

TEST REPORT

RADIOCOMMUNICATIONS

FCC TITLE 47 PART 15C (WiFi)

CLASS II PERMISSIVE CHANGE

Client: Industrea Mining technology Pty Ltd
T/A: Digital Mining Technology

Address: 3 Co-wyn Close, Fountaindale, NSW 2258, Australia

Report Number: 0712INT_CASGPSIVU_FCC15C

Dates of Testing: 10 Nov. 2021 to 3 May 2022

File Number: INT210709

Equipment Name: CAS-GPS IVU

Model Number: PROD0842-2, PROD0847-2, PROD0842-2NB, PROD0847-2NB

FCC ID: XPYJODYW263 (WiFi module)

Description: Collision Avoidance System

Result: The sample tested **COMPLIED** with the applicable requirements of the standard.
(Refer to Compliance Summary page for details).

Tested by: Steven Garnham
Test Engineer



Approved by: Colin Gan
Assessment Engineer



Date of Issue: 18 Jul. 2022

Results appearing herein relate only to the sample(s) tested.

This report is issued errors and omissions exempt and is subject to withdrawal at Austest Laboratories discretion.

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1 REPORT REVISION HISTORY

Date	Report Number	Changes
18 Jul. 2022	0712INT_CASGPSIVU_FCC15C	Original Report.

2 REFERENCES

Document		Issue/ Amended
FCC Title 47	FCC Title 47 Part 15 – Radio Frequency Devices	1 Oct. 2020
ANSI C63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	2013
558074 D01	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under Section 15.247 of the FCC rules	v05r02 2 Apr. 2019
ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz	2014
Client Test Plan	IND01 223, Certification Test Procedure Ver, 0.2	7 Sep. 2021

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3 COMPLIANCE SUMMARY

DISCLAIMER: Austest Laboratories makes no claim regarding the consistency of production versions of the EUT. The results in this report apply only to the sample tested, as described in Section 5 of this report.

FCC Part 15, Subpart C – Intentional Radiators - RSE		Result	Notes
15.203	Antenna Requirement	Complied	(i)
15.205	Restricted Bands of Operation	Complied	-
15.209	Radiated Emission Limits, General Requirements	Complied	-
15.247	Operation within the Bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz	Complied	-
15.247(b)(1)	Equivalent Peak Conducted Output Power	Complied	(ii)
15.247(d)	Out of band emissions	Complied	-
15.247(i)	Maximum Permissible Exposure (MPE)	Complied	-

Notes

- (i) The EUT must be professionally installed, typically in mining vehicles.
- (ii) Power settings were as per the original filing. Although the antenna gain had increased, it remained below 6 dBi and therefore does not impact the power limits used in the original filing.

4 MODIFICATIONS

No modifications were made to the sample.

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5 EQUIPMENT UNDER TEST INFORMATION

5.1 EUT Summary

EUT Name:	CAS-GPS IVU	
Models:	PROD0842-2, PROD0847-2, PROD0842-2NB, PROD0847-2NB	
Serial Number:	8476 2106 0003G (as tested)	
External Supply Rating:	9 – 36 VDC	
Frequency Range:	2400 MHz – 2483.5 MHz	
Transmit Power:	Maximum +16 dBm *	
Modulation Technique:	DSSS, OFDM	
Number of Channels:	11 (Ch.1 to Ch. 11)	
Antenna Specifications:	External 3.0 dBi (as specified by the manufacturer)	

*Output power and operating modes adjusted as per table in Section 6.2.

5.2 EUT Description

The EUT was a CAS-GPS IVU (Collision Avoidance System component) and consisted of an In-Vehicle Unit (IVU) with V2V transceiver, 2.4 GHz WLAN, 3G / 4G / LTE modem, User Interface Display and GNSS Receiver.

The tested model was PROD0847-2 containing the WLAN, GNSS, GSM / 3G / LTE module.

Model PROD0842-2 was without the GSM / 3G / LTE module.

The EUT was a revised construction of PROD0842-x and PROD0847-x with compliant u-blox WiFi module, model Jody-W263-00B, a u-blox GNSS module, model ZED-F9P-00B-002, and an external 3 dBi gain antenna.

Bluetooth is disabled by routing the Bluetooth antenna port into 50 Ohm terminations on the circuit board as shown in the schematic and internal block diagram following. This guarantees that Bluetooth is not used. The WiFi 5 GHz operation is disabled in the software configuration. Hence, these functions will not be available in supplied versions to the customer.

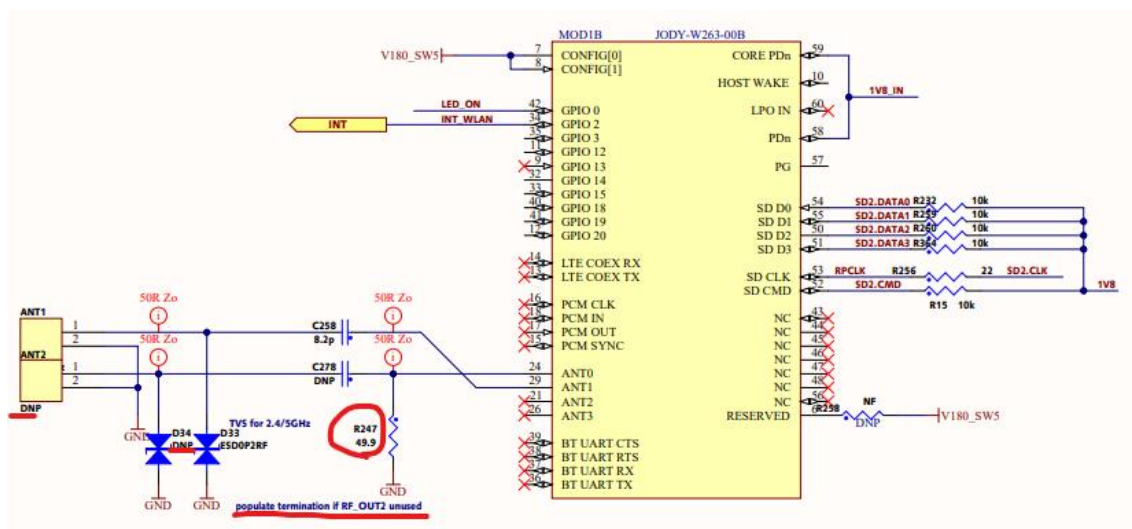
The EUT was also assessed with the internal battery fitted.

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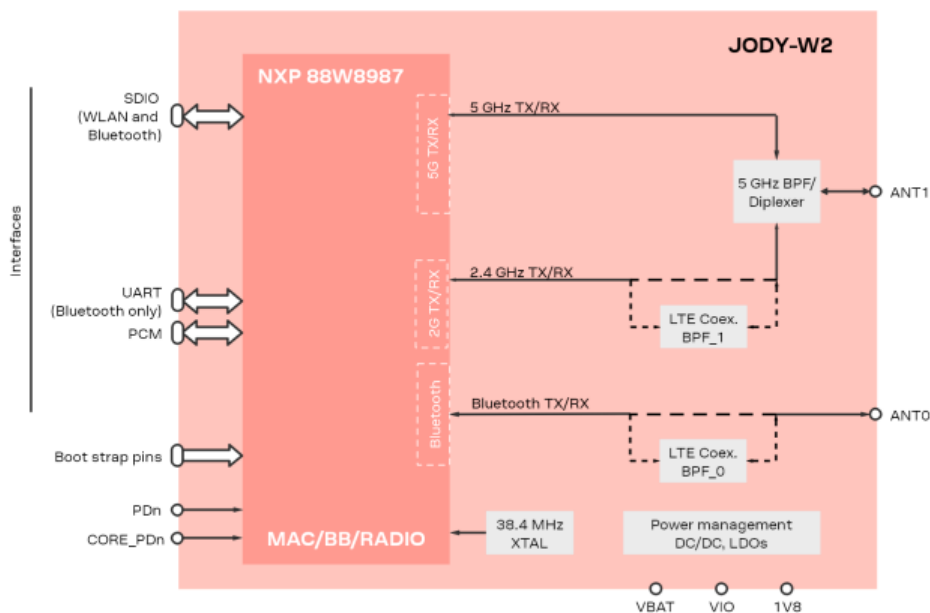
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Schematic



Internal Block Diagram

5.3 Description of Class II Change

The major change filed under this application is:

Use of a 3 dBi gain antenna compared to the original test with a 2.2 dBi gain antenna.

Antenna Type: SYSKIM WiFi OMNI Antenna

Model: OYHO2020-NF

Frequency: 2400 MHz – 2483.5 MHz

Antenna Gain: 3 dBi

The EUT was fitted with a compliant WiFi module, FCC ID: XPYJODYW263, and a GNSS module, model ZED-F9P-00B-002.

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6 TEST SETUP AND EUT CONFIGURATION

6.1 EUT Configurations

The EUT was located on the test table and connected as per the manufacturer's test procedures.

A pre-programmed USB drive was inserted to enable control of the WiFi operational modes via the associated laptop.

The information contained within the original compliant test report MDE_UBLOX_2008_FCC_2 was used in configuring the operating channels, output power and modulation, to enable a direct comparison using the antenna with 3 dBi gain, compared to the original 2.2 dBi gain.

Refer to the photographs in Appendix B for the EUT test setup and physical configuration.

6.2 EUT Operating Modes

The supplied unit had both the WiFi operation on the 5 GHz band and the 2.4 GHz BLE mode disabled. The supplied software was used to operate the WLAN module (2.4 GHz band only) in all modes, 802.11 b, g, n20 and n40, as per the below table from the original test report MDE_UBLOX_2008_FCC_02 under FCC filing ID: XPYJODYW263.

WLAN Power settings: (dBm)

Channel	1	2	3	4	5	6	7	8	9	10	11
Frequency (MHz)	2412	2417	2422	2427	2432	2437	2442	2447	2452	2457	2462
WLAN b	12	12	12	12	12	12	12	12	12	12	12
WLAN g	11	16	16	16	16	16	16	16	16	16	11
WLAN n 20	11	16	16	16	16	16	16	16	16	16	11
WLAN n 40	-	-	10	11	12	13	13	13	12	-	-

Tested data rates: WLAN b: 1 Mbps; WLAN g: 6 Mbps; WLAN n: MCS0.

6.3 Supporting Equipment

Equipment	Brand & Model
Display	PROD0839A
Variable DC Power Supply	GWInstek
Ethernet Switch	Netgear FS108
Laptop	Lenovo Thinkpad T430

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6.4 Cables / Ports

EUT Port	Source/Load	Cable Type	Length*
Deutsch Connector	Multiple Cables / Loop Back	Supplied cable harness	1.3m
Deutsch Connector	USB	Supplied cable harness	1.3m
Deutsch Connector	DC Supply In	Supplied cable harness	1.3m
LAN	Ethernet Switch	Supplied Shielded RJ45	3m
Display	PROD0839A	As Supplied	15.3m
GSM	Laird, Cell Antenna, 1700MHz-2700MHz, TRA6927M3PWN-001	Coax	3m
V2V	Laird, 902 – 923MHz Antenna TRAB902NP	Coax	5.3m
GPS	Tallysman Antenna 33-3972-01-01	Coax	3m
WLAN	SYSKIM Antenna OYH O202O-NF	Coax	1m
Associated Equipment LAN	Associated Equipment Ethernet Switch	UTP RJ45	1.8m

*Cable length was adjusted by bundling or cut to length in accordance with the standard.

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7 TEST SPECIFICATIONS

7.1 Test Facility

Testing was performed at Austest Laboratories located at 46 Glenola Farm Lane in Yarramalong Valley, New South Wales, Australia.

Radiated emission testing was performed at an OATS, where some ambient signals may have exceeded the continuous disturbance limit. The possibility of missing an emission during testing was removed by performing pre-scans in a shielded enclosure prior to the final OATS measurements.

For testing below 30 MHz, measurements were performed over the normal OATS ground plane and also over a non-conductive ground plane as per ANSI C63.10, clause 5.2.

7.2 Accreditations and Listings

Test facilities at Austest Laboratories are accredited by A2LA, Certificate Number 2765.02. The tests reported herein have been performed in accordance with its terms of accreditation.

Austest Laboratories Yarramalong and Castle Hill test facilities are accredited with the FCC under the ACMA-FCC APEC-TEL MRA. Designation Number AU0003 / Registration number 520620.

7.3 Deviations from Standards and/or Accreditations

No deviations to the standard or Austest accreditation was required.

7.4 Test Witnesses

None.

7.5 Test Equipment

All critical items are maintained on a scheduled calibration recall program or verified with equipment maintained on a scheduled calibration program. Emission measurements are traceable to Australian National standards or international equivalents.

ID	Brand/Model	Description	Last Calibrated	Calibration Due
72	HP8574B	Spectrum Analyser / EMI Rx	07/11/2021	07/11/2023
74	HP8447x	RF Preamplifier	07/04/2021	07/04/2023
83	OATS 1 / FSOATS 1	3 m/10 m Open Area Test Site NSA, Svswr compliant	16/01/2020	16/01/2023
225	EM6876	Active Loop Antenna 9 kHz – 30 MHz	29/03/2022	29/03/2024
1101	Com-Power SAS/571	DRG Horn	08/05/2021	08/05/2024

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ID	Brand/Model	Description	Last Calibrated	Calibration Due
1241	Com-Power PAM-118A	RF Preamp	02/05/2022	20/05/2024
1385	FSP40	Spectrum analyser 38GHz	24/09/2020	24/09/2022
1590	Ametek CBL6141B	Bilog Antenna	22/09/2020	22/09/2022
-	Huber + Suhner	Coax Cables	14/04/2022	14/04/2024
-	HP85869C	Test Software	Verified	
-	Rohde & Schwarz	RS Commander Capture Software	Verified	

7.6 Measurement Uncertainty

Measurement uncertainty U_{Lab} was calculated for a 95% level of confidence and based on a coverage factor of $k=2$.

Measurement	Uncertainty	
	U_{Cispr}	U_{Lab}
RF Frequency	-	± 5 part in 10^{10}
RF power conducted	-	± 1.3 dB
RF power radiated <1GHz	-	± 4.5 dB
RF power radiated >1GHz	-	± 4.9 dB
Radiated Emissions – 30 MHz to 1000 MHz	6.3 dB	± 4.7 dB
Radiated Emissions – 1 GHz to 6 GHz	5.2 dB	± 4.9 dB
Radiated Emissions – 6 GHz to 18 GHz	5.5 dB	± 5.3 dB

7.7 Emission Test Criteria

The laboratory expanded MIU (U_{lab}) was less than the CISPR 16-4-2 criterion for the expanded MIU (U_{Cispr}) and therefore:

- Compliance was deemed to occur if no measured disturbance exceeded the disturbance limit;
- Non-compliance was deemed to occur if any measured disturbance exceeded the disturbance limit.

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8 ANTENNA REQUIREMENT, §15.203

The EUT complied with this requirement, since the installation must be professionally performed, typically in mining vehicles.

The manufacturer indicated that installation will be performed using only antennas and materials provided by the manufacturer and thereby precludes unauthorised substitution.

Furthermore, user manual includes following statement in Section 5, Regulatory Information:

“The antenna is considered an integral system component. Use of any antenna other than those specified in the installation manual or supplied with the product may void the product’s compliance.”

9 RESTRICTED BANDS OF OPERATION, §15.205

The EUT complied with the requirements of this Section since it did not operate within the listed Restricted Bands of Operation.

Out of band emissions falling within the Restricted Bands of Operation were found to be below limits specified in FCC section 15.209.

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10 RADIATED SPURIOUS EMISSIONS, 15.209, 15.247

10.1 EUT Operating Mode

- a. Refer Section 6.
- b. Prior to performing measurements, the RF output power was checked and adjusted to that as indicated within the original settings table shown in section 6.2 of this report.
- c. Although the antenna gain had increased, it remained below 6 dBi and therefore does not impact the power limits used in the original filing.

10.2 Test Method

- a. Measurements were performed in accordance with ANSI C63.10-2013, KDB 558074. Peak measurements were performed using a Peak Detector; Average measurements were performed with an average detector; video averaging was not employed.
- b. The measuring receiver BW settings were:

Frequency Range	Antenna	Measurement	Detector	RBW	VBW
0.15 to 30 MHz	60 cm Loop	Pre-scan	Peak	9 kHz	30 kHz
		Final Quasi-Peak	Quasi-Peak	9 kHz	-
30 to 1000 MHz	Hybrid (Bicon/log)	Pre-scan Peak	Peak	120 kHz	300 kHz
		Final Quasi-Peak	Quasi-Peak	120 kHz	-
Above 1000 MHz	Double-ridged guide horn	Pre-scan Peak	Peak	1 MHz	3 MHz
		Pre-scan Average	Average	1 MHz	3 MHz
		Final Peak	Peak	1 MHz	3 MHz
		Final Average	Average	1 MHz	3 MHz

- c. The EUT was setup on a non-conductive turntable.
- d. For measurement below 1 GHz at a height of 0.8 m above the OATS conductive ground plane and at the indicated test distance away from the measuring antenna.
- e. For measurements above 1 GHz at a height of 1.5 m above the OATS conductive ground plane with RF absorber placed between the test table and measuring antenna.
- f. To maximise emissions, the EUT was rotated through 360°, and the measuring antenna height adjusted between 1 m to 4 m in the following antenna orientations:
 - i. Loop antenna (9 kHz to 30 MHz) over a non-metallic ground plane – Coaxial, Coplanar and also horizontal (parallel to ground) orientations.
 - ii. Bilog antenna (30 MHz to 1 GHz) - Both vertical and horizontal polarizations.
 - iii. Horn antenna (above 1 GHz) - Both vertical and horizontal polarizations.
- g. The maximised emission level was measured and the above repeated for all measurement frequencies.
- h. Average level measurements were not made where the peak level did not exceed the average limit.
- i. Linearity of the measuring system was checked, reducing gain when required.
- j. Test distances: Where the actual test distance used was different to that specified, then the test data results shown in any tables were extrapolated to the required distance using the formula specified within ANSI C63.10:2013. For simplicity, the test data plots have the limit lines adjusted to reflect any different test distance giving a visual indication of the relative margins.
- k. **Ambient Emissions:** Measurements were performed at an Open Area Test Site (OATS), where some ambient signals may exceed the limit. The possibility of missing an emission during testing was removed by performing pre-scans in a shielded enclosure prior to the final OATS measurements. The ambient emissions are indicated as a '1' or 'A' on the scans, refer to the notes after the graphs.

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10.3 Sample Calculation Example

The final radiated emission levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

$$E = V + AF + L_{cbl} - G_{pre}$$

Where:

- E = Radiated Electric Field Strength in dB μ V/m at the specified distance.
- V = EMI Receiver measured signal input voltage in dB μ V.
- AF = Antenna Factor of the measuring antenna in dB/m.
- L_{cbl} = Total cable insertion loss in dB.
- G_{pre} = Preamplifier gain in dB.

Frequency (MHz)	Receiver Level, V (dB μ V)	AF (dB/m)	L _{cbl} (dB)	G _{pre} (dB)	Corrected Level, E (dB μ V/m)
100.0	40.0	12.0	2.9	22.5	32.4

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10.4 Test Results

10.4.1 Radiated Emissions: 9 kHz to 150 kHz at 10 m distance

Test Date:	11 th November 2021	Temperature:	20°C
Test Officer:	Steven Garnham	Humidity:	80%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

9 kHz to 150 kHz measured at 10 meters.

Measured data extrapolated to distance defined by limits (300 m for 9-490 kHz and 30 m for 490 kHz – 30 MHz).

The $\lambda/2\pi$ distance in m, $d_{near\ field}$, shall be determined using equation (1)

$$d_{near\ field} = 47.77 / f_{MHz}$$

Where f_{MHz} is the frequency of emission being measured in MHz.

In accordance with ANSI C63.10 Clause 6.4.4.1:

Below 4.8 MHz used 40 dB/decade extrapolation.

Where 4.8 MHz calculated as the near field point for 10-meter measurements.

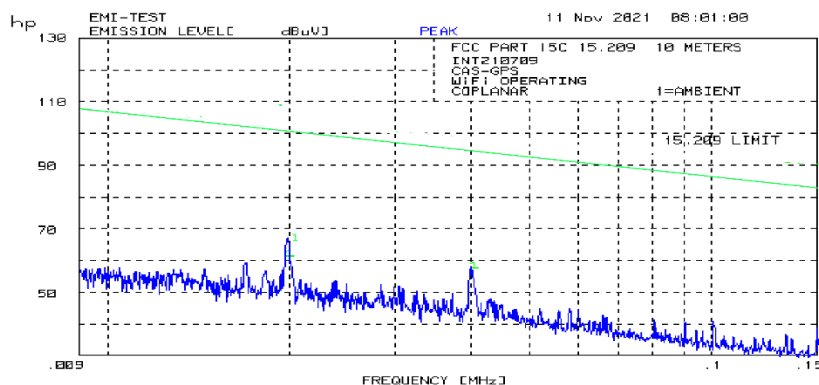
Measurements were performed both on an OATS ground plane and finally also over a non-conductive ground plane as specified in ANSI C63.10:2013, clause 5.2.

Pre-scan results were used to identify the orientation that produced the highest measured emissions in the three antenna positions, Coaxial, Coplanar and Parallel.

The highest measured emission or noise floor with respect to limit was as shown in table below:

Frequency (kHz)	Receiver Level (dBμV)	AF + L _{cbl} (uV/m)	Corrected Level 10 m (dBμV/m)	Extrapolated Level to 300 m (dBuV/m)	300 m Limit (dBuV/m)	Margin (dB)
All measured non-Ambient emission levels were >40 dB below limits.						

Plot with maximum emissions shown at 10 meters.



Maximum Emissions

Note: A Green '1' indicates an ambient emission.

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10.4.2 Radiated Emissions: 150 kHz to 30 MHz at 3 m distance

Test Date:	11 th November 2021	Temperature:	20°C
Test Officer:	Steven Garnham	Humidity:	80%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

150 kHz to 30 MHz measured at 3 meters.

Measured data extrapolated to distance defined by limits (300 m for 9-490 kHz and 30 m for 490 kHz – 30 MHz).

The $\lambda/2\pi$ distance in m, $d_{near\ field}$, shall be determined using equation (1)

$$d_{near\ field} = 47.77 / f_{MHz}$$

Where f_{MHz} is the frequency of emission being measured in MHz.

In accordance with ANSI C63.10 Clause 6.4.4.1:

Below 15.9 MHz used 40 dB/decade extrapolation.

Above 15.9 MHz used 20 dB/decade extrapolation.

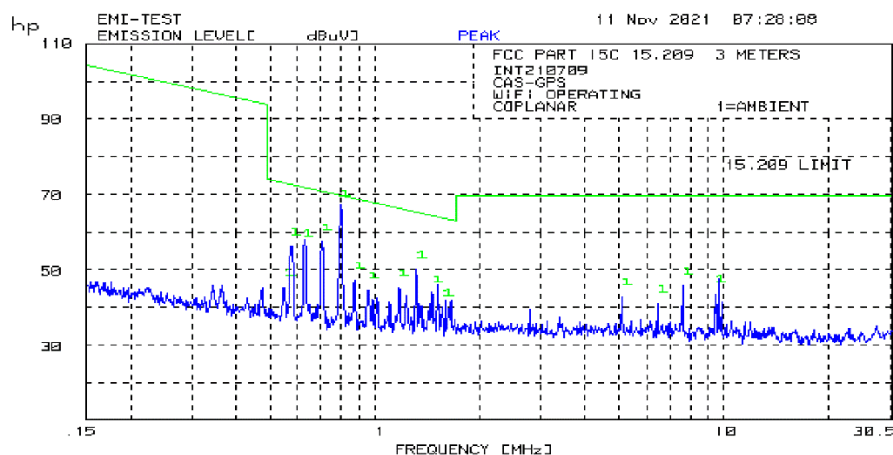
Where 15.9 MHz calculated as the near field point for 3-meter measurements.

Measurements were performed both on an OATS ground plane and finally also over a non-conductive ground plane as specified in ANSI C63.10:2013, clause 5.2.

Pre-scan results were used to identify the orientation that produced the highest measured emissions in the three measurement antenna positions, Coaxial, Coplanar and Parallel.

The highest measured emission or noise floor with respect to limit was as shown in table below:

Frequency (kHz)	Receiver Level (dBμV)	AF + L _{cbl} (uV/m)	Corrected Level 3 m (dBμV/m)	Extrapolated Level to 30 m (dBuV/m)	30 m Limit (dBuV/m)	Margin (dB)
All measured non-Ambient emission levels were greater than 20 dB below limits.						



Maximum Emissions

Note: A Green '1' indicates an ambient emission.

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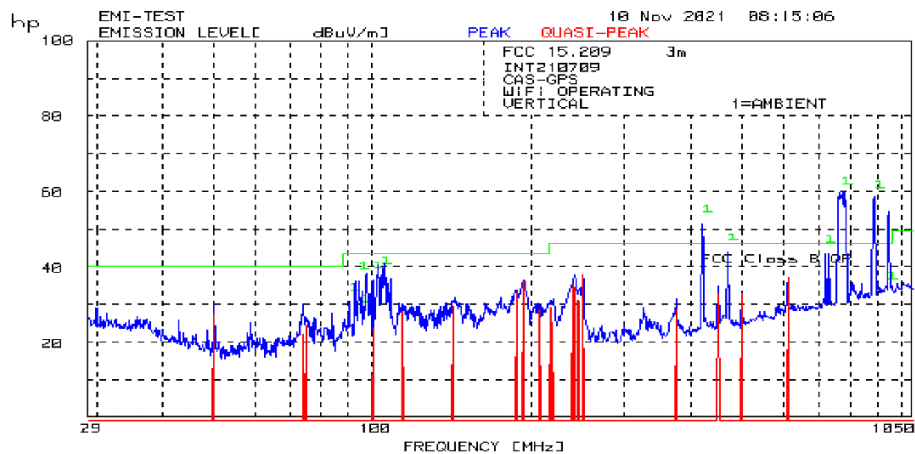


10.4.3 Radiated Emissions: 30 MHz to 1000 MHz at 3 m distance

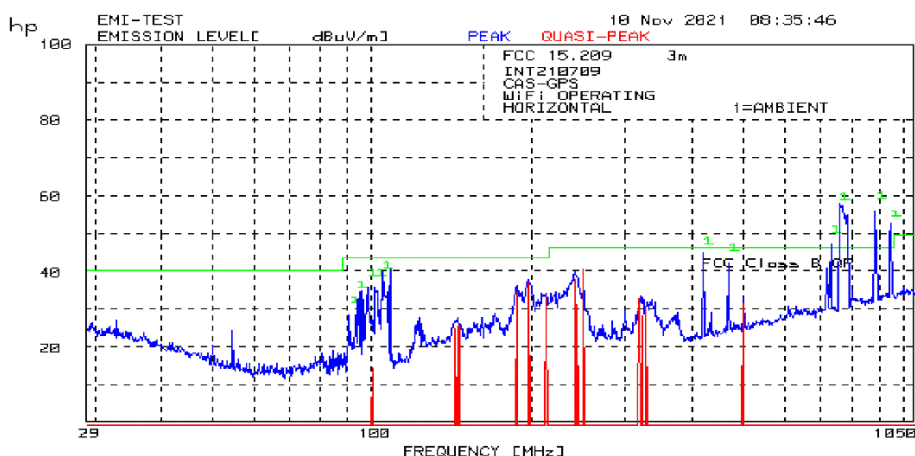
Test Date:	10 th November 2021	Temperature:	22°C
Test Officer:	Steven Garnham	Humidity:	65%
Test Location:	Austest Laboratories (Yarramalong, NSW)		

Measured spurious levels were independent of channel or mode selection.

Frequency (MHz)	Antenna Polarity	Pk / Quasi-Peak (dBμV/m)		
		Level	Limit	Margin
250.0	Horizontal	40.4	46.0	-5.6
197.5	Horizontal	36.6	43.5	-6.9
192.6	Vertical	35.9	43.5	-7.6
241.4	Horizontal	37.9	46.0	-8.1
250.0	Vertical	37.8	46.0	-8.2
611.0	Vertical	37	46.0	-9.0



Radiated Emissions (30MHz to 1000MHz – Vertical)



Radiated Emissions (30MHz to 1000MHz - Horizontal)

Note: A Green '1' indicates an ambient emission.

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10.4.4 Radiated Emissions: 1 GHz to 25 GHz at 3 m distance

Test Dates:	5 th April 2022	Temperature:	18°C 25°C	Humidity:	72% 59%
Test Officer:	Steven Garnham				
Test Location:	Austest Laboratories (Yarramalong)				

For simplicity the radiated FCC 15.209 limits were applied over the required range as they were lower than the related in-band reference levels.

WLAN Mode: 802.11 b; 20 MHz; 1 Mb/s

Analyser BW settings: RBW=1 MHz; VBW=3 MHz.

Ch No.	Ch. Centre Freq. (MHz)	RF Power Setting (dBm)	Spurious level		Detector (Pk/Avg)	Limit (dBuV/m)	Margin (dB)	Antenna Polarity
			Freq. (MHz)	Level (dBuV/m)				
1	2412	12	4824.0	43.9	Avg	54.0	-10.1	Vertical
			4824.0	63.1	Pk	74.0	-10.9	
			7236.0	44.3	Avg	54.0	-9.7	
			7236.0	58.9	Pk	74.0	-15.1	
1	2412	12	4824.0	33.8	Avg	54.0	>-20	Horizontal
			4824.0	37.6	Pk	74.0	>-20	
			7236.0	34	Avg	54.0	>-20	
			7236.0	-	Pk	74.0	>-20	
6	2437	12	4874.0	38.8	Avg	54.0	-15.2	Vertical
			4874.0	57.8	Pk	74.0	>-20	
			7311.0	39.4	Avg	54.0	-14.6	
			7311.0	53.8	Pk	74.0	>-20	
6	2437	12	4874.0	32.7	Avg	54.0	>-20	Horizontal
			4874.0	48.1	Pk	74.0	>-20	
			7311.0	-	Avg	54.0	>-20	
			7311.0	-	Pk	74.0	>-20	
11	2462	12	4924.0	39.9	Avg	54.0	-14.1	Vertical
			4924.0	58.5	Pk	74.0	-15.5	
			7386.0	41.4	Avg	54.0	-12.6	
			7386.0	55.2	Pk	74.0	-18.8	
11	2462	12	4924.0	38.0	Avg	54.0	-16.0	Horizontal
			4924.0	56.2	Pk	74.0	-17.8	
			7386.0	39.0	Avg	54.0	-15.0	
			7386.0	52.5	Pk	74.0	>-20	

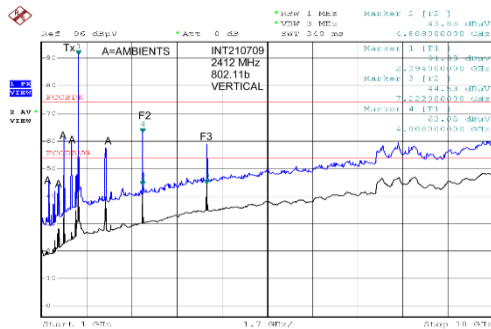
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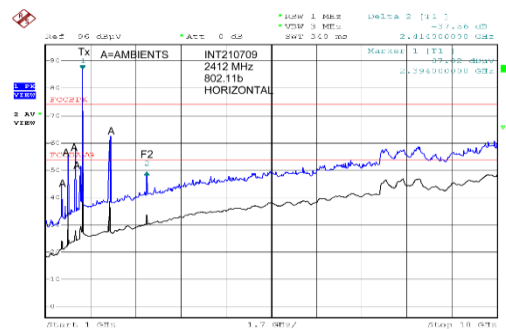


IEEE 802.11 b



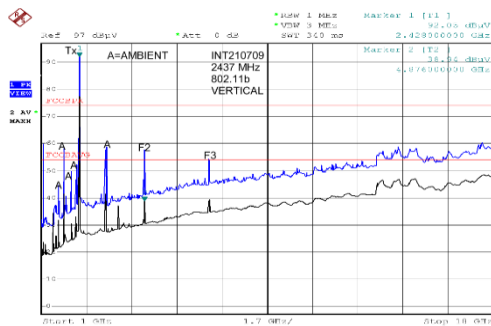
Date: 5.APR.2022 13:40:56

2412 MHz–Peak/Average Vertical Polarisation



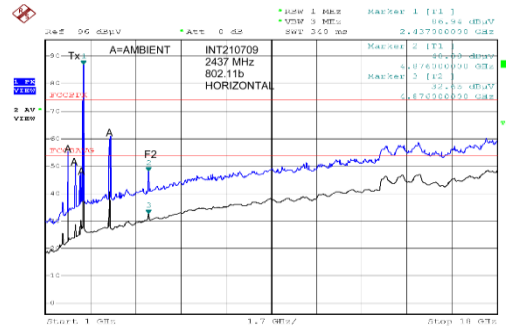
Date: 5.APR.2022 13:55:25

2412 MHz–Peak/Avg Horizontal Polarisation



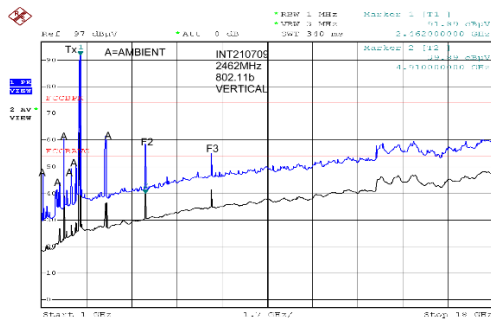
Date: 5.APR.2022 14:17:10

2437 MHz–Peak/Average Vertical Polarisation



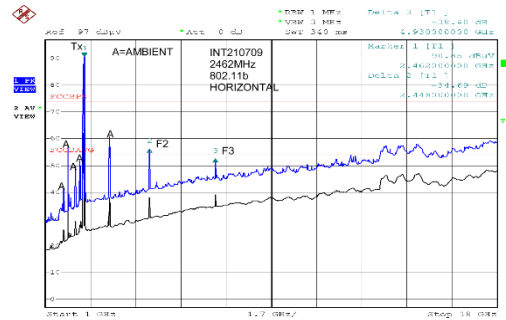
Date: 5.APR.2022 14:01:26

2437 MHz–Peak/Avg Horizontal Polarisation



Date: 5.APR.2022 14:25:26

2462 MHz–Peak/Average Vertical Polarisation



Date: 5.APR.2022 14:30:53

2462 MHz–Peak/Avg Horizontal Polarisation

Note: 'A' indicates an ambient emission.
 Note: 'Tx' indicates an intentional transmitter emission.

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WLAN Mode: 802.11 g; 20 MHz; 6 Mb/s

Analyser BW settings: RBW=1 MHz; VBW=3 MHz.

Ch No.	Ch. Centre Freq. (MHz)	RF Power Setting (dBm)	Spurious level		Detector (Pk/Avg)	Limit (dBuV/m)	Margin (dB)	Antenna Polarity
			Freq. (MHz)	Level (dBuV/m)				
2	2417	16	4834.0	46.6	Avg	54.0	-7.4	Vertical
			4834.0	66.1	Pk	74.0	-7.9	
			7251.0	52.7	Avg	54.0	-1.3	
			7251.0	72.8	Pk	74.0	-1.2	
2	2417	16	4834.0	41.6	Avg	54.0	-12.4	Horizontal
			4834.0	61.7	Pk	74.0	-12.3	
			7251.0	45.3	Avg	54.0	-8.7	
			7251.0	61.8	Pk	74.0	-12.2	
6	2437	16	4874.0	46.3	Avg	54.0	-7.7	Vertical
			4874.0	66.1	Pk	74.0	-7.9	
			7311.0	48.8	Avg	54.0	-5.2	
			7311.0	66.3	Pk	74.0	-7.7	
6	2437	16	4874.0	43.1	Avg	54.0	-10.9	Horizontal
			4874.0	63.1	Pk	74.0	-10.9	
			7311.0	44.8	Avg	54.0	-9.2	
			7311.0	63.7	Pk	74.0	-10.3	
10	2457	16	4914.0	43.8	Avg	54.0	-10.2	Vertical
			4914.0	57.1	Pk	74.0	-16.9	
			7371.0	50.3	Avg	54.0	-3.7	
			7371.0	65.0	Pk	74.0	-9.0	
10	2457	16	4914.0	41.2	Avg	54.0	-12.8	Horizontal
			4914.0	56.7	Pk	74.0	-17.3	
			7371.0	45.39	Avg	54.0	-8.1	
			7371.0	63.7	Pk	74.0	-10.3	

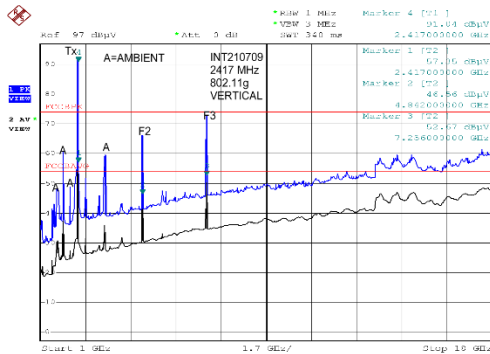
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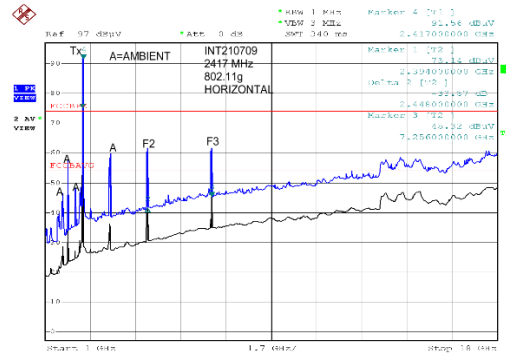


IEEE 802.11 g



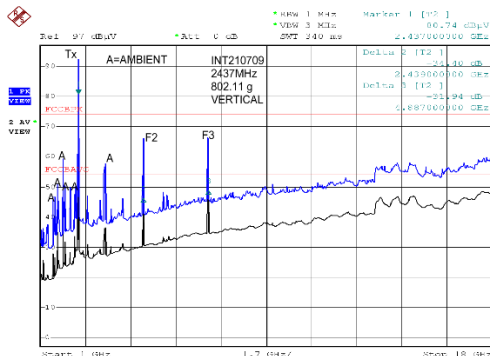
Date: 5.APR.2022 15:25:39

2417 MHz–Peak/Average Vertical Polarisation



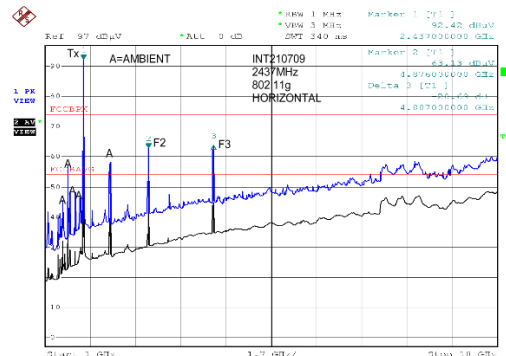
Date: 5.APR.2022 15:29:20

2417 MHz–Peak/Avg Horizontal Polarisation



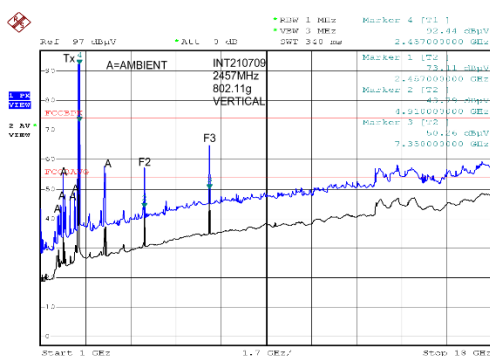
Date: 5.APR.2022 14:44:20

2437 MHz–Peak/Average Vertical Polarisation



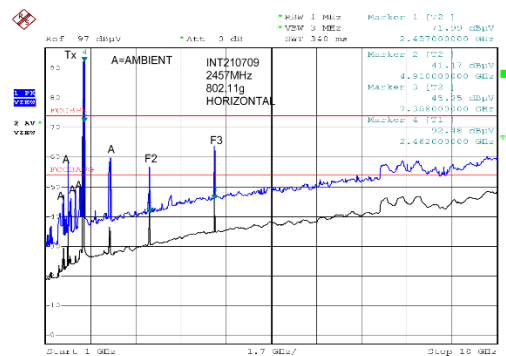
Date: 5.APR.2022 14:39:10

2437 MHz–Peak/Avg Horizontal Polarisation



Date: 5.APR.2022 15:41:24

2457 MHz–Peak/Average Vertical Polarisation



Date: 5.APR.2022 15:33:56

2457 MHz–Peak/Avg Horizontal Polarisation

Note: 'A' indicates an ambient emission.
 Note: 'Tx' indicates an intentional transmitter emission.

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WLAN Mode: 802.11 n; 20 MHz; MCS0

Analyser BW settings: RBW=1 MHz; VBW=3 MHz.

Ch No.	Ch. Centre Freq. (MHz)	RF Power Setting (dBm)	Spurious level		Detector (Pk/Avg)	Limit (dBUV/m)	Margin (dB)	Antenna Polarity
			Freq. (MHz)	Level (dBUV/m)				
2	2417	16	4834.0	46.4	Avg	54.0	-7.7	Vertical
			4834.0	66.7	Pk	74.0	-7.3	
			7251.0	53.1	Avg	54.0	-0.9	
			7251.0	73.2	Pk	74.0	-0.8	
2	2417	16	4834.0	43.2	Avg	54.0	-10.8	Horizontal
			4834.0	61.5	Pk	74.0	-12.5	
			7251.0	47.2	Avg	54.0	-6.8	
			7251.0	64.1	Pk	74.0	-9.9	
6	2437	16	4874.0	46.4	Avg	54.0	-7.6	Vertical
			4874.0	66.2	Pk	74.0	-7.8	
			7311.0	48.8	Avg	54.0	-5.2	
			7311.0	67.1	Pk	74.0	-6.9	
6	2437	16	4874.0	45.2	Avg	54.0	-8.8	Horizontal
			4874.0	65.3	Pk	74.0	-8.7	
			7311.0	47.2	Avg	54.0	-6.8	
			7311.0	65.4	Pk	74.0	-8.6	
10	2457	16	4914.0	45.2	Avg	54.0	-8.8	Vertical
			4914.0	60.6	Pk	74.0	-13.4	
			7371.0	53.0	Avg	54.0	-1.0	
			7371.0	71.1	Pk	74.0	-2.9	
			9428.0	40.0	Avg	54.0	-14.0	
			9428.0	60.3	Pk	74.0	-13.7	
10	2457	16	4914.0	43.2	Avg	54.0	-10.8	Horizontal
			4914.0	58.3	Pk	74.0	-15.7	
			7371.0	47.8	Avg	54.0	-6.2	
			7371.0	68.4	Pk	74.0	-5.6	

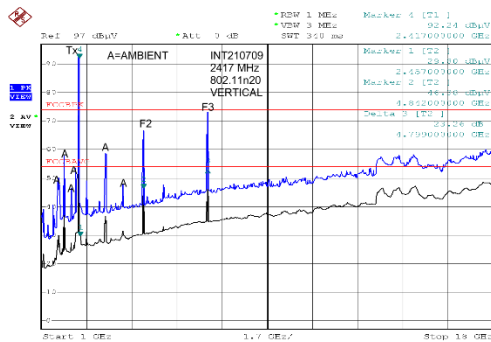
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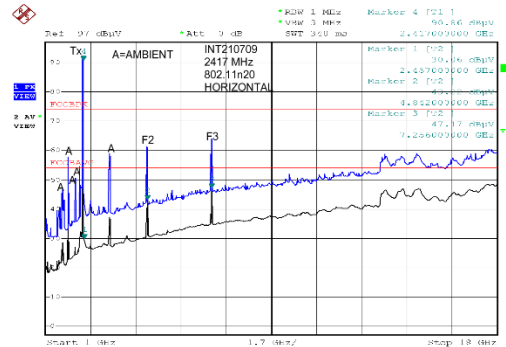


IEEE 802.11 n20



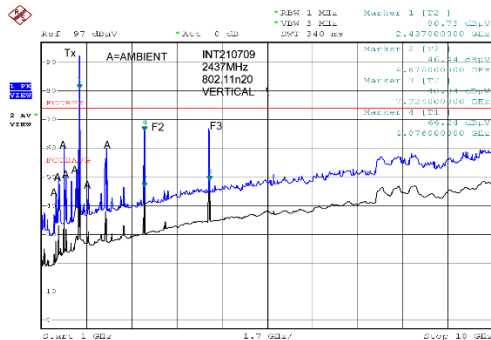
Date: 5.APR.2022 15:57:03

2417 MHz–Peak/Average Vertical Polarisation



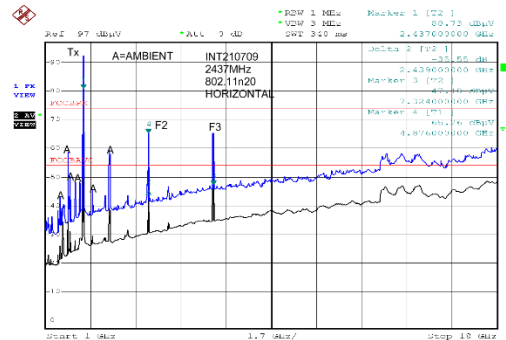
Date: 5.APR.2022 16:00:53

2417 MHz–Peak/Avg Horizontal Polarisation



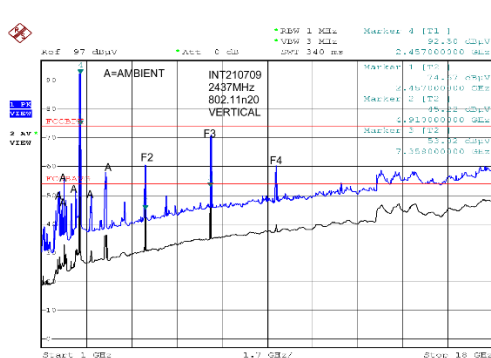
Date: 5.APR.2022 16:10:12

2437 MHz–Peak/Average Vertical Polarisation



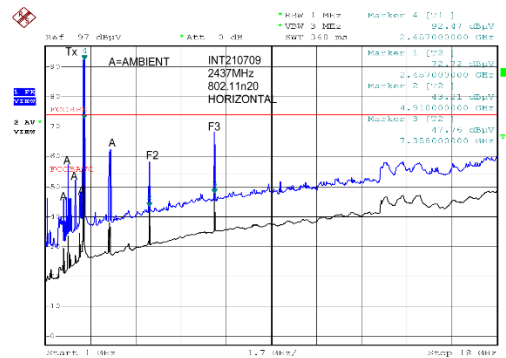
Date: 5.APR.2022 16:14:52

2437 MHz–Peak/Avg Horizontal Polarisation



Date: 5.APR.2022 16:10:11

2457 MHz–Peak/Average Vertical Polarisation



Date: 5.APR.2022 16:10:14

2457 MHz–Peak/Avg Horizontal Polarisation

Note: 'A' indicates an ambient emission.
 Note: 'Tx' indicates an intentional transmitter emission.

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WLAN Mode: 802.11 n; 40MHz; MCS0

Analyser BW settings: RBW=1 MHz; VBW=3 MHz.

Ch No.	Ch. Centre Freq. (MHz)	RF Power Setting (dBm)	Spurious level		Detector (Pk/Avg)	Limit (dBUV/m)	Margin (dB)	Antenna Polarity
			Freq. (MHz)	Level (dBUV/m)				
3	2422	10	4844.0	3	Avg	54.0	-11.2	Vertical
			4844.0	59.1	Pk	74.0	-14.9	
			7266.0	42.8	Avg	54.0	-11.2	
			7266.0	60.0	Pk	74.0	-14.0	
3	2422	10	4844.0	36.2	Avg	54.0	-17.8	Horizontal
			4844.0	51.4	Pk	74.0	>-20	
			7266.0	35.9	Avg	54.0	-18.1	
			7266.0	49.5	Pk	74.0	>-20	
8	2447	13	4874.0	41.2	Avg	54.0	-12.8	Vertical
			4874.0	60.5	Pk	74.0	-13.5	
			7311.0	42.0	Avg	54.0	-12.0	
			7311.0	58.4	Pk	74.0	-15.6	
8	2447	13	4874.0	39.8	Avg	54.0	-14.2	Horizontal
			4874.0	59.5	Pk	74.0	-14.5	
			7311.0	40.8	Avg	54.0	-13.2	
			7311.0	58.0	Pk	74.0	-16.0	
9	2452	12	4904.0	38.9	Avg	54.0	-15.1	Vertical
			4904.0	55.6	Pk	74.0	-18.4	
			7356.0	47.6	Avg	54.0	-6.4	
			7356.0	64.8	Pk	74.0	-9.2	
			9808.0	37.4	Avg	54.0	-16.6	
			9808.0	54.9	Pk	74.0	-19.1	
9	2452	12	4904.0	34.8	Avg	54.0	-19.2	Horizontal
			4904.0	47.7	Pk	74.0	>-20	
			7356.0	38.6	Avg	54.0	-15.4	
			7356.0	52.3	Pk	74.0	>-20	

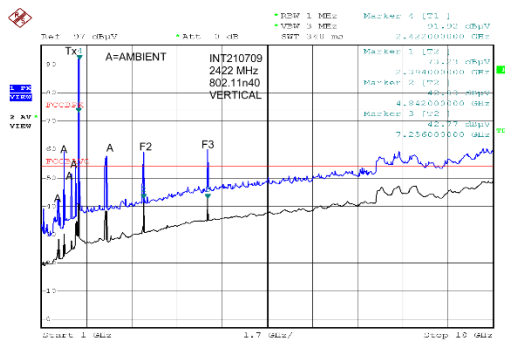
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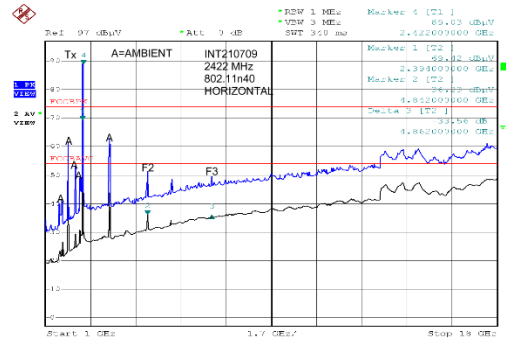


IEEE 802.11 n40



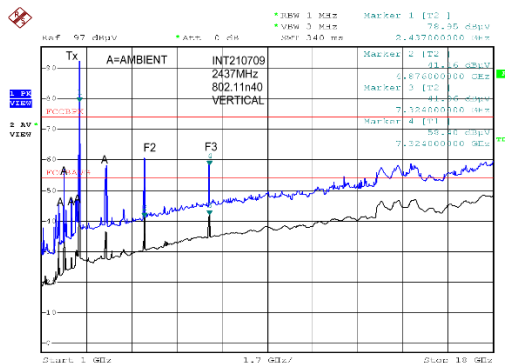
Date: 5.APR.2022 16:18:39

2422 MHz–Peak/Average Vertical Polarisation



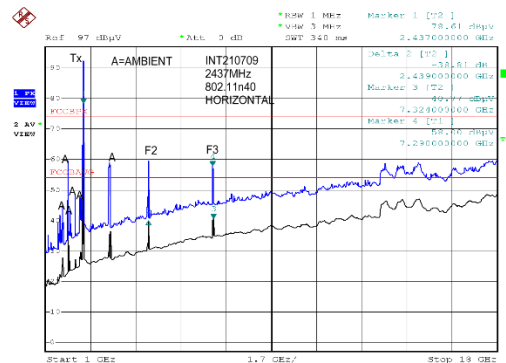
Date: 5.APR.2022 16:23:24

2422 MHz–Peak/Avg Horizontal Polarisation



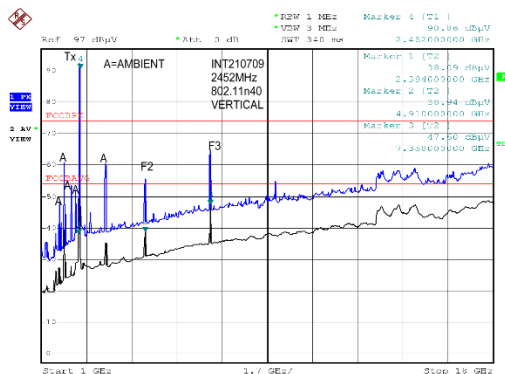
Date: 5.APR.2022 15:04:36

2437 MHz–Peak/Average Vertical Polarisation



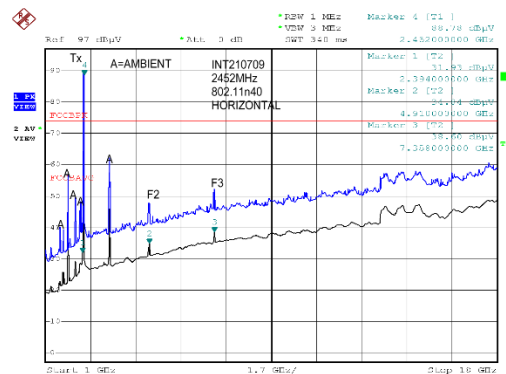
Date: 5.APR.2022 14:59:39

2437 MHz–Peak/Avg Horizontal Polarisation



Date: 5.APR.2022 16:33:43

2452 MHz–Peak/Average Vertical Polarisation



Date: 5.APR.2022 16:28:37

2452 MHz–Peak/Avg Horizontal Polarisation

Note: 'A' indicates an ambient emission.
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10.4.5 Radiated Emissions: 18 GHz to 25 GHz at 1 m distance

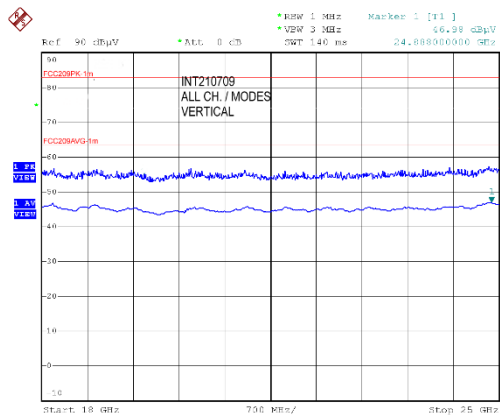
Measured field strength levels performed at a 1 meter distance were extrapolated to a 3 meter distance using the extrapolation factor of 20 dB/decade.

There were no measured radiated spurious emissions above the system noise floor.
 Emissions were assessed on Low, Mid, High channels on all modes 802.11 b, 802.11 g, 802.11 n20 and 802.11 n40.

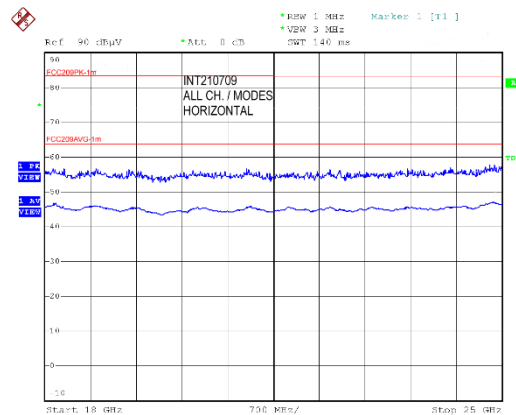
Frequency (GHz)	Channel Number	Antenna Pol.	Pk Level Measured at 1 m (dB μ V/m)	Pk Level Extrapolated to 3 m (dB μ V/m)	Pk Limit at 3 m (dB μ V/m)	Margin (dB)
25.89	Any	V / H	57.5	48.5	74.0	>-20

Frequency (GHz)	Channel Number	Antenna Pol.	Avg Level Measured at 1m (dB μ V/m)	Avg Level Extrapolated to 3 m (dB μ V/m)	Avg Limit at 3 m (dB μ V/m)	Margin (dB)
25.89	Any	V / H	47.0	37.5	54.0	-16.5

Following plots indicate limits calculated for a 1m distance.



Peak / Avg Vertical Polarisation



Peak / Avg Horizontal Polarisation

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10.5 Band Edge Measurements; Radiated at 3 meters

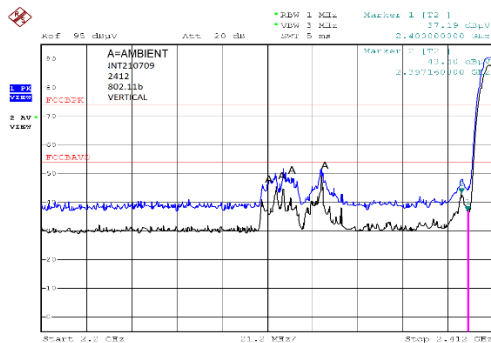
10.5.1 Restricted bands 2200 – 2300 MHz, 2310 – 2390 MHz, 2483.5 - 2500 MHz

WLAN Mode: IEEE 802.11 b; 1 Mb/s

Analyser BW settings: RBW=1 MHz; VBW=3 MHz

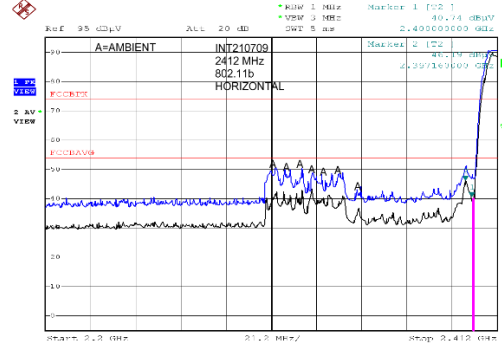
Ch No.	Ch. Centre Freq. (MHz)	Band Edge (MHz)	Spurious level or B.E.		Detector (Pk / Avg)	Limit (dBuV/m)	Margin (dB)	Antenna Polarity
			Freq. (MHz)	Level. (dBuV/m)				
1	2412	2400	2397.16	43.4	Avg	54	-10.6	Vertical
				-	Pk	74	>-20	
				46.2	Avg	54	-7.8	Horizontal
				-	Pk	74	>-20	
11	2462	2483.5	2492.31	36.0	Avg	54	-18.0	Vertical
				-	Pk	74	>-20	
			2483.50	32.3	Avg	54	>-20	Horizontal
				-	Pk	74	>-20	

2200 MHz – 2400 MHz



Date: 5.APR.2022 08:42:10

2412 MHz–Peak/Average Vertical Polarisation



Date: 5.APR.2022 08:53:12

2412 MHz–Peak/Avg Horizontal Polarisation

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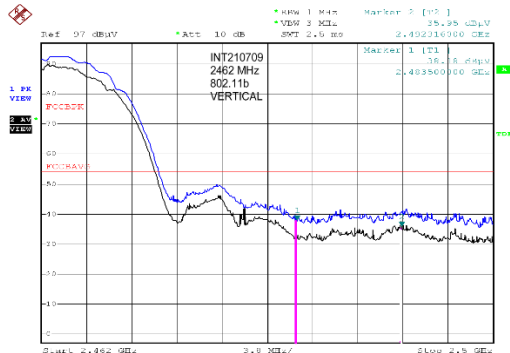
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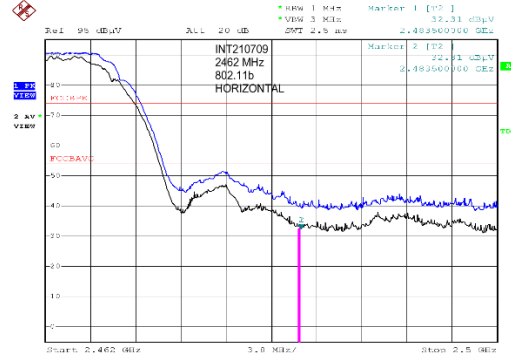


2483.5 MHz – 2500 MHz



Date: 5.APR.2022 09:32:32

2462 MHz–Peak/Average Vertical Polarisation



Date: 5.APR.2022 09:04:00

2462 MHz–Peak/Avg Horizontal Polarisation

Note: 'A' indicates an ambient emission.

WLAN Mode: IEEE 802.11 g; 6 Mb/s

Analyser BW settings: RBW=1 MHz; VBW=3 MHz.

Ch No.	Ch. Centre Freq. (MHz)	Band Edge (MHz)	Spurious level or B.E.		Detector (Pk / Avg)	Limit (dBuV/m)	Margin (dB)	Antenna Polarity
			Freq. (MHz)	Level. (dBuV/m)				
1	2412	2400	2396.51	44.8	Avg	54	-9.2	Vertical
				-	Pk	74	>-20	
				44.6	Avg	54	-9.4	Horizontal
				-	Pk	74	>-20	
11	2462	2483.5	2500.00	36.8	Avg	54	-17.2	Vertical
				-	Pk	74	>-20	
				34.3	Avg	54	-19.7	Horizontal
				-	Pk	74	>-20	

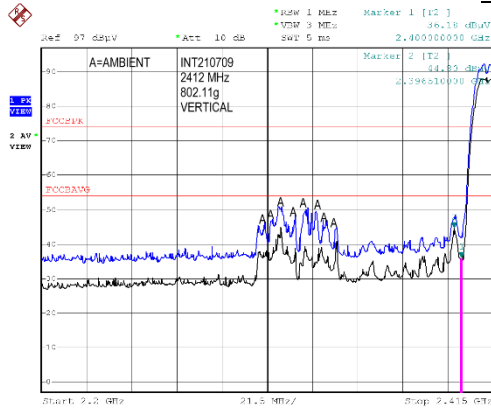
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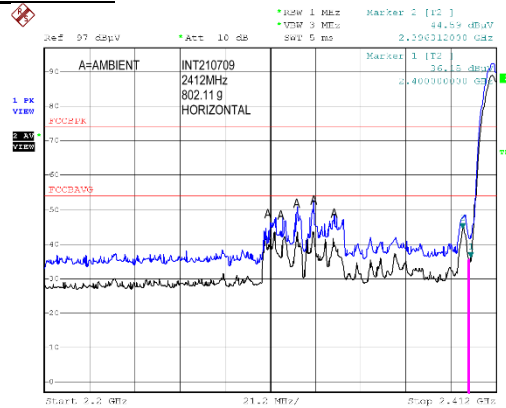
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2200 MHz – 2400 MHz



Date: 5.APR.2022 09:21:55

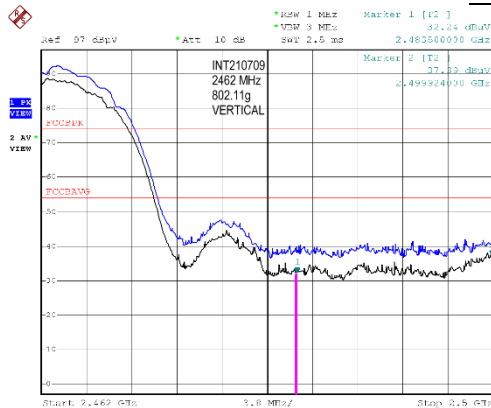


Date: 5.APR.2022 10:12:13

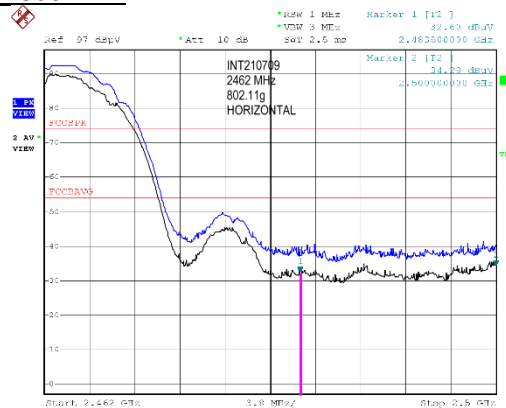
2412 MHz–Peak/Average Vertical Polarisation

2412 MHz–Peak/Avg Horizontal Polarisation

2483.5 MHz – 2500 MHz



Date: 5.APR.2022 09:42:07



Date: 5.APR.2022 09:58:28

2462 MHz–Peak/Average Vertical Polarisation

2462 MHz–Peak/Avg Horizontal Polarisation

Note: 'A' indicates an ambient emission.

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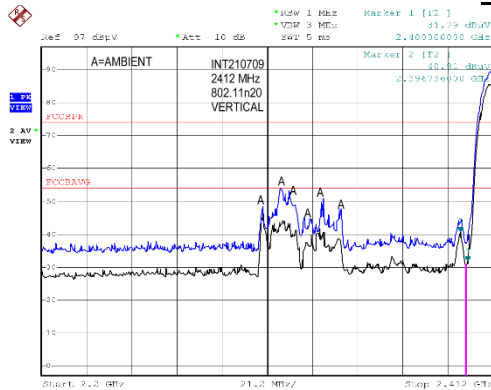


WLAN Mode: IEEE 802.11 n; 20 MHz; MCS0

Analyser BW settings: RBW=1 MHz; VBW=3 MHz.

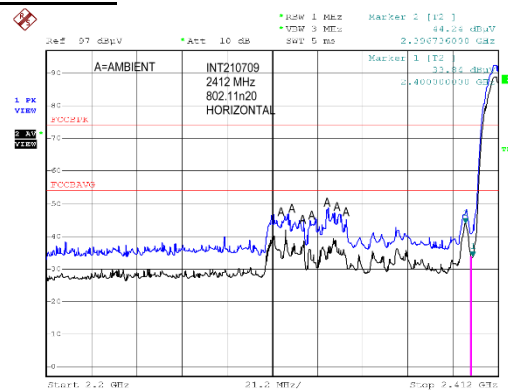
Ch No.	Ch. Centre Freq. (MHz)	Band Edge (MHz)	Spurious level or B.E.		Detector (Pk / Avg)	Limit (dBuV/m)	Margin (dB)	Antenna Polarity
			Freq. (MHz)	Level. (dBuV/m)				
1	2412	2400	2396.73	40.8	Avg	54	-13.2	Vertical
				-	Pk	74	>-20	
				44.2	Avg	54	-9.8	Horizontal
				-	Pk	74	>-20	
11	2462	2483.5	2483.50	30.5	Avg	54	>-20	Vertical
				-	Pk	74	>-20	
			2485.60	34.0	Avg	54	-20	Horizontal
				-	Pk	74	>-20	

2200 MHz – 2400 MHz



Date: 5.APR.2022 10:19:07

2412 MHz–Peak/Average Vertical Polarisation



Date: 5.APR.2022 10:23:24

2412 MHz–Peak/Avg Horizontal Polarisation

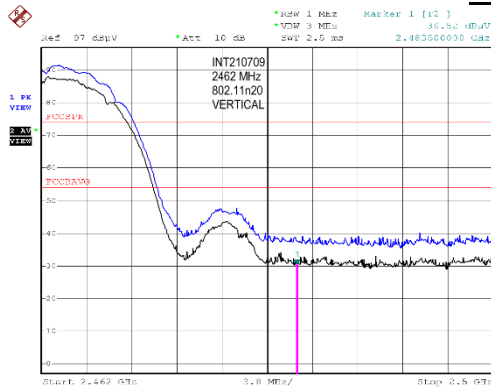
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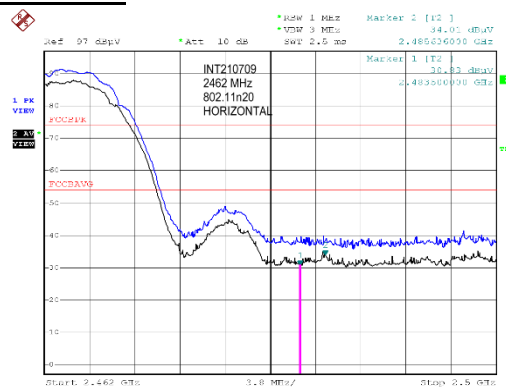


2483.5 MHz – 2500 MHz



Date: 5.APR.2022 10:21:42

2462 MHz–Peak/Average Vertical Polarisation



Date: 5.APR.2022 10:28:21

2462 MHz–Peak/Avg Horizontal Polarisation

Note: 'A' indicates an ambient emission.

WLAN Mode: IEEE 802.11 n; 40 MHz; MCS0

Analyser BW settings: RBW=1 MHz; VBW=3 MHz.

Ch No.	Ch. Centre Freq. (MHz)	Band Edge (MHz)	Spurious level or B.E.		Detector (Pk / Avg)	Limit (dBuV/m)	Margin (dB)	Antenna Polarity
			Freq. (MHz)	Level. (dBuV/m)				
3	2422	2400	2400.00	41.7	Avg	54	-12.3	Vertical
				-	Pk	74	>-20	
				40.0	Avg	54	-14.0	Horizontal
				-	Pk	74	>-20	
9	2452	2483.5	2483.50	46.9	Avg	54	-7.1	Vertical
				61.2	Pk	74	-12.8	
				50.5	Avg	54	-3.5	Horizontal
				61.1	Pk	74	-12.9	

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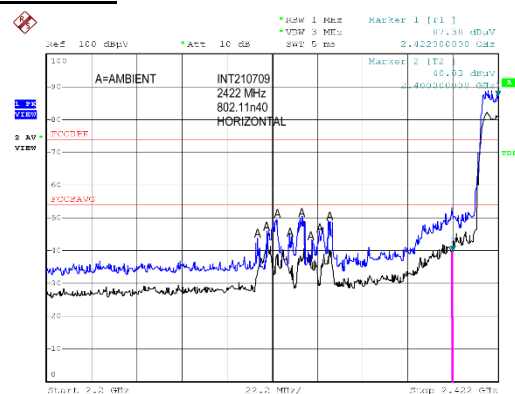


2200 MHz – 2400 MHz



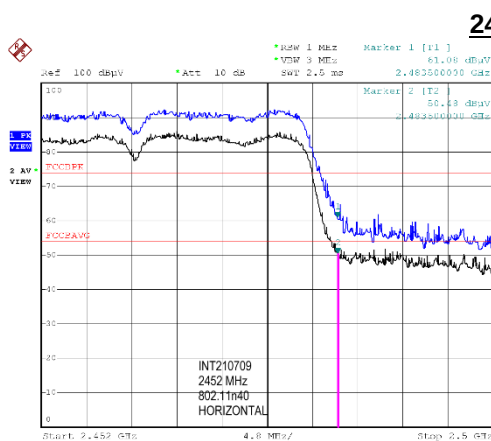
Date: 5.APR.2022 11:05:26

2422 MHz–Peak/Average Vertical Polarisation



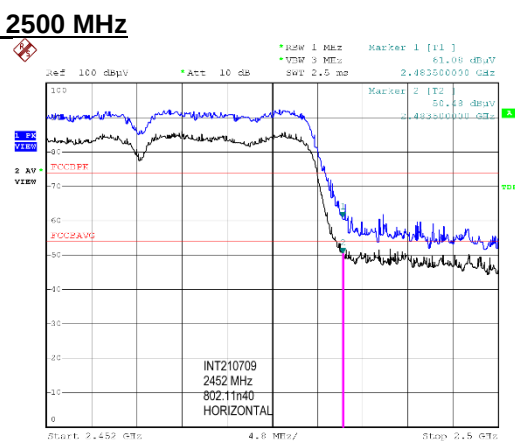
Date: 5.APR.2022 10:57:21

2422 MHz–Peak/Avg Horizontal Polarisation



Date: 5.APR.2022 11:25:53

2452 MHz–Peak/Average Vertical Polarisation



Date: 5.APR.2022 11:25:53

2452 MHz–Peak/Avg Horizontal Polarisation

Note: 'A' indicates an ambient emission.

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