



Radio Test Report

Zinwave Ltd

Zinwave UNtivity 5000 Remote Unit

308-0007-1

47 CFR Part 27 Effective Date 1st October 2021

47 CFR Part 2 Effective Date 1st October 2021

Test Date: 7th to 18th November 2022

Report Number: 11-13924-2-22 Issue 01

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Certificate of Test 13924-2

The equipment noted below has been fully tested by R.N. Electronics Limited and, where appropriate, conforms to the relevant subpart of FCC Part 27. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

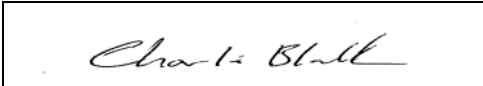


Equipment:	Zinwave UNItivity 5000 Remote Unit
Model Number:	308-0007-1
Unique Serial Number:	Sample #1 (T4237)
Applicant:	Zinwave Ltd Harston Mill, Royston Road Harston, Cambridge CB22 7GG
Proposed FCC ID	UPO308-0007-1
Full measurement results are detailed in Report Number:	11-13924-2-22 Issue 01
Test Standards:	47 CFR Part 27 Effective Date 1st October 2021 47 CFR Part 2 Effective Date 1st October 2021

NOTE:

Certain tests were not performed based upon manufacturer's declarations. Certain other requirements are subject to manufacturer declaration only and have not been tested/verified. For details refer to section 3 of this report. This report only pertains to the operation of the equipment to 47CFR part 27, for details of testing to other rule parts please see RN reports: 11-13924-1-22 (Part 24E).

DEVIATIONS: No deviations have been applied.

This certificate relates only to the unit tested as identified by a unique serial number and in the condition at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of unit not meeting the intentions of the standard or the requirements of the Federal Regulations, particularly under different conditions to those during testing. Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Date Of Test:	7th to 18th November 2022
Test Engineer:	
Approved By: Radio Manager	
Customer Representative:	



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2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Zinwave Ltd Harston Mill Royston Road Harston Cambridge CB22 7GG	
Manufacturer of EUT	Zinwave Ltd	
Full Name of EUT	Zinwave UNItivity 5000 Remote Unit	
Model Number of EUT	308-0007-1	
Serial Number of EUT	Sample #1 (T4237)	
Date Received	7 th November 2022	
Date of Test:	7 th to 18 th November 2022	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	20 th November 2022	
Main Function	Distributed Antenna remote unit	
Information Specification	Height	70 mm
	Width	218 mm
	Depth	270 mm
	Weight	5.5 kg
	Voltage	48 V DC
	Current	0.85 A

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Wall mounted
Choice of model(s) for type tests	Production unit
Antenna details	external max 8dBi
Antenna port	External: 1x TX; 1x RX (N-type ports)
Baseband Data port (yes/no)?	NO
Highest Signal generated in EUT	2690 MHz
Lowest Signal generated in EUT	Not stated
Hardware Version	1.0
Software Version	Hub Software 5.21rc02
Firmware Version	5.61
Type of Equipment	Booster, Distributed Antenna System
Technology Type	Various – wideband distributed antenna system
Geo-location (yes/no)	No
TX Parameters	
Alignment range – transmitter	150 - 2690 MHz
EUT Declared Modulation Parameters	Device supports wideband Commercial Mobile Radio Services under this rule part
EUT Declared Power level	+24dBm
EUT Declared Signal Bandwidths	Device supports wideband Commercial Mobile Radio Services under this rule part
EUT Declared Channel Spacing's	Device supports wideband Commercial Mobile Radio Services under this rule part
EUT Declared Duty Cycle	up to 100%
Unmodulated carrier available?	Yes - EUT provides at its output whatever is presented to its input
Declared frequency stability	0ppm (DAS without frequency translation)
RX Parameters	
Alignment range – receiver	As per Transmitter range
EUT Declared RX Signal Bandwidth	As per Transmitter
Receiver Signal Level (RSL)	N/A
Method of Monitoring Receiver BER	N/A

2.3 Functional description

The Remote Unit is used as part of the Zinwave UNItivity 5000 system to provide cellular and private radio services within buildings, sports arenas and similar areas.

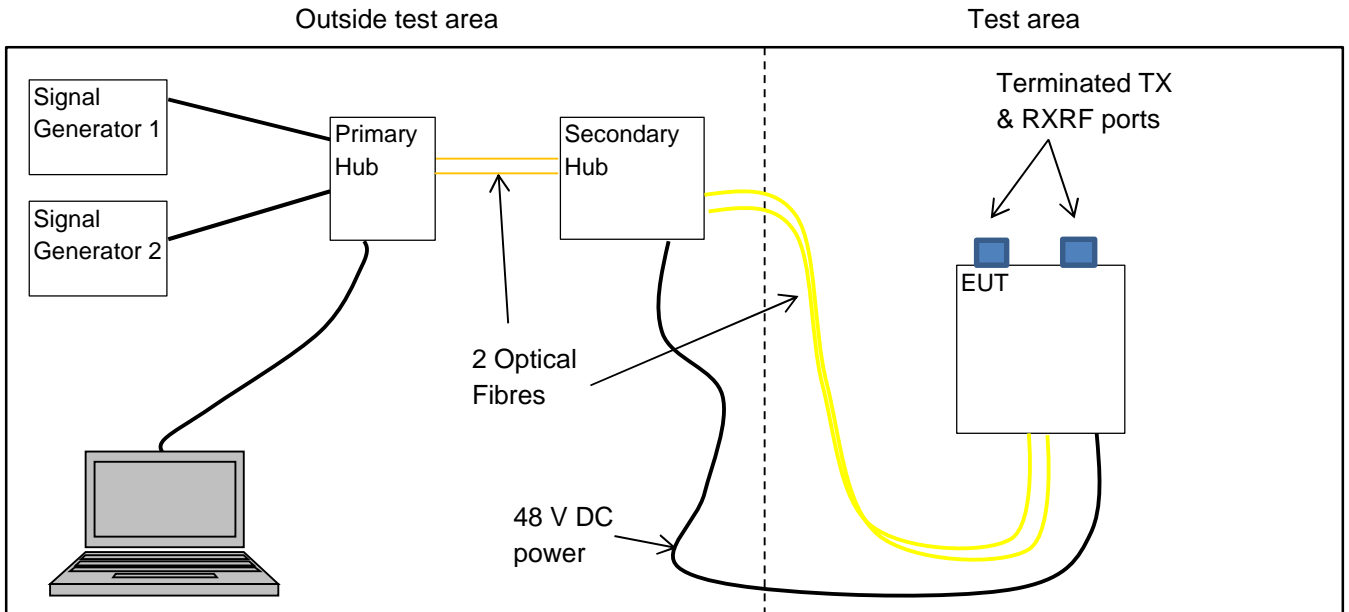
The system is wideband in nature and can support a wide range of radio services depending upon the system that is connected to the service module of the Primary Hub.

2.4 Modes of operation

Mode Reference	Description	Used for testing
Mode 1	CW Sweep from 2110 – 2180 MHz to determine f0	Yes
Mode 2	Single mode Channel AWGN at f0 (2112.5MHz) in band 2110 – 2180 MHz	Yes
Mode 3	Single Low channel AWGN at 2112.5 MHz	Yes
Mode 4	Single Mid channel AWGN at 2142.5 MHz	Yes
Mode 5	Single High channel AWGN at 2177.5 MHz	Yes
Mode 6	Dual Low channel AWGN at 2112.5 MHz & 2127.5 MHz	Yes
Mode 7	Dual High channel AWGN at 2172.5 MHz & 2177.5 MHz	Yes
Mode 8	CW Sweep from 2496 – 2690 MHz to determine f0	Yes
Mode 9	Single mode Channel AWGN at f0 (2687.5MHz) in band 2496 – 2690 MHz	Yes
Mode 10	Single Low channel AWGN at 2498.5 MHz	Yes
Mode 11	Single Mid channel AWGN at 2600 MHz	Yes
Mode 12	Single High channel AWGN at 2687.5 MHz	Yes
Mode 13	Dual Low channel AWGN at 2498.5 MHz & 2503.5 MHz	Yes
Mode 14	Dual High channel AWGN at 2682.5 MHz & 2687.5 MHz	Yes

Note: This report only pertains to the operation of the equipment to 47CFR part 27, for details of testing to other rule parts please see RN report: 11-13924-1-22 (Parts 24E)

2.5 Emissions configuration



The unit was powered from the secondary hub at 48V DC. The unit was configured using the supplied network management software using the settings files prepared by Zinwave Ltd, this provided 29 dB gain and +24 dBm EUT output power in conjunction with an input level of -5dBm. Any attenuation introduced by the Primary/secondary hub system was also accounted for in the set-up files provided by Zinwave Ltd. Test channels and required modulations were set using the signal generators connected to the primary hub. Single channel operation was provided by generator 1 and dual channel was using two signal generators. Output power of the signal generators was set to provide -5dBm at input to primary hub. The transmit mode was 100% continuous with EUT output power maintained at +24 dBm (29 dB gain). Test channels and combinations of used are stated in test modes section 2.4. The system supports operation with a number of wideband services, so testing was performed with AWGN modulation signal as per KDB 935210 D05, and a CW signal for determination of f_0 .

For conducted RF tests the RF ports were connected via suitable attenuation and filtering where required and connected directly to a spectrum analyser, with losses accounted for in the measurement results. The system is designed for operation with antennas having a maximum gain of 8.0 dBi or 5.85 dBd. This is the value used for determining EIRP or ERP where required.

2.5.1 Signal leads

Port Name	Cable Type	Connected
DC power	2 cores	Yes
Fibre TX	Fibre	Yes
Fibre RX	Fibre	Yes
Transmit port	N-type coaxial	Yes
Receive port	N-type coaxial	Yes

3 Summary of test results

The Zinwave UNItivity 5000 Remote Unit, 308-0007-1 was tested for compliance to the following standard(s) :

47 CFR Part 27 Effective Date 1st October 2021
47 CFR Part 2 Effective Date 1st October 2021

Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of equipment not meeting the intentions of the standard or the essential requirements of the directive, particularly under different conditions to those during testing. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Title	References	Results
Transmitter Tests		
1. Spurious emissions at antenna terminals	FCC Part 27 Clause 27.53(a)(g)(h)(m)2 FCC Part 2 Clause 2.1051	PASSED ¹
2. RF Power Output	FCC Part 27 Clause 27.50(c)(d)(a)(h) FCC Part 2 Clause 2.1046	PASSED
3. Frequency stability	FCC Part 2 Clause 2.1055	NOT APPLICABLE ²
4. Occupied bandwidth	FCC Part 2 Clause 2.1049	PASSED
5. Field strength of spurious radiations	FCC Part 27 Clause 27.53(a)(g)(h)(m)2 FCC Part 2 Clause 2.1053	PASSED ¹
6. Band edge emissions	FCC Part 27 Clause 27.53(a)(g)(h)(m)2 FCC Part 2 Clause 2.1051	PASSED
7. Modulation characteristics	FCC Part 2 Clause 2.1047	PROVIDED ³
8. Determination of f ₀	KDB 935210 D05 Clause 3.3	PERFORMED

¹ Spectrum investigated started at a frequency of 30MHz up to a frequency of 27GHz based on 10 times the highest channel of 2687.5MHz

² EUT does not contain an oscillator and only reproduces what is provided at its input.

³ Modulation characteristics information provided in section 2.2.

4 Specifications

The tests were performed and operated in accordance with R.N. Electronics Ltd procedures and the relevant standards listed below.

4.1 Relevant standards

Ref.	Standard Number	Version	Description
4.1.1	FCC Part 27	2020	Miscellaneous Wireless Communications Services
4.1.2	47CFR part 2J	2020	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations
4.1.3	KDB 971168 D01 v03r01	2018	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Measurement Guidance for Certification of Licensed Digital Transmitters
4.1.4	ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
4.1.5	KDB 935210 D05 v01r04	2020	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Measurement guidance for Industrial and Non-consumer signal booster, repeater and amplifier devices
4.1.6	662911 D01 v02r01	2013	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Emissions Testing of transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc)

4.2 Deviations

No deviations were applied.

5 Tests, methods and results

5.1 Spurious emissions at antenna terminals

5.1.1 Test methods

Test Requirements:	FCC Part 27 Clause 27.53 [Reference 4.1.1 of this report] FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 2015 Clause 5.5 [Reference 4.1.4 of this report] KDB 935210 D05 Clause 3.6 / 4.7 [Reference 4.1.5 of this report]
Limits:	FCC Part 27 Clause 27.53 [Reference 4.1.1 of this report]

5.1.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. RX port was terminated into a 50 Ohm load. EUT was tested across Low, Middle and High channels within each applicable band in a single channel input mode and at bottom and top of the band in dual channel input mode modes, which are specified in section 2.4 of this report.

5.1.3 Test procedure

The EUT system was set up to maximum gain using the network management software provided. EUT signal level was raised until maximum output power was reached per channel/band setting as required. Measurements were made and plots taken in the required Resolution bandwidths, where applicable results are referenced to EIRP limits by consideration of the antenna gain used with the EUT of 8dBi (5.85dBd) and indicated. Only results within 20dB of limits are reported.

Note: some emissions >1 MHz from band edge were measured using the spectrum analyser adjacent power function that integrated power from a lower resolution bandwidth into the 1MHz required by the rule part. Compliance with MIMO operation is demonstrated by following KDB 662911 D01 section E(3) and adding $10\log(2)$, or 3dB, to the spurious emission measured from a single unit

Tests were performed in test site N.

5.1.4 Test equipment

F075, H071, H072, E602

See Section 8 for more details

5.1.5 Test results

Temperature of test environment	17-23°C
Humidity of test environment	35-58%
Pressure of test environment	102kPa

For band edge results please refer to section 5.6 within this report

Single channel results (SISO operation).

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2112.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions within 20 dB of the limit		

Plots	
2110-2180 CSE_low	
2110-2180 CSE_high	

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	2142.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions within 20 dB of the limit		

Plots	
2110-2180 CSE_low	
2110-2180 CSE_high	

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	2177.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions within 20 dB of the limit		

Plots	
2110-2180 CSE_low	
2110-2180 CSE_high	

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2498.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions within 20 dB of the limit		

Plots	
2496-2690 CSE_low	
2496-2690 CSE_high	

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	2600 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions within 20 dB of the limit		

Plots	
2496-2690 CSE_low	
2496-2690 CSE_high	

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	2687.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No emissions within 20 dB of the limit		

Plots	
2496-2690 CSE_low	
2496-2690 CSE_high	

Single channel results (MIMO operation).

Note: Results below are SISO measurements with 3dB added for 2 signal MIMO.

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2112.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Add 3dB	Difference to Limit (dB)
2107.0	-35.03	-32.03	-19.03

Plots	
2110-2180 CSE_low	
2110-2180 CSE_high	

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	2142.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Add 3dB	Difference to Limit (dB)
4290.2	-43.53	40.53	-27.53

Plots	
2110-2180 CSE_low	
2110-2180 CSE_high	

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	2177.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Add 3dB	Difference to Limit (dB)
4335.0	-41.77	-38.77	-25.77

Plots	
2110-2180 CSE_low	
2110-2180 CSE_high	

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2498.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Add 3dB	Difference to Limit (dB)
2492.5	-34.37	-31.37	-18.37
4996.8	-35.76	-32.76	-19.76

Plots	
2496-2690 CSE_low	
2496-2690 CSE_high	

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	2600 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Add 3dB	Difference to Limit (dB)
5199.6	-34.44	-31.44	-18.44

Plots	
2496-2690 CSE_low	
2496-2690 CSE_high	

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	2687.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Add 3dB	Difference to Limit (dB)
5374.6	-34.31	-31.31	-18.31

Plots	
2496-2690 CSE_low	
2496-2690 CSE_high	

Results are also presented graphically in section 6.

LIMITS:

Parts 27.53 (h) for operation in the 2110-2180 MHz band

Parts 27.53 (m), for operation in the 2496 – 2690 MHz band.

In all cases, absolute limits are determined from the relative limit as per example:

Limits based on $43+10\log P$. dB attenuation below Output power in Watts: i.e. +24 dBm = 0.251W therefore:

$43+10*\log 0.251 = 37\text{dB}$. +24 dBm – 37 = -13dBm.

In accordance with KDB 662911 D01 3dB has been added to measured results for two signal MIMO operation and then compared with the limits.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 2.8 dB

5.2 RF Power Output

5.2.1 Test methods

Test Requirements:	FCC Part 27 Clause 27.53(a)(g)(h)(m2) [Reference 4.1.1 of this report] FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 2015 Clause 5.2 [Reference 4.1.4 of this report] KDB 935210 D05 Clause 3.5 / 4.5 [Reference 4.1.5 of this report]
Limits:	FCC Part 27 Clause 27.53(a)(g)(h)(m2) [Reference 4.1.1 of this report]

5.2.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. RX port was terminated into a 50 Ohm load. EUT was tested at determined f_0 in each applicable band. Test modes used were

5.2.3 Test procedure

Tests were made in accordance with the test method noted above using the measuring equipment listed in the 'Test Equipment' Section. The EUT system was set up to maximum gain using the network management software provided. EUT signal level was raised until maximum output power was reached per channel/band setting as required and the frequency under test was set to an appropriate channel to include f_0 as determined in section 5.8. An RMS detector was set and Channel power was measured using the channel power function, in addition, the Peak to Average power ratio was also measured using the CCDF function of the analyser.

MIMO operation is permitted when 2 units are collated and feed the same antenna. Each Remote unit has just one antenna port, so total power to the antenna is determined by adding $10\log(2)$, or 3dB, to the power measured from a single unit

5.2.4 Test equipment

F075, H071, H072, E602

See Section 8 for more details

5.2.5 Test results

Temperature of test environment	18-22°C
Humidity of test environment	40-50%
Pressure of test environment	102kPa

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
f_0 frequency	2112.5 MHz

Test conditions		Average Power (SISO) (dBm)	Pk to AV Power ratio (dB)	TX power EIRP (dBm)	TX Power EIRP (W)
Temp Ambient	Volts Nominal	24.12	7.91	32.12	1.63

Note: 8dBi Antenna gain used.

Test conditions		Average Power (MIMO) (dBm)	Pk to AV Power ratio (dB)	TX power EIRP (dBm)	TX Power EIRP (W)
Temp Ambient	Volts Nominal	27.12	7.91	35.12	3.25

Note: 8dBi Antenna gain used. 3dB added to result for MIMO operation on single port.

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
f0 frequency	2687.5 MHz

Test conditions		Average Power (SISO) (dBm)	Pk to AV Power ratio (dB)	TX power EIRP (dBm)	TX Power EIRP (W)
Temp Ambient	Volts Nominal	24.17	7.86	32.17	1.65

Note: 8dBi Antenna gain used.

Test conditions		Average Power (MIMO) (dBm)	Pk to AV Power ratio (dB)	TX power EIRP (dBm)	TX Power EIRP (W)
Temp Ambient	Volts Nominal	27.17	7.86	35.17	3.29

Note: 8dBi Antenna gain used. 3dB added to result for MIMO operation on single port.

Results are also presented graphically in section 6

LIMITS:

27.50(c), 65 W EIRP (Limit is actually W / MHz, but since bandwidth of signal is not known and the actual TX power is < 1W EIRP, the 65 W limit from table 3 covers all options for bandwidth and antenna height across the whole band)

27.50(d), 1640 W EIRP

27.50(a), 2000 W / 5 MHz EIRP

27.50(h), 2000 W EIRP

In accordance with KDB 662911 D01 3dB has been added to measured results for two signal MIMO operation and then compared with the limits.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
< ±1 dB.

5.3 Frequency stability

NOT APPLICABLE: EUT does not contain an oscillator and only reproduces what is provided at its input.

5.4 Occupied bandwidth / Input versus output signal

5.4.1 Test methods

Test Requirements:	FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 2015 Clause 5.4 [Reference 4.1.4 of this report] KDB 935210 D05 Clause 3.3 / 3.4, 4.3 / 4.4 [Reference 4.1.5 of this report]
Limits:	None

5.4.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. RX port was terminated into a 50 Ohm load. EUT was tested at centre frequency of each applicable band, these were modes 4 and 11.

5.4.3 Test procedure

Tests were made in accordance with the test method noted above using the measuring equipment listed in the 'Test Equipment' Section. The EUT system was set up to maximum gain using the network management software provided. EUT signal level was raised until maximum output power was reached per channel/band setting as required and the frequency under test was set the centre channel of each band. A peak detector was set with max hold and sweeps made comparing the input and the output signals and their -26dB bandwidth points. Trace data as measured on the analyser was captured and relevant markers placed on the plots to demonstrate the bandwidths of input and Output signals.

5.4.4 Test equipment

F075, H071, H072, E602

See Section 8 for more details

5.4.5 Test results

Temperature of test environment	18-22°C
Humidity of test environment	45-58%
Pressure of test environment	102Pa

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Centre frequency	2142.5 MHz

99% Occupied BW (MHz)	
Input measurement	4.0733
Output measurement	4.0837
Plot reference	2110-2180 Occupied Bandwidth

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Centre frequency	2600 MHz

99% Occupied BW (MHz)	
Input measurement	4.0753
Output measurement	4.0777
Plot reference	2496-2690 Occupied Bandwidth

Results are also presented graphically in section 6

LIMITS:

Emissions to be contained within the applicable emissions mask/band edges.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
< ± 1.9%

5.5 Field strength of spurious radiations

5.5.1 Test methods

Test Requirements:	FCC Part 27 Clause 27.53 [Reference 4.1.1 of this report] FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 2015 Clause 5.5 [Reference 4.1.4 of this report] KDB 935210 D05 Clause 3.6 / 4.7 [Reference 4.1.5 of this report]
Limits:	FCC Part 27 Clause 27.53 [Reference 4.1.1 of this report]

5.5.2 Configuration of EUT

The EUT was tested in an ALSE and ambient conditions were monitored. The EUT was examined in its declared normal use position. The transmit port was terminated into a 30dB Attenuator and a 50Ohm load. RX port was terminated into a 50 Ohm load. EUT was tested across all required modes as specified in section 2.4 of this report.

5.5.3 Test procedure

Tests were made in accordance with the test method noted above using the measuring equipment listed in the 'Test Equipment' Section. The EUT system was set up to maximum gain using the network management software provided. EUT signal level was raised until maximum output power was reached. Peak field strength pre-scans using the field strength method were performed. The EUT's emissions were maximised by rotating it 360 degrees. This method was used to determine any signals for substitution. An RMS detector was used for any final measurements.

30MHz - 1GHz.

The measuring antenna was scanned 1 - 4m in both Horizontal and Vertical polarisations. Where required a Substitution method was performed using tuned dipoles / a calibrated bi-conical antenna. Measurement distance of 3metres was used.

1GHz – 27GHz.

The measuring antenna was used in both Horizontal and Vertical polarisations. Where required a Substitution method was performed using standard gain horn antennas. Measurement distances used were: 1 – 6 GHz at 3metres, 6 – 18 GHz at 1.2metres and 18 – 27 GHz at 0.3metres.

Tests were performed in test sites B & M.

5.5.4 Test equipment

E534, E535, E914, E745, LPE261, LPE333, TMS78, TMS79, CAL08, E830, E007-2, E453, E330, E331, E853, E268, E428, E904, E296-2, E856, E642, E412, E777

See Section 8 for more details

5.5.5 Test results

Temperature of test environment	15-20°C
Humidity of test environment	50-55%
Pressure of test environment	102kPa

Single channel results.

Note: only results within 20dB of limits are shown

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2112.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	2142.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	2177.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2498.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	2600 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	2687.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Note: Emissions in above tables are generic emissions and present regardless of channel settings.

DUAL CHANNEL RESULTS.

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	2112.5 MHz + 2117.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Setup Table

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channels	2172.5 MHz + 2177.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
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33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	2498.5 MHz + 2503.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Setup Table

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channels	2682.5 MHz + 2687.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
33.18	-27.63	-14.63	Vertical	Upright
41.5	-34.17	-21.17	Vertical	Upright

Note: Emissions in above tables are generic emissions and present regardless of channel settings.

LIMITS:

Parts 27.53 (h) for operation in the 2110-2180 MHz band

Parts 27.53 (m), for operation in the 2496 – 2690 MHz band

Absolute limits are determined from the relative limit as per example:

Limits based on $43+10\log P$. dB attenuation below Output power in Watts: i.e. +24 dBm = 0.251W therefore:

$43+10*\log 0.251 = 37\text{dB}$. +24 dBm – 37 = -13dBm.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:

30MHz - 1GHz ± 3.9 dB, 1 – 18 GHz ± 3.5 dB, 18 – 27 GHz ± 3.9 dB

5.6 Band edge emissions

5.6.1 Test methods

Test Requirements:	FCC Part 27 Clause 27.53 [Reference 4.1.1 of this report] FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 2015 Clause 5.5 [Reference 4.1.4 of this report] KDB 935210 D05 Clause 3.6 / 4.7 [Reference 4.1.5 of this report]
Limits:	FCC Part 27 Clause 27.53 [Reference 4.1.1 of this report]

5.6.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. RX port was terminated into a 50 Ohm load. EUT was tested across all required modes as specified in section 2.4 of this report.

5.6.3 Test procedure

The EUT system was set up to maximum gain using the network management software provided. EUT signal level was raised until maximum output power was reached per channel/band setting as required. Measurements were made and plots taken in the required Resolution bandwidths, where applicable results are referenced to EIRP limits by consideration of the antenna gain used with the EUT of 8dBi (5.85dBd) and indicated.

Measurements within one measurement bandwidth of the band edge were made using a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter. Emissions just outside this bandwidth were measured by integrating the power over the required measurement bandwidth using the spectrum analyser Adjacent Channel Power measurement function. Compliance with MIMO operation is demonstrated by following KDB 662911 D01 section E(3) and adding $10\log(2)$, or 3dB, to the spurious emission measured from a single unit.

Tests were performed in test site A.

5.6.4 Test equipment

F075, H071, H072, E602

See Section 8 for more details

5.6.5 Test results

Temperature of test environment	18-22°C
Humidity of test environment	40-50%
Pressure of test environment	102kPa

Single channel results – SISO operation

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2112.5 MHz
High channel	2177.5 MHz

	Lower band edge (2110 MHz)	Upper band edge (2180 MHz)
(dBm)	-29.84	-31.91
Plot reference	2110MHz_single_band_edge	2180MHz_single_band_edge

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2498.5 MHz
High channel	2687.5 MHz

	Lower band edge (2496 MHz)	Upper band edge (2690 MHz)
(dBm)	-26.79	-24.40
Plot reference	2496MHz_single_band_edge	2690MHz_single_band_edge

Single channel results – MIMO operation

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2112.5 MHz
High channel	2177.5 MHz

	Lower band edge (2110 MHz)	Upper band edge (2180 MHz)
(dBm)	-29.84	-31.91
Add 3dB	-26.84	-28.91
Plot reference	2110MHz_single_band_edge	2180MHz_single_band_edge

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	2498.5 MHz
High channel	2687.5 MHz

	Lower band edge (2496 MHz)	Upper band edge (2690 MHz)
(dBm)	-26.79	-24.40
Add 3dB	-23.79	-21.40
Plot reference	2496MHz_single_band_edge	2690MHz_single_band_edge

Dual channel results – SISO operation

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	2112.5 + 2117.5 MHz
High channels	2172.5 + 2177.5 MHz

	Lower band edge (2110 MHz)	Upper band edge (2180 MHz)
(dBm)	-30.90	-31.58
Plot reference	2110MHz_dual_band_edge	2110MHz_dual_band_edge

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	2498.5 + 2503.5 MHz
High channels	2682.5 + 2687.5 MHz

	Lower band edge (2496 MHz)	Upper band edge (2690 MHz)
(dBm)	-28.34	-24.24
	2496MHz_dual_band_edge	2690MHz_dual_band_edge

Dual channel results – MIMO operation

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	2112.5 + 2117.5 MHz
High channels	2172.5 + 2177.5 MHz

	Lower band edge (2110 MHz)	Upper band edge (2180 MHz)
(dBm)	-30.90	-31.58
Add 3dB	-27.90	-28.58
Plot reference	2110MHz_dual_band_edge	2110MHz_dual_band_edge

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	2498.5 + 2503.5 MHz
High channels	2682.5 + 2687.5 MHz

	Lower band edge (2496 MHz)	Upper band edge (2690 MHz)
(dBm)	-28.34	-24.24
Add 3dB	-25.34	-21.24
	2496MHz_dual_band_edge	2690MHz_dual_band_edge

Results are also presented graphically in section 6

LIMITS:

Parts 27.53 (h) for operation in the 2110-2180 MHz band

Parts 27.53 (m)(2), for operation in the 2496 – 2690 MHz band

In accordance with KDB 662911 D01 3dB has been added to measured results for two signal MIMO operation and then compared with the limits.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
< ± 2.8 dB

5.7 Modulation characteristics

EUT uses digital modulation techniques. Modulation schemes and information is detailed in section 2.2 of this report.

5.8 Determination of f_0

5.8.1 Test methods

Test Requirements:	KDB 935210 D05 Clause 3.3 / 4.3 [Reference 4.1.5 of this report]
Test Method:	ANSI C63.26 2015 Clause 5.5 [Reference 4.1.4 of this report]
	KDB 935210 D05 Clause 3.3 / 4.3 [Reference 4.1.5 of this report]
Limits:	None.

5.8.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. RX port was terminated into a 50 Ohm load. EUT was swept across the 5 operational bands with a CW signal to determine the frequency of highest power in the band. Test performed in modes 1 and 8

5.8.3 Test procedure

Tests were made in accordance with the test method noted above using the measuring equipment listed in the 'Test Equipment' Section. The EUT system was set up to maximum gain using the network management software provided. EUT signal level was raised until maximum output power was reached. The EUT input signal was then swept across the applicable service band frequency and plots taken showing the frequency of highest power in the band (f_0).

5.8.4 Test equipment

F075, H071, H072, E602

See Section 8 for more details

5.8.5 Test results

Temperature of test environment	18-22°C
Humidity of test environment	40-50%
Pressure of test environment	102kPa

Band	2110-2180 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	CW

Band (MHz)	f_0 determined (MHz)
2110 - 2180	2110.0

Note: Measurement was performed over the service band frequency range only.

Band	2496-2690 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	CW

Band (MHz)	f_0 determined (MHz)
2496 - 2690	2690.0

Note: Measurement was performed over the service band frequency range only.

Results are also presented graphically in section 6.

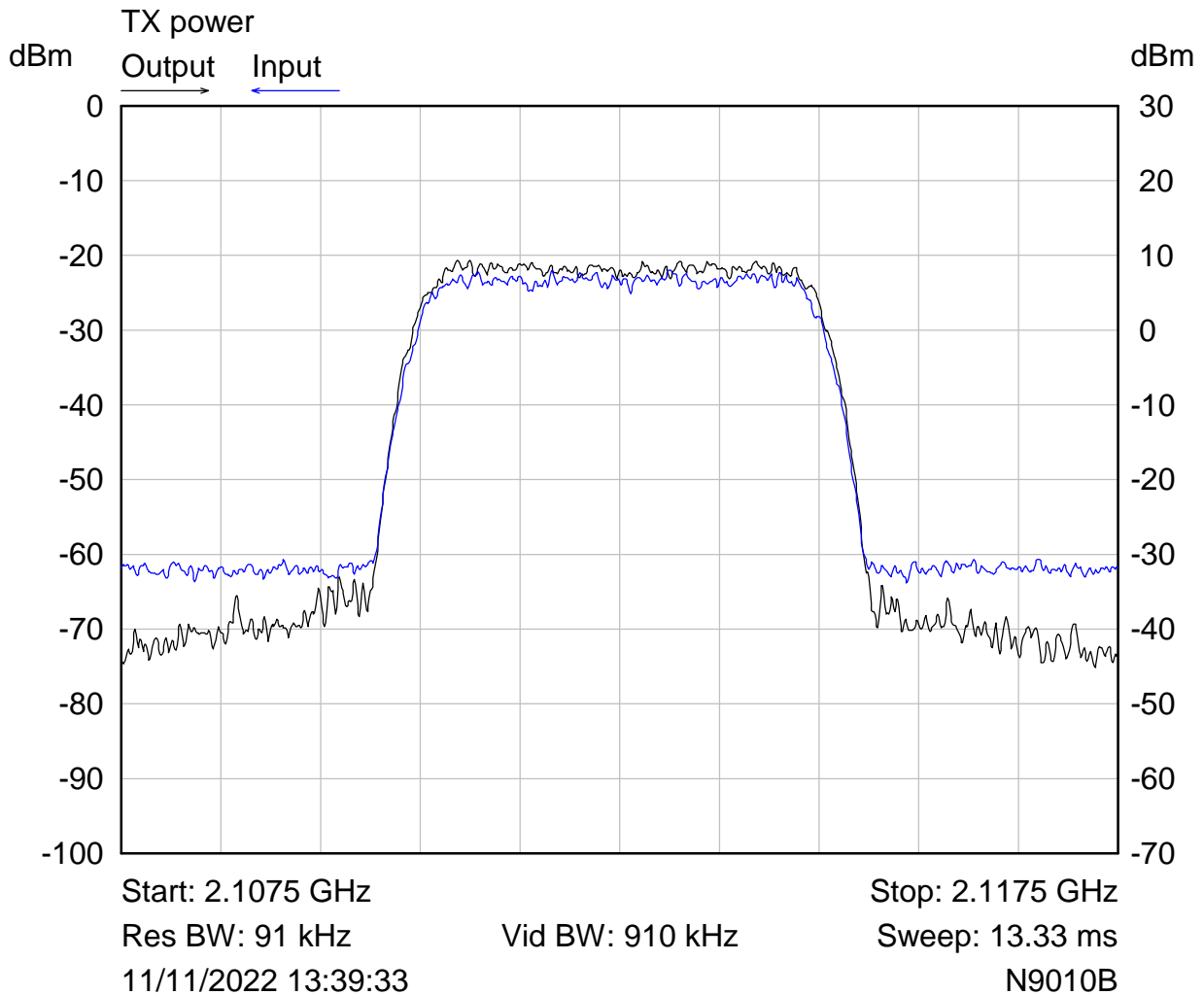
LIMITS:

None.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 1 dB

6.2 RF Power Output

RF Parameters: Band 2110-2180 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN,
 Channel 2112.5 MHz (nearest channel centre to determined f_0)



Output

Measurement Parameter	Value
Total channel power	24.12 dBm

Input

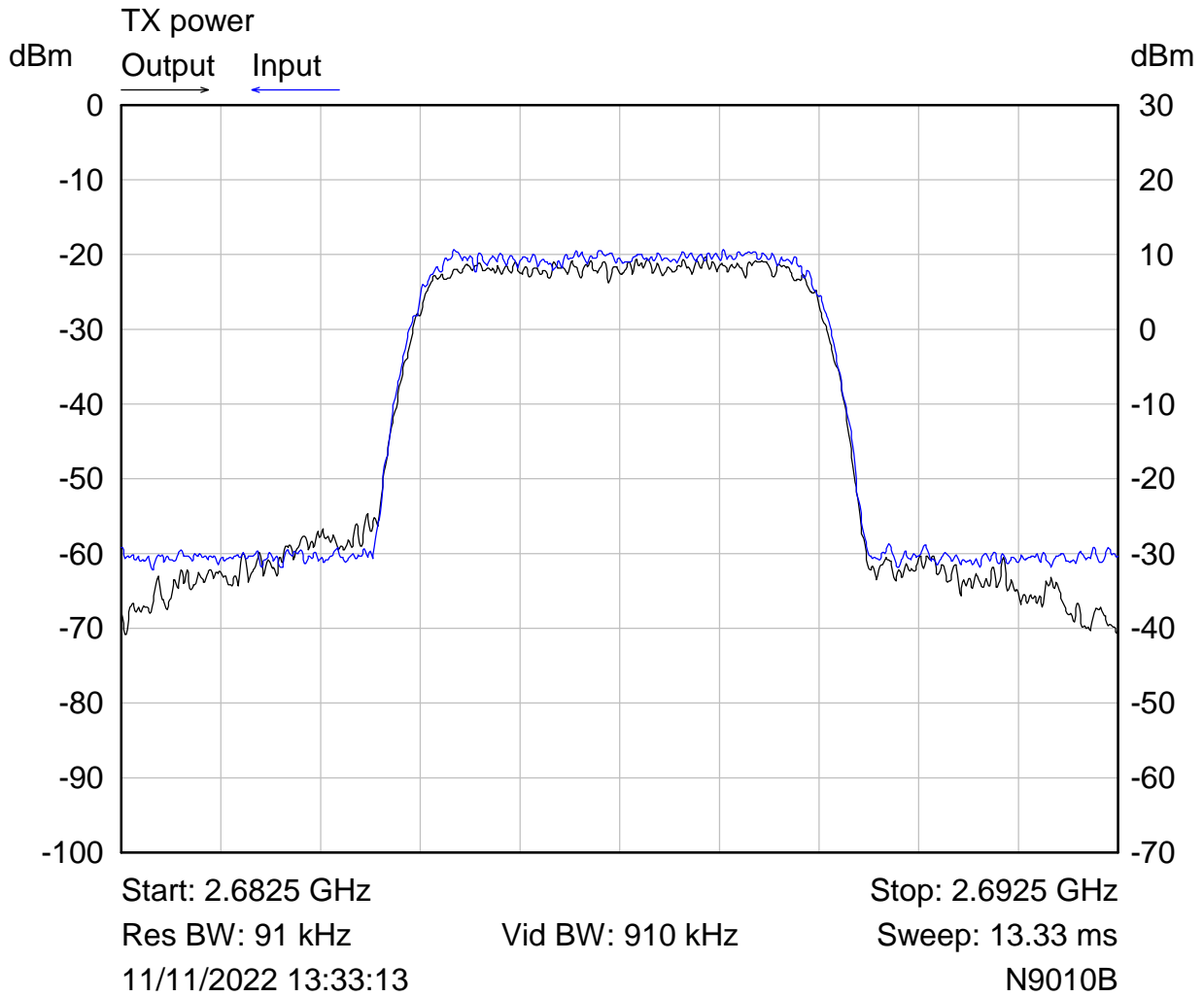
Measurement Parameter	Value
Total channel power	-7.35 dBm

Plot of Channel power at determined f_0 in band 2110-2180 MHz



Plot of Peak to Average power ratio at determined f_0 in band 2110-2180 MHz

RF Parameters: Band 2496-2690 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN,
 Channel 2687.5 MHz (nearest channel centre to determined f_0)



Output

Measurement Parameter	Value
Total channel power	24.17 dBm

Input

Measurement Parameter	Value
Total channel power	-4.49 dBm

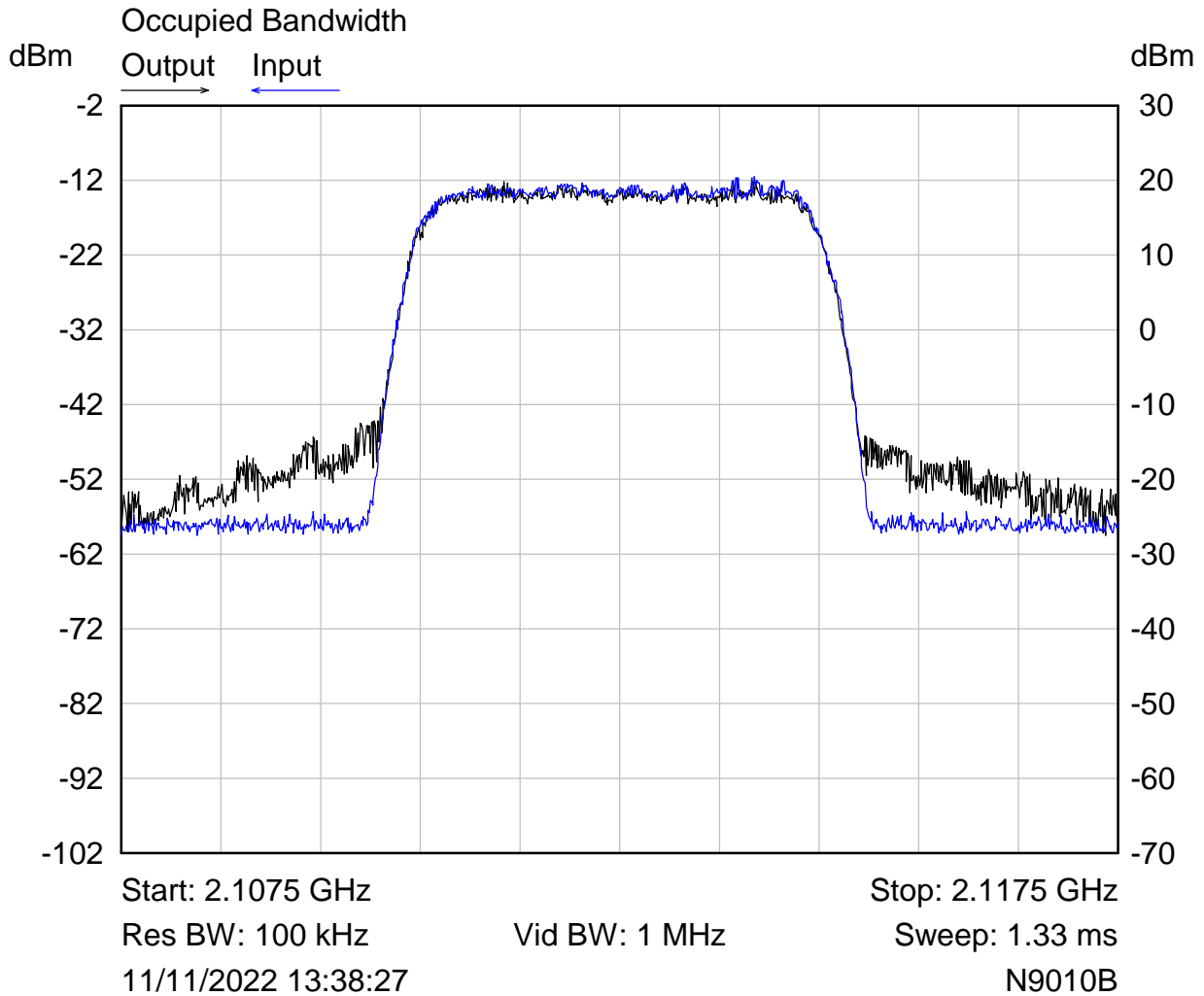
Plot of Channel power at determined f_0 in band 2496-2690 MHz



Plot of Peak to Average power ratio at determined f_0 in band 2496-2690 MHz

6.3 Occupied bandwidth / Input versus output signal

RF Parameters: Band 2110-2180 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 2112.5 MHz



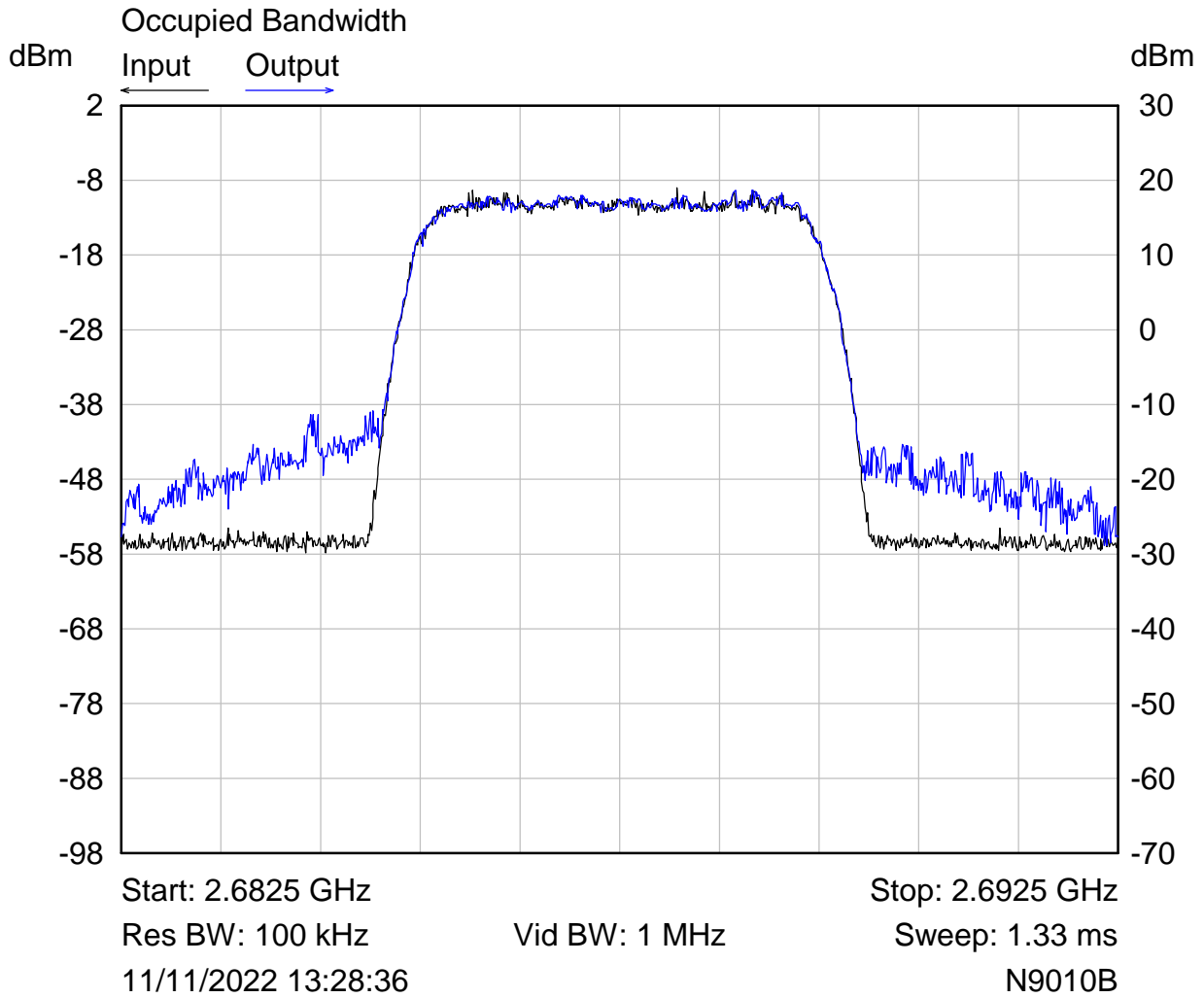
Output

Measurement Parameter	Value
Occupied Bandwidth	4.0837 MHz

Input

Measurement Parameter	Value
Occupied Bandwidth	4.0733 MHz

RF Parameters: Band 2496-2690 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN,
 Channel 2600 MHz



Output

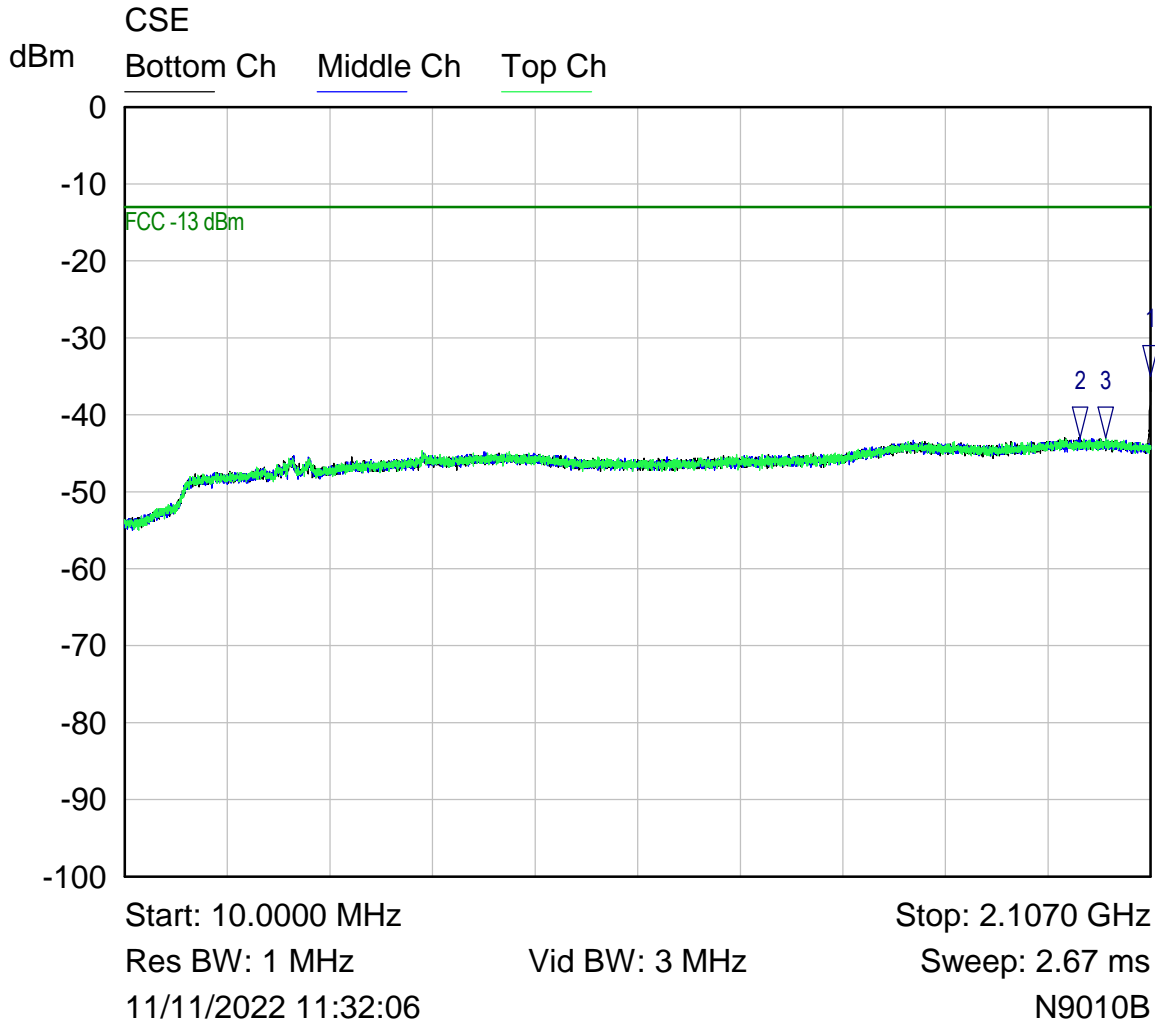
Measurement Parameter	Value
Occupied Bandwidth	4.0777 MHz

Input

Measurement Parameter	Value
Occupied Bandwidth	4.0753 MHz

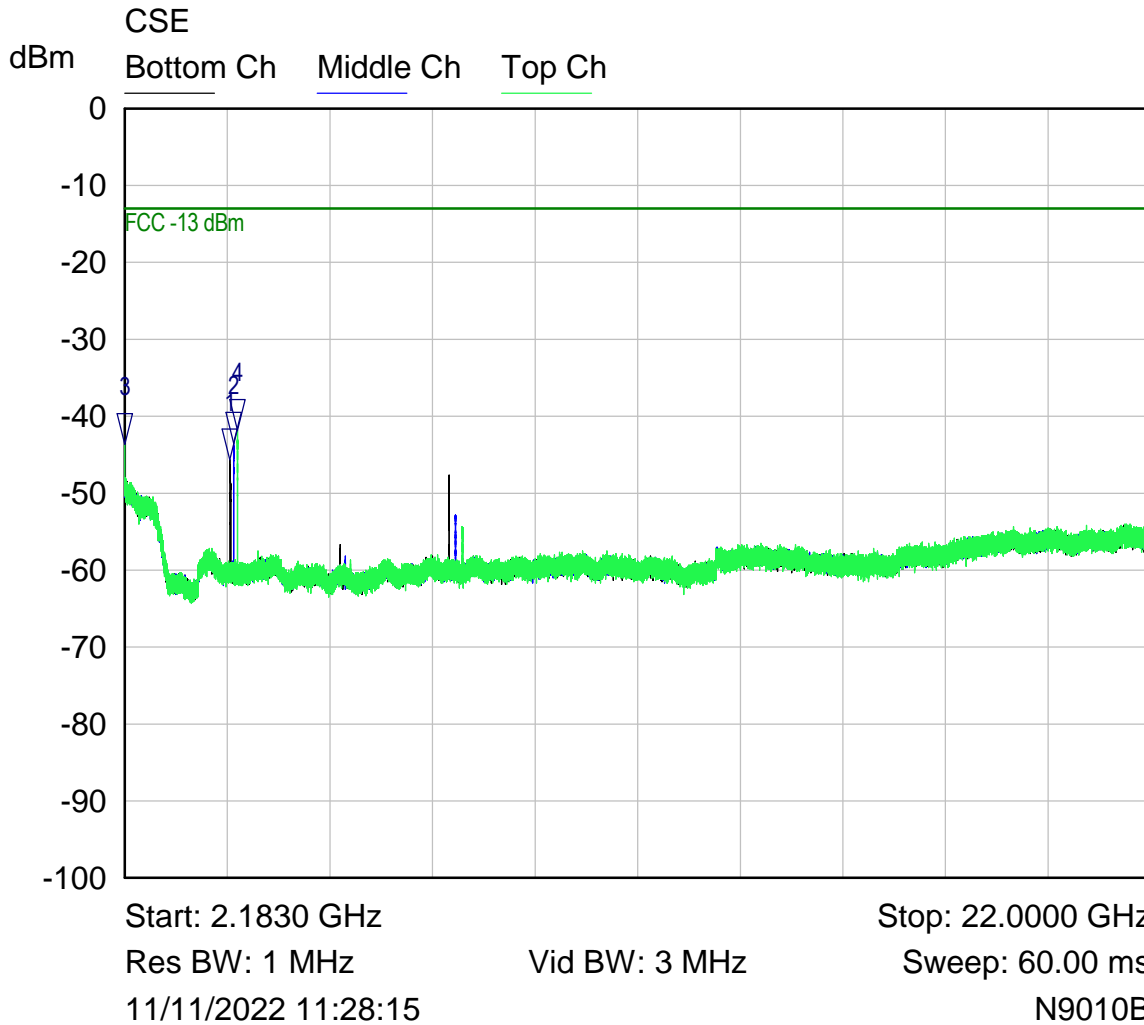
6.4 Spurious emissions at antenna terminals

RF Parameters: Band 2110-2180 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN,
 Channels 2112.5 MHz, 2142.5 MHz, 2177.5 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▾	Bottom Ch	2.1070 GHz	-35.03 dBm	
2 ▾	Middle Ch	1.9621 GHz	-43.06 dBm	
3 ▾	Top Ch	2.0145 GHz	-43.08 dBm	

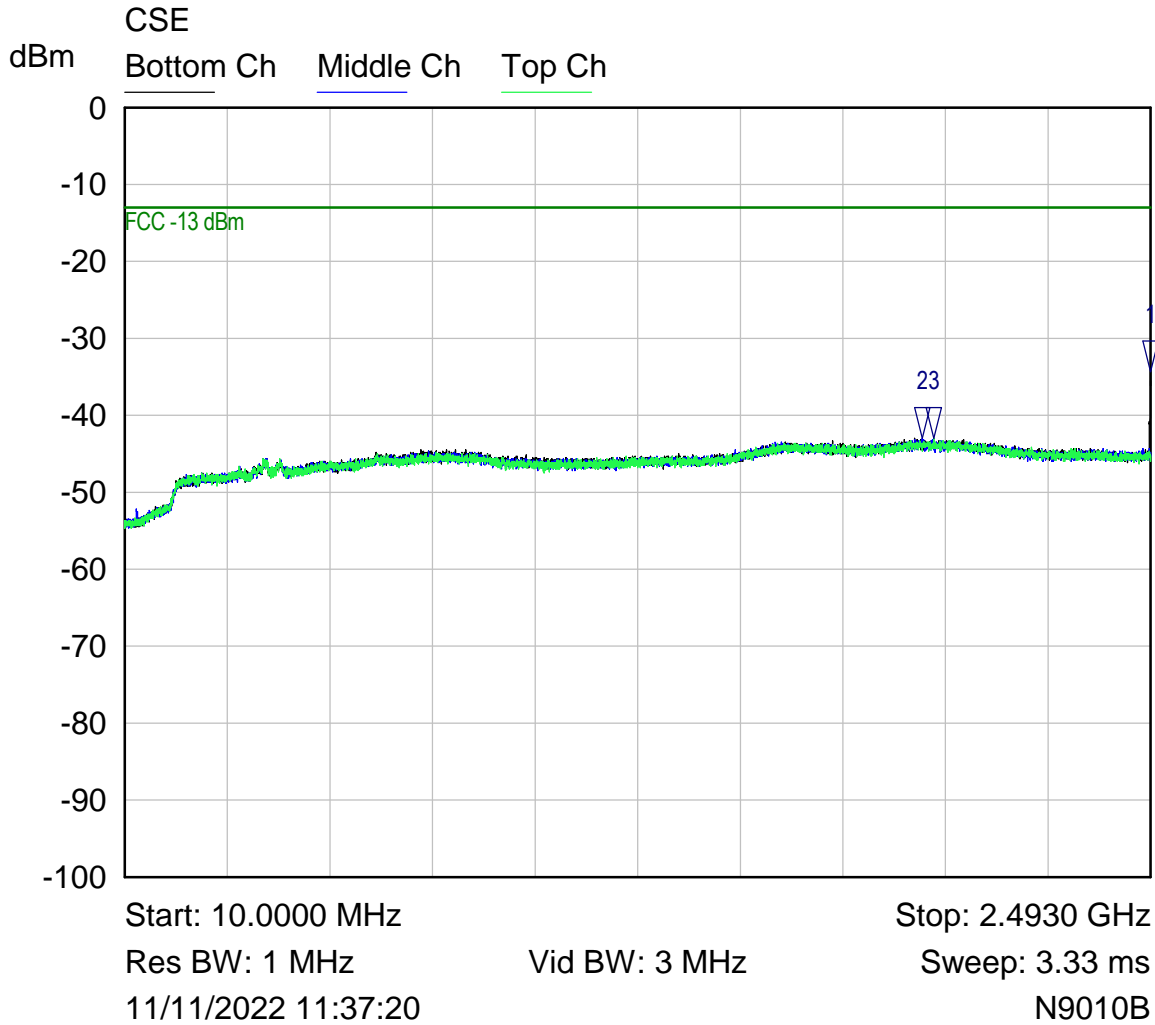
Plot of conducted emissions single channel mode 10 – 2107 MHz range
 (Note: Low, Mid and High channels overlaid on a single plot using 3 separate traces)



Mkr	Trace	X-Axis	Value	Notes
1 ▾	Bottom Ch	4.2252 GHz	-45.74 dBm	
2 ▾	Middle Ch	4.2902 GHz	-43.53 dBm	
3 ▾	Top Ch	2.1830 GHz	-43.69 dBm	
4 ▾	Top Ch	4.3550 GHz	-41.77 dBm	

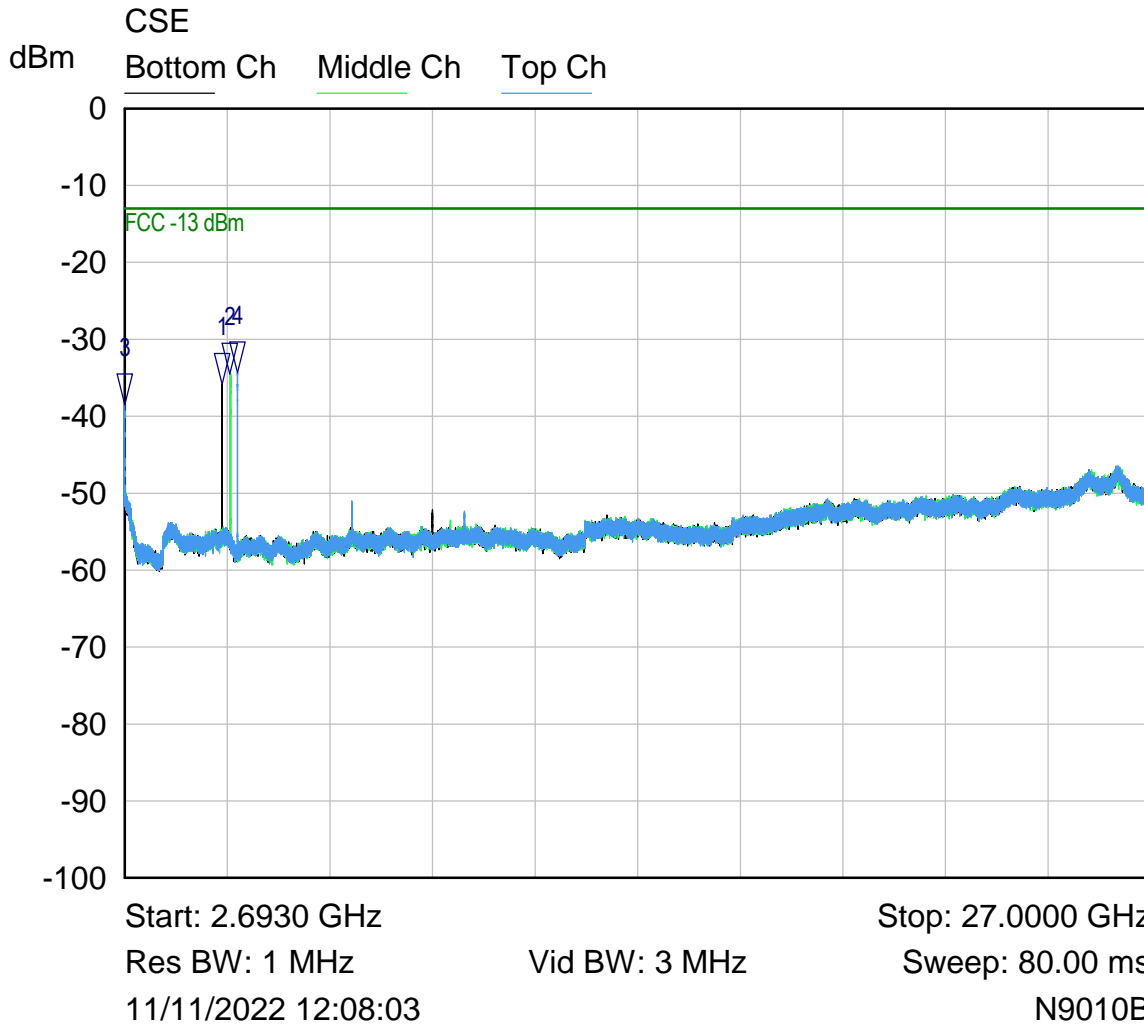
Plot of conducted emissions single channel mode 2.183 – 22 GHz range
 (Note: Low, Mid and High channels overlaid on a single plot using 3 separate traces)

RF Parameters: Band 2496-2690 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN,
 Channels 2498.5 MHz, 2600 MHz, 2687.5 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▾	Bottom Ch	2.4925 GHz	-34.37 dBm	
2 ▾	Middle Ch	1.9390 GHz	-42.94 dBm	
3 ▾	Top Ch	1.9693 GHz	-42.98 dBm	

Plot of conducted emissions single channel mode 10 – 2495 MHz range
 (Note: Low, Mid and High channels overlaid on a single plot using 3 separate traces)



Mkr	Trace	X-Axis	Value	Notes
1 ▾	Bottom Ch	4.9968 GHz	-35.76 dBm	
2 ▾	Middle Ch	5.1996 GHz	-34.44 dBm	
3 ▾	Top Ch	2.6930 GHz	-38.52 dBm	
4 ▾	Top Ch	5.3746 GHz	-34.31 dBm	

Plot of conducted emissions single channel mode 2.692 – 27 GHz range
 (Note: Low, Mid and High channels overlaid on a single plot using 3 separate traces)

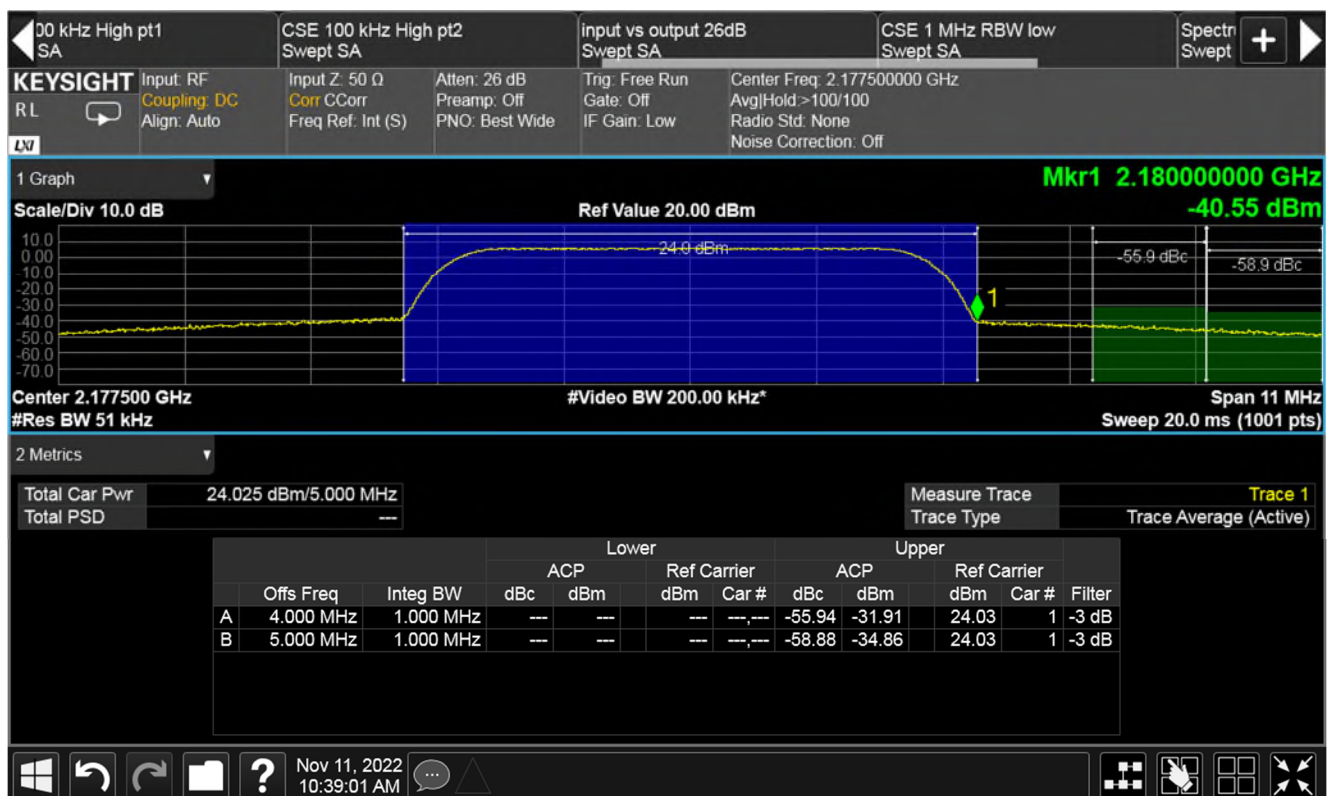
6.5 Band edge emissions

RF Parameters: Band 2110-2180 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 2112.5 MHz, Single channel mode



Plot of lower band edge for Low channel (2112.5MHz)

RF Parameters: Band 2110-2180 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 2177.5 MHz, Single channel mode



Plot of upper band edge for High channel (2177.5MHz)

RF Parameters: Band 2110-2180 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN, Channels 2112.5 & 2117.5MHz, Dual channel mode



Plot of lower band edge for Low channels (2112.5 & 2117.5 MHz)

RF Parameters: Band 2110-2180 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN, Channels 2172.5 & 2177.5MHz, Dual channel mode



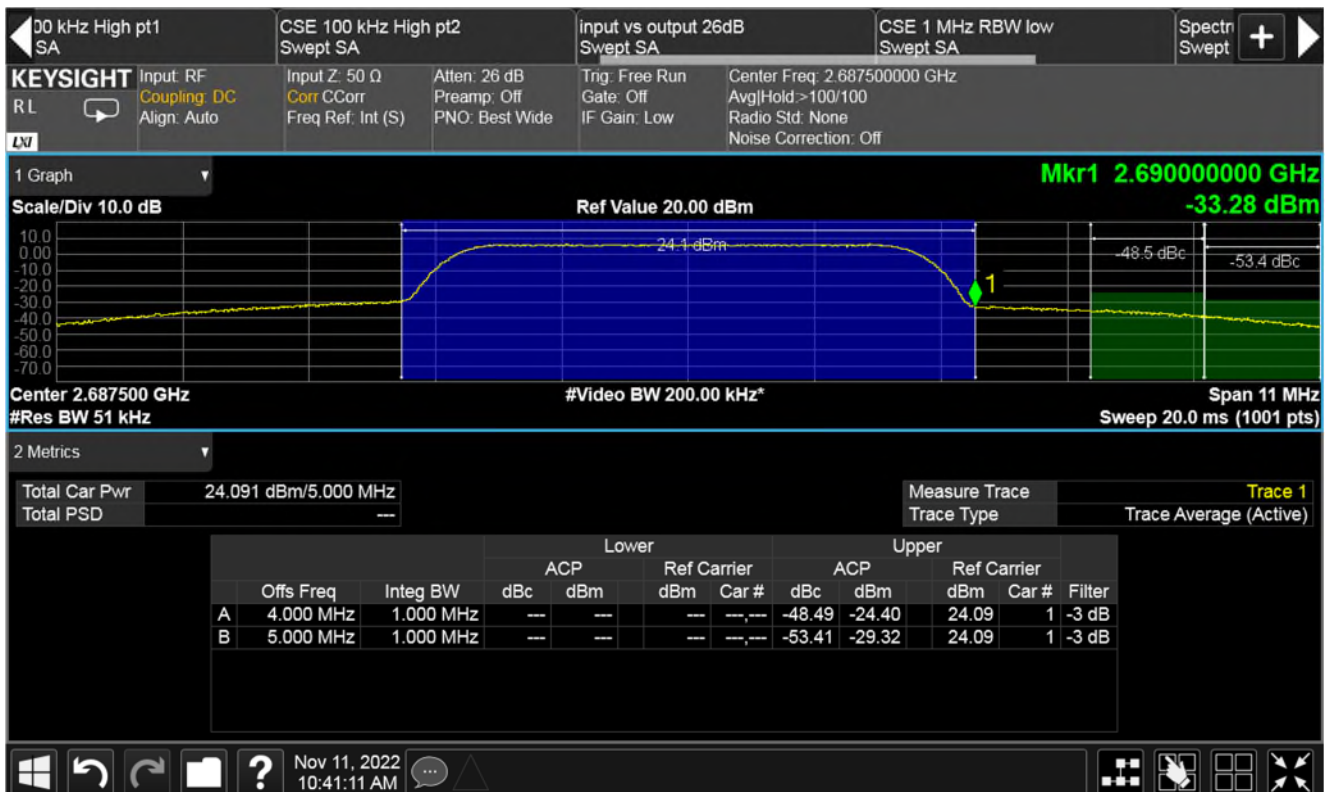
Plot of upper band edge for High channels (2172.5 & 2177.5MHz)

RF Parameters: Band 2496-2690 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 2498.5 MHz, Single channel mode



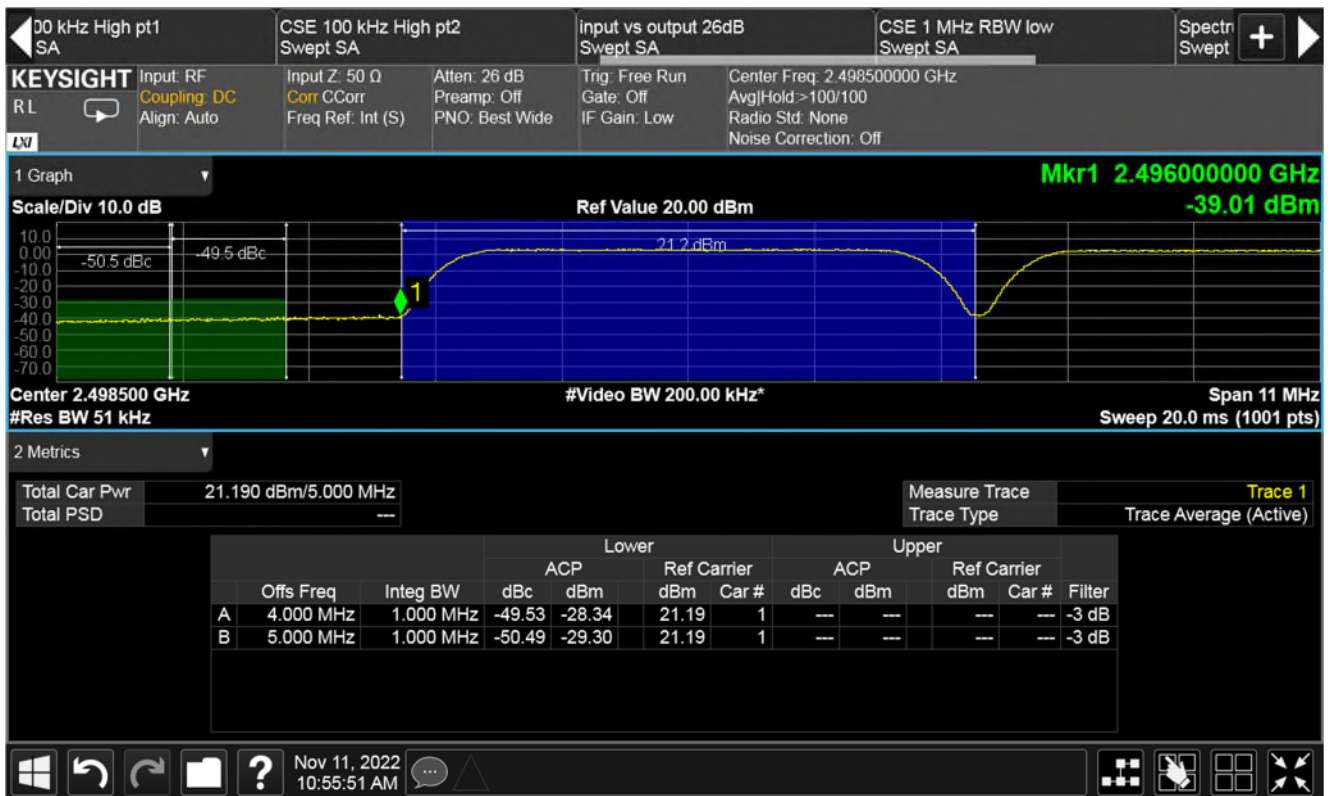
Plot of lower band edge for Low channel (2498.5MHz)

RF Parameters: Band 2496-2690 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 2687.5 MHz, Single channel mode



Plot of upper band edge for High channel (2687.5MHz)

RF Parameters: Band 2496-2690 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN, Channels 2498.5 & 2503.5MHz, Dual channel mode



Plot of lower band edge for Low channels (2498.5 & 2503.5MHz)

RF Parameters: Band 2496-2690 MHz, Power +24 dBm, Channel Spacing 5MHz, Modulation AWGN, Channels 2682.5 & 2687.5MHz, Dual channel mode



Plot of upper band edge for High channels (2682.5 & 2687.5MHz)

7 Photographs

For confidentiality purposes, photographs are not included at client's request.

8 Test equipment calibration list

The following is a list of the test equipment used by R.N. Electronics Ltd to test the unit detailed within this report. In line with our procedures, the equipment was within calibration for the period during which testing was carried out.

RN No.	Model No.	Description	Manufacturer	Calibration date	Cal period
CAL08	MWX221	Cable N Type to SMA Blue 2m	Junflon	12-Aug-2022	12 months
E007-2	VHA9103	Antenna Bi-con	Schwarzbeck	23-Apr-2021	36 months
E268	BHA 9118	Horn Antenna 1 - 18 GHz	Schaffner	02-Apr-2022	12 months
E330	2224-20	Horn Antenna 26.5-40GHz	Flann (FMI)	22-Apr-2022	12 months
E331	22093-KF20	Horn Antenna 26.5-40GHz	Flann (FMI)	22-Apr-2022	12 months
E412	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	21-Jun-2022	24 months
E428	HF906	Horn Antenna 1 - 18 GHz	Rohde & Schwarz	02-Apr-2022	12 months
E453	20240-20-AA	Horn Std Gain 17.6 - 26.7 GHz	Flann (FMI)	25-May-2022	12 months
E534	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	24-Jan-2022	24 months
E535	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	25-Jan-2022	12 months
E602	MG3692A	Signal Generator 10 MHz - 20 GHz	Anritsu	21-Feb-2022	12 months
E642	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	14-Dec-2021	24 months
E745	2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	04-Feb-2022	12 months
E777	MG3695B	Signal Generator 8 MHz - 50 GHz	Anritsu	21-Jun-2022	12 months
E856	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	14-Dec-2021	12 months
E904	5086-7805	Pre-Amplifier 1GHz - 26.5GHz	Hewlett Packard	04-Mar-2022	12 months
E914	VULB 9163	Antenna BiLog 30MHz to 3GHz	Schwarzbeck	23-Apr-2022	12 months
F075	AA18-10H	Attenuator SMA 10dB 18GHz	AtlanTecRF	19-Aug-2022	12 months
H071	N9010B	EXA Signal Analyser 10 Hz to 44 GHz	Keysight Technologies	#09-Nov-2022	3 months
H072	N9000B	PXA Signal Analyser 9 kHz to 26.5 GHz	Keysight Technologies	09-Feb-2021	24 months
LPE261	3115	Horn Antenna 1 - 18 GHz	EMCO	02-Apr-2022	12 months
LPE333	8449B	Pre-Amplifier 1GHz - 26.5GHz	Hewlett Packard	27-May-2022	12 months
TMS78	3160-08	Horn Std Gain 12.4 - 18 GHz	ETS Systems	30-Sep-2022	12 months
TMS79	3160-09	Horn Std Gain 18 - 26.5 GHz	ETS Systems	25-May-2022	12 months

Equipment was within calibration dates for tests and has been re-calibrated since/during date of tests.

9 Auxiliary and peripheral equipment

9.1 Customer supplied equipment

Item No.	Model No.	Description	Manufacturer	Serial No.
1	N5172B	EXG signal generator	Agilent	MY53050810
2	N5172B	EXG signal generator	Keysight	MY53050728
3	15542	30 dB attenuator	Mini-Circuits	VUU78901032
4	15542	30 dB attenuator	Mini-Circuits	VUU72800911
5	UNAT-20+	20 dB attenuator	Mini-Circuits	42600852
6	UNAT-20+	20 dB attenuator	Mini-Circuits	42600852
7	306-0001	UNItivity 5000 Primary Hub	Zinwave Ltd	680102010400
8	305-0004	Zinwave Secondary Hub	Zinwave Ltd	620110000204
9	E4432B	ESG-D signal generator	Keysight	ZE000094
10	E4432B	ESG-D signal generator	Keysight	ZE000107
11	-	Dual long fibre optic cables	-	-
12	-	DC power cable	-	-
13	-	Male to Male N RF cables (x4)	-	-
14	306-0001	UNItivity 5000 primary hub	Zinwave Ltd	680102010401
15	308-0004	Zinwave Secondary Hub	Zinwave Ltd	830110000216
16	N5172B	EXG Signal Generator	Keysight	ZE0000007
17	N5172B	EXG Signal Generator	Keysight	ZE000107

9.2 RN Electronics supplied equipment

RN No.	Model No.	Description	Manufacturer	Serial No
E587	68217-02	Cable N-N	Rosenberger Micro Coax	Fa210b1015007070
E482	26-6-34	Attenuator 6dB 18GHz	Weinschel Corp	BC4907
E478	LQ2992/H	Filter Band Pass 1-3GHz	RACAL-MESL	006

10 Condition of the equipment tested

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

10.1 Modifications before test

No modifications were made before test by RN Electronics Ltd.

10.2 Modifications during test

No modifications were made during test by RN Electronics Ltd.

11 Description of test sites

Site A	Radio Laboratory and Anechoic Chamber
Site B	Semi-Anechoic Chamber and Control Room FCC Registration No. 293246, ISED Registration No. 5612A-4
Site C	Transient Laboratory
Site D	Screened Room (Conducted Immunity)
Site E	Screened Room (Control Room for Site D)
Site F	Screened Room (Conducted Emissions)
Site G	Screened Room (Control Room for Site H)
Site H	3m Semi-Anechoic Chamber (indoor OATS) FCC Registration No. 293246, ISED Registration No. 5612A-2, VCCI Registration No. 4065
Site J	Transient Laboratory
Site K	Screened Room (Control Room for Site M)
Site M	3m Semi-Anechoic Chamber (indoor OATS) FCC Registration No. 293246, ISED Registration No. 5612A-3
Site N	Radio Laboratory
Site Q	Fully-Anechoic Chamber
Site OATS 3m and 10m Open Area Test Site	FCC Registration No. 293246, ISED Registration No. 5612A-1
Site R	Screened Room (Conducted Immunity)
Site S	Safety Laboratory
Site T	Transient Laboratory

RN Electronics CAB identifier as issued by Innovation, Science and Economic Development Canada is UK0002
RN Electronics CAB identifier as issued by FCC is UK0015

12 Abbreviations and units

%	Percent	LBT	Listen Before Talk
µA/m	microAmps per metre	LO	Local Oscillator
µV	microVolts	mA	milliAmps
µW	microWatts	max	maximum
AC	Alternating Current	kPa	Kilopascal
ALSE	Absorber Lined Screened Enclosure	Mbit/s	MegaBits per second
AM	Amplitude Modulation	MHz	MegaHertz
Amb	Ambient	mic	Microphone
ATPC	Automatic Transmit Power Control	min	minimum
BER	Bit Error Rate	mm	milliMetres
°C	Degrees Celsius	ms	milliSeconds
C/I	Carrier / Interferer	mW	milliWatts
CEPT	European Conference of Postal and Telecommunications Administrations	NA	Not Applicable
COFDM	Coherent OFDM	nom	Nominal
CS	Channel Spacing	nW	nanoWatt
CW	Continuous Wave	OATS	Open Area Test Site
dB	deciBels	OFDM	Orthogonal Frequency Division Multiplexing
dBµA/m	deciBels relative to 1µA/m	ppm	Parts per million
dBµV	deciBels relative to 1µV	PRBS	Pseudo Random Bit Sequence
dBc	deciBels relative to Carrier	QAM	Quadrature Amplitude Modulation
dBm	deciBels relative to 1mW	QPSK	Quadrature Phase Shift Keying
DC	Direct Current	R&TTE	Radio and Telecommunication Terminal Equipment
DTA	Digital Transmission Analyser	Ref	Reference
EIRP	Equivalent Isotropic Radiated Power	RF	Radio Frequency
ERP	Effective Radiated Power	RFC	Remote Frequency Control
EU	European Union	RSL	Received Signal Level
EUT	Equipment Under Test	RTP	Room Temperature and Pressure
FM	Frequency Modulation	RTPC	Remote Transmit Power Control
FSK	Frequency Shift Keying	Rx	Receiver
g	Grams	s	Seconds
GHz	GigaHertz	SINAD	Signal to Noise And Distortion
Hz	Hertz	Tx	Transmitter
IF	Intermediate Frequency	V	Volts
kHz	kiloHertz		