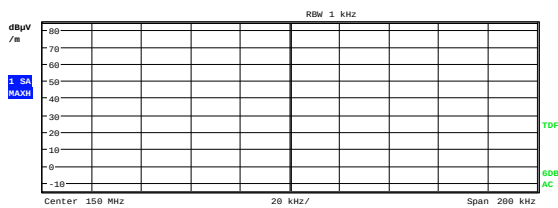
Date: 25.OCT.2021 19:33:50

Radiated Emissions 30-1000 MHz, Ch052, 802.11n MCS0, VP



Date: 25.OCT.2021 19:14:34

Radiated Emissions 30-1000 MHz, Ch052, 802.11n MCS0, HP



Radiated Emissions 150 MHz, HP

3.5 Radiated Emissions, 1 – 40 GHz

FCC 15.205, 15.209, 15.407

ISED RSS-GEN, Issue 5, Clause 8.9

Measurement procedure: ANSI C63.10-2013 Clause 12.7

Test Results: Complies

Measurement Data:

Measuring distance 3m up to 18 GHz, 1m above 18 GHz.

RBW/VBW = 1MHz/3MHz

Worst Carrier Frequency (MHz)	Spurious Frequency (GHz)	Modulation	Measured Emissions (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
			Peak	Average	Peak	Average	Peak	Average
Any	5150	Any	<58	<46	74	54	>18	>8
Any	5350	Any	<58	<46	74	54	>18	>8
Any	5460	Any	<58	<46	74	54	>18	>8
Any	Any	Any	<58	<46	74	54	>18	>8

Band Edge values with Peak Detector are reported in clause 2.8

Band Stop Filters were used for measurements from 1 to 18 GHz that were not at the Band Edge.

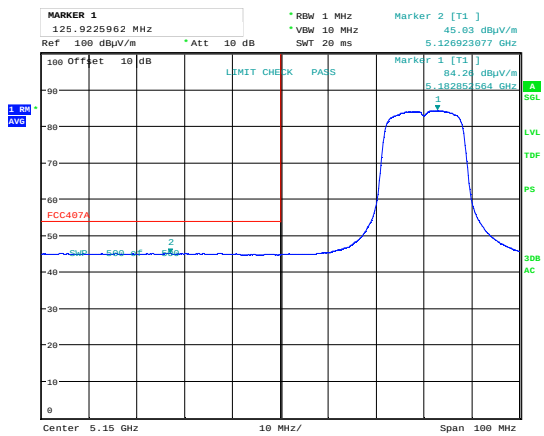
A 10 dB attenuator was used before the preamp for all Band Edge measurements.

Antenna factor, amplifier gain and cable loss are included in Spectrum Analyzer "Transducer factor".

See attached plots.

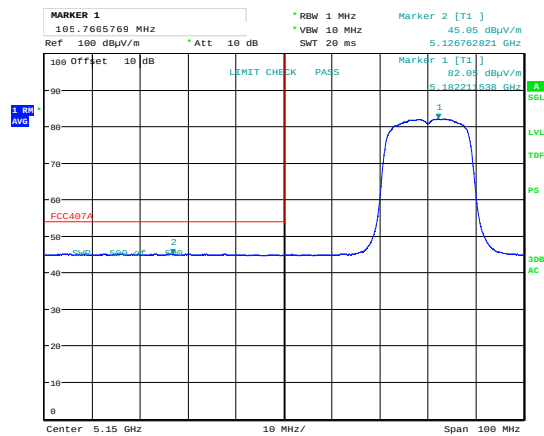
Requirements/Limit

FCC	Part 15.209 @ frequencies defined in §15.205	
ISED	RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10	
	Radiated emission limit @3 meters	
Frequency	Average Detector (dBμV/m)	Peak Detector (dBμV/m)
1 – 40 GHz	54.0	74.0



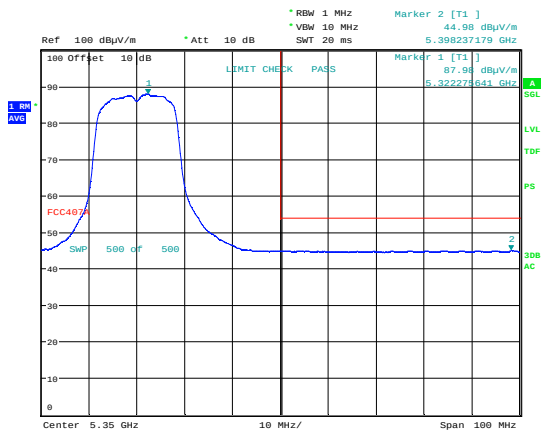
Date: 25.OCT.2021 15:40:04

Band Edge, 5150 MHz, Ch036, 802.11a 6M, AV, Max



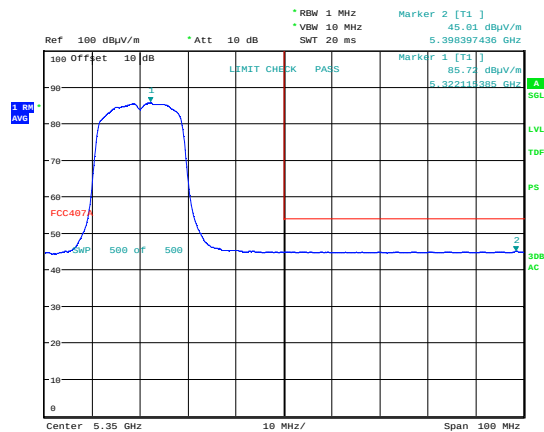
Date: 25.OCT.2021 15:44:24

Band Edge, 5150 MHz, Ch036, 802.11n MCS0, AV, Max



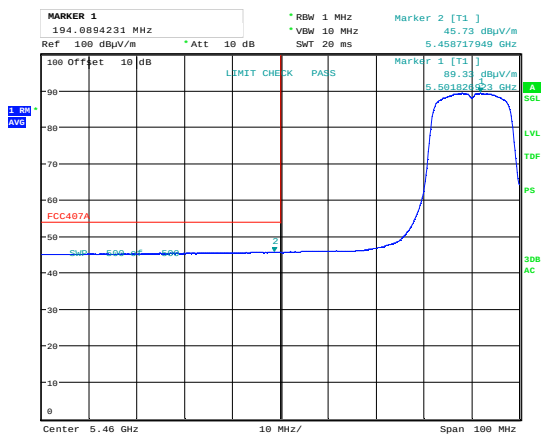
Date: 25.OCT.2021 15:24:24

Band Edge, 5350 MHz, Ch064, 802.11a 6M, AV, Max



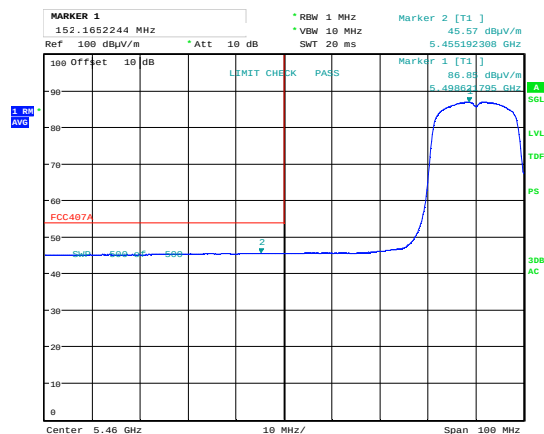
Date: 25.OCT.2021 15:27:26

Band Edge, 5350 MHz, Ch064, 802.11n MCS0, AV, Max



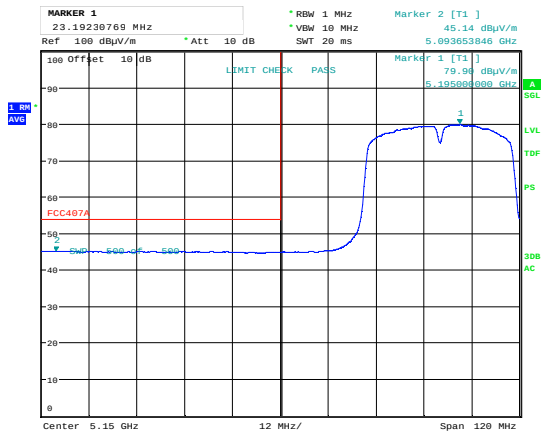
Date: 25.OCT.2021 15:37:19

Band Edge, 5460 MHz, Ch100, 802.11a 6M, AV, Max



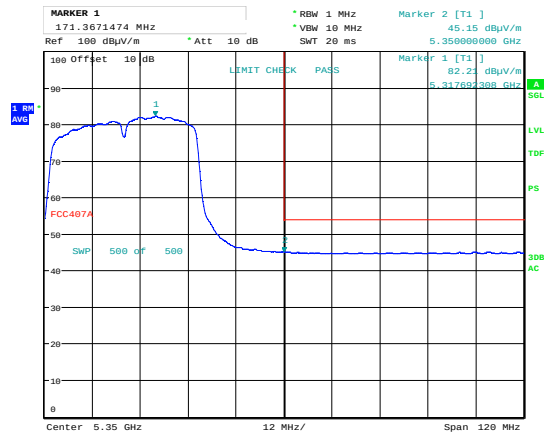
Date: 25.OCT.2021 15:32:57

Band Edge, 5460 MHz, Ch100, 802.11n MCS0, AV, Max



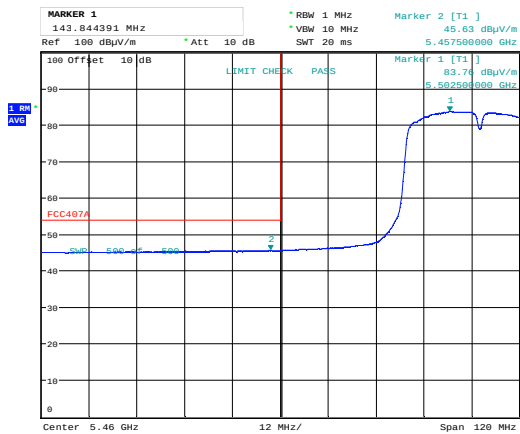
Date: 25.OCT.2021 16:07:16

Band Edge, 5150 MHz, Ch038, 802.11n HT40 MCS0, AV, Max



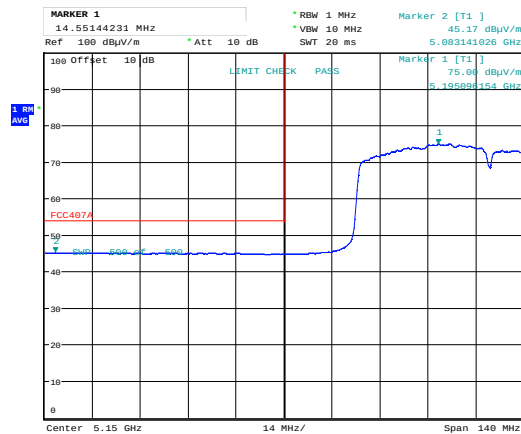
Date: 25.OCT.2021 16:09:55

Band Edge, 5350 MHz, Ch062, 802.11n HT40 MCS0, AV, Max



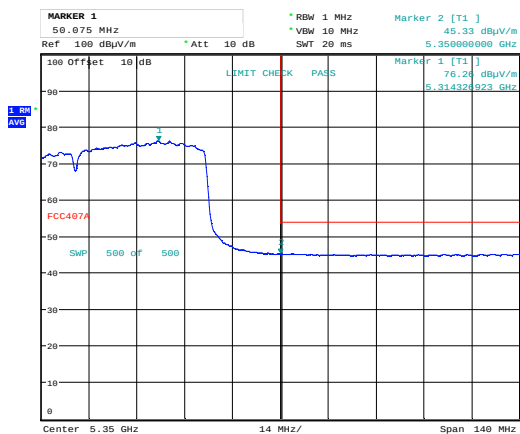
Date: 25.OCT.2021 16:13:58

Band Edge, 5460 MHz, Ch102, 802.11n HT40 MCS0, AV, Max



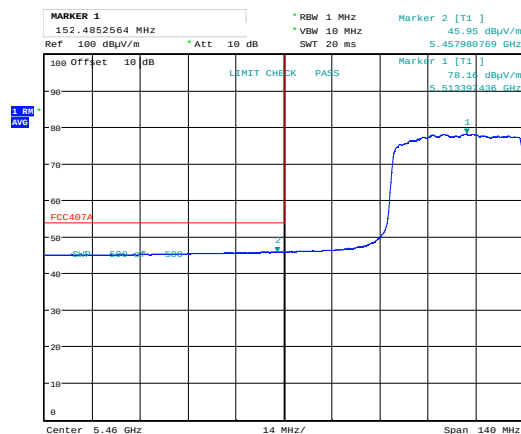
Date: 25.OCT.2021 16:24:22

Band Edge, 5150 MHz, Ch042, 802.11ac VHT80 MCS0, AV, Max



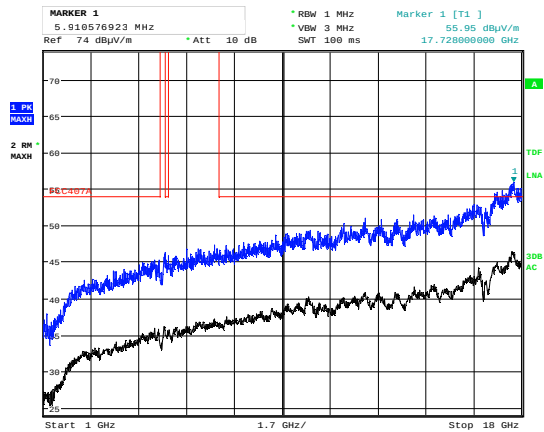
Date: 25.OCT.2021 16:27:36

Band Edge, 5350 MHz, Ch058, 802.11ac VHT80 MCS0, AV, Max



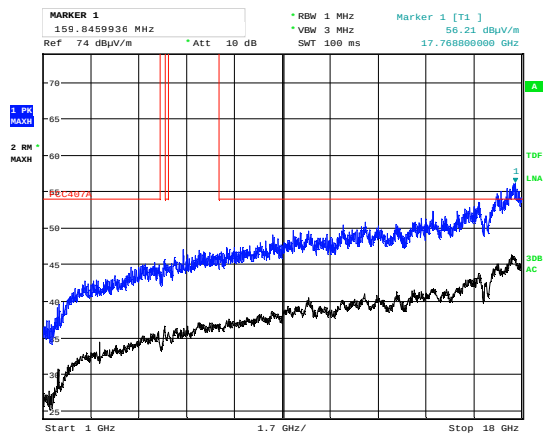
Date: 25.OCT.2021 16:29:47

Band Edge, 5460 MHz, Ch106, 802.11ac VHT80 MCS0, AV, Max



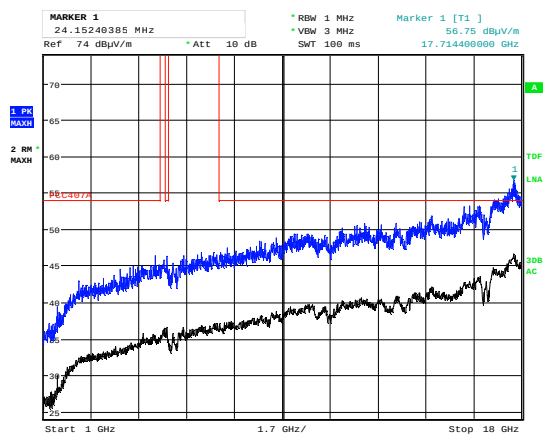
Date: 25.OCT.2021 16:47:53

Radiated Emissions 1 -18 GHz, Ch052, 802.11a 6M, HP



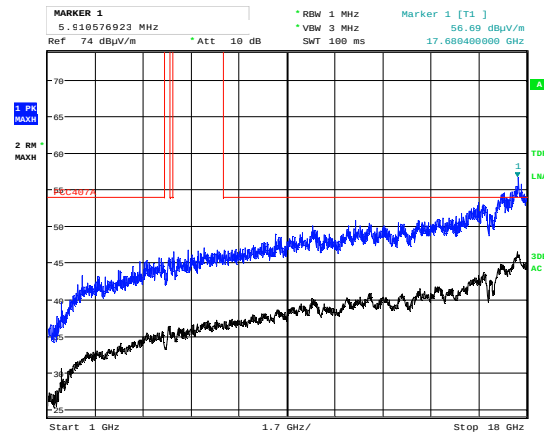
Date: 25.OCT.2021 16:53:49

Radiated Emissions 1 -18 GHz, Ch052, 802.11n MCS0, HP



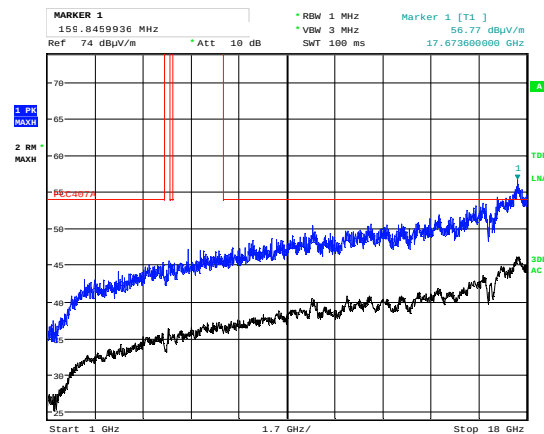
Date: 25.OCT.2021 17:10:04

Radiated Emissions 1 -18 GHz, Ch116, 802.11a 6M, HP



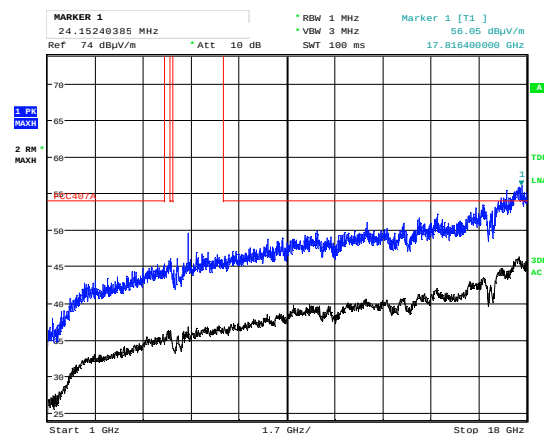
Date: 25.OCT.2021 16:45:48

Radiated Emissions 1 -18 GHz, Ch052, 802.11a 6M, VP



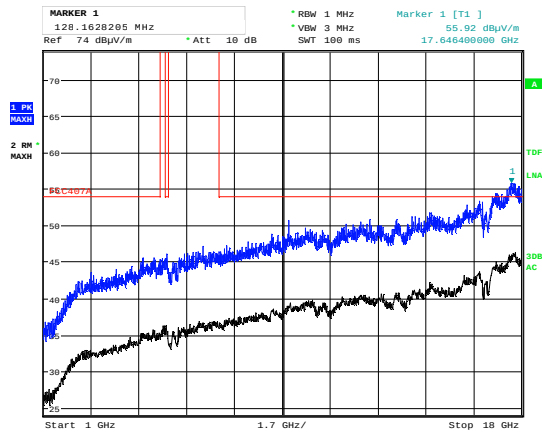
Date: 25.OCT.2021 16:51:36

Radiated Emissions 1 -18 GHz, Ch052, 802.11n MCS0, VP



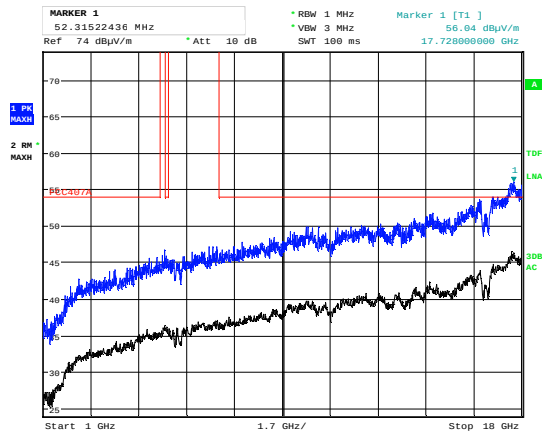
Date: 25.OCT.2021 17:07:58

Radiated Emissions 1 -18 GHz, Ch116, 802.11a 6M, VP



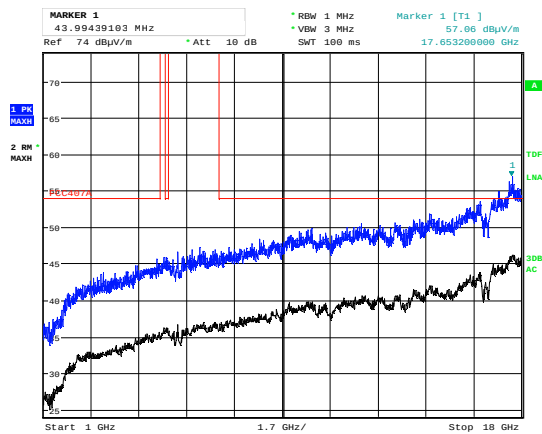
Date: 25.OCT.2021 17:02:07

Radiated Emissions 1 -18 GHz, Ch116, 802.11n MCS0, HP



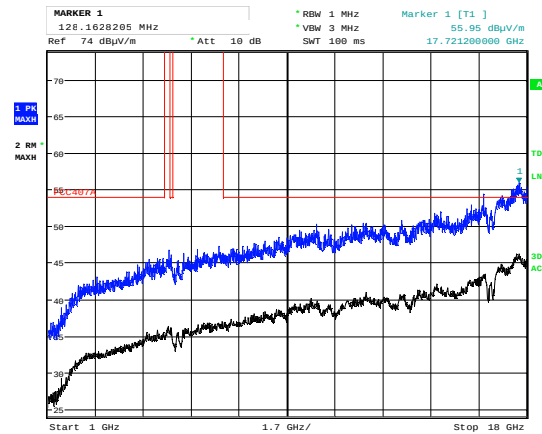
Date: 25.OCT.2021 17:16:54

Radiated Emissions 1 -18 GHz, Ch157, 802.11a 6M, HP



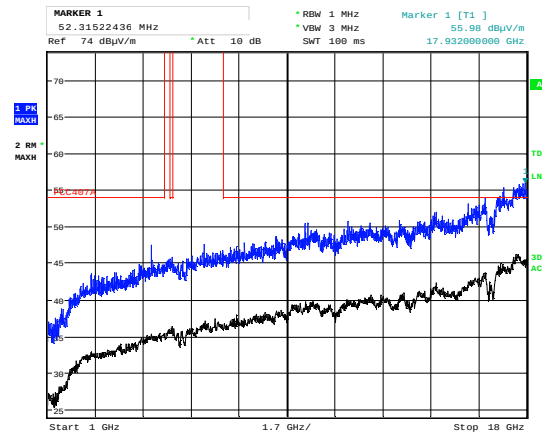
Date: 25.OCT.2021 17:22:12

Radiated Emissions 1 -18 GHz, Ch157, 802.11n MCS0, HP



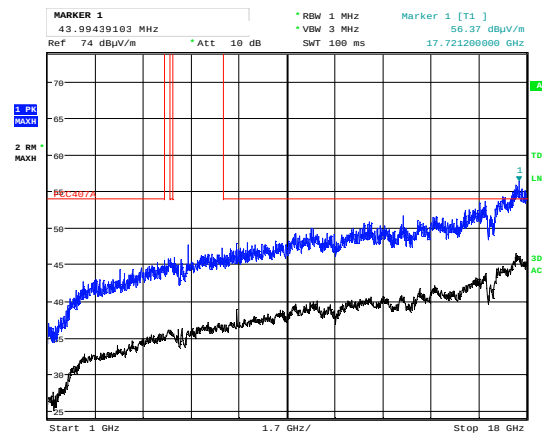
Date: 25.OCT.2021 16:59:53

Radiated Emissions 1 -18 GHz, Ch116, 802.11n MCS0, VP



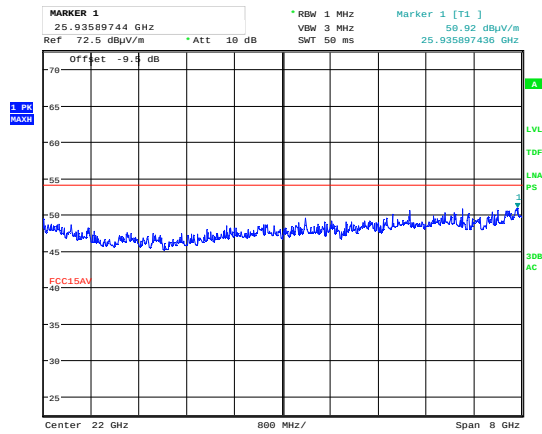
Date: 25.OCT.2021 17:14:41

Radiated Emissions 1 -18 GHz, Ch157, 802.11a 6M, VP



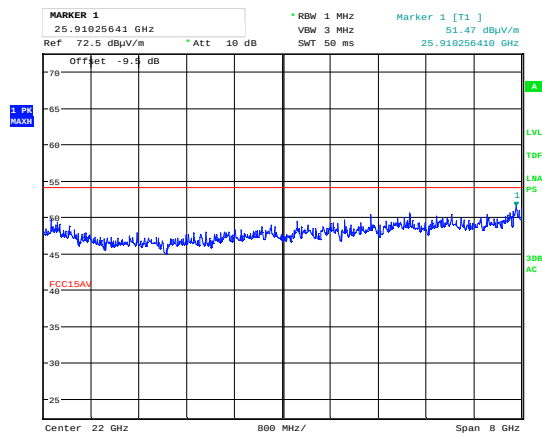
Date: 25.OCT.2021 17:20:00

Radiated Emissions 1 -18 GHz, Ch157, 802.11n MCS0, VP



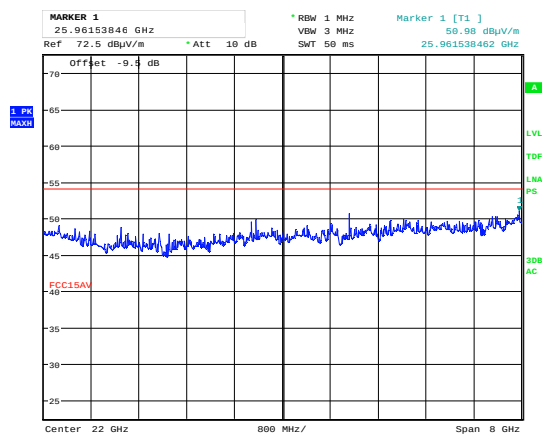
Date: 12.OCT.2021 15:50:40

Emissions 18-26 GHz, Ch052, 802.11a 6M, HP @1m



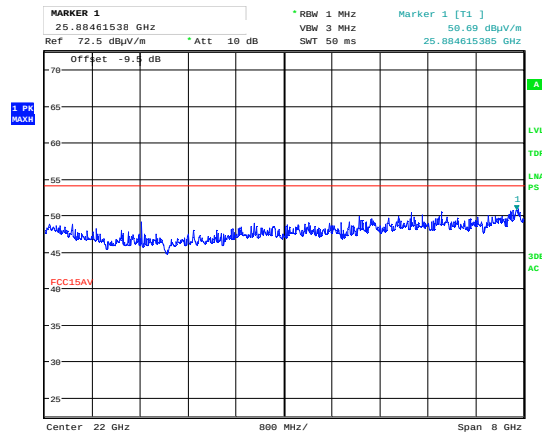
Date: 12.OCT.2021 15:49:34

Emissions 18-26 GHz, Ch116, 802.11a 6M, HP @1m



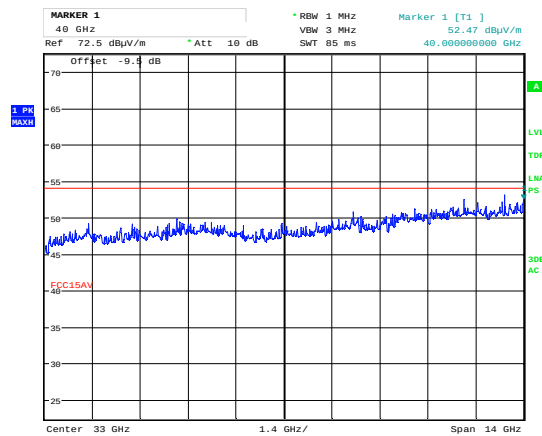
Date: 12.OCT.2021 15:46:47

Emissions 18-26 GHz, Ch157, 802.11a 6M, HP @1m



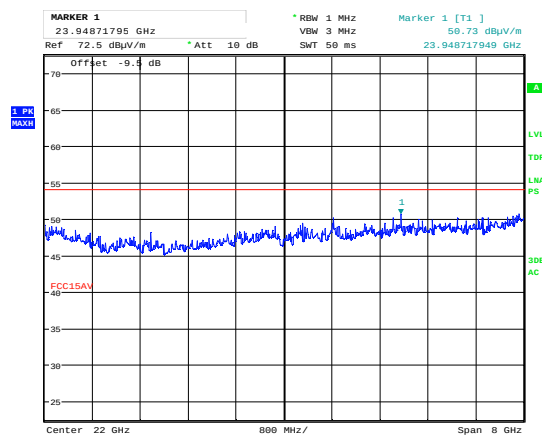
Date: 12.OCT.2021 15:51:20

Emissions 18-26 GHz, Ch052, 802.11a 6M, VP @1m



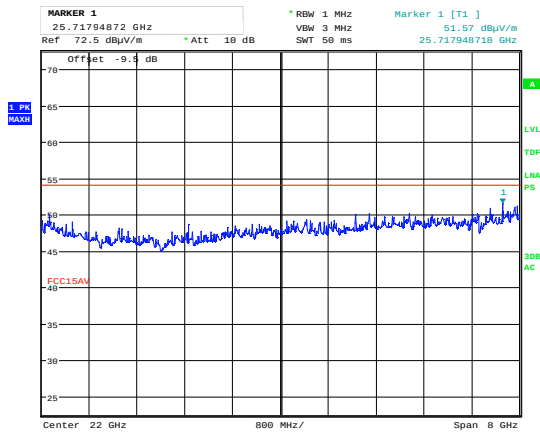
Date: 12.OCT.2021 16:07:17

Emissions 18-26 GHz, Ch116, 802.11a 6M, VP @1m



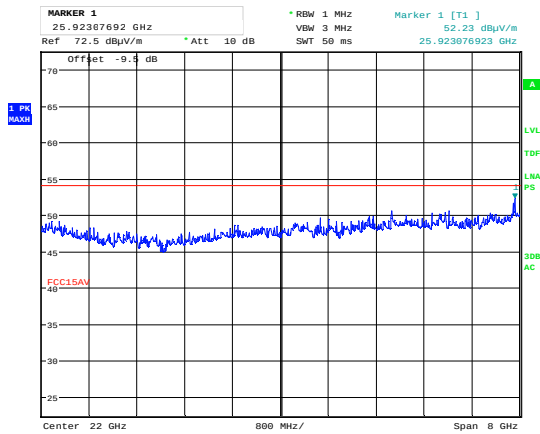
Date: 12.OCT.2021 15:47:41

Emissions 18-26 GHz, Ch157, 802.11a 6M, VP @1m



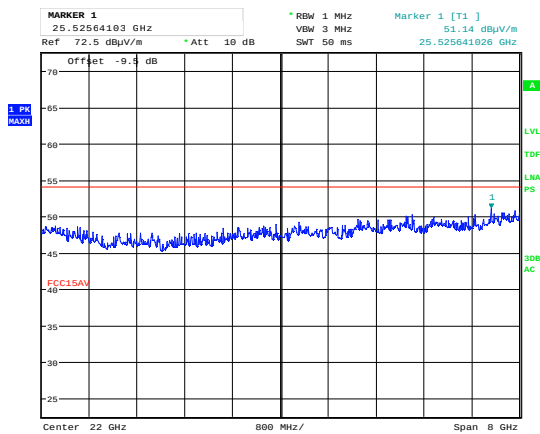
Date: 12.OCT.2021 15:39:59

Emissions 18-26 GHz, Ch052, 802.11n MCS0, HP @1m



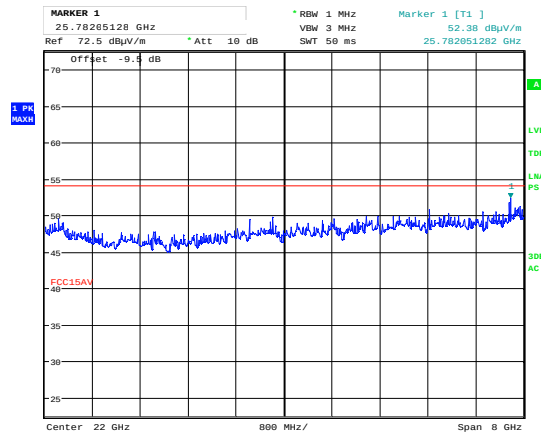
Date: 12.OCT.2021 15:41:07

Emissions 18-26 GHz, Ch116, 802.11n MCS0, HP @1m



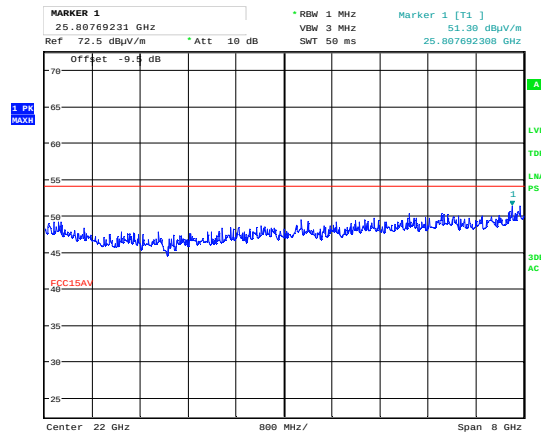
Date: 12.OCT.2021 15:45:20

Emissions 18-26 GHz, Ch157, 802.11n MCS0, HP @1m



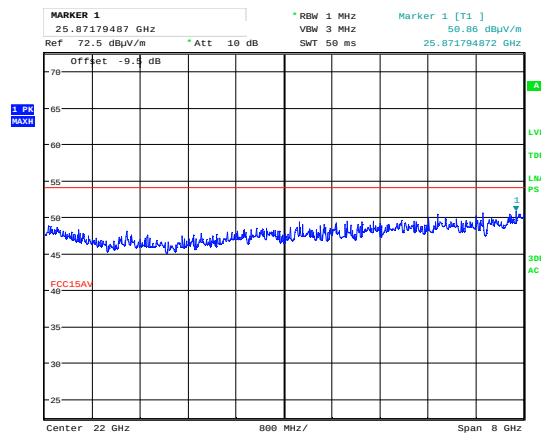
Date: 12.OCT.2021 15:39:08

Emissions 18-26 GHz, Ch052, 802.11n MCS0, VP @1m



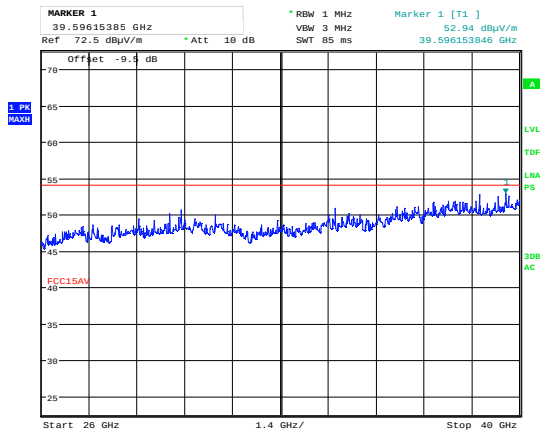
Date: 12.OCT.2021 15:43:42

Emissions 18-26 GHz, Ch116, 802.11n MCS0, VP @1m



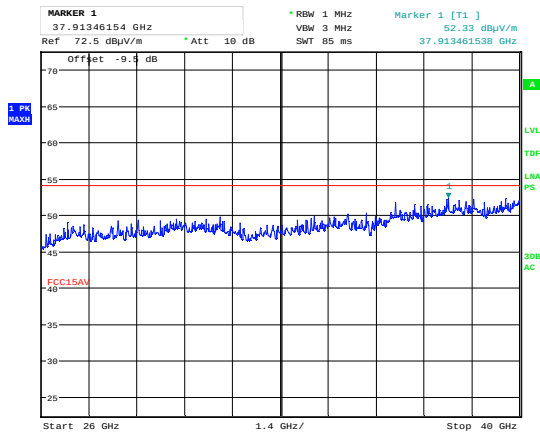
Date: 12.OCT.2021 15:44:34

Emissions 18-26 GHz, Ch157, 802.11n MCS06M, VP @1m



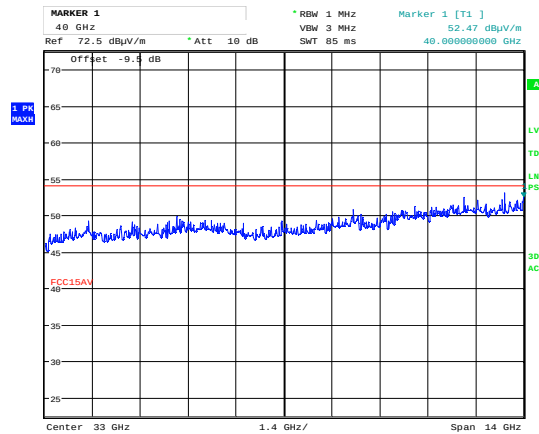
Date: 12.OCT.2021 16:08:06

Emissions 26-40 GHz, Ch116, 802.11a 6M, HP @1m



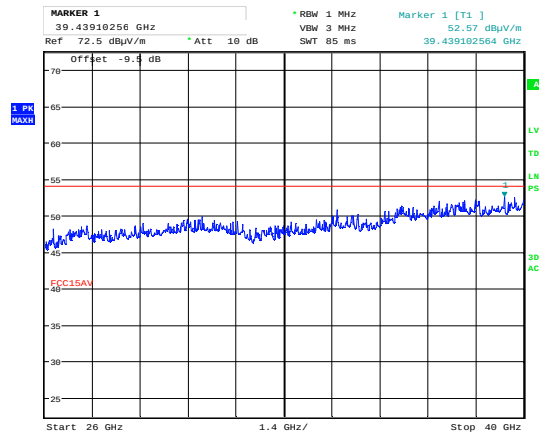
Date: 12.OCT.2021 16:09:46

Emissions 26-40 GHz, Ch116, 802.11n MCS0, HP @1m



Date: 12.OCT.2021 16:07:17

Emissions 26-40 GHz, Ch116, 802.11a 6M, VP @1m



Date: 12.OCT.2021 16:10:37

Emissions 26-40 GHz, Ch116, 802.11n MCS0, VP @1m

4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		Uncertainty
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	< 3.6 GHz	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	< 1 GHz	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	Frequency	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	ESU40	Measuring Receiver	Rohde & Schwarz	LR 1639	2021-02	2022-02
2	6810-17B	Attenuator	Suhner	LR 1669	2021-08	2022-08
3	317	Preamplifier	Sonoma Inst.	LR 1687	2021-08	2022-08
4	8449A	Pre-amplifier	Hewlett Packard	LR 1322	2021-08	2022-08
5	3115	Horn Antenna	EMCO	LR 1330	N/A	
6	3117-PA	Horn Antenna +PreAmp	EMCO	LR 1717	2021-08	2022-08
7	Model 638	Antenna Horn	Narda	LR 1480	N/A	
8	WLK5-1100-1485-7000-40SS	Low Pass Filter (1 GHz)	Wainwright Inst.	LR 1761	COU	
9	N0452501 (5150-5350 MHz)	BandStop Filter	Microwave Circuits	LR 1775	COU	
10	N0555983 (5470-5725 MHz)	BandStop Filter	Microwave Circuits	LR 1774	COU	
11	N0257881 (5725-5850 MHz)	BandStop Filter	Microwave Circuits	LR 1764	COU	
12	ST18/SMA/N/36	RF Cable	Suhner	LR 1627	COU	

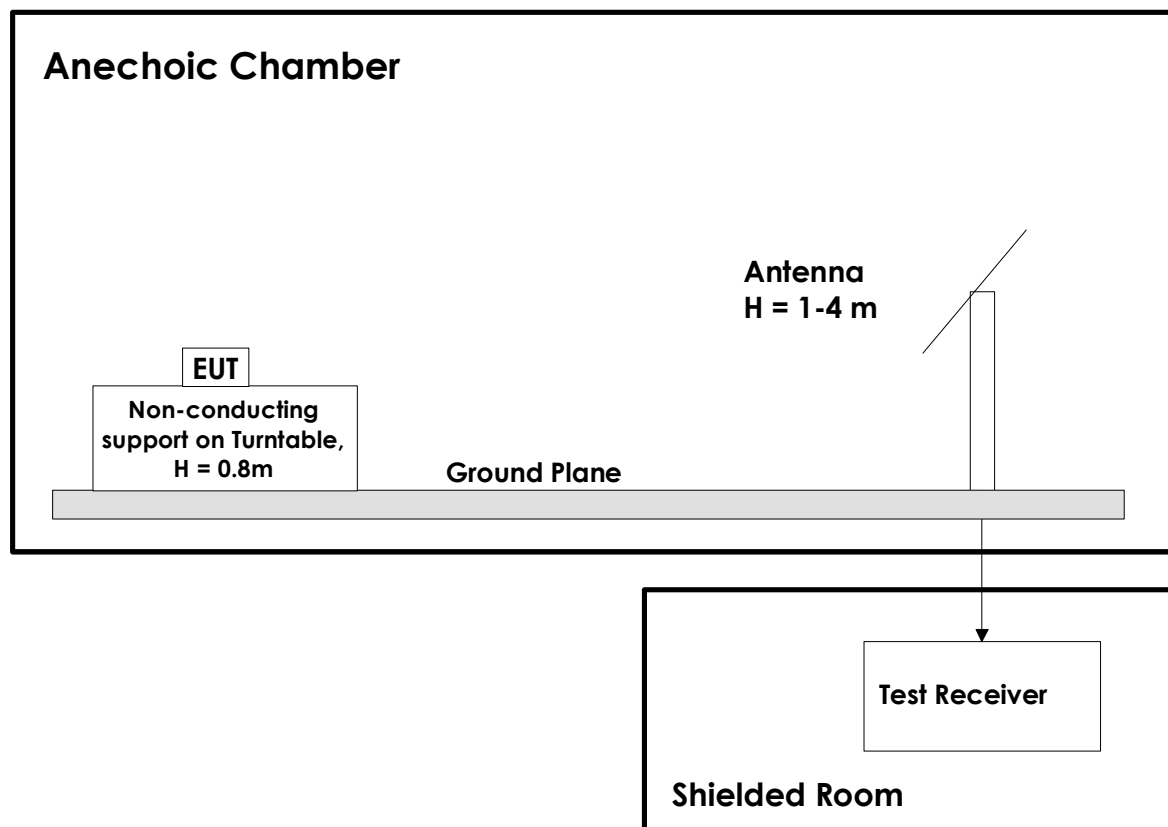
Note: COU – calibrate on use; N/A – Not Applicable

The software listed below has been used for one or more tests.

No.	Manufacturer	Name	Version	Comment
1	Rohde & Schwarz	EMC32	10.50.10	EMC test software
2	Nemko AS	RSPlot	1.0.8.0	Screenshots from R&S Spectrum Analyzers

6 BLOCK DIAGRAM

6.1 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. Measuring distance is 3m for all frequencies.

Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna.

All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers.

A pre-amplifier is used for all measurements, and High-Pass filter is used for all harmonics.