



Radio Test Report

Zinwave Ltd

Uniwave Remote Unit

308-0007-1

47 CFR Part 27 Effective Date 1st October 2021

↳ 47CFR part 2J 2021 Effective Date 1st October 2021

Test Date: 21st March 2023 to 12th April 2023

Report Number: 04-14169-2-23 Issue 01

The testing was carried out by RN Electronics Ltd, an independent test house, at their test facility located at:

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Arnolds Court, Arnolds Farm Lane, Mountnessing, Brentwood Essex, CM13 1UT

Certificate of Test 14169-2

The equipment noted below has been partially 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:	Uniwave Remote Unit
Model Number:	308-0007-1
Unique Serial Number:	810110000190
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:	04-14169-2-23 Issue 01
Test Standards:	47 CFR Part 27 Effective Date 1st October 2021 ↳ 47CFR part 2J 2021 Effective Date 1st October 2021

NOTE:

Certain tests were not performed based upon applicant's declarations. Certain other requirements are subject to applicant's declaration only and have not been tested/verified. For details refer to section 3 of this report.

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: 21st March 2023 to 12th April 2023

Test Engineer:
Jack Chilvers

A handwritten signature in blue ink, appearing to read 'Jack Chilvers', is enclosed within a rectangular box.

Approved By:
Radio Approvals Manager

Digitally signed by: Daniel Sims
DN: CN = Daniel Sims C = GB O = RN
Electronics Ltd
Date: 2023.05.22 13:58:14 Z

A digital signature in blue ink, appearing to read 'Daniel Sims', is enclosed within a rectangular box. To the right of the signature is a yellow arrow pointing to the right, with the text 'Digitally signed by: Daniel Sims' and 'DN: CN = Daniel Sims C = GB O = RN Electronics Ltd Date: 2023.05.22 13:58:14 Z'.

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	Uniwave Remote Unit	
Model Number of EUT	308-0007-1	
Serial Number of EUT	810110000190	
Date Received	17th March 2023	
Date of Test:	21st March 2023 to 12th April 2023	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	17th April 2023	
Main Function	Remote Unit in distributed antenna system. Takes RF over fibre and amplifies it before feeding to a wideband antenna.	
Information Specification	Height	70 mm
	Width	218 mm
	Depth	270 mm
	Weight	5.5 kg
	Voltage	48 VDC
	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	Omnidirectional Ceiling Mounted - Laird/TE CFD69383P1 or Laird/TE CFS60383P (Gain: 5.2 dBi)
Antenna port	1 Tx port and 1 Rx port
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	3980 MHz for these bands of operation
Lowest Signal generated in EUT	11 MHz
Hardware Version (HVIN)	1
Software Version	5.21rc06 (Primary Hub)
Firmware Version (FVIN)	5.65 (EUT)
Type of Equipment	Booster, Distributed Antenna System
Technology Type	Various Cellular – wideband distributed antenna system
Geo-location (yes/no)	No
TX Parameters	
Alignment range – transmitter	150-3980MHz Booster range (this band/report covers 617-652 MHz, 716-756 MHz, 3450-3550 MHz & 3700-3980 MHz, service bands)
EUT Declared Modulation Parameters	Device supports Miscellaneous Wireless Communications services under this rule part
EUT Declared Power level	+21, +23 or +24 dBm depending on operating band.
EUT Declared Signal Bandwidths	Device supports Miscellaneous Wireless Communications services under this rule part
EUT Declared Channel Spacing's	Device supports Miscellaneous Wireless Communications 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

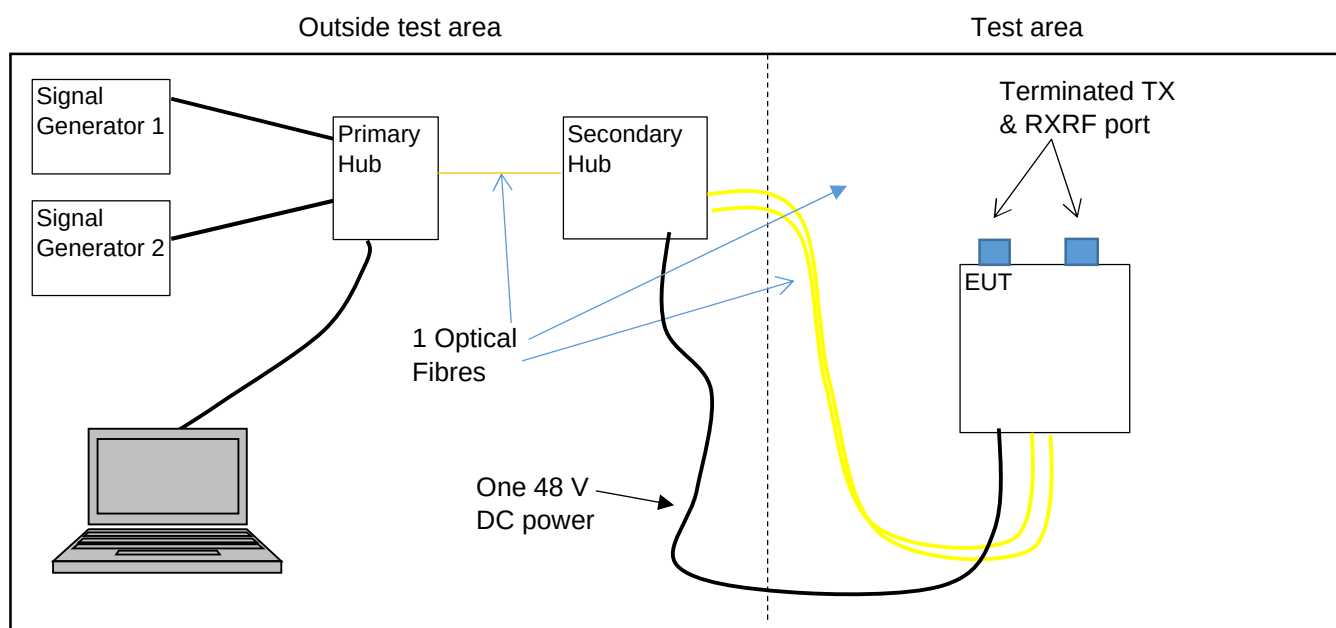
The Distributed Antenna System comprises a primary hub which accepts cellular base-station signals; this connects to 1 - 8 secondary hubs, each of which fan out the base-station signal to up to 8 Remote Units. The Remote Units require FCC certification since they are connected to a transmitting antenna.

2.4 Modes of operation

Mode Reference	Description	Used for testing
Band 617-652 MHz		
Mode 1	CW Sweep from 617-652 MHz to determine f0	Yes
Mode 2	Single mode Channel AWGN at f0 (619.5 MHz) in band 617-652MHz	Yes
Mode 3	Single Low channel AWGN at 619.5 MHz	Yes
Mode 4	Single Mid channel AWGN at 634 MHz	Yes
Mode 5	Single High channel AWGN at 649.5 MHz	Yes
Mode 6	Dual Low channel AWGN at 619.5 MHz & 624.5 MHz	Yes
Mode 7	Dual High channel AWGN at 644.5 MHz & 649.5 MHz	Yes
Band 716-758 MHz		
Mode 8	CW Sweep from 716-758 MHz to determine f0	Yes
Mode 9	Single mode Channel AWGN at f0 (718.5 MHz) in band 716-758 MHz	Yes
Mode 10	Single Low channel AWGN at 718.5.5 MHz	Yes
Mode 11	Single Mid channel AWGN at 740 MHz	Yes
Mode 12	Single High channel AWGN at 755.5 MHz	Yes
Mode 13	Dual Low channel AWGN at 718.5 MHz & 723.5 MHz	Yes
Mode 14	Dual High channel AWGN at 750.5 MHz & 755.5 MHz	Yes
Band 3450-3550 MHz		
Mode 15	CW Sweep from 3450-3550 MHz to determine f0	Yes
Mode 16	Single mode Channel AWGN at f0 (3452.5 MHz) in band 3450-3550 MHz	Yes
Mode 17	Single Low channel AWGN at 3452.5 MHz	Yes
Mode 18	Single Mid channel AWGN at 3500 MHz	Yes
Mode 19	Single High channel AWGN at 3547.5 MHz	Yes
Mode 20	Dual Low channel AWGN at 3452.5 MHz & 3457.5 MHz	Yes
Mode 21	Dual Mid channel AWGN at 3500 MHz & 3505 MHz	Yes
Mode 22	Dual High channel AWGN at 3542.5 MHz & 3547.5 MHz	Yes
Band 3700-3980 MHz		
Mode 23	CW Sweep from 3700-3980 MHz to determine f0	Yes
Mode 24	Single mode Channel AWGN at f0 (3772.5 MHz) in band 3700-3980 MHz	Yes
Mode 25	Single Low channel AWGN at 3702.5 MHz	Yes
Mode 26	Single Mid channel AWGN at 3840 MHz	Yes

Note: This report only pertains to the operation of the equipment to 47 CFR part 27, for details of testing to other rule parts please see RN reports: 04-14169-1-23 (Part 22H) & 04-14169-3-23 (Part 96)

2.5 Emissions configuration



The EUT 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. The unit provided either 24dB or 21 dB of gain, this was dependent on service band usage and single/dual channel usage. Target output power was set at either +21dBm (617-652 MHz and 716-758 MHz), +23dBm (3450-3550 MHz) or +24dBm (3700-3980 MHz) at the TX output port in conjunction with the signal generator settings. 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 the target powers of the device under test. The transmit mode was 100% continuous with EUT output power maintained at required target output power. Test channels and combinations 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 5.2 dBi or 3.06 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 1	2 cores	Yes
Fibre TX 1	Fibre	Yes
Fibre RX 1	Fibre	Yes
Transmit port 1	N-type coaxial	Yes
Receive port 1	N-type coaxial	Yes

3 Summary of test results

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

47 CFR Part 27 Effective Date 1st October 2021
↳ 47CFR part 2J 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(n)(1), (l)(1) FCC Part 2 Clause 2.1051	PASSED ³
2. RF Power Output	FCC Part 27 Clause 27.50(j)(k) FCC Part 2 Clause 2.1046	PASSED
3. Frequency stability	FCC Part 2 Clause 2.1055	NOT APPLICABLE ¹
4. Occupied Bandwidth	FCC Part 2 Clause 2.1049	PASSED
5. Field strength of spurious radiations	FCC Part 27 Clause 27.53(n)(1), (l)(1) FCC Part 2 Clause 2.1053	PASSED
6. Band edge / spectrum mask additional emissions limitations	FCC Part 27 Clause 27.53(n)(1), (l)(1) FCC Part 2 Clause 2.1051	PASSED
7. Modulation characteristics	FCC Part 2 Clause 2.1047	NOT TESTED ²
8. Determination of f_0	KDB 935210 D05 Clause 3.3	PERFORMED

¹ EUT does not contain an oscillator and only reproduces what is provided at its input.

² EUT uses digital modulation techniques. Modulation schemes and information is detailed in section 2.2 of this report.

³ Spectrum investigated started at a frequency of 30 MHz up to a frequency of 40 GHz based on 10 times the highest channel of 3977.5 MHz.

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	2021	Miscellaneous Wireless Communications Services
4.1.2	47CFR part 2J	2021	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations
4.1.3	KDB 971168 D01 v03	2017	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 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
4.1.6	TIA-603-E	2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards, Telecommunications Industry Association, June 2010

4.2 Deviations

No Deviations have been 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

The EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation and or filtering. The RX port was terminated into a 50 Ohm load. The EUT was tested across Low, Middle and High channels within each applicable band in a single channel input mode and in a dual channel input mode modes as specified in section 2.4 of this report. The EUT was operated in Mode 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 25, 26, 27, 28, 29 and 30

5.1.3 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. A complete scan of emissions from the lowest frequency generated/ used within the equipment up to 10 times the highest frequency generated/ used was made, to identify any signals within 20dB of the limits. 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 5.2dBi (3.06dBd) and indicated. Tests were performed in site N..

5.1.4 Test equipment

E383, E558, E615, E701, E777, E853, E937, E970, F021, F030, F031, F081, F408, F409, F931, G002, H071

See Section 8 for more details

5.1.5 Test results

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

Single Channel Results (617-652 MHz)

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Low channel	619.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1239	-18.89	-5.89

Plots
CSE, Band 617-652 MHz, Single, 10 - 617 MHz
CSE, Band 617-652 MHz, Single, 652 MHz - 1 GHz
CSE, Band 617-652 MHz, Single, 1-10 GHz

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Mid channel	634 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1268	-19.91	-6.91

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
High channel	649.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1299	-21.03	-8.03

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Dual Channel Results (617-652 MHz)

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Low channel	619.5 + 624.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1244	-29.74	-16.74

Plots
CSE, Band 617-652 MHz, Dual, 10-617 MHz
CSE, Band 617-652 MHz, Dual, 652 MHz - 1 GHz
CSE, Band 617-652 MHz, Dual, 1-10 GHz

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
High channel	644.5 + 649.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1294	-31.26	-18.26

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Single Channel Results (716-758 MHz)

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Low channel	718.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1437	-26.02	-13.02

Plots
CSE, Band 716-758 MHz, Single, 10 - 716 MHz
CSE, Band 716-758 MHz, Single, 758 MHz - 1 GHz
CSE, Band 716-758 MHz, Single, 1-10 GHz

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Mid channel	740 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1480	-27.91	-14.91

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
High channel	755.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1511	-27.98	-14.98

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Dual Channel Results (716-758 MHz)

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Low channel	718.5 + 723.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1442	-30.11	-17.11

Plots
CSE, Band 716-758 MHz, Dual, 10 - 716 MHz
CSE, Band 716-758 MHz, Dual, 758 MHz - 1 GHz
CSE, Band 716-758 MHz, Dual, 1-10 GHz

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Dual mode 5 MHz

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Mod Scheme	AWGN
High channel	750.5 + 755.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1506	-32.98	-19.98

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Single Channel Results (3450-3550 MHz)

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Low channel	3452.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
4525	-48	-8
6905	-43.1	-3.1
3241.7	-48.1	-8.1

Plots	
CSE, Band 3450-3550 MHz, Single, 10 - 3450 MHz	
CSE, Band 3450-3550 MHz, Single, 3.55 - 11 GHz	
CSE, Band 3450-3550 MHz, Single, 11 - 18 GHz	
CSE, Band 3450-3550 MHz, Single, 18 - 26.5 GHz	
CSE, Band 3450-3550 MHz, Single, 26.5 - 40 GHz	

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Mid channel	3500 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
4525	-48	-8
7000	-43.91	-3.9
3241.7	-48.1	-8.1

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
High channel	3547.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
4525	-48	-8
7095	-44.34	-4.34
3241.7	-48.1	-8.1

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Dual Channel Results (3450-3550 MHz)

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Low channel	3452.5 + 3457.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
4406.6	-45.15	-5.15
6910	-43.82	-3.82
3241.7	-48.1	-8.1

Plots
CSE, Band 3450-3550 MHz, Dual, 10 - 3450 MHz
CSE, Band 3450-3550 MHz, Dual, 3.55 - 11 GHz
CSE, Band 3450-3550 MHz, Dual, 11 - 18 GHz
CSE, Band 3450-3550 MHz, Dual, 18 - 26.5 GHz
CSE, Band 3450-3550 MHz, Dual, 26.5 - 40 GHz

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Mid channel	3500 + 3505 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
4406.6	-45.15	-5.15
7005	-45.43	-5.43
3241.7	-48.1	-8.1

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
High channel	3542.5 + 3547.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
4406.6	-45.15	-5.15
7090	-46.53	-6.33
3241.7	-48.1	-8.1

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Single Channel Results (3700-3980 MHz)

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Low channel	3702.5 MHz

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

Plots
CSE, Band 3700-3980 MHz, Single, 10 - 1000 MHz
CSE, Band 3700-3980 MHz, Single, 1 - 3.7 GHz
CSE, Band 3700-3980 MHz, Single, 3.98 - 30 GHz
CSE, Band 3700-3980 MHz, Single, 30 - 40 GHz

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Mid channel	3840 MHz

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

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
High channel	3977.5 MHz

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

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Dual Channel Results (3700-3980 MHz)

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Low channel	3702.5 + 3707.5 MHz

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

Plots	
CSE, Band 3700-3980 MHz, Dual, 10 - 1000 MHz	
CSE, Band 3700-3980 MHz, Dual, 1 - 3.7 GHz	
CSE, Band 3700-3980 MHz, Dual, 3.98 - 30 GHz	
CSE, Band 3700-3980 MHz, Dual, 30 - 40 GHz	

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Mid channel	3840 + 3845 MHz

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

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
High channel	3972.5 + 3977.5 MHz

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

Note: Mid channel plots are shown as second trace on Low channel plot file referenced above.

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LIMITS:

Parts 27.53(a)(1) for operation in the 2345-2360 MHz band (plotted as -45 dBm, $75 + 10 \log P$, for simplicity)

Parts 27.53 (c) and 27.53(f) for operation in the 746-758 MHz band

Parts 27.53 (g) for operation in the 698-746 MHz band

Parts 27.53(l)(1) for operation in the 3700-3980 MHz band

Parts 27.53 (n)(1) for operation in the 3450-3550 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. +20dBm = 0.1W
therefore:

$$43+10*\log 0.1 = 33\text{dB}. +20\text{dBm} - 33 = -13\text{dBm}.$$

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
 ± 2.8 dB up to 26.5 GHz. 26.5 – 60 GHz ± 3.6 dB, 60 – 110 GHz ± 4.1 dB, 110 GHz – 200 GHz ± 4.9 dB

5.2 RF Power Output

5.2.1 Test methods

Test FCC Part 27 Clause 27.53(a)(g)(h)(m2) [Reference 4.1.1 of this report]
Requirements: 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(c)(b)(j)(k) [Reference 4.1.1 of this report]

5.2.2 Configuration of EUT

The EUT was measured on a bench using a power meter & spectrum analyser connected to the external RF port.

The EUT was operated in Mode 2 and Mode 9 and Mode 16 and Mode 24 for this test.

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 Analyser was used to measure channel power over 5MHz BW using an RMS detector. CCDF function of the analyser was then used to determine Peak to Average Power Ratio.

Measurements were made in site N.

5.2.4 Test equipment

E558, H071

See Section 8 for more details

5.2.5 Test results

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

Single operation band 617-652 MHz

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low1 channel	619.5 MHz (FO)

Test Instance (e.g. modulation or Resource block)	Average Cond Power (dBm) TX Chain 1	Antenna Gain dBi (dBd)	TX Power EIRP (dBm)	TX Power EIRP (W)	Power Limit (dBm)	Power Margin (dB)
AWGN channel closest to FO	21.04	5.2 (3.06)	24.1	0.257	37	-12.9

Note: 5.2dBi Antenna gain (3.06dBd) is used. 619.5 MHz is the lowest 5MHz channel centre frequency within the band of operation and encompasses f_0 of 617.0014 MHz. Please refer to input/output plot for channel power measurement.

Peak to AV ratio (dB)	#Plot\Down	PK to AV Limit (dB)	PK to AV Margin (dB)
6.58	14169-2 619.5	13	-6.42

Single operation band 716-756 MHz

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Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low1 channel	718.5 MHz (FO)

Test Instance (e.g. modulation or Resource block)	Average Cond Power (dBm) TX Chain 1	Antenna Gain dBi (dBd)	TX Power EIRP (dBm)	TX Power EIRP (W)	Power Limit (dBm)	Power Margin (dB)
AWGN channel closest to FO	21.15	5.2 (3.06)	24.21	0.264	37	-12.79

Note: 5.2dBi Antenna gain (3.06dBd) is used. 718.5 MHz is the lowest 5MHz channel centre frequency within the band of operation and encompasses fo of 716.0567 MHz. Please refer to input/output plot for channel power measurement.

Peak to AV ratio (dB)	#Plot\Down	PK to AV Limit (dB)	PK to AV Margin (dB)
7.39	14169-2 718.5	13	-5.61

Single operation band 3450-3550 MHz

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low1 channel	3452.5 MHz (FO)

Test Instance (e.g. modulation or Resource block)	Average Cond Power (dBm) TX Chain 1	Antenna Gain dBi	TX Power EIRP (dBm)	TX Power EIRP (W)	Power Limit (dBm)	Power Margin (dB)
AWGN channel closest to FO	23.17	5.2	28.37	0.687	37	-8.63

Note: 3452.5 MHz is the lowest 5MHz channel centre frequency within the band of operation and encompasses fo of 3450 MHz. Please refer to input/output plot for channel power measurement.

Peak to AV ratio (dB)	#Plot\Down	PK to AV Limit (dB)	PK to AV Margin (dB)
8.14	14169-2 3452.5	13	-4.86

Single operation band 3700-3980 MHz

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low1 channel	3772.5 MHz (FO)

Test Instance (e.g. modulation or Resource block)	Average Cond Power (dBm) TX Chain 1	Antenna Gain dBi	TX Power EIRP (dBm)	TX Power EIRP (W)	Power Limit (dBm)	Power Margin (dB)
AWGN channel closest to FO	24.05	5.2	29.25	0.841	37	-7.75

Note: 3772.5 MHz is the 29th 5MHz channel centre frequency within the band of operation and encompasses fo of 3721.879 MHz. Please refer to input/output plot for channel power measurement.

Peak to AV ratio (dB)	#Plot\Down	PK to AV Limit (dB)	PK to AV Margin (dB)
7.91	14169-2 3772.5	13	-5.09

LIMITS:

27.50(c)(3) Fixed and base stations transmitting a signal with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP in accordance 27.50(b)(4) (c)(3) Fixed and base stations transmitting a signal in the 746–757 MHz and 776–787 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP

27.50(j)(1), The power of each fixed or base station transmitting in the 3700-3980 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to an equivalent isotropically radiated power (EIRP) of 3280 Watts/MHz.

27.50(j)(2), The power of each fixed or base station transmitting in the 3700-3980 MHz band and situated in any geographic location other than that described in paragraph (j)(1) of this section is limited to an EIRP of 1640 Watts/MHz.

27.50(j)(4), The peak-to-average power ratio (PAPR) of the transmission may not exceed 13 dB.

27.50(k)(1), The power of each fixed or base station transmitting in the 3450-3550 MHz band and located in any county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, is limited to an equivalent isotropically radiated power (EIRP) of 3280 Watts/MHz.

27.50(k)(2), The power of each fixed or base station transmitting in the 3450-3550 MHz band and situated in any geographic location other than that described in paragraph (j)(1) of this section is limited to an EIRP of 1640 Watts/MHz.

27.50(k)(4), The peak-to-average power ratio (PAPR) of the transmission may not exceed 13 dB.

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:
UR02D - 3-6.6 GHz ± 1.96 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

5.4.1 Test methods

Test Requirements: FCC Part 2 Clause 2.1049 [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: Emissions to be contained within the applicable emissions mask/band edges.

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 on the channel that encompassed the determined f_0 in each applicable band. The EUT was operated in Mode 2 and Mode 9 and Mode 16 and Mode 24 mode.

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 to an appropriate channel to include f_0 as determined in section 5.8. An RMS detector was set, and sweeps made comparing the 99% BW input and the output signals. Tests were performed using Test Site N.

5.4.4 Test equipment

E558, H071

See Section 8 for more details

5.4.5 Test results

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

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low1 channel	619.5 MHz (FO)

Single channel	
99 % Bandwidth (MHz) Nominal Temp & Volts	4.44
Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts	619.5 MH (channel closest to FO)

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low1 channel	718.5 MHz (FO)

	Single channel
99 % Bandwidth (MHz) Nominal Temp & Volts	4.42
Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts	718.5 MH (channel closest to FO)

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low1 channel	3452.5 MHz (FO)

	Single channel
99 % Bandwidth (MHz) Nominal Temp & Volts	4.42
Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts	3452.5 MH (channel closest to FO)

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low1 channel	3772.5 MHz (FO)

	Single channel
99 % Bandwidth (MHz) Nominal Temp & Volts	4.42
Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts	3772.5 MH (channel closest to FO)

Plots for the 99% bandwidth can be found in Section 6 of this report.

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(c)(g)(i)(n) [Reference 4.1.1 of this report]

5.5.2 Configuration of EUT

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. The EUT was operated in Mode 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 25, 26, 27, 28, 29 and 30. Both RF ports were active during tests with the same channel frequency settings for single channel and dual channel modes of operation, therefore MIMO operation is also covered under the results listed below.

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 from the EUT was maximised by rotating it 360 degrees. Appropriate band-pass filters were used to ensure the fundamental did not distort the results. An RMS detector was used for final measurements.

25MHz - 1GHz.

The measuring antenna was scanned 1 - 4m in both Horizontal and Vertical polarisations. Substitution method was performed using tuned dipoles / a calibrated bi-conical antenna.

1GHz – 40GHz.

The measuring antenna was used in both Horizontal and Vertical polarisations. Substitution method was performed using standard gain horn antennas.

Tests were performed in site M & B

5.5.4 Test equipment

CAL07, CAL08, E007-2, E136, E268, E296-2, E330, E411, E412, E428, E433, E624, E642, E743, E856, E904, E932, F190, F191, LPE364, TMS78, TMS79, TMS812, TMS82

See Section 8 for more details

5.5.5 Test results

Temperature of test environment	16°C
Humidity of test environment	68%
Pressure of test environment	103kPa

Setup Table

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Low channel	619.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Mid channel	634 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
High channel	649.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Low channel	718.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Mid channel	740 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
High channel	755.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Low channel	3452.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
30.35	-49.52	-9.52	Vertical	Normal use position
77.95	-53.00	-13	Vertical	Normal use position
284.16	-42.53	-2.53	Vertical	Normal use position
302.63	-45.62	-5.62	Vertical	Normal use position
348.27	-45.25	-5.25	Vertical	Normal use position
34.86	-47.72	-7.72	Horizontal	Normal use position
273.98	-42.39	-2.39	Horizontal	Normal use position
296.85	-45.05	-5.05	Horizontal	Normal use position
349.22	-45.5	-5.5	Horizontal	Normal use position

Setup Table

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Mid channel	3500 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
30.35	-49.52	-9.52	Vertical	Normal use position
77.95	-53.00	-13	Vertical	Normal use position
284.16	-42.53	-2.53	Vertical	Normal use position
302.63	-45.62	-5.62	Vertical	Normal use position
348.27	-45.25	-5.25	Vertical	Normal use position
34.86	-47.72	-7.72	Horizontal	Normal use position
273.98	-42.39	-2.39	Horizontal	Normal use position
296.85	-45.05	-5.05	Horizontal	Normal use position
349.22	-45.5	-5.5	Horizontal	Normal use position
14000	-45.93	-5.93	Vertical	Normal use position

Setup Table

Band	3450-3550 MHz
Power Level	23 dBm

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Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
High channel	3547.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
30.35	-49.52	-9.52	Vertical	Normal use position
77.95	-53.00	-13	Vertical	Normal use position
284.16	-42.53	-2.53	Vertical	Normal use position
302.63	-45.62	-5.62	Vertical	Normal use position
348.27	-45.25	-5.25	Vertical	Normal use position
34.86	-47.72	-7.72	Horizontal	Normal use position
273.98	-42.39	-2.39	Horizontal	Normal use position
296.85	-45.05	-5.05	Horizontal	Normal use position
349.22	-45.5	-5.5	Horizontal	Normal use position
14190	-52.11	-12.11	Vertical	Normal use position

Setup Table

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Low channel	3702.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
Mid channel	3840 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Single mode 5 MHz
Mod Scheme	AWGN
High channel	3977.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	617-652 MHz
Power Level	21 dBm

Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Low channel	619.5 + 624.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
High channel	644.5 + 649.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Low channel	718.5 + 723.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	716-758 MHz
Power Level	21 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
High channel	750.5 + 755.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Low channel	3452.5 + 3457.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
30.35	-49.52	-9.52	Vertical	Normal use position
77.95	-53.00	-13	Vertical	Normal use position
284.16	-42.53	-2.53	Vertical	Normal use position
302.63	-45.62	-5.62	Vertical	Normal use position
348.27	-45.25	-5.25	Vertical	Normal use position
34.86	-47.72	-7.72	Horizontal	Normal use position
273.98	-42.39	-2.39	Horizontal	Normal use position
296.85	-45.05	-5.05	Horizontal	Normal use position
349.22	-45.5	-5.5	Horizontal	Normal use position

Setup Table

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Mid channel	3500 + 3505 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
30.35	-49.52	-9.52	Vertical	Normal use position
77.95	-53.00	-13	Vertical	Normal use position
284.16	-42.53	-2.53	Vertical	Normal use position
302.63	-45.62	-5.62	Vertical	Normal use position
348.27	-45.25	-5.25	Vertical	Normal use position
34.86	-47.72	-7.72	Horizontal	Normal use position
273.98	-42.39	-2.39	Horizontal	Normal use position
296.85	-45.05	-5.05	Horizontal	Normal use position
349.22	-45.5	-5.5	Horizontal	Normal use position
14010	-46.63	-6.63	Vertical	Normal use position

Setup Table

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
High channel	3542.5 + 3547.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
30.35	-49.52	-9.52	Vertical	Normal use position
77.95	-53.00	-13	Vertical	Normal use position
284.16	-42.53	-2.53	Vertical	Normal use position
302.63	-45.62	-5.62	Vertical	Normal use position
348.27	-45.25	-5.25	Vertical	Normal use position
34.86	-47.72	-7.72	Horizontal	Normal use position
273.98	-42.39	-2.39	Horizontal	Normal use position
296.85	-45.05	-5.05	Horizontal	Normal use position
349.22	-45.5	-5.5	Horizontal	Normal use position
14180	-46.76	-6.76	Vertical	Normal use position

Setup Table

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Low channel	3702.5 + 3707.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	3700-3980 MHz
Power Level	2 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
Mid channel	3840 + 3845 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

Setup Table

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	Dual mode 5 MHz
Mod Scheme	AWGN
High channel	3972.5 + 3977.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions observed within 20 dB of limit				

LIMITS:

Parts 27.53 (c) and 27.53(f) for operation in the 746-758 MHz band

Parts 27.53 (g) for operation in the 698-746 MHz band

Parts 27.53(l)(1) for operation in the 3700-3980 MHz band

Parts 27.53 (n)(1) for operation in the 3450-3550 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. +20dBm = 0.1W therefore:

$43+10\log 0.1 = 33\text{dB}$. +20dBm – 33 = -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 $\pm 3.9\text{ dB}$, 1 – 18 GHz $\pm 3.5\text{dB}$, 18 – 27 GHz $\pm 3.9\text{dB}$

5.6 Band edge / spectrum mask additional emissions limitations

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

The EUT was operated on a test bench. Measurements were made at the 50 ohm coaxial transmit / receive port. The EUT was operated in Mode 3 and Mode 5 and Mode 6 and Mode 7 and Mode 10 and Mode 12 and Mode 13, 14, 17, 19, 20, 22, 25, 27, 28 and 30 for this test, encompassing low and high channels in both single and dual channel modes.

5.6.3 Test procedure

Tests were made in accordance with the Test Method noted above, using the measuring equipment listed in the 'Test Equipment' Section. A 51kHz RBW (1% of EBW), 3x VBW, auto sweep time and max hold settings using an RMS detector were used to show the EUT's spectrum at the band/block edges integrated back to the appropriate RBW and limit. AWGN modulation and 5MHz channel bandwidth was used per KDB 935210 to measure upper and lower channel frequency signals with ACP function on the analyser enabled and plotted.

The EUT was tested in Site N.

5.6.4 Test equipment

E558, H071

See Section 8 for more details

5.6.5 Test results

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

Band	617-652 MHz
Power Level	21 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	619.5 MHz
High channel	649.5 MHz
Dual Low channels	619.5 + 624.5 MHz
Dual High channels	644.5 + 649.5 MHz

Test Instance (e.g. modulation or Resource block)	Band edge result SISO Port 1 (dBm)	Plot reference Port 1	SISO Port 1 (dB) Margin
AWGN Single Low Chan	-28.19	14169-2 619.5 MHz	-15.19
AWGN Single High Chan	-30.68	14169-2 649.5 MHz	-17.68
AWGN Dual Low Chan	-30.22	14169-2 619.5 + 624.5 MHz	-17.22
AWGN Dual High Chan	-33.57	14169-2 644.5 + 649.5 MHz	-20.57

Band	716-756 MHz
Power Level	21 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	718.5 MHz
High channel	755.5 MHz
Dual Low channels	718.5 + 723.5 MHz
Dual High channels	750.5 + 755.5 MHz

Test Instance (e.g. modulation or Resource block)	Band edge result SISO Port 1 (dBm)	Plot reference Port 1	SISO Port 1 (dB) Margin
AWGN Single Low Chan	-33.51	14169-2 718.5 MHz	-20.51
AWGN Single High Chan	-36.74	14169-2 755.5 MHz	-23.74
AWGN Dual Low Chan	-37.33	14169-2 718.5 + 723.5 MHz	-24.33
AWGN Dual High Chan	-40.98	14169-2 750.5 + 755.5 MHz	-27.98

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	3452.5 MHz
High channel	3547.5 MHz
Dual Low channels	3452.5 + 3457.5 MHz
Dual High channels	3542.5 + 3547.5 MHz

Test Instance (e.g. modulation or Resource block)	Band edge result SISO Port 1 (dBm)	Plot reference Port 1	SISO Port 1 (dB) Margin
AWGN Single Low Chan	-42.04	14169-2 3452.5 MHz	-29.04
AWGN Single High Chan	-41.52	14169-2 3547.5 MHz	-28.52
AWGN Dual Low Chan	-43.18	14169-2 3452.5 + 3457.5 MHz	-30.18
AWGN Dual High Chan	-43.68	14169-2 3542.5 + 3547.5 MHz	-30.68

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	3702.5 MHz
High channel	3977.5 MHz
Dual Low channels	3702.5 + 3707.5 MHz
Dual High channels	3972.5 + 3977.5 MHz

Test Instance (e.g. modulation or Resource block)	Band edge result SISO Port 1 (dBm)	Plot reference Port 1	SISO Port 1 (dB) Margin
AWGN Single Low Chan	-36.49	14169-2 3702.5 MHz	-23.49
AWGN Single High Chan	-38.29	14169-2 3977.5 MHz	-25.29
AWGN Dual Low Chan	-37.26	14169-2 3702.5 + 3707.5 MHz	-24.26
AWGN Dual High Chan	-40.27	14169-2 3972.5 + 3977.5 MHz	-27.27

The plots referred to in the above table may be found in section 6.

LIMITS:

Parts 27.53 (c) and 27.53(f) for operation in the 746-758 MHz band

Parts 27.53 (g) for operation in the 698-746 MHz band

Parts 27.53(l)(1) for operation in the 3700-3980 MHz band

Parts 27.53 (n)(1) for operation in the 3450-3550 MHz band

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 up to 26.5 GHz

5.7 Modulation characteristics

NOT TESTED: 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 operational band with a CW signal to determine the frequency of highest power in the band. Test performed in mode 1.

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).

The two radio cards in the unit are identical, so testing on one port is representative of both transmit ports.

5.8.4 Test equipment

F075, H071, 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	617-652 MHz
Power Level	21 dBm
Channel Spacing	N/A
Mod Scheme	CW

Band (MHz)	f_0 determined (MHz)
617-652 MHz	617.0014

Band	716-756 MHz
Power Level	21 dBm
Channel Spacing	N/A
Mod Scheme	CW

Band (MHz)	f_0 determined (MHz)
716-756 MHz	716.0567

Band	3450-3550 MHz
Power Level	23 dBm
Channel Spacing	N/A
Mod Scheme	CW

Band (MHz)	f ₀ determined (MHz)
3450-3550 MHz	3450

Band	3700-3980 MHz
Power Level	24 dBm
Channel Spacing	N/A
Mod Scheme	CW

Band (MHz)	f ₀ determined (MHz)
3700-3980 MHz	3721.9

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

Results are also presented graphically in section 6.

LIMITS:

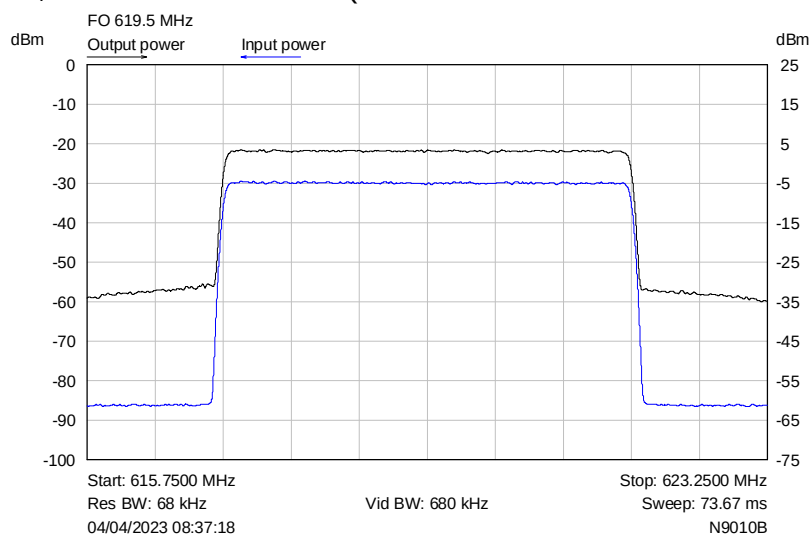
None.

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

6 Plots/Graphical results

6.1 RF Power Output (ERP)

RF Parameters: Band 617-652 MHz, Power 21 dBm, Channel Spacing 5 MHz, Modulation AWGN, Channel 619.5 MHz (channel centre near to determined FO)



Input power

Measurement Parameter	Value
Total channel power	-0.01 dBm

Output power

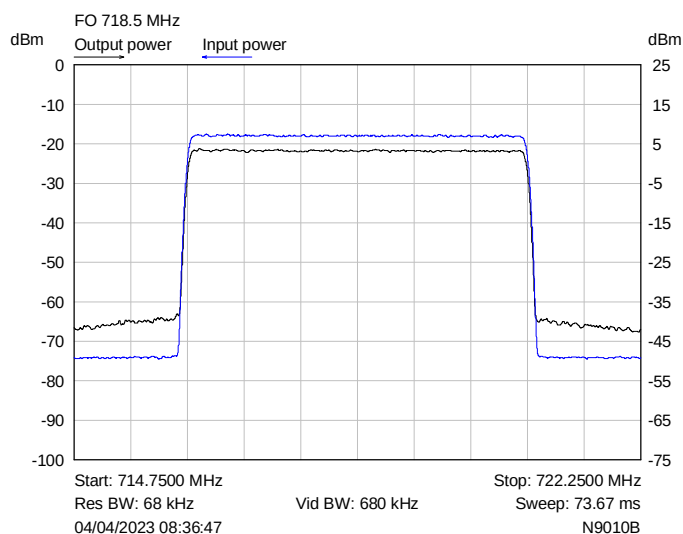
Measurement Parameter	Value
Total channel power	21.04 dBm

Input versus Output power Plot (channel closest to determined fo)



PAPR Plot (channel closest to determined fo)

RF Parameters: Band 716-756 MHz, Power 21 dBm, Channel Spacing 5 MHz, Modulation
AWGN, Channel 718.5 MHz (channel centre near to determined FO)



Input power

Measurement Parameter	Value
Total channel power	-0.08 dBm

Output power

Measurement Parameter	Value
Total channel power	21.15 dBm

Input versus Output power Plot (channel closest to determined fo)

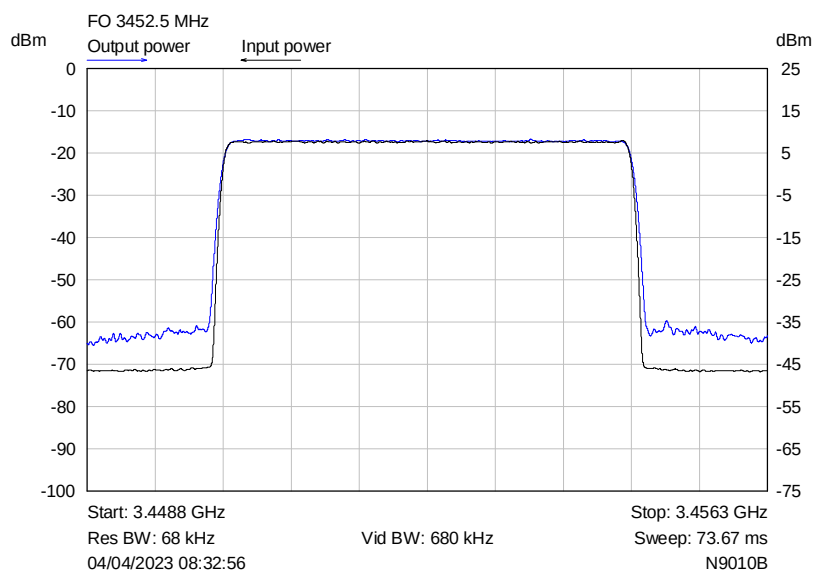


PAPR Plot (channel closest to determined fo)

RF Parameters: Band 3450-3550 MHz, Power 23 dBm, Channel Spacing 5 MHz, Modulation
AWGN, Channel 3452.5 MHz (channel centre near to determined FO)

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Input power	
Measurement Parameter	Value
Total channel power	-1.50 dBm

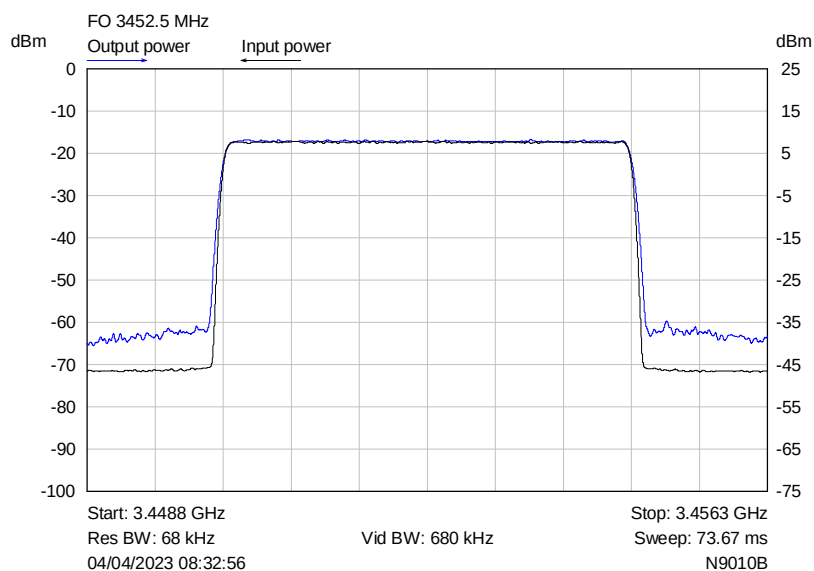
Output power	
Measurement Parameter	Value
Total channel power	23.17 dBm

Input versus Output power Plot (channel closest to determined fo)



PAPR Plot (channel closest to determined fo)

RF Parameters: Band 3700-3980 MHz, Power 24 dBm, Channel Spacing 5 MHz, Modulation AWGN, Channel 3772.5 MHz (channel centre near to determined FO)



Input power

Measurement Parameter	Value
Total channel power	-1.50 dBm

Output power

Measurement Parameter	Value
Total channel power	23.17 dBm

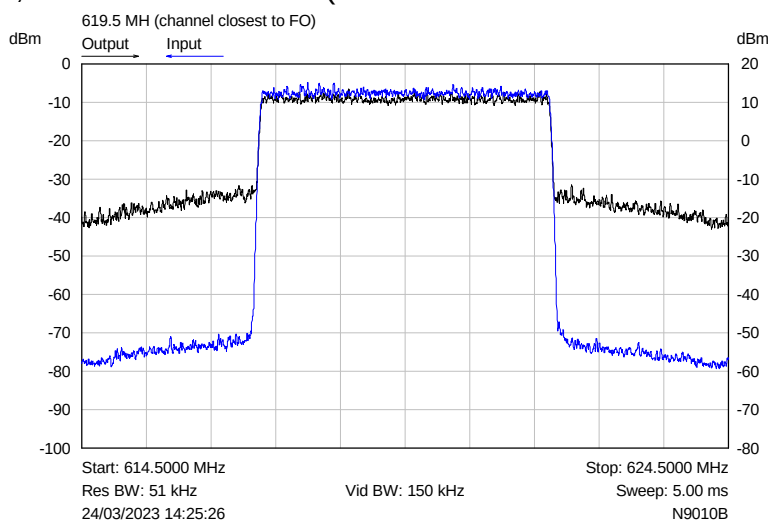
Input versus Output power Plot (channel closest to determined fo)



PAPR Plot (channel closest to determined fo)

6.2 Occupied bandwidth / Input vs Output

RF Parameters: Band 617-652 MHz, Power 21 dBm, Channel Spacing 5 MHz, Modulation AWGN, Channel 619.5 MHz (channel centre near to determined FO)



Output

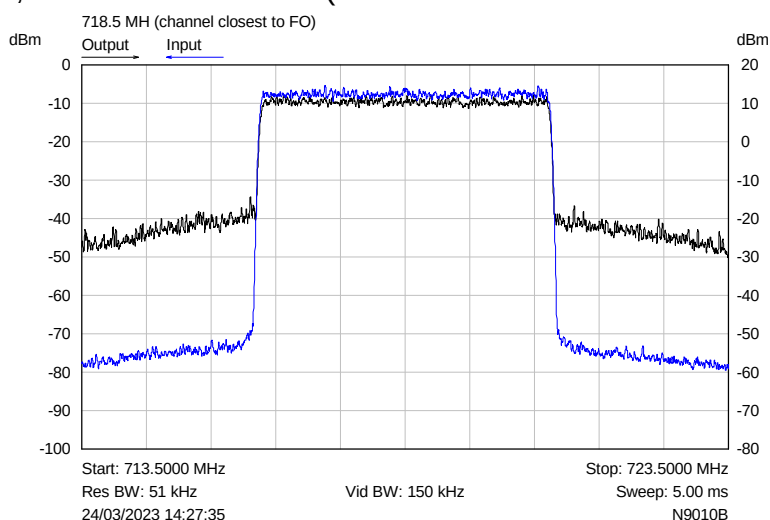
Measurement Parameter	Value
Occupied Bandwidth	4.44 MHz

Input

Measurement Parameter	Value
Occupied Bandwidth	4.42 MHz

Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts (channel closest to determined fo)

RF Parameters: Band 716-756 MHz, Power 21 dBm, Channel Spacing 5 MHz, Modulation AWGN, Channel 718.5 MHz (channel centre near to determined FO)



Output

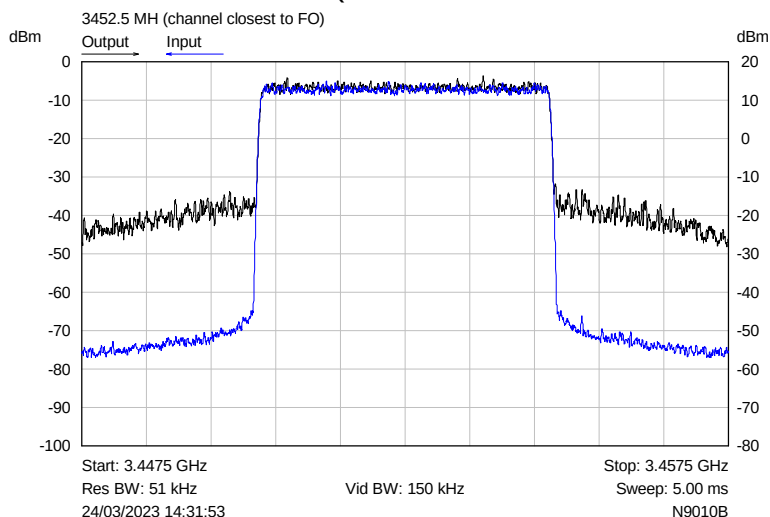
Measurement Parameter	Value
Occupied Bandwidth	4.42 MHz

Input

Measurement Parameter	Value
Occupied Bandwidth	4.42 MHz

Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts (channel closest to determined fo)

RF Parameters: Band 3450-3550 MHz, Power 23 dBm, Channel Spacing 5 MHz, Modulation
AWGN, Channel 3452.5 MHz (channel centre near to determined FO)



Output

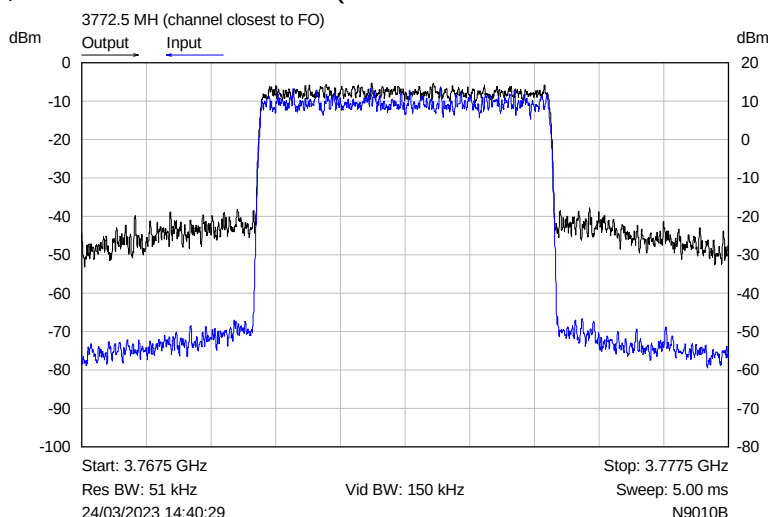
Measurement Parameter	Value
Occupied Bandwidth	4.42 MHz

Input

Measurement Parameter	Value
Occupied Bandwidth	4.42 MHz

Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts (channel closest to determined fo)

RF Parameters: Band 3700-3980 MHz, Power 24 dBm, Channel Spacing 5 MHz, Modulation
AWGN, Channel 3772.5 MHz (channel centre near to determined FO)



Output

Measurement Parameter	Value
Occupied Bandwidth	4.42 MHz

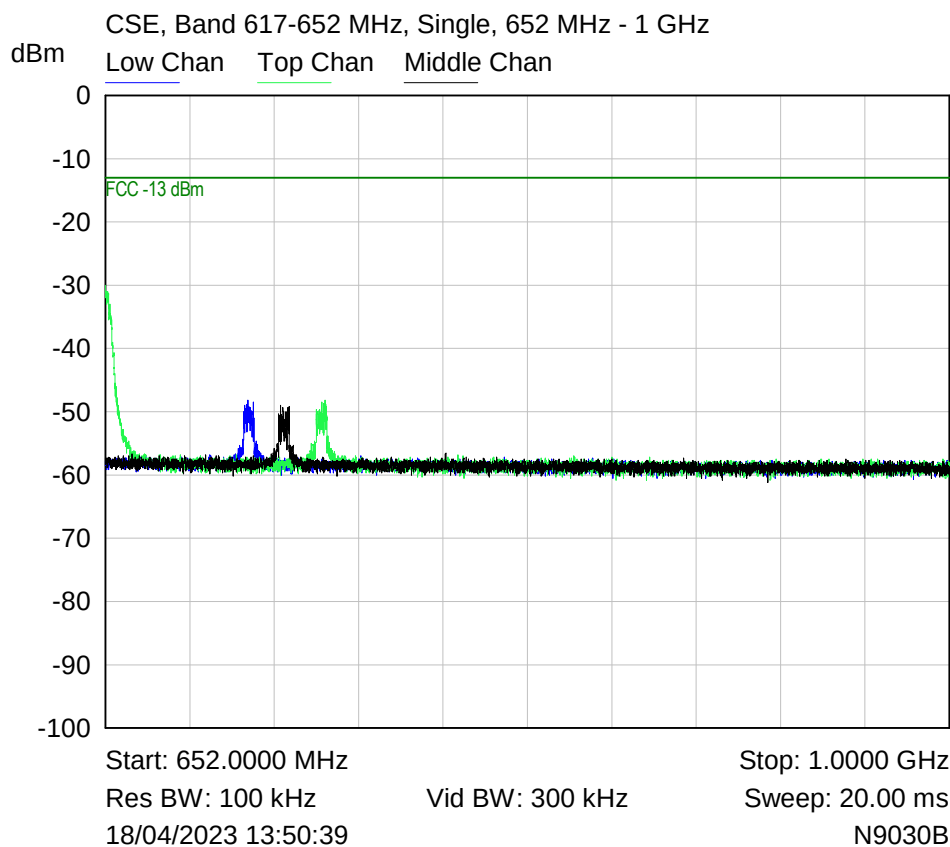
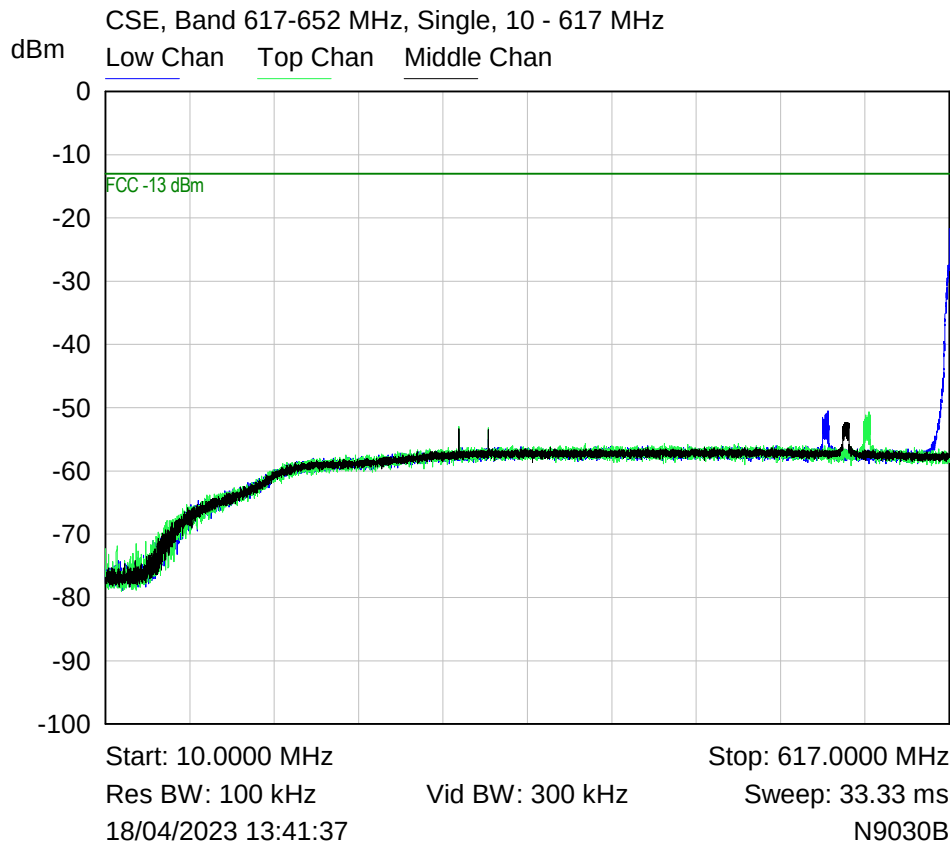
Input

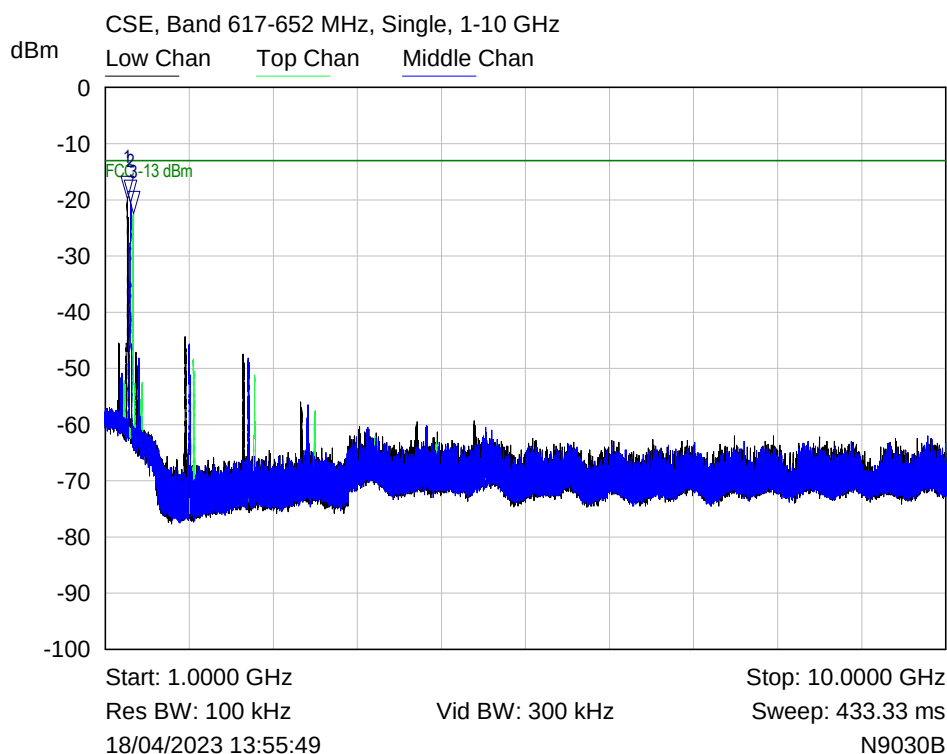
Measurement Parameter	Value
Occupied Bandwidth	4.42 MHz

Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts (channel closest to determined fo)

6.3 Spurious emissions at antenna terminals

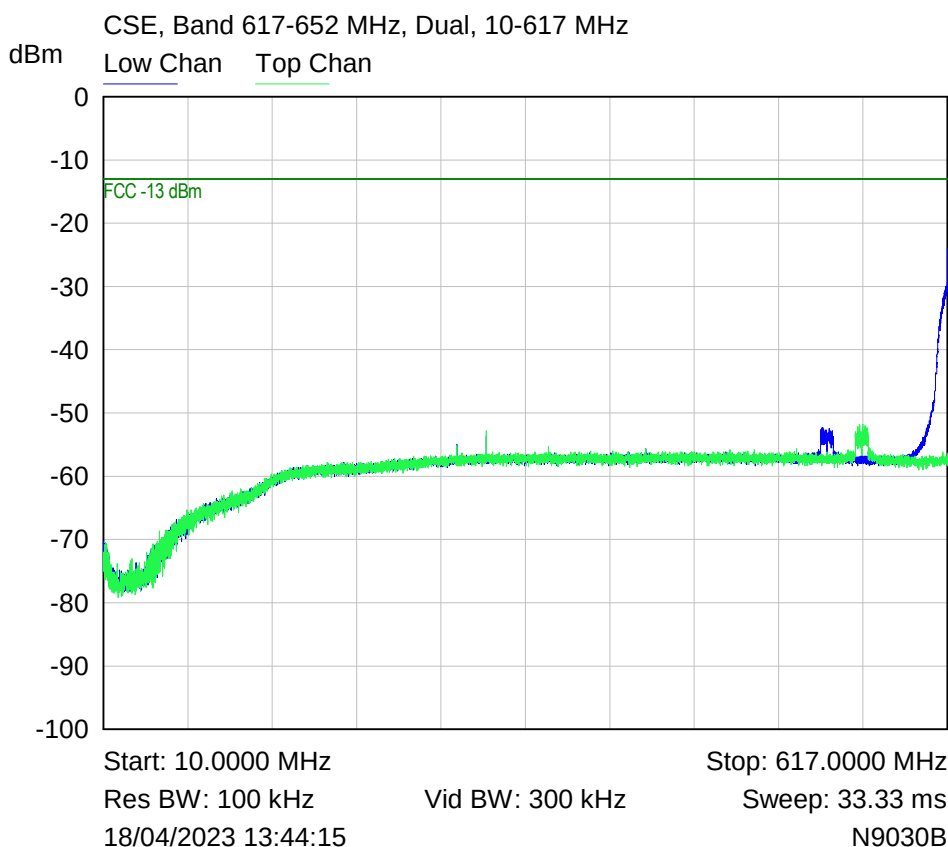
RF Parameters: Band 617-652 MHz, Power 21 dBm, Channel Spacing 5 MHz, Modulation
AWGN, single channel mode

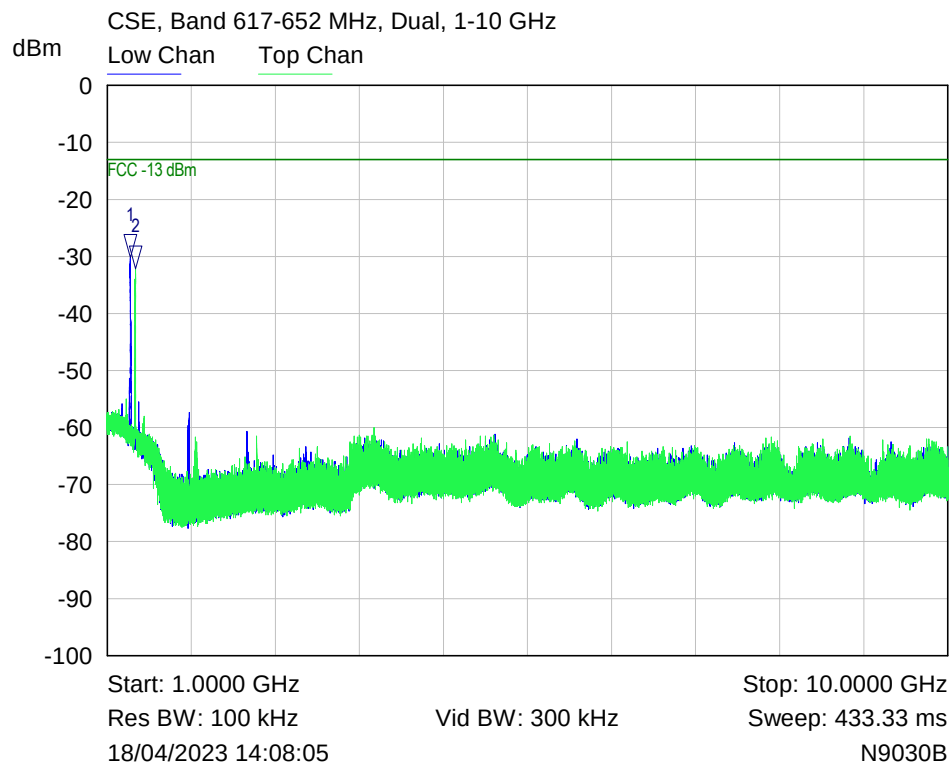
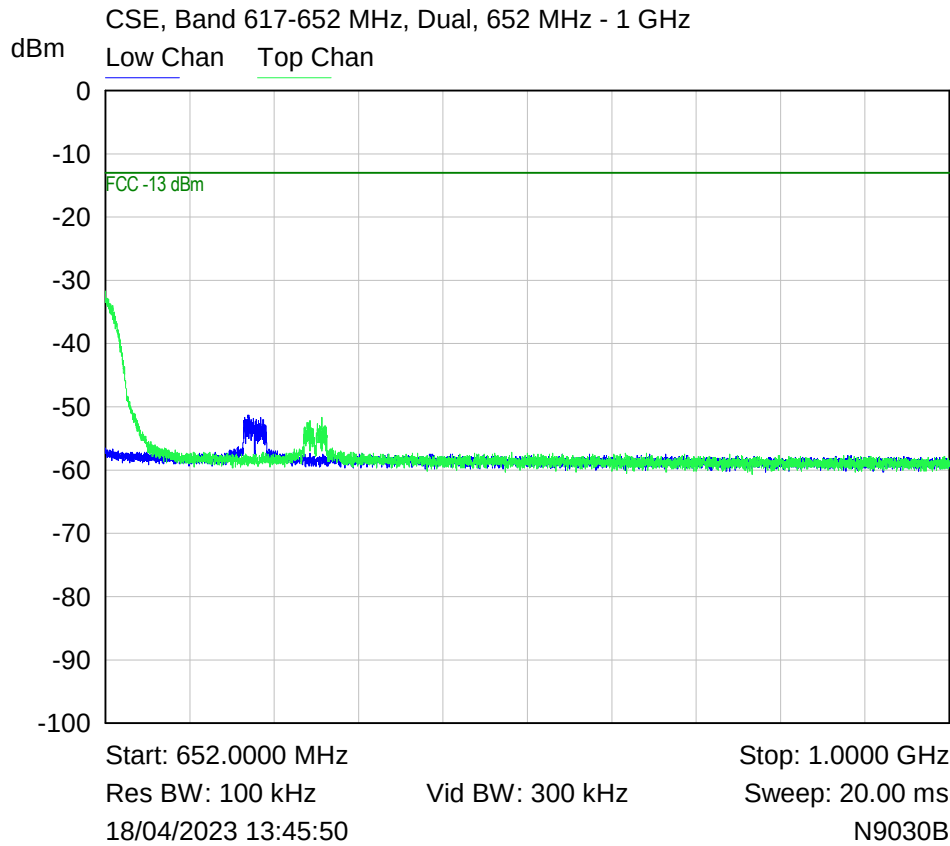




Mkr	Trace	X-Axis	Value	Notes
1 ▾	Low Chan	1.2383 GHz	-19.83 dBm	
2 ▾	Middle Chan	1.2686 GHz	-20.56 dBm	
3 ▾	Top Chan	1.2993 GHz	-22.53 dBm	

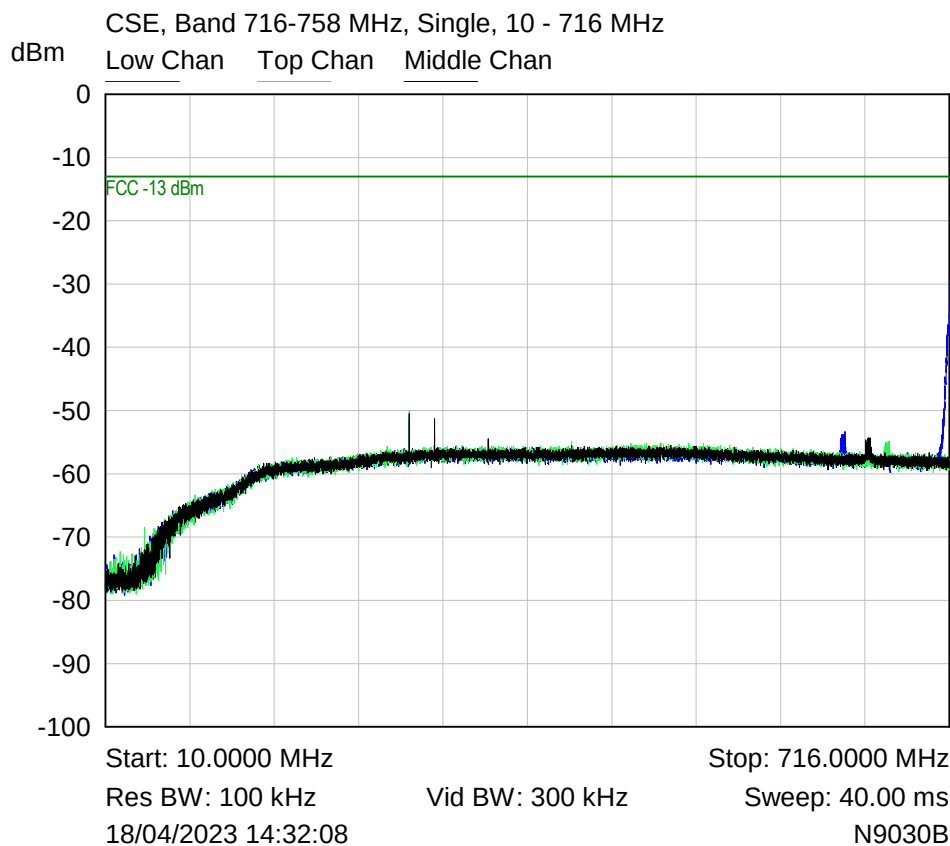
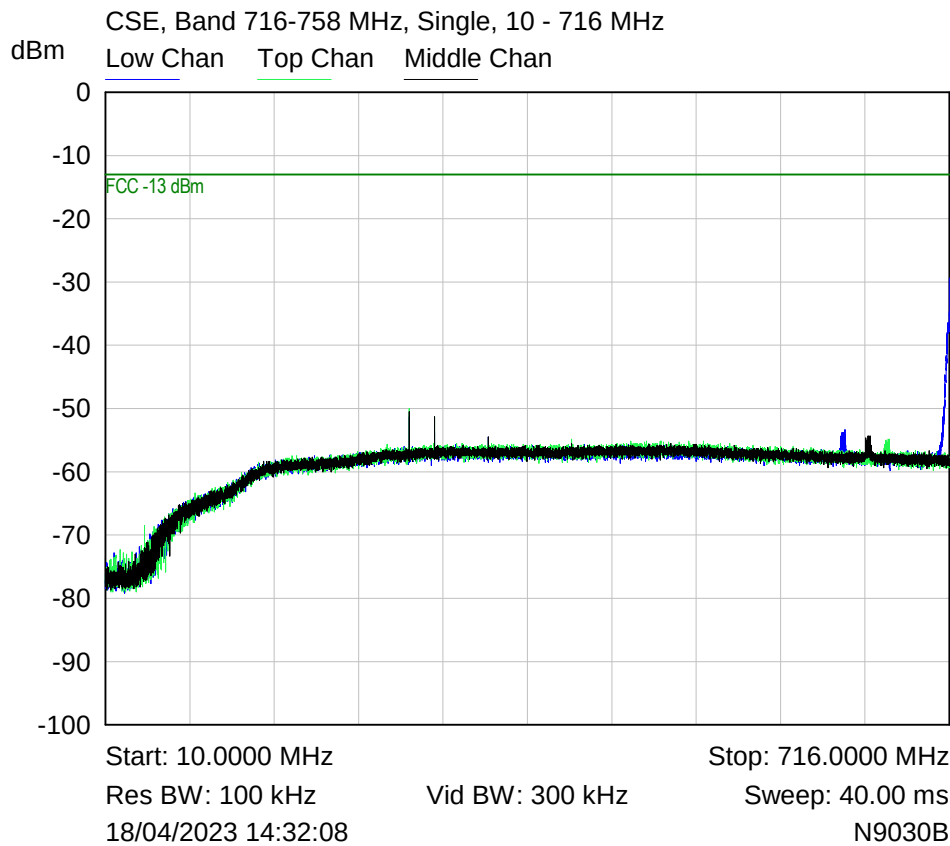
RF Parameters: Band 617-652 MHz, Power 21 dBm, Channel Spacing 5 MHz, Modulation
AWGN, Dual channel mode

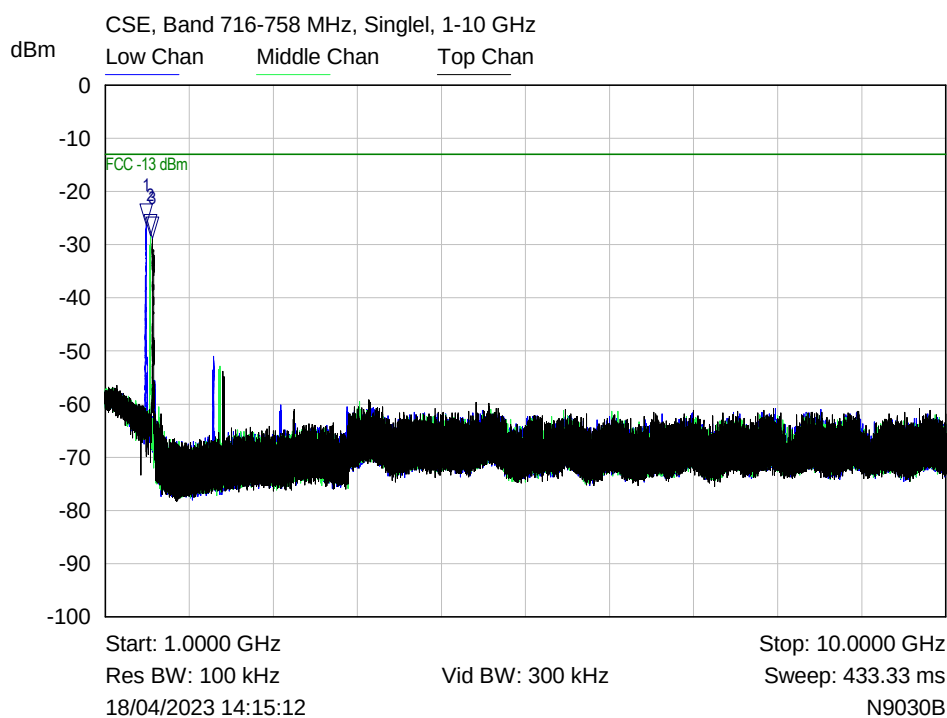




Mkr	Trace	X-Axis	Value	Notes
1 ▽	Low Chan	1.2488 GHz	-30.22 dBm	
2 ▽	Top Chan	1.2991 GHz	-32.08 dBm	

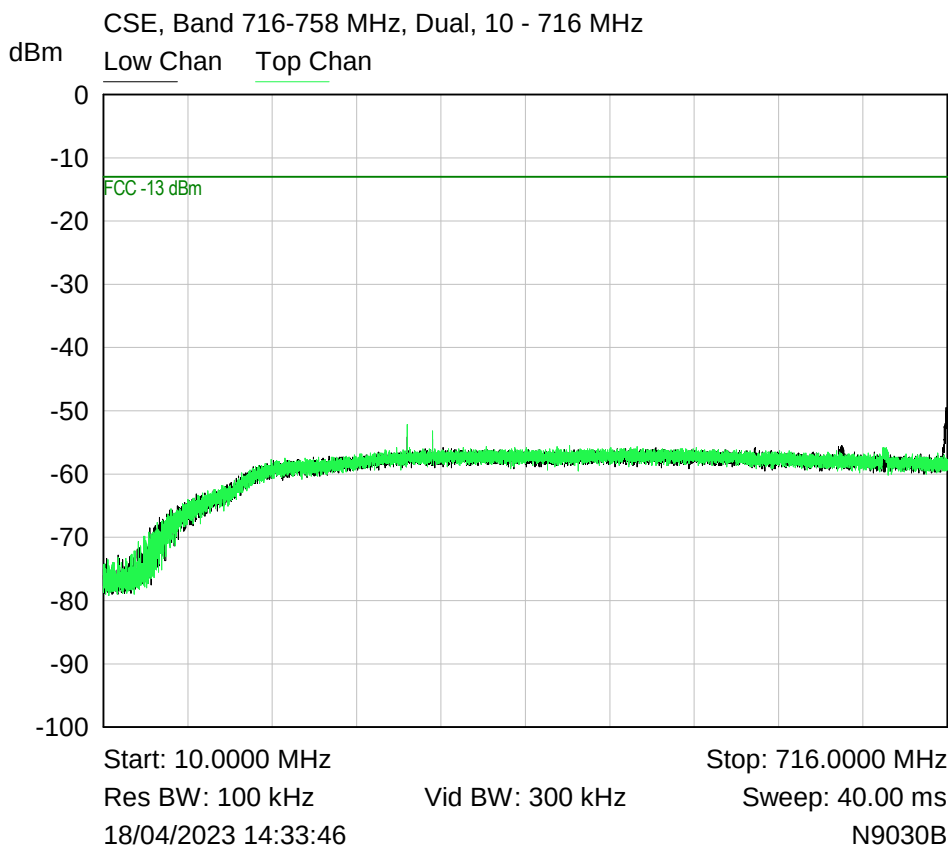
RF Parameters: Band 716-756 MHz, Power 21 dBm, Channel Spacing 5 MHz, Modulation
AWGN, single channel mode

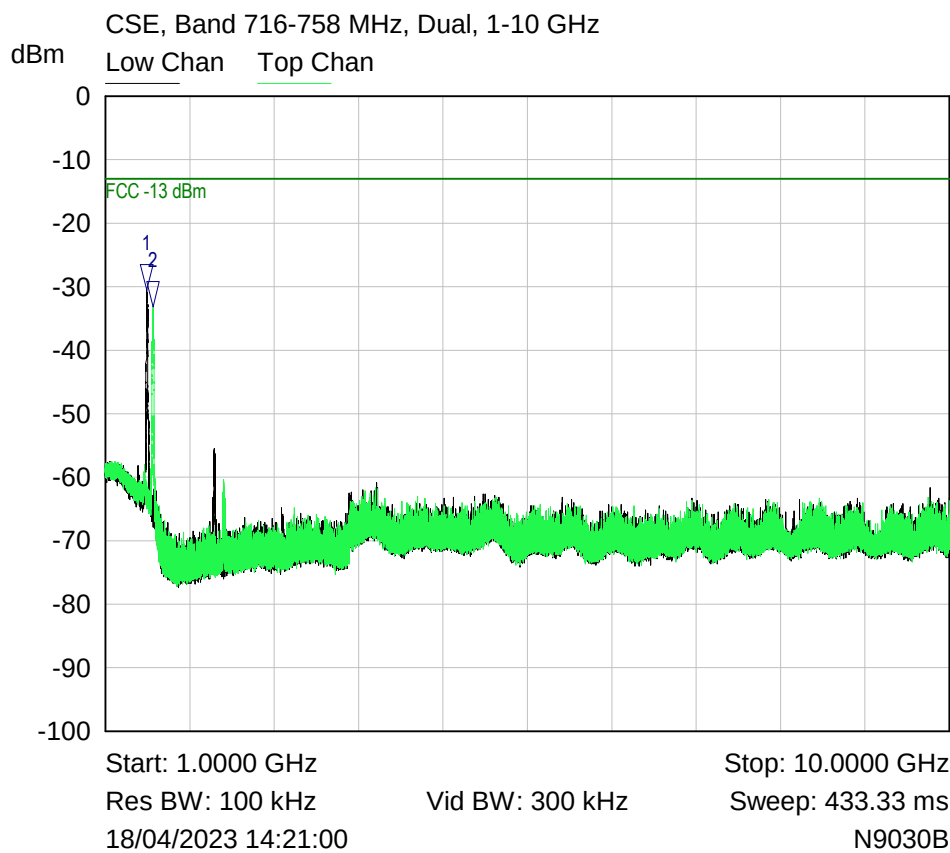
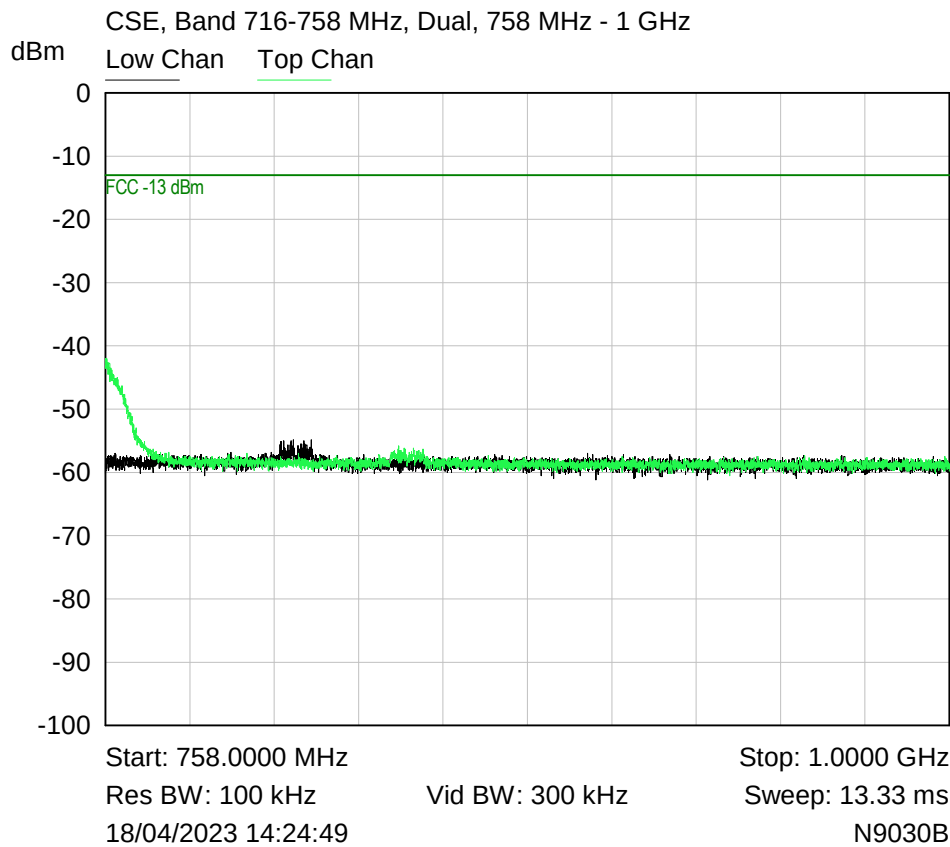




Mkr	Trace	X-Axis	Value	Notes
1 ▾	Low Chan	1.4366 GHz	-26.29 dBm	
2 ▾	Middle Chan	1.4791 GHz	-28.36 dBm	
3 ▾	Top Chan	1.5117 GHz	-28.86 dBm	

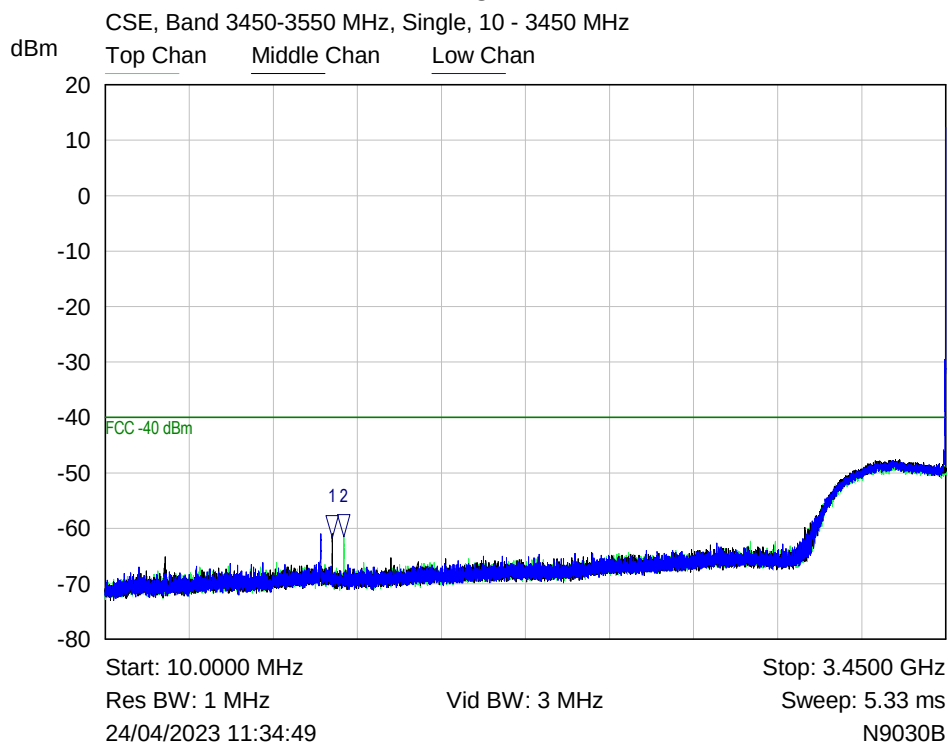
RF Parameters: Band 716-756 MHz, Power 21 dBm, Channel Spacing 5 MHz, Modulation
AWGN, Dual channel mode



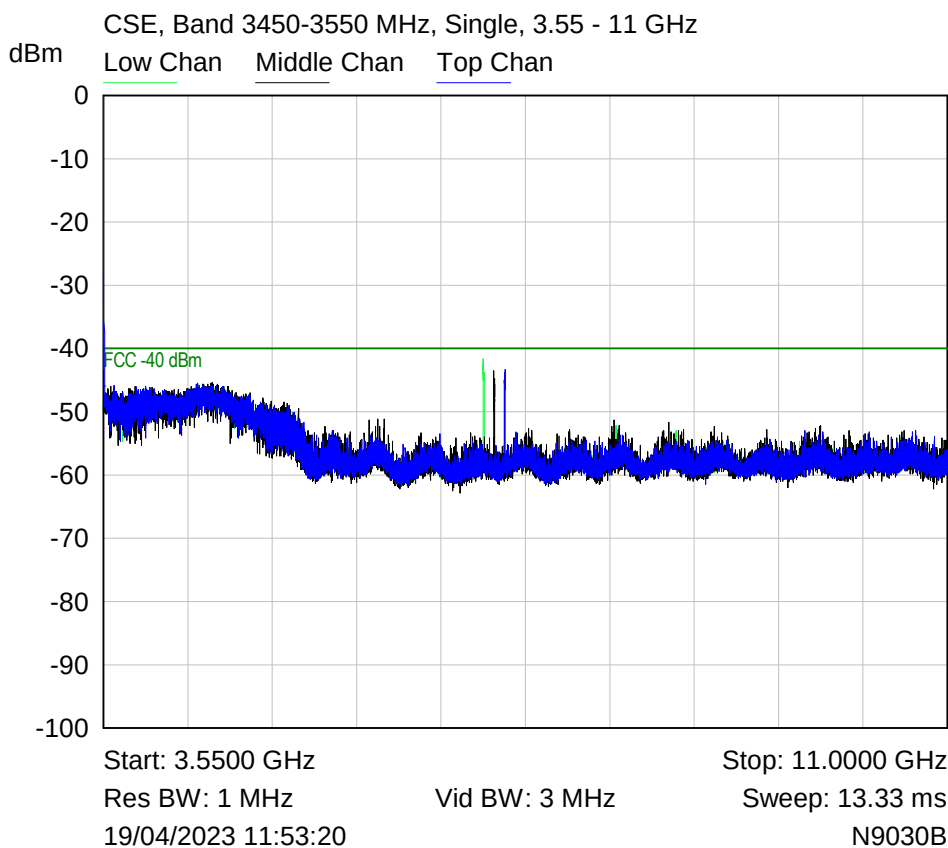


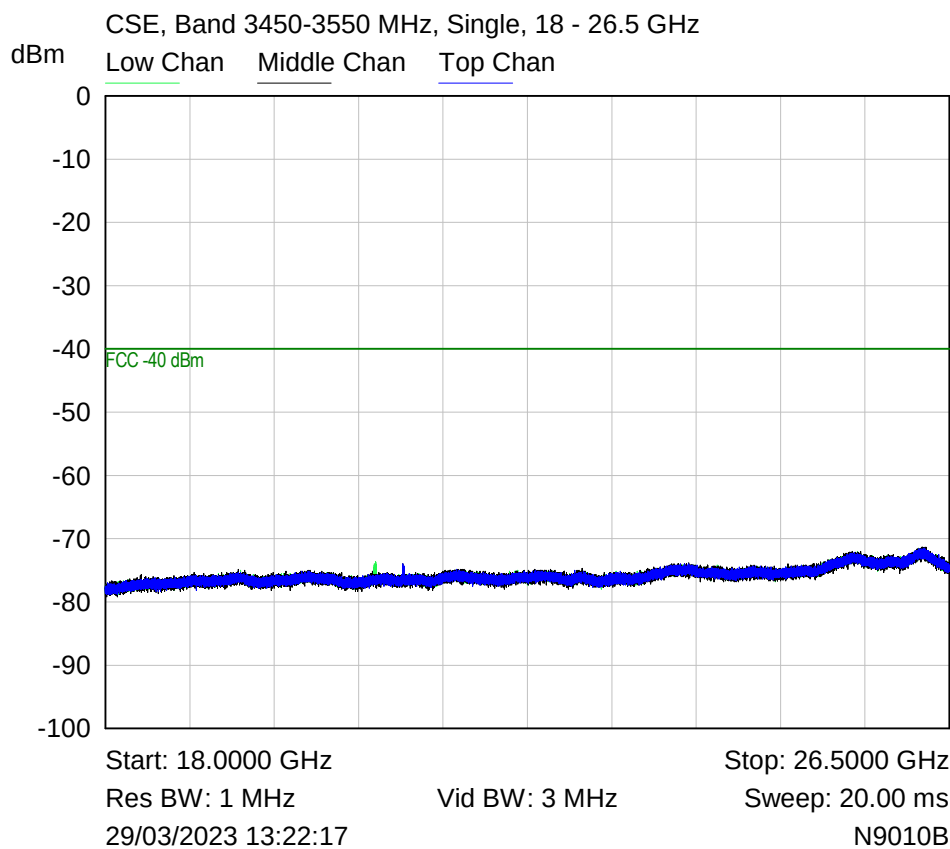
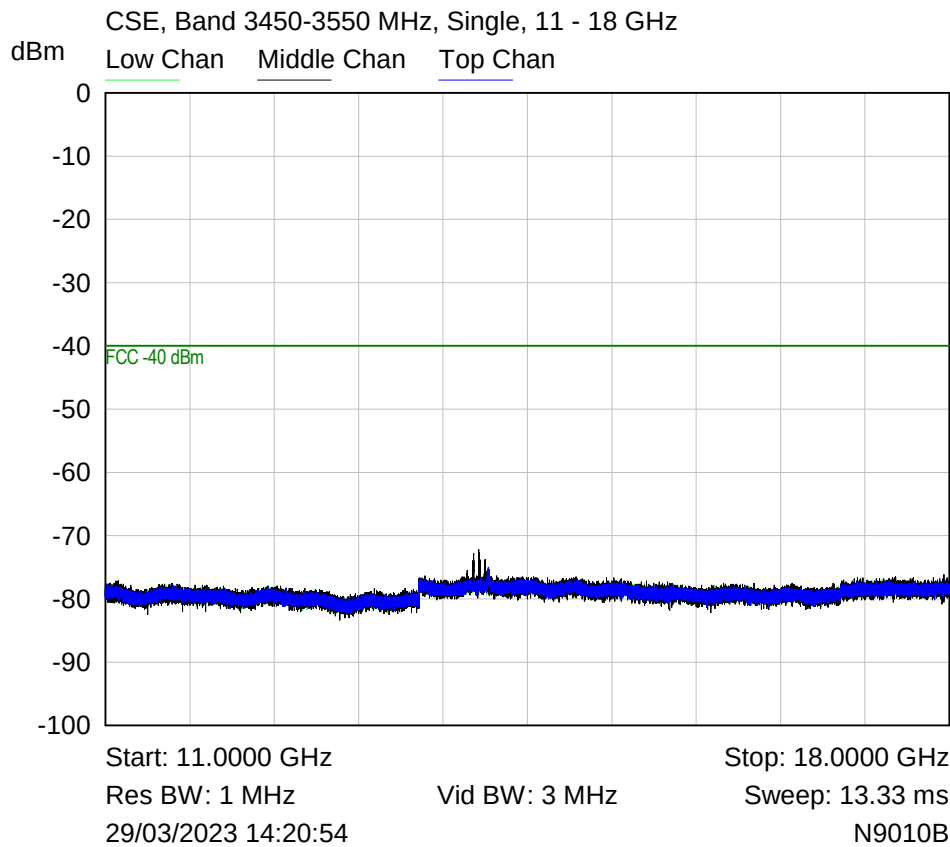
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Low Chan	1.4412 GHz	-30.45 dBm	
2 ▽	Top Chan	1.5062 GHz	-33.16 dBm	

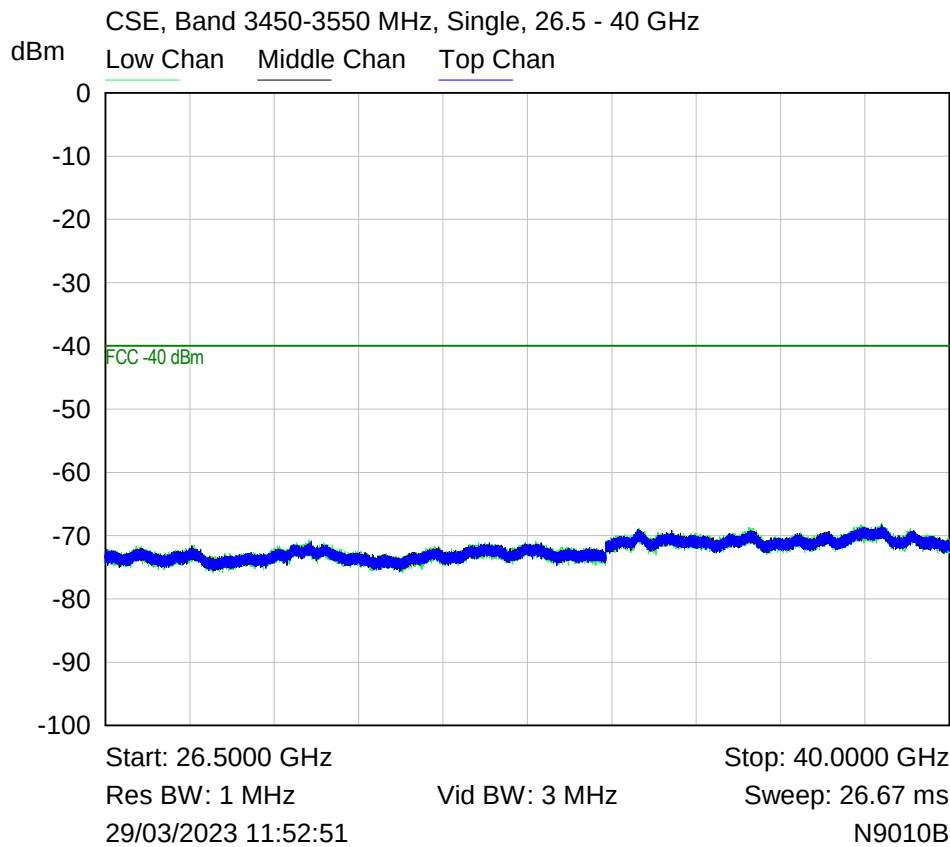
RF Parameters: Band 3450-3550 MHz, Power 23 dBm, Channel Spacing 5 MHz, Modulation
AWGN, single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▾	Middle Chan	938.5024 MHz	-61.66 dBm	
2 ▾	Top Chan	986.1488 MHz	-61.58 dBm	







RF Parameters: Band 3450-3550 MHz, Power 23 dBm, Channel Spacing 5 MHz, Modulation
AWGN, Dual channel mode

