Radio Test Report

Zinwave Ltd

Zinwave UNItivity 5000 Remote Unit

305-0007

47 CFR Part 22 Effective Date 1st October 2017
47 CFR Part 24 Effective Date 1st October 2017
47 CFR Part 2 Effective Date 1st October 2017
Test Date: 21st February 2018 to 4th June 2018
Report Number: 03-10383-1-18 Issue 01

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Certificate of Test 10383-1

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:	305-0007
Unique Serial Number:	660100000021
Applicant:	Zinwave Ltd Harston Mill, Royston Road Harston, Cambridge CB22 7GG
Proposed FCC ID	UPO305-0007
Full measurement results are detailed in Report Number:	03-10383-1-18 Issue 01
Test Standards:	47 CFR Part 22 Effective Date 1st October 2017 47 CFR Part 24 Effective Date 1st October 2017 47 CFR Part 2 Effective Date 1st October 2017

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 parts 22 & 24, for details of testing to other rule parts please see RN reports: 03-10383-4-18 (Part 90), 03-10383-3-18 (Part 74H), and 03-10383-2-18 (Part 27).

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 February 2018 to 4th June 2018
Test Engineer:	Charlie Blatt
Approved By: Radio Approvals Manager	Digitally signed by: Daniel Sims DN: CN = Daniel Sims C = GB O = RN Electronics Ltd Date: 2018.06.04 15:56:38 Z
Customer Representative:	

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1 Contents

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	305-0007	
Serial Number of EUT	660100000021	
Date Received	20th February 2018	
Date of Test:	21st February 2018 to 4th June 2018	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	15th March 2018	
Main Function	Distributed Antenna remote unit	
Information Specification	Height	250mm
	Width	250mm
	Depth	50mm
	Weight	2kg
	Voltage	48 V DC
	Current	< 1 A (35W)

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, but 1995MHz is maximum frequency for these rule parts
Lowest Signal generated in EUT	Not stated
Hardware Version	1.00
Software Version	4.209
Firmware Version	N/A
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 Public Mobile Radio Services and personal Communications services under this rule part
EUT Declared Power level	+20dBm
EUT Declared Signal Bandwidths	Device supports Public Mobile Radio Services and personal Communications services under this rule part
EUT Declared Channel Spacing's	Device supports Public Mobile Radio Services and personal 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 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.

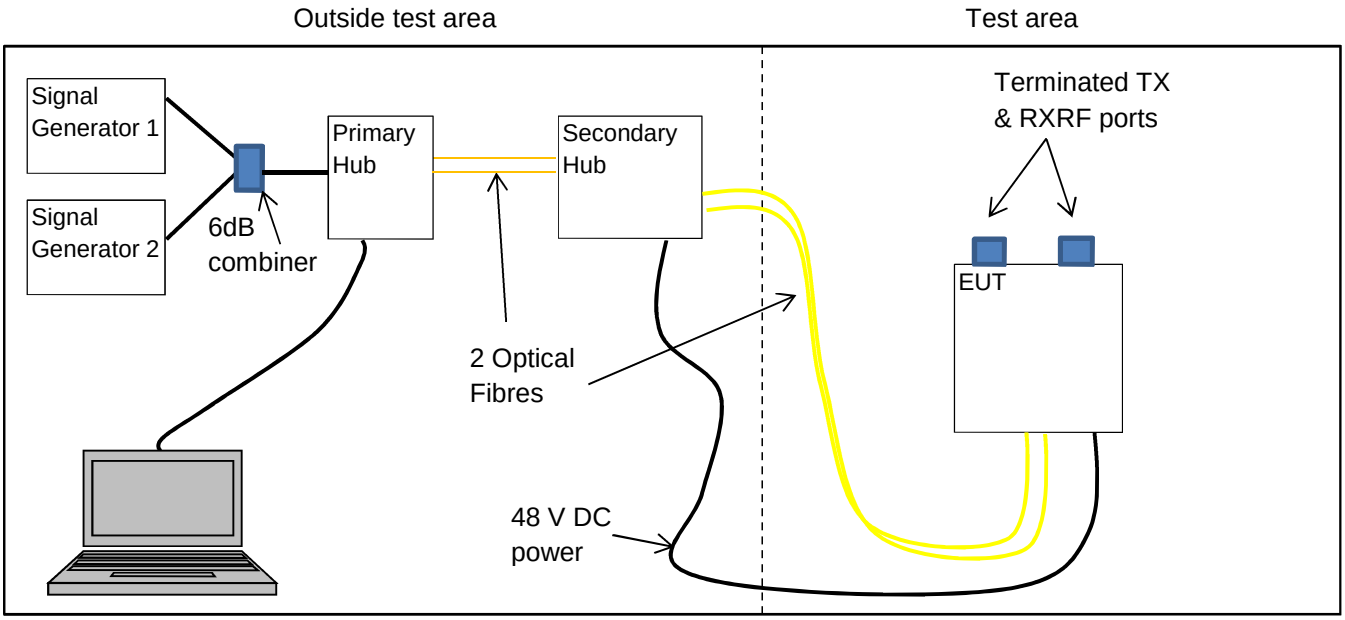
2.4 Modes of operation

Mode Reference	Description	Used for testing
CW sweep Band 869-894 MHz	EUT being fed a swept CW signal across the band 869-894 MHz @ -5dBm amplitude level	Yes
CW sweep Band 1930-1995 MHz	EUT being fed a swept CW signal across the band 1930-1935 MHz @ -5dBm amplitude level	Yes
CW sweep Band 929-930 MHz	EUT being fed a swept CW signal across the band 929-930 MHz @ -5dBm amplitude level	Yes
CW sweep Band 931-932 MHz	EUT being fed a swept CW signal across the band 931-932 MHz @ -5dBm amplitude level	Yes
f_o Determined in Band 869-894 MHz	EUT Being fed a Signal at 878.9 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
f_o Determined in Band 1930-1995 MHz	EUT Being fed a Signal at 1993.6 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
f_o Determined in Band 929-930 MHz	EUT Being fed a Signal at 929.285 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
f_o Determined in Band 931-932 MHz	EUT Being fed a Signal at 931.844 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Single Low channel band 869-894 MHz	EUT Being fed a Signal at 871.5 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Single Mid channel band 869-894 MHz	EUT Being fed a Signal at 881.5 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Single High channel band 869-894 MHz	EUT Being fed a Signal at 891.5 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Single Low channel band 1930-1995 MHz	EUT Being fed a Signal at 1932.5 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Single Mid channel band 1930-1995 MHz	EUT Being fed a Signal at 1962.5MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Single High channel band 1930-1995 MHz	EUT Being fed a Signal at 1992.5 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Single Low channel band 929-930 MHz	EUT Being fed a Signal at 929.0125 MHz @ -5dBm using CW and 25kHz channel BW (RADIATED EM TEST CHANNELS)	Yes
Single Mid channel band 929-930 MHz	EUT Being fed a Signal at 929.5 MHz @ -5dBm using CW and 25kHz channel BW (RADIATED EM TEST CHANNELS)	Yes
Single High channel band 929-930 MHz	EUT Being fed a Signal at 929.9875 MHz @ -5dBm using CW and 25kHz channel BW (RADIATED EM TEST CHANNELS)	Yes
Single Low channel band 931-932 MHz	EUT Being fed a Signal at 931.0125 MHz @ -5dBm using CW and 25kHz channel BW	Yes
Single Mid channel band 931-932 MHz	EUT Being fed a Signal at 931.5 MHz @ -5dBm using CW and 25kHz channel BW	Yes
Single High channel band 931-932 MHz	EUT Being fed a Signal at 931.9875 MHz @ -5dBm CW and 25kHz channel BW	Yes

Dual Low channels band 869-894 MHz	EUT Being fed a Signal at 871.5 & 876.5 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Dual High channels band 869-894 MHz	EUT Being fed a Signal at 876.5 & 891.5 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Dual Low channels band 1930-1995 MHz	EUT Being fed a Signal at 1932.5 & 1937.5 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Dual High channels band 1930-1995 MHz	EUT Being fed a Signal at 1987.5 & 1992.5 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Dual band 929-930 MHz either side f_0	EUT Being fed a Signal at 929.2725 & 929.2975MHz @ -5dBm using CW and 25kHz channel BW	Yes
Dual band 931-932 MHz either side f_0	EUT Being fed a Signal at 931.8315 & 931.8565 MHz @ -5dBm using CW and 25kHz channel BW	Yes

Note: This report only pertains to the operation of the equipment to 47CFR part 22E,22H and 24E, for details of testing to other rule parts please see RN reports:03-10383-2-18 (Part 27)
03-10383-3-18 (Part 74H)
03-10383-4-18 (Part 90)

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 25dB gain and +20dBm EUT output power in conjunction with the signal generator settings 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 and a combiner. 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 +20dBm (25dB 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 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 core	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, 305-0007 was tested for compliance to the following standard(s) :

47 CFR Part 22 Effective Date 1st October 2017
47 CFR Part 24 Effective Date 1st October 2017
47 CFR Part 2 Effective Date 1st October 2017

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 22 Clause 22.917(a)(b) FCC Part 24 Clause 24.238 FCC Part 2 Clause 2.1051	PASSED[1]
2. RF Power Output	FCC Part 22 Clause 22.535 & 22.913 FCC Part 24 Clause 24.232(a) FCC Part 2 Clause 2.1046	PASSED
3. Frequency stability	FCC Part 2 Clause 2.1055	NOT APPLICABLE[2]
4. Occupied bandwidth	FCC Part 24 Clause 24.238 FCC Part 2 Clause 2.1049	PASSED
5. Field strength of spurious radiations	FCC Part 22 Clause 22.917 FCC Part 24 Clause 24.238 FCC Part 2 Clause 2.1053	PASSED[1]
6. Band edge emissions	FCC Part 22 Clause 22.917(a)(b) FCC Part 24 Clause 24.238 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 20GHz based on 10 times the highest channel of 1992.5 MHz.
[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 22	2017	Part 22 – Public Mobile Services
4.1.2	47CFR part 2J	2017	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations
4.1.3	KDB 971168 D01 v02r02	2014	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 v01r02	2017	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	FCC Part 24	2017	Part 24 – Personal Communications Services

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 22 Clause 22.917 [Reference 4.1.1 of this report]
	FCC Part 24 Clause 24.238 [Reference 4.1.6 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 22 Clause 22.917 [Reference 4.1.1 of this report]
	FCC Part 24 Clause 24.238 [Reference 4.1.6 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 in a dual channel input mode modes 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.

Tests were performed in test site A.

5.1.4 Test equipment

E301, E412, E498, E642, E755

See Section 8 for more details

5.1.5 Test results

Temperature of test environment	17-22°C
Humidity of test environment	30-42%
Pressure of test environment	100-103kPa

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

Single channel results.

Setup Table

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	871.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1743	-29.3 (100 kHz RBW)	-16.3
2614	-36.7 (100 kHz RBW)	-23.7

Setup Table

Band	869-894 MHz

Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	881.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1763	-29.7 (100 kHz RBW)	-16.7
2644	-37.0 (100 kHz RBW)	-24.0

Plots
Plot of conducted emissions single Mid channel (881.5 MHz) 10 MHz – 869 MHz range
Plot of conducted emissions single Mid channel (881.5 MHz) 900 MHz – 5 GHz range
Plot of conducted emissions single Mid channel (881.5 MHz) 5 GHz – 10 GHz range

Note: Whilst Low, Mid and High channels of the band have been tested and any applicable results reported, only mid channel plots are shown in the plots section to minimise report size.

Setup Table

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	891.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1783	-30.1 (100 kHz RBW)	-17.1
2674	-36.9 (100 kHz RBW)	-23.9

Setup Table

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	1932.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No Emissions observed within 20dB of limits		

Setup Table

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	1962.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
Plot of conducted emissions single Mid channel (1962.5 MHz) 30 MHz – 1.93 GHz range		
Plot of conducted emissions single Mid channel (1962.5 MHz) 1.995 GHz – 20 GHz range		

Note: Whilst Low, Mid and High channels of the band have been tested and any applicable results reported, only mid channel plots are shown in the plots section to minimise report size.

Setup Table

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	1992.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No Emissions observed within 20dB of limits		

Setup Table

Band	929-930 MHz
Power Level	20 dBm
Channel Spacing	25kHz
Mod Scheme	CW
Low channel	929.0125 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1858	-29.8 (100 kHz RBW)	-16.8
2787	-36.9 (100 kHz RBW)	-23.9

Setup Table

Band	929-930 MHz
Power Level	20 dBm
Channel Spacing	25kHz
Mod Scheme	CW
Mid channel	929.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1859	-30.1 (100 kHz RBW)	-17.1
2788	-37.1 (100 kHz RBW)	-24.1

Plots
Plot of conducted emissions single Mid channel (929.5 MHz) 30 MHz – 5 GHz range
Plot of conducted emissions single Mid channel (929.5 MHz) 5 GHz – 10 GHz range

Note: Whilst Low, Mid and High channels of the band have been tested and any applicable results reported, only mid channel plots are shown in the plots section to minimise report size.

Setup Table

Band	929-930 MHz
Power Level	20 dBm
Channel Spacing	25kHz
Mod Scheme	CW
High channel	929.9875 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1860	-30.2 (100 kHz RBW)	-17.2
2790	-37.4 (100 kHz RBW)	-24.4

Setup Table

Band	931-932 MHz
Power Level	20 dBm
Channel Spacing	25kHz
Mod Scheme	CW
Low channel	931.0125 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1862	-30.1 (100 kHz RBW)	-17.1
2793	-37.1 (100 kHz RBW)	-24.1

Setup Table

Band	931-932 MHz
Power Level	20 dBm
Channel Spacing	25kHz
Mod Scheme	CW
Mid channel	933 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1863	-30.2 (100 kHz RBW)	-17.2
2794	-37.5 (100 kHz RBW)	-24.5

Plots
Plot of conducted emissions single Mid channel (933 MHz) 30 MHz – 5 GHz range
Plot of conducted emissions single Mid channel (933 MHz) 5 GHz – 10 GHz range

Note: Whilst Low, Mid and High channels of the band have been tested and any applicable results reported, only mid channel plots are shown in the plots section to minimise report size.

Setup Table

Band	931-932MHz
Power Level	20 dBm
Channel Spacing	25kHz
Mod Scheme	CW
High channel	934.9875 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1864	-30.3 (100 kHz RBW)	-17.3
2796	-37.1 (100 kHz RBW)	-24.1

Dual channel results.

Setup Table

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	871.5 MHz + 876.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No Emissions observed within 20dB of limits.		

Plots
Please refer to single channel plots as emissions were the same.

Setup Table

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channels	876.5 MHz + 891.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No Emissions observed within 20dB of limits.		

Plots
Please refer to single channel plots as emissions were the same.

Setup Table

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	1932.5 MHz + 1937.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No Emissions observed within 20dB of limits.		

Plots
Please refer to single channel plots as emissions were the same.

Setup Table

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channels	1987.5 MHz + 1992.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
No Emissions observed within 20dB of limits.		

Plots
Please refer to single channel plots as emissions were the same.

Setup Table

Band	929-930 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	929.0015 MHz + 929.0265 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
Please refer to results in single channel mode		

Plots
Please refer to single channel plots as emissions were the same.

Setup Table

Band	931-932MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	931.0088 MHz + 931.0338 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
Please refer to results in single channel mode		

Plots
Please refer to single channel plots as emissions were the same.

Results are also presented graphically in section 6.

LIMITS:
22.917 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) 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:
<± 2.8 dB

5.2 RF Power Output

5.2.1 Test methods

Test Requirements:	FCC Part 22 Clause 22.535 & 22.913 [Reference 4.1.1 of this report]
	FCC Part 24 Clause 24.232(a) [Reference 4.1.6 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 22 Clause 22.535 & 22.913 [Reference 4.1.1 of this report]
	FCC Part 24 Clause 24.232(a) [Reference 4.1.6 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 f0 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.

5.2.4 Test equipment

E301, E498, E642, E755

See Section 8 for more details

5.2.5 Test results

Temperature of test environment	17-22°C
Humidity of test environment	30-42%
Pressure of test environment	100-103kPa

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
f0 frequency	878.9 MHz

Test conditions		Average Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (W)	PK to Average Power ratio (dB)
Temp Ambient	Volts Nominal	20.1	28.1	0.65	8.6

Note: 8dBi Antenna gain used.

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
f0 frequency	1993.6 MHz

Test conditions		Average Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (W)	PK to Average Power ratio (dB)
Temp Ambient	Volts Nominal	20.2	28.2	0.66	9.54

Note: 8dBi Antenna gain used. 1992.5 MHz is the highest 5MHz channel centre frequency within the band of operation and encompasses f0 of 1993.6MHz.

Band	929-930 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
f0 frequency	929.285 MHz

Test conditions		Average Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (W)
Temp Ambient	Volts Nominal	19.7	27.7	0.59

Note: 8dBi Antenna gain used. PK to AV power ratio not required for Narrowband.

Band	931-932 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
f0 frequency	931.844 MHz

Test conditions		Average Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (W)
Temp Ambient	Volts Nominal	19.6	27.6	0.58

Note: 8dBi Antenna gain used. PK to AV power ratio not required for Narrowband.

Results are also presented graphically in section 6

LIMITS:
22E, 5W ERP
22H, 500W ERP
24.232(a) 1640 W ERP

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 determined f_0 for each applicable band.

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 input and the output signals and their -26dBc points indicated on the plots taken.

5.4.4 Test equipment

E301, E498, E642, E755

See Section 8 for more details

5.4.5 Test results

Temperature of test environment 17-22°C
Humidity of test environment 30-44%
Pressure of test environment 100-103kPa

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
f0 frequency	878.9 MHz

	26dB BW (MHz)	Occupied BW (MHz)
Input measurement	4.67	4.13
Output measurement	4.69	4.12
Plot reference	Occupied BW 878.9 MHz channel	

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
f0 frequency	1993.6 MHz

	26dB BW (MHz)	Occupied BW (MHz)
Input measurement	4.67	4.13
Output measurement	4.70	4.14

Plot reference	Occupied BW 1993.5 MHz channel

Note: 1992.5 MHz is the highest 5MHz channel centre frequency within the band of operation and encompasses f0 of 1993.6MHz.

Band	929-930 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
f0 frequency	929.285 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	25.3	18.18
Output measurement	25.28	17.94
Plot reference	Occupied BW 929.285 MHz channel	

Band	931-932MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
f0 frequency	931.844 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	25.49	18.28
Output measurement	25.12	18.30
Plot reference	Occupied BW 931.844 MHz channel	

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 22 Clause 22.917 & 22.359(a) [Reference 4.1.1 of this report]
	FCC Part 24 Clause 24.238 [Reference 4.1.6 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 22 Clause 22.917 & 22.359(a) [Reference 4.1.1 of this report]
	FCC Part 24 Clause 24.238 [Reference 4.1.6 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 – 20GHz.
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 – 20 GHz at 0.3metres.
Tests were performed in test sites B & M.

5.5.4 Test equipment

LPE364, E743, E624, E411, E412, E755, TMS82, E268, E428, TMS78, TMS79, E602, E433, E452, E453, E454

See Section 8 for more details

5.5.5 Test results

Temperature of test environment	15-20°C
Humidity of test environment	30-42%
Pressure of test environment	102kPa

Single channel results.

Setup Table

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	871.5 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	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	881.5 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	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	891.5 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	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	1932.5 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	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Mid channel	1962.5 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	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channel	1992.5 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	929-930 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
Low channel	929.0125 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	929-930 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
Mid channel	929.5 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	929-930 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
High channel	929.9875 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	931-932 MHz

Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
Low channel	931.0125 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	931-935 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
Mid channel	931.5 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	931-935 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
High channel	931.9875 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				

DUAL CHANNEL RESULTS.

Setup Table

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	871.5 MHz + 876.5 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	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz

Mod Scheme	AWGN
High channels	876.5 MHz + 891.5 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	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	1932.5 MHz + 1937.5 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	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
High channels	1987.5 MHz + 1992.5 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	929-930 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
Low channels	929.0265 MHz + 929.0015 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	931-932 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW
Low channels	931.0338 MHz + 931.0088 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:
22.917 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) 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: 30MHz - 1GHz ± 3.9 dB, 1 – 18 GHz ±3.5dB, 18 – 27 GHz ±3.9dB

5.6 Band edge emissions

5.6.1 Test methods

Test Requirements:	FCC Part 22 Clause 22.917 & 22.359(a) [Reference 4.1.1 of this report]
	FCC Part 24 Clause 24.238 [Reference 4.1.6 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 22 Clause 22.917 & 22.359(a) [Reference 4.1.1 of this report]
	FCC Part 24 Clause 24.238 [Reference 4.1.6 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.

Tests were performed in test site A.

5.6.4 Test equipment

E301, E498, E642, E755

See Section 8 for more details

5.6.5 Test results

Temperature of test environment	17-22°C
Humidity of test environment	30-42%
Pressure of test environment	100-103kPa

Single channel results

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	871.5 MHz
High channel	891.5 MHz

	Lower band edge (869MHz)	Upper band edge (894MHz)
Plot reference	Plot of lower band edge for Low channel (871.5 MHz)	Plot of upper band edge for High channel (891.5 MHz)

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channel	1932.5 MHz

High channel	1992.5 MHz

	Lower band edge (1930MHz)	Upper band edge (1995MHz)
Plot reference	Plot of lower band edge for Low channel 100kHz RBW (1932.5 MHz)	Plot of upper band edge for High channel 100kHz RBW (1992.5 MHz)

Dual channel results

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	871.5 + 876.5 MHz
High channels	886.5 + 891.5 MHz

	Lower band edge (869MHz)	Upper band edge (894MHz)
Plot reference	Plot of lower band edge for Low channels (871.5 & 876.5 MHz)	Plot of upper band edge for High channels (886.5 & 891.5 MHz)

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	5 MHz
Mod Scheme	AWGN
Low channels	1932.5 + 1937.5 MHz
High channels	1987.5 + 1992.5 MHz

	Lower band edge (1930MHz)	Upper band edge (1995MHz)
Plot reference	Plot of lower band edge for Low channels 100kHz RBW (1932.5 & 1937.5 MHz)	Plot of upper band edge for High channels 100kHz RBW (1987.5 & 1992.5 MHz)

Band	930-931 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
channels	929.2725 & 929.2975MHz

	Lower band edge (929MHz)	Upper band edge (930MHz)
Plot reference	Plot of band edges for channels (929.2725 & 929.2975MHz)	

Band	931-932 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
channels	931.8315 & 931.8565MHz

	Lower band edge (931MHz)	Upper band edge (932MHz)
Plot reference	Plot of band edges for channels (931.8315 & 931.8565MHz)	

Results are also presented graphically in section 6

LIMITS:
22.917 (a) & 24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) 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:
< ± 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 4 operational bands with a CW signal to determine the frequency of highest power in the band. Test performed in **CW sweep Band 869-894 MHz, CW sweep Band 1930-1995 MHz, CW sweep Band 929-930 MHz and CW sweep Band 931-932 MHz** modes.

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

E498, E642, E755

See Section 8 for more details

5.8.5 Test results

Temperature of test environment	17-22°C
Humidity of test environment	30-44%
Pressure of test environment	100-103kPa

Band	869-894 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

Band (MHz)	f_0 determined(MHz)
869-894	878.9

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

Band	1930-1995 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

Band (MHz)	f_0 determined (MHz)
1930-1995	1993.6

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

Band	929-930 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW

Band (MHz)	f_0 determined (MHz)
929-930	929.285

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

Band	931-932MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	CW

Band (MHz)	f_0 determined (MHz)
931-932	931.844

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

Results are also presented graphically in section 6.

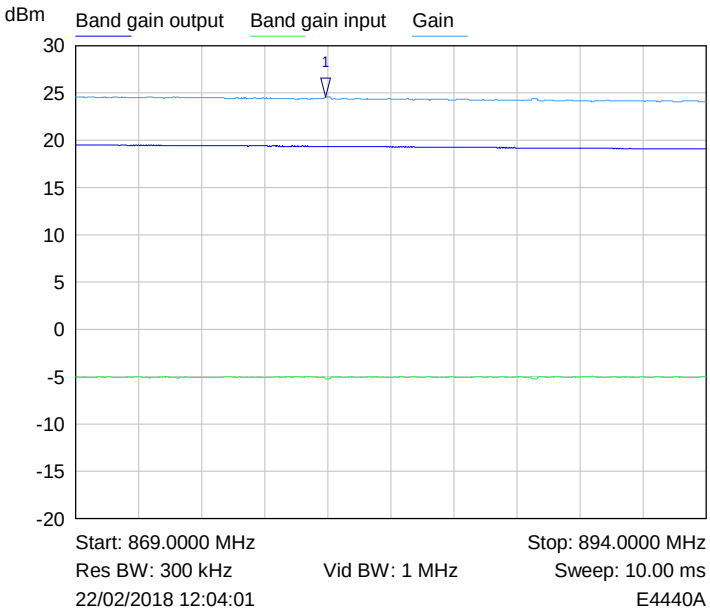
LIMITS:
None.

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 Determination of f_0

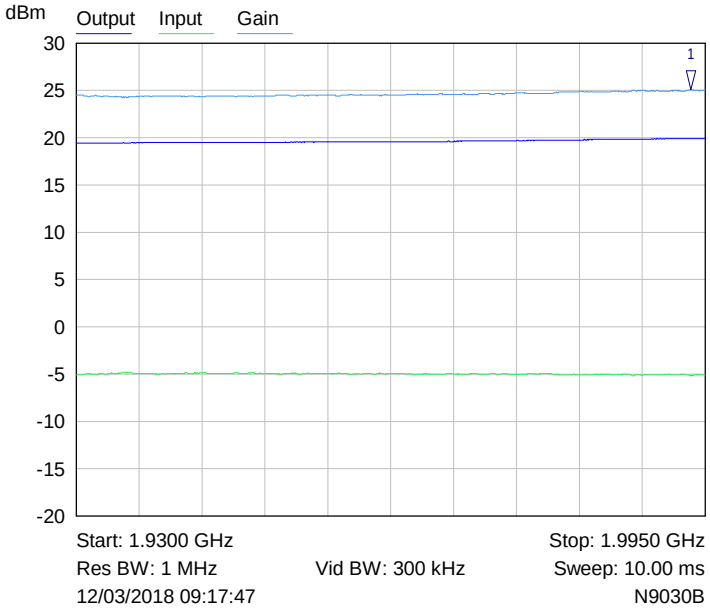
RF Parameters: Band 869-894 MHz, Power +20 dBm, Swept CW



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Gain	878.9000 MHz	24.62 dBm	Max gain (dB), f0

Plot of f0 determined in band 869-894 MHz.

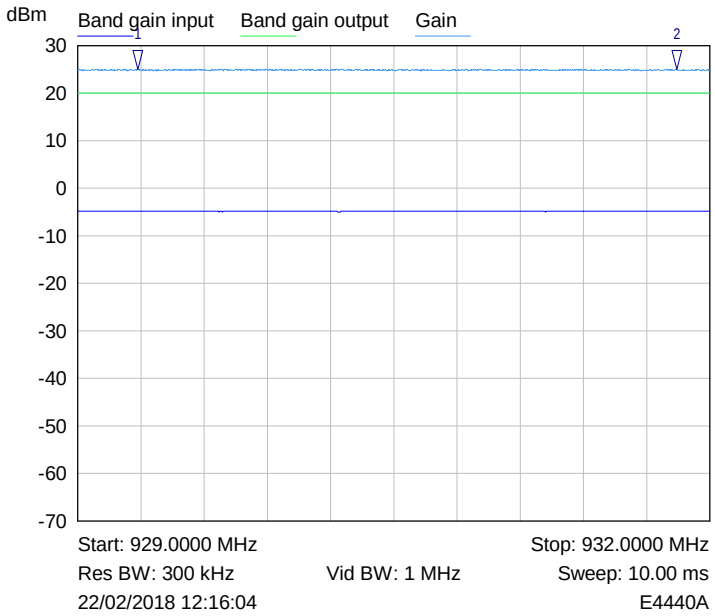
RF Parameters: Band 1930-1995 MHz, Power +20 dBm, Swept CW



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Gain	1.9936 GHz	25.06 dBm	

Plot of f0 determined in band 1930-1995 MHz.

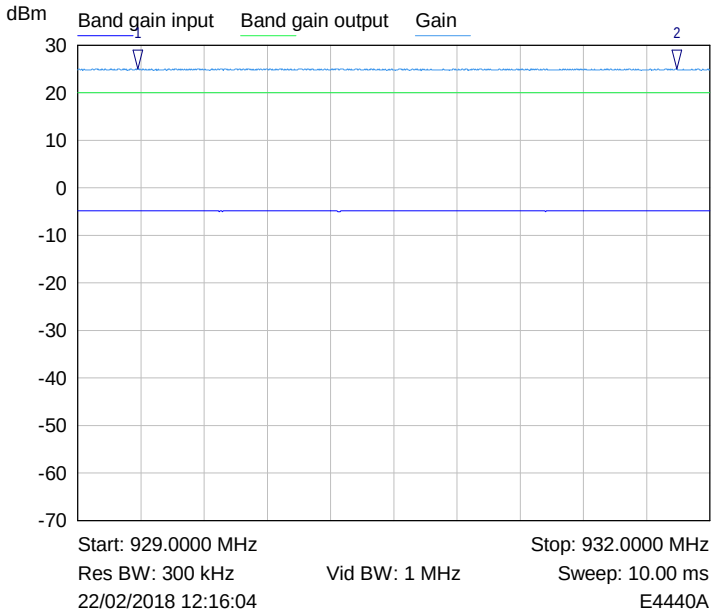
RF Parameters: Band 929-930 MHz, Power +20 dBm, Swept CW



Mkr	Trace	X-Axis	Value	Notes
1	Gain	929.2850 MHz	25.04 dBm	Max gain (dB), f0
2	Gain	931.8440 MHz	24.97 dBm	Max gain (dB), f0

Plot of f0 determined in band 929-930 MHz.

RF Parameters: Band 931-932 MHz, Power +20 dBm, Swept CW

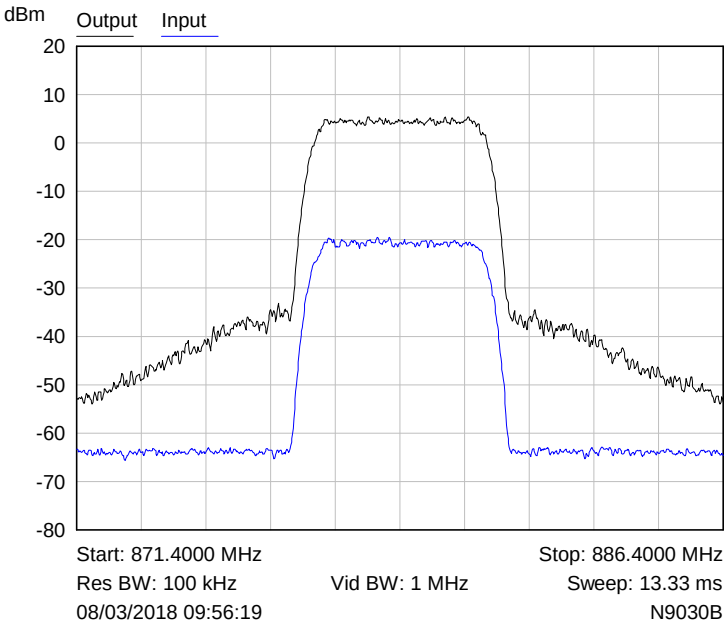


Mkr	Trace	X-Axis	Value	Notes
1	Gain	929.2850 MHz	25.04 dBm	Max gain (dB), f0
2	Gain	931.8440 MHz	24.97 dBm	Max gain (dB), f0

Plot of f0 determined in band 931-932 MHz.

6.2 RF Power Output

RF Parameters: Band 869-894 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 878.9 MHz (determined f_0)



Input

Measurement Parameter	Value
Total channel power	-5.04 dBm
Power Spectral Density	-72.03 dBm/Hz

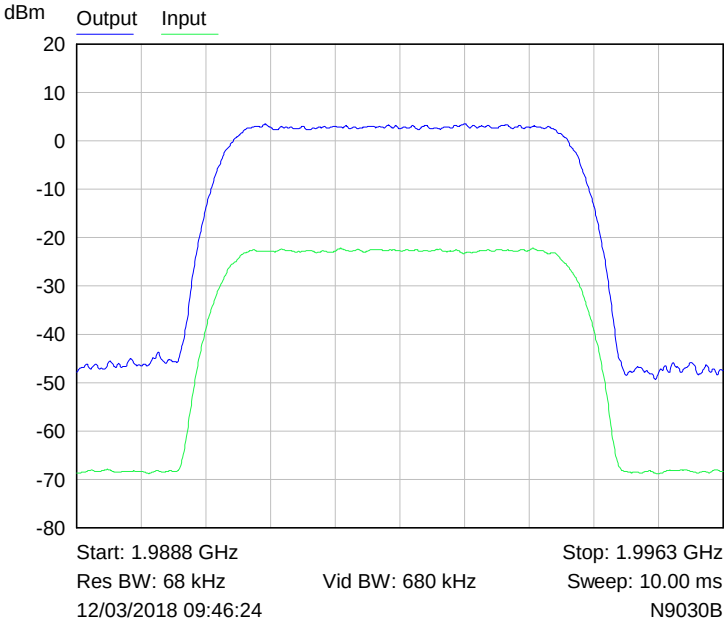
Output

Measurement Parameter	Value
Total channel power	20.10 dBm
Power Spectral Density	-46.89 dBm/Hz

Plot of Channel power at determined f_0 in band 869-894 MHz

Plot of Peak to Average power ratio at determined f_0 in band 869-894 MHz

RF Parameters: Band 1930-1995 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 1992.5 MHz (highest channel centre near determined f_0)



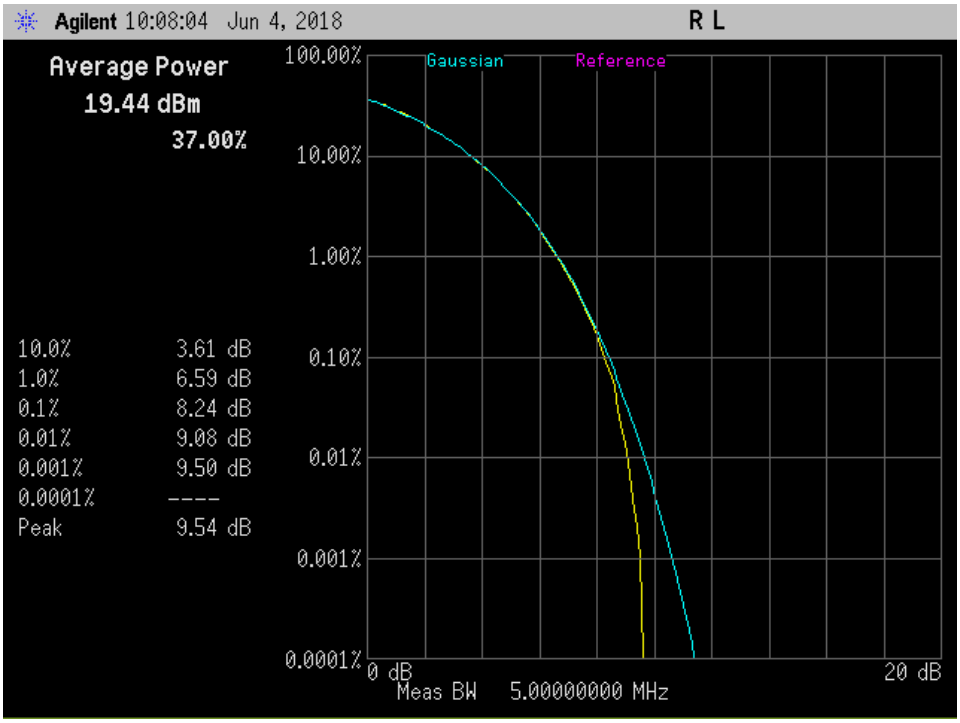
Input

Measurement Parameter	Value
Total channel power	-5.37 dBm
Power Spectral Density	-72.35 dBm/Hz

Output

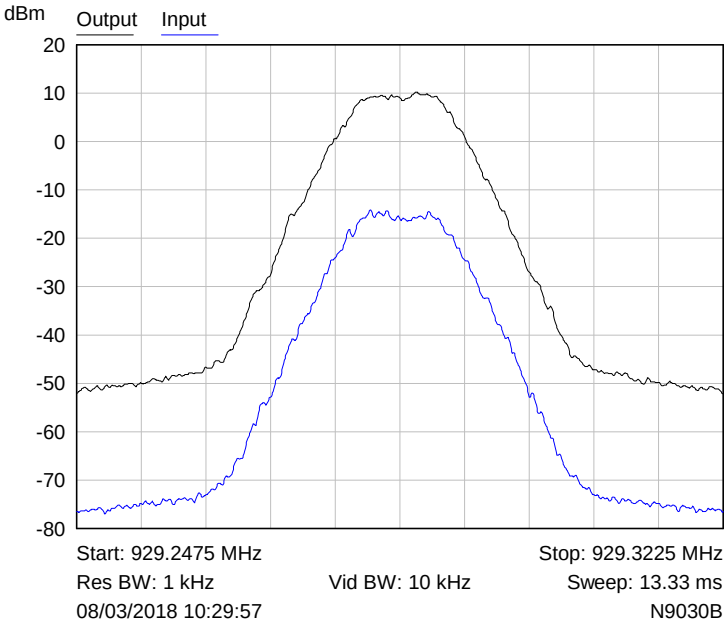
Measurement Parameter	Value
Total channel power	20.19 dBm
Power Spectral Density	-46.80 dBm/Hz

Plot of Channel power at determined f_0 in band 1930-1995 MHz



Plot of Peak to Average power ratio at determined f_0 in band 1930-1995 MHz

RF Parameters: Band 929-930 MHz, Power +20 dBm, Channel Spacing 25kHz, Modulation CW, Channel 929.285 MHz (determined f_0)



Input

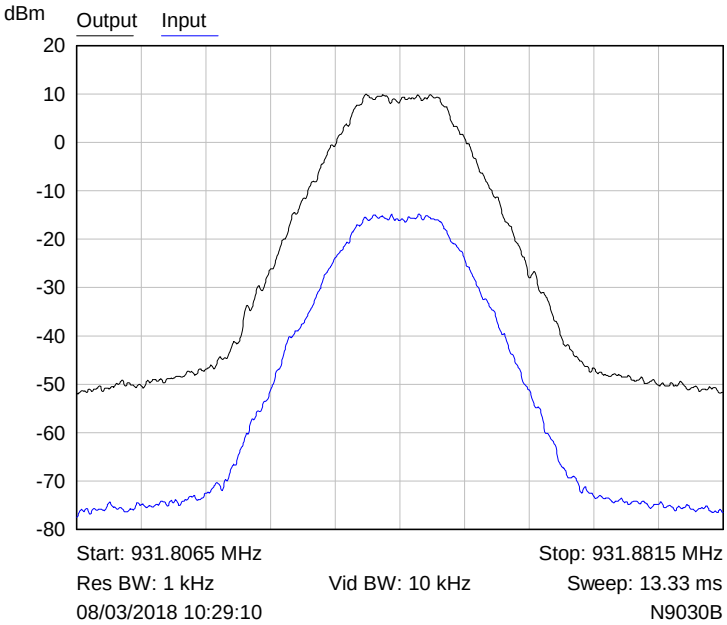
Measurement Parameter	Value
Total channel power	-5.03 dBm
Power Spectral Density	-49.01 dBm/Hz

Output

Measurement Parameter	Value
Total channel power	19.73 dBm
Power Spectral Density	-24.25 dBm/Hz

Plot of Channel power at determined f_0 in band 929-930 MHz

RF Parameters: Band 931-932 MHz, Power +20 dBm, Channel Spacing 25kHz, Modulation CW, Channel 931.844 MHz (determined f_0)



Input

Measurement Parameter	Value
Total channel power	-5.19 dBm
Power Spectral Density	-49.17 dBm/Hz

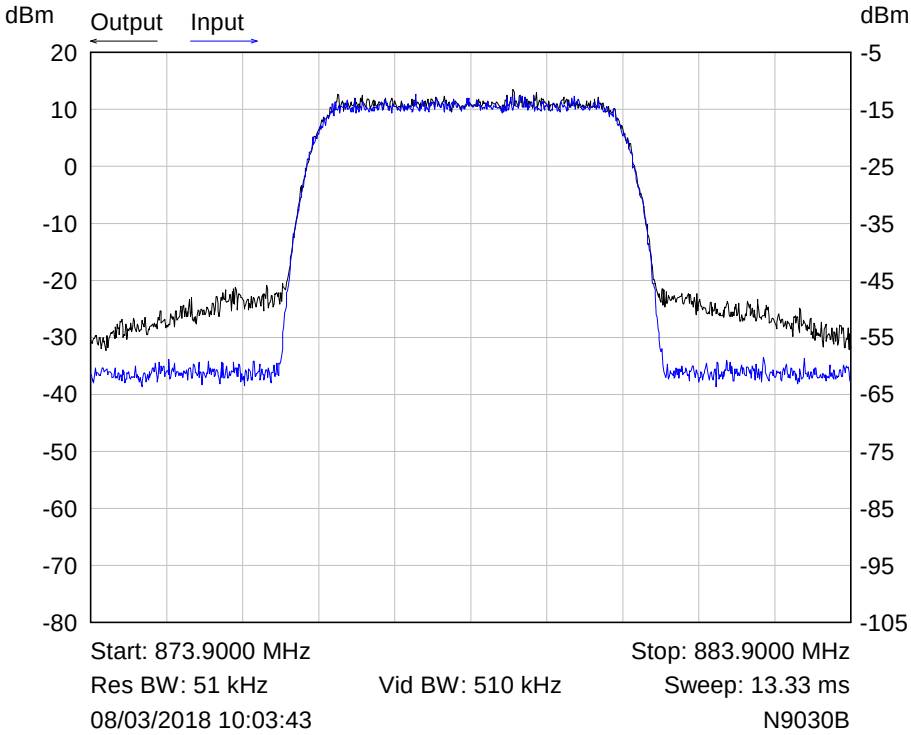
Output

Measurement Parameter	Value
Total channel power	19.63 dBm
Power Spectral Density	-24.35 dBm/Hz

Plot of Channel power at determined f_0 in band 931-932 MHz

6.3 Occupied bandwidth / Input versus output signal

RF Parameters: Band 869-894 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 878.9 MHz (determined f_0)



Input

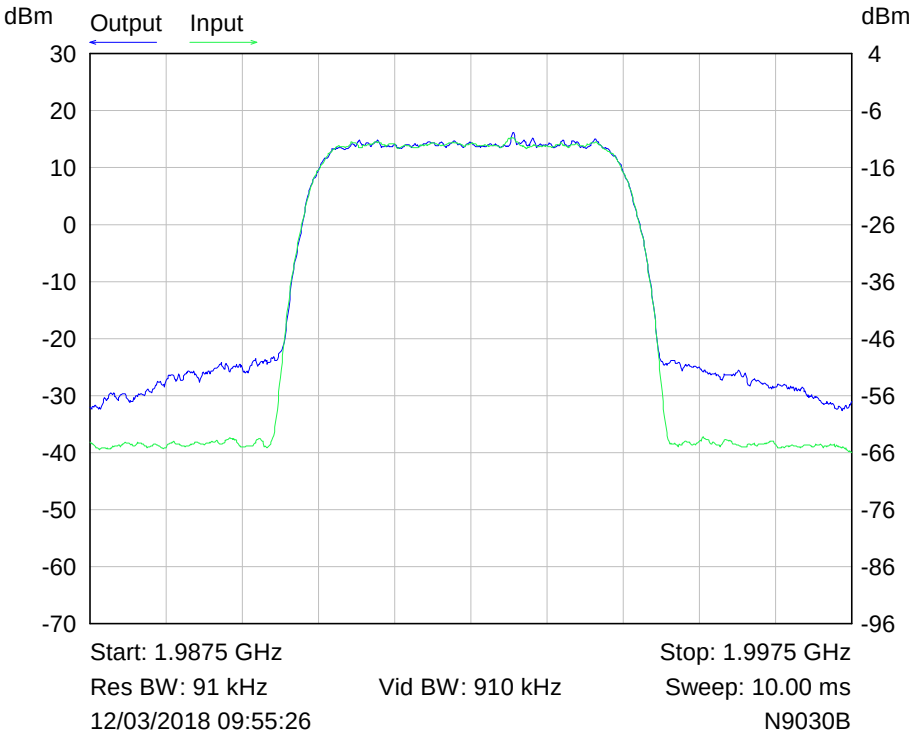
Measurement Parameter	Value
Occupied Bandwidth	4.13 MHz
Power in Occupied Bandwidth	4.20 dBm
Transmit Freq Error	-5.45 kHz
-26.00 dB Bandwidth	4.67 MHz

Output

Measurement Parameter	Value
Occupied Bandwidth	4.12 MHz
Power in Occupied Bandwidth	29.63 dBm
Transmit Freq Error	255.67 Hz
-26.00 dB Bandwidth	4.69 MHz

Occupied BW 878.9 MHz channel

RF Parameters: Band 1930-1995 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 1992.5 MHz (highest channel centre near determined f_0)



Input

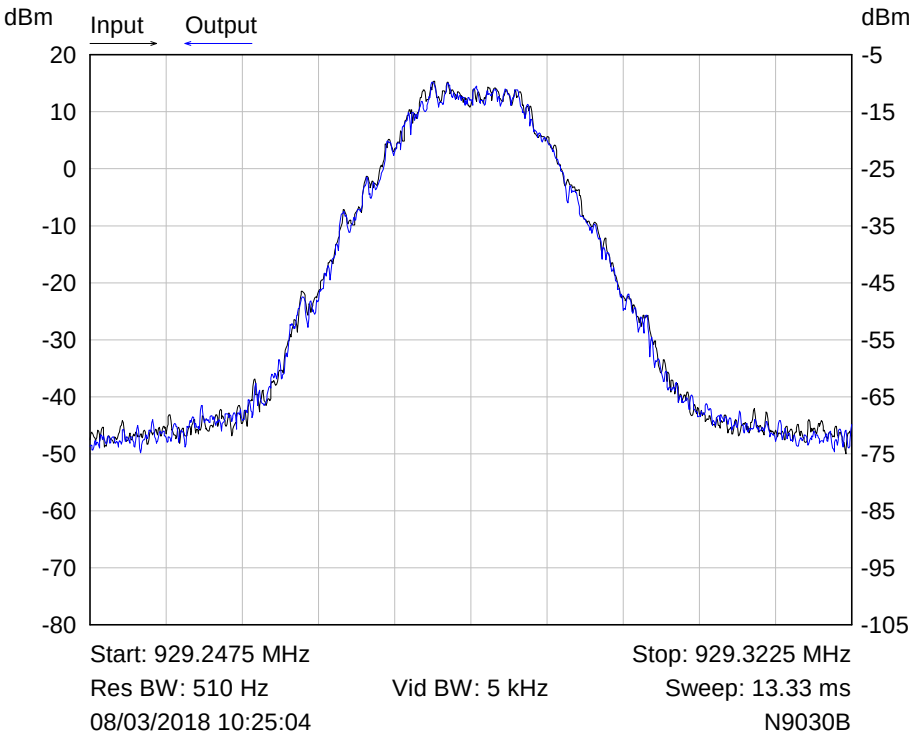
Measurement Parameter	Value
Occupied Bandwidth	4.13 MHz
Power in Occupied Bandwidth	4.06 dBm
Transmit Freq Error	415.19 Hz
-26.00 dB Bandwidth	4.67 MHz

Output

Measurement Parameter	Value
Occupied Bandwidth	4.14 MHz
Power in Occupied Bandwidth	30.11 dBm
Transmit Freq Error	-7.27 kHz
-26.00 dB Bandwidth	4.70 MHz

Occupied BW 1992.5MHz channel

RF Parameters: Band 929-930 MHz, Power +20 dBm, Channel Spacing 25kHz, Modulation CW, Channel 929.285 MHz (determined f_0)



Input

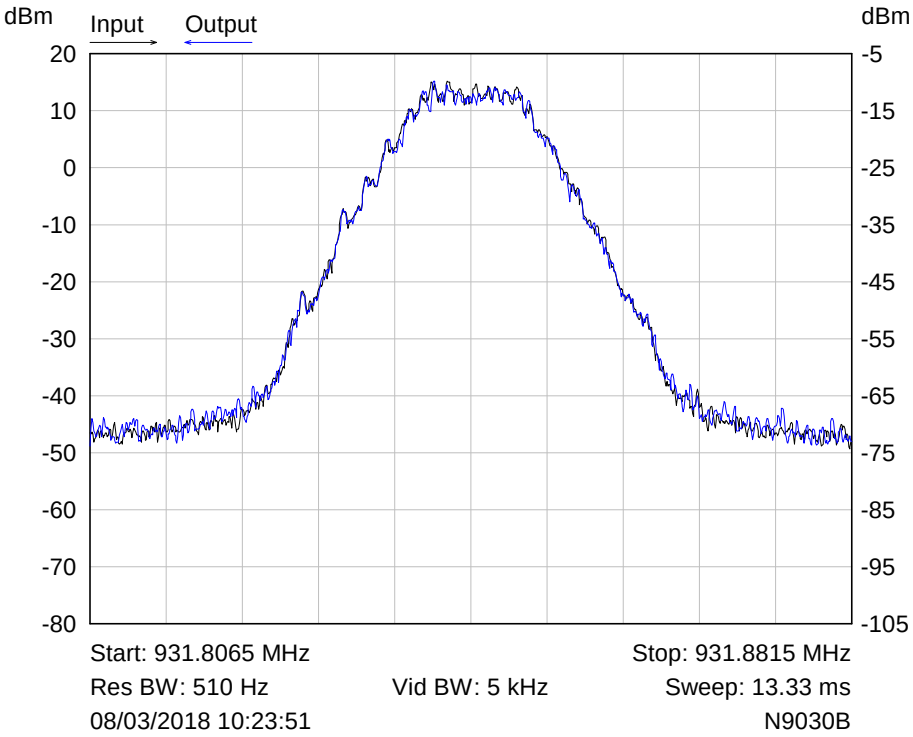
Measurement Parameter	Value
Occupied Bandwidth	18.18 kHz
Power in Occupied Bandwidth	1.64 dBm
Transmit Freq Error	-98.34 Hz
-26.00 dB Bandwidth	25.30 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	17.94 kHz
Power in Occupied Bandwidth	26.34 dBm
Transmit Freq Error	-101.58 Hz
-26.00 dB Bandwidth	25.28 kHz

Occupied BW 929.285 MHz channel

RF Parameters: Band 931-932 MHz, Power +20 dBm, Channel Spacing 25kHz, Modulation CW, Channel 931.844 MHz (determined f_0)



Input

Measurement Parameter	Value
Occupied Bandwidth	18.28 kHz
Power in Occupied Bandwidth	1.61 dBm
Transmit Freq Error	-54.75 Hz
-26.00 dB Bandwidth	25.49 kHz

Output

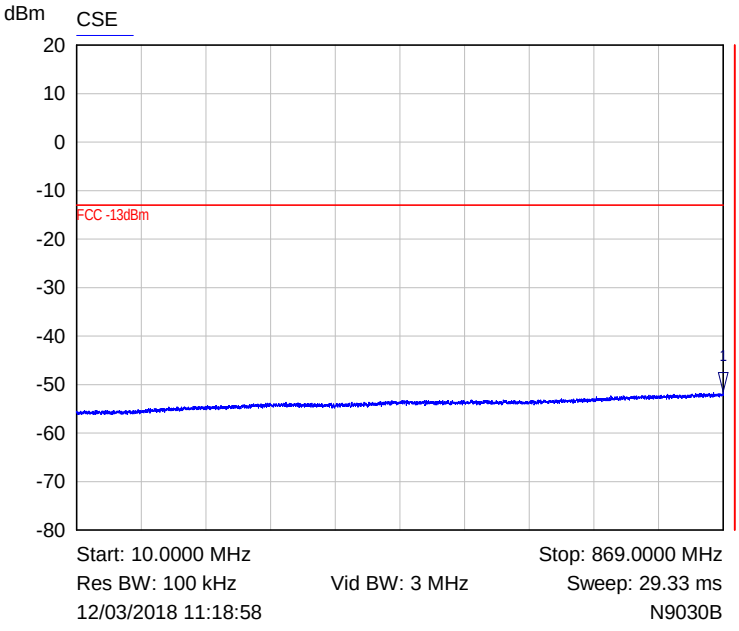
Measurement Parameter	Value
Occupied Bandwidth	18.30 kHz
Power in Occupied Bandwidth	26.29 dBm
Transmit Freq Error	-141.27 Hz
-26.00 dB Bandwidth	25.12 kHz

Occupied BW 931.844 MHz channel

6.4 Spurious emissions at antenna terminals

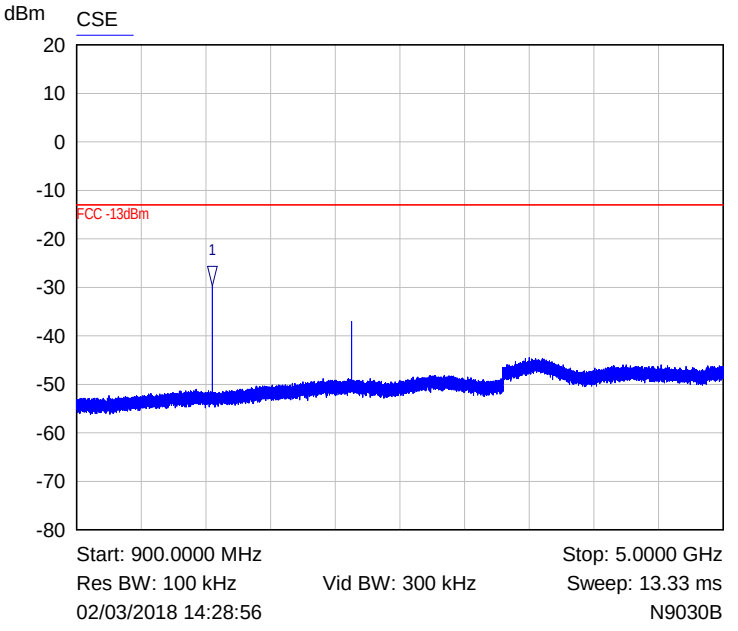
Note: Whilst Low, Mid and high channels in both Single channel and dual channel modes have been tested, only Mid channel plots are included in report for each band of operation to minimise report size.

RF Parameters: Band 869-894 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 881.5 MHz, Single channel mode



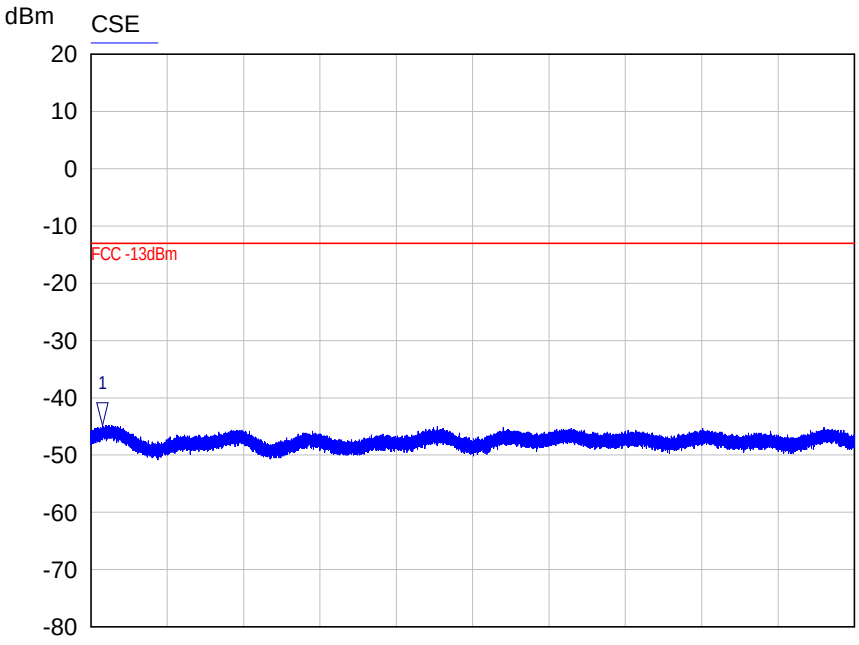
Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	869.0000 MHz	-38.56 dBm	Relative to limit

Plot of conducted emissions single Mid channel (881.5 MHz) 10 MHz – 869 MHz range



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	1.7630 GHz	-29.69 dBm	Max emission

Plot of conducted emissions single Mid channel (881.5 MHz) 900 MHz – 5 GHz range



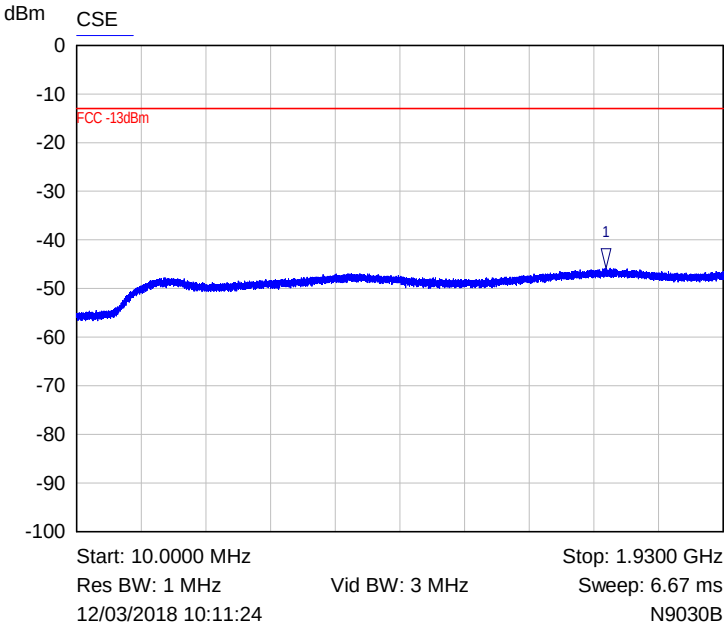
Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	5.0760 GHz	-44.77 dBm	Max emission

Plot of conducted emissions single Mid channel (881.5 MHz) 5 GHz – 10 GHz range

RF Parameters: Band 869-894 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channels 871.5 & 876.5 MHz, dual channel mode

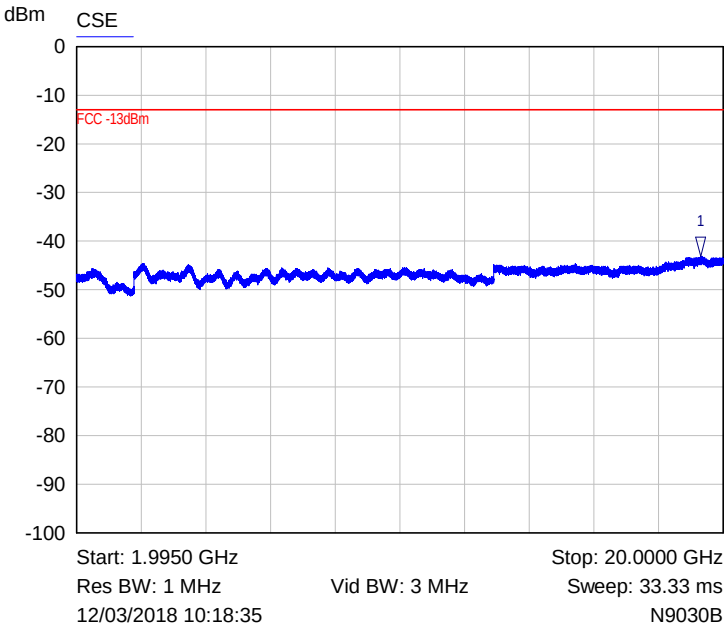
Please refer to plots for single channel mode as emissions were identical in this range and no emissions were observed within 20dB of limits.

RF Parameters: Band 1930-1995 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 1962.5 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	1.5809 GHz	-45.85 dBm	

Plot of conducted emissions single Mid channel (1962.5 MHz) 30 MHz – 1.93 GHz range



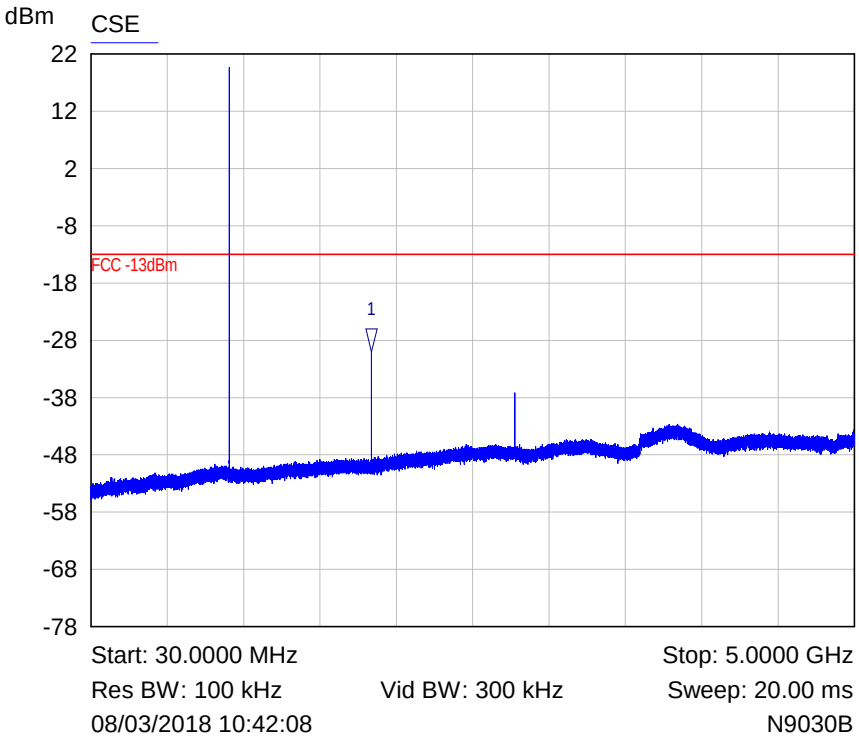
Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	19.3745 GHz	-43.13 dBm	

Plot of conducted emissions single Mid channel (1962.5 MHz) 1.995 GHz – 20 GHz range

RF Parameters: Band 1930-1995 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channels 1932.5 MHz & 1937.5 MHz, Dual channel mode

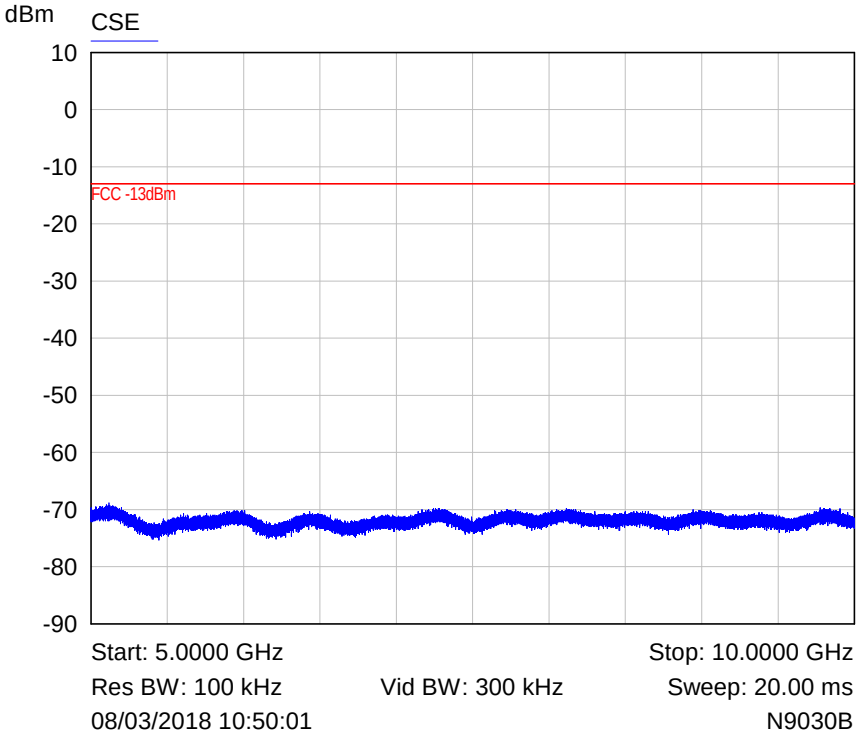
Please refer to plots for single channel mode as emissions were identical in this range and no emissions were observed within 20dB of limits

RF Parameters: Band 929-930 MHz, Power +20 dBm, Channel Spacing 25kHz, Modulation CW, Channel 929.5 MHz, Single channel mode



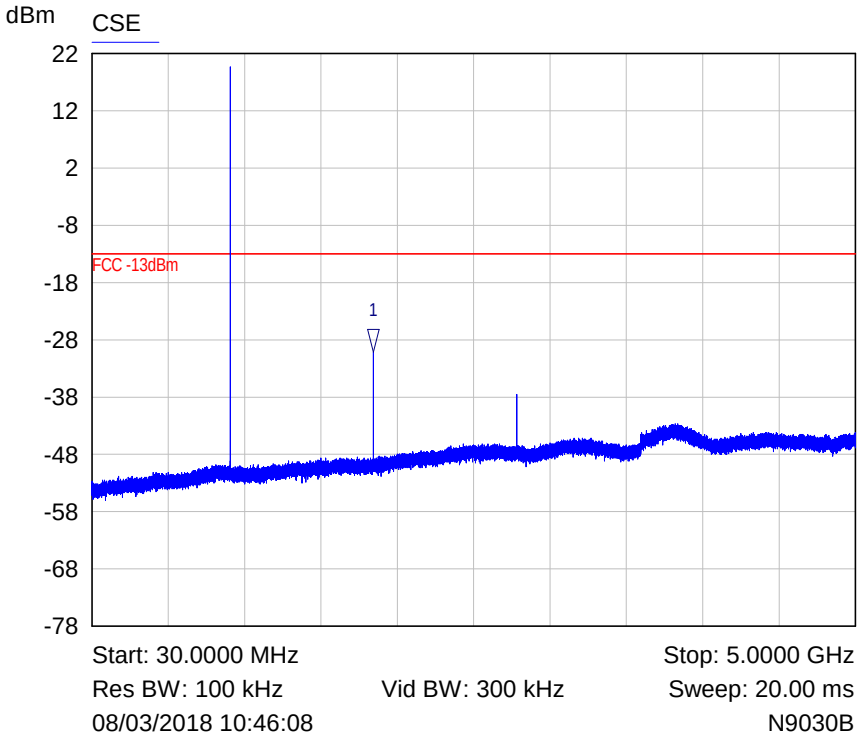
Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	1.8590 GHz	-30.05 dBm	Max emission

Plot of conducted emissions single Mid channel (929.5 MHz) 30 MHz – 5 GHz range



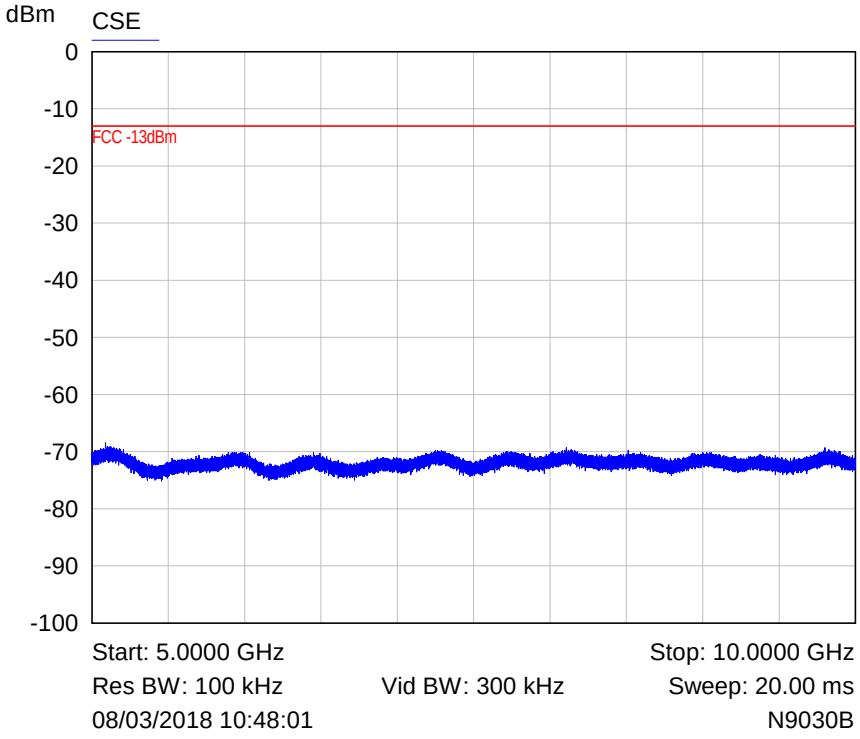
Plot of conducted emissions single Mid channel (929.5 MHz) 5 GHz – 10 GHz range

RF Parameters: Band 931-932MHz, Power +20 dBm, Channel Spacing 25kHz, Modulation CW, Channel 933 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	1.8630 GHz	-30.18 dBm	Max emission

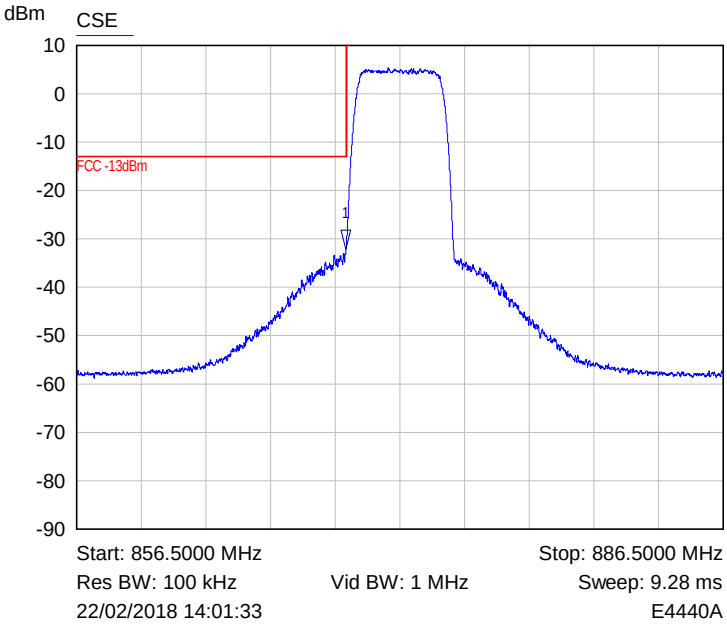
Plot of conducted emissions single Mid channel (931.5 MHz) 30 MHz – 5 GHz range



Plot of conducted emissions single Mid channel (933 MHz) 5 GHz – 10 GHz range

6.5 Band edge emissions

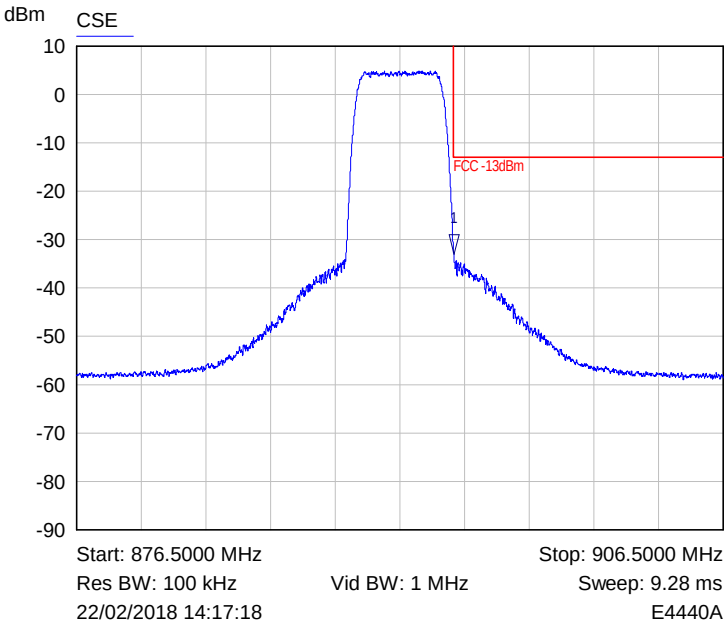
RF Parameters: Band 869-894 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 871.5 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	869.0003 MHz	-19.13 dBm	Relative to limit

Plot of lower band edge for Low channel (871.5 MHz)

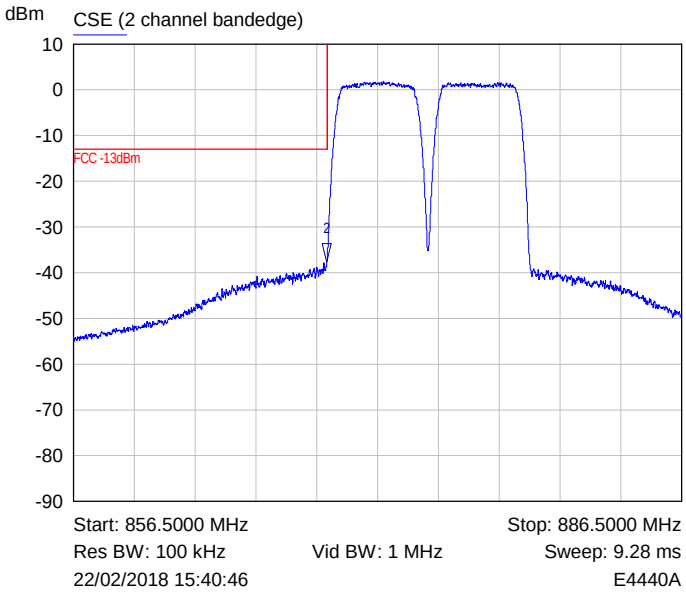
RF Parameters: Band 869-894 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 891.5 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	893.9997 MHz	-19.93 dBm	Relative to limit

Plot of upper band edge for High channel (891.5 MHz)

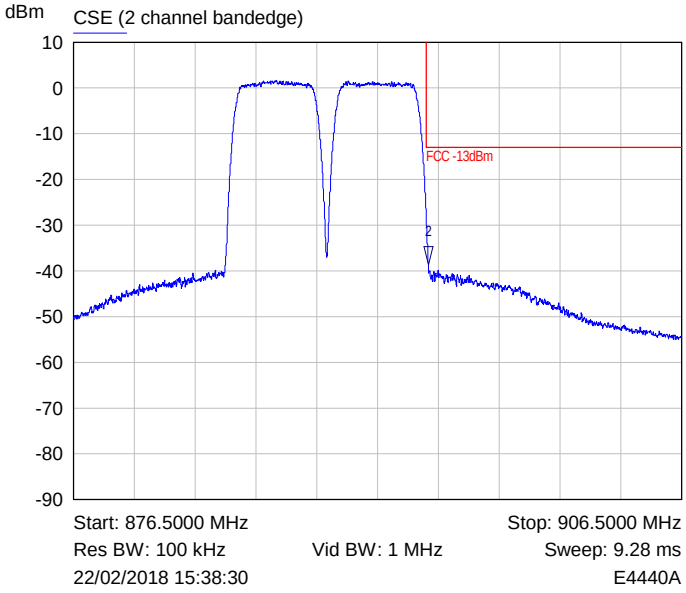
RF Parameters: Band 869-894 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 871.5 & 876.5 MHz, Dual channel mode



Mkr	Trace	X-Axis	Value	Notes
2 ▽	CSE (2 channel bandedge)	869.0003 MHz	-24.68 dBm	Relative to limit

Plot of lower band edge for Low channels (871.5 & 876.5 MHz)

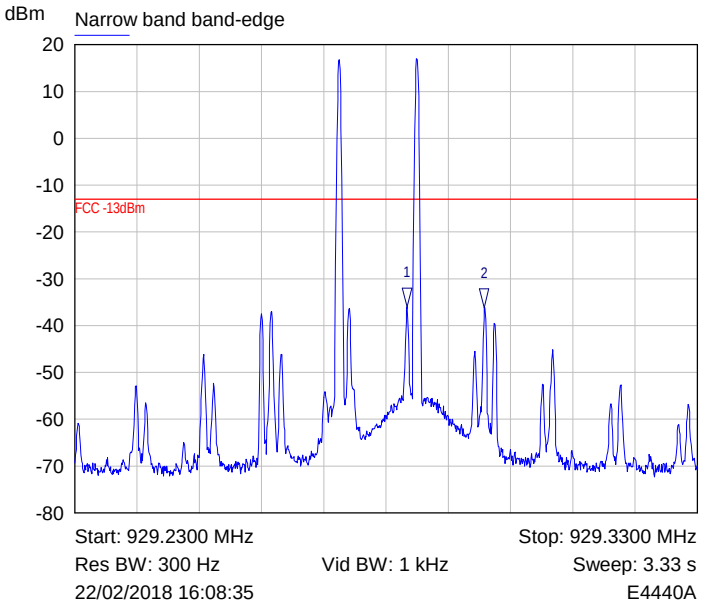
RF Parameters: Band 869-894 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 886.5 & 891.5 MHz, Dual channel mode



Mkr	Trace	X-Axis	Value	Notes
2 ▽	CSE (2 channel bandedge)	893.9997 MHz	-25.63 dBm	Relative to limit

Plot of upper band edge for High channels (886.5 & 891.5 MHz)

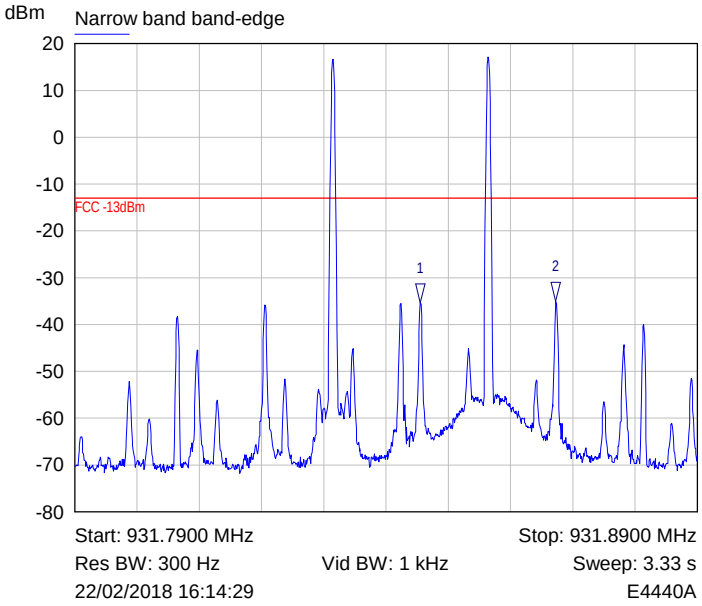
RF Parameters: Band 929-930 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channels 929.2725 & 929.2975MHz, Dual channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Narrow band band-edge	929.2834 MHz	-23.08 dBm	Relative to limit
2 ▽	Narrow band band-edge	929.2958 MHz	-23.17 dBm	Relative to limit

Plot of band edges for channels (929.2725 & 929.2975MHz)

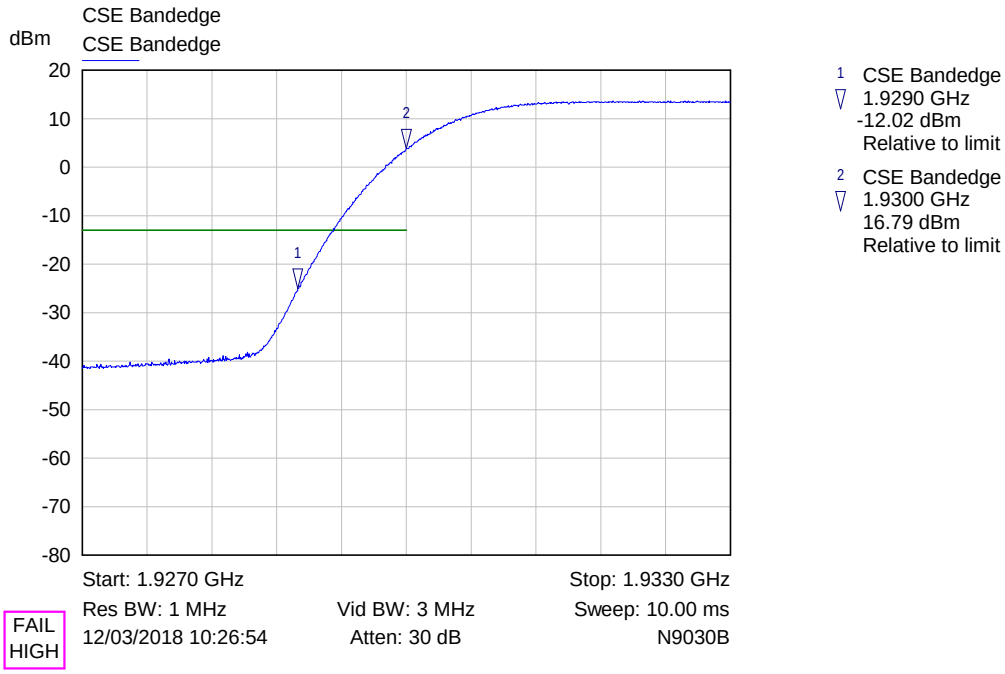
RF Parameters: Band 931-932 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channels 931.8315 & 931.8565MHz, Dual channel mode



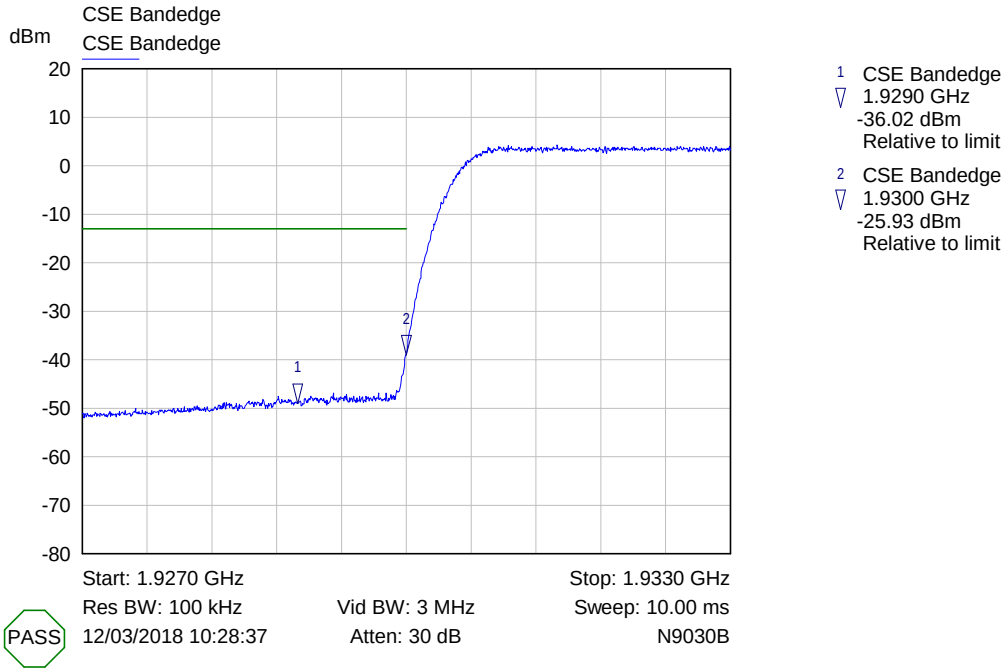
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Narrow band band-edge	931.8455 MHz	-22.29 dBm	Relative to limit
2 ▽	Narrow band band-edge	931.8673 MHz	-21.93 dBm	Relative to limit

Plot of band edges for channels (931.8315 & 931.8565MHz)

RF Parameters: Band 1930-1995 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 1932.5 MHz, Single channel mode

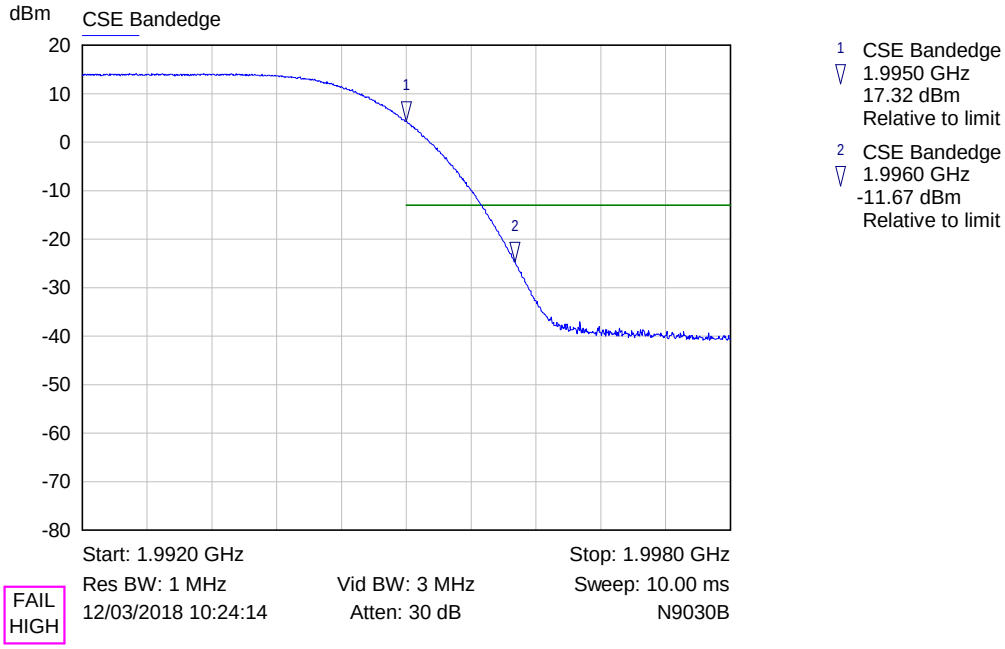


Plot of lower band edge for Low channel 1MHz RBW (1932.5 MHz)

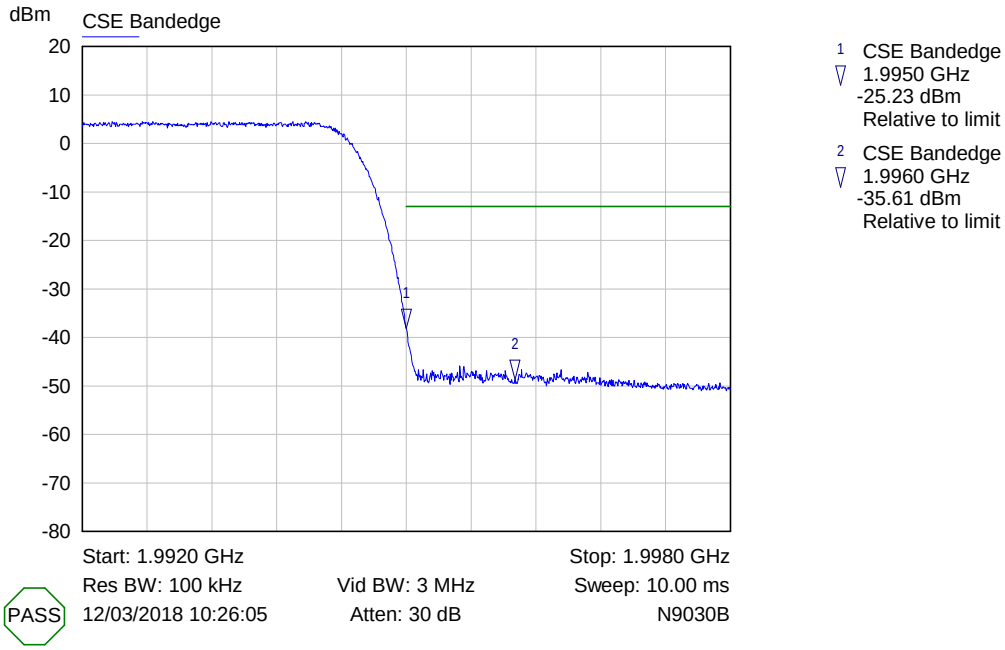


Plot of lower band edge for Low channel 100kHz RBW (1932.5 MHz)

RF Parameters: Band 1930-1995 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 1992.5 MHz, Single channel mode

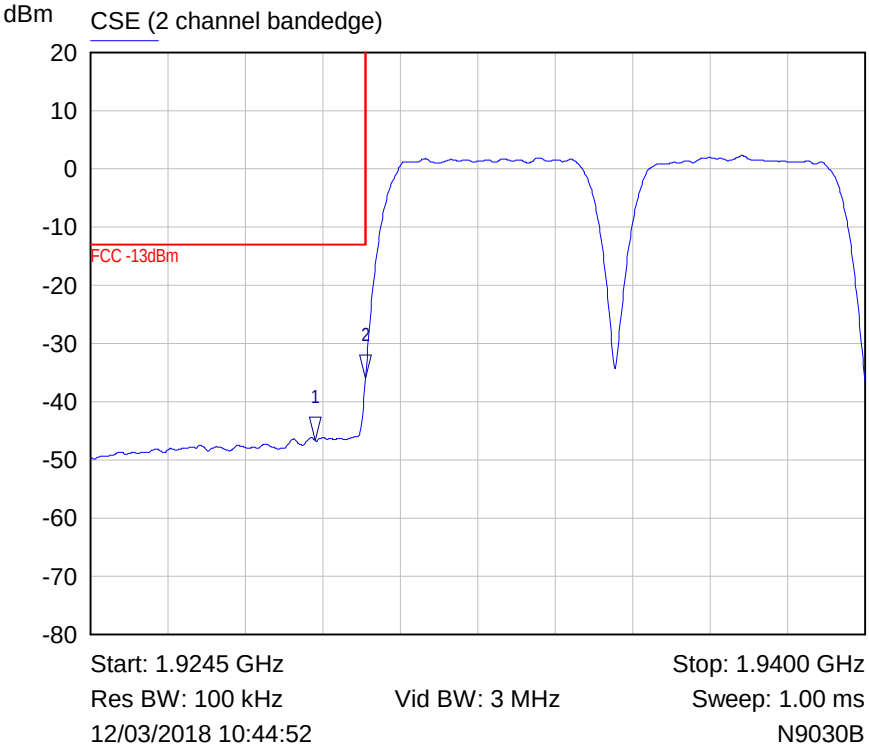


Plot of upper band edge for High channel 1MHz RBW (1992.5 MHz)



Plot of upper band edge for High channel 100kHz RBW (1992.5 MHz)

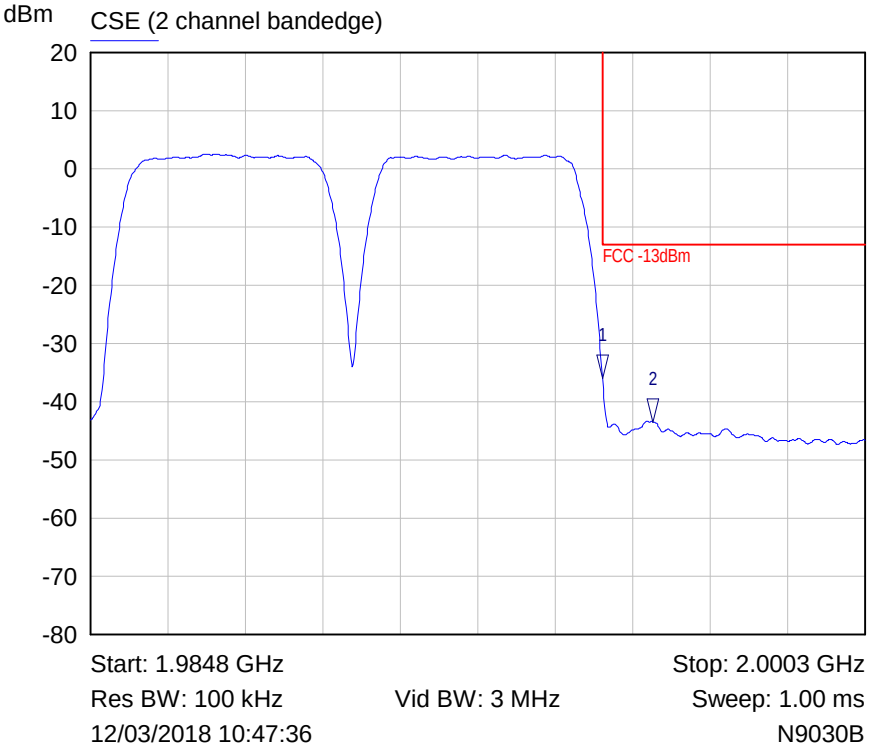
RF Parameters: Band 1930-1995 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channels 1932.5 & 1937.5 MHz, Dual channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE (2 channel bandedge)	1.9290 GHz	-33.69 dBm	Relative to limit
2 ▽	CSE (2 channel bandedge)	1.9300 GHz	-23.00 dBm	Relative to limit

Plot of lower band edge for Low channels 100kHz RBW (1932.5 & 1937.5 MHz)

RF Parameters: Band 1930-1995 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channels 1987.5 & 1992.5 MHz, Dual channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE (2 channel bandedge)	1.9950 GHz	-23.08 dBm	Relative to limit
2 ▽	CSE (2 channel bandedge)	1.9960 GHz	-30.43 dBm	Relative to limit

Plot of upper band edge for High channels 100kHz RBW (1987.5 & 1992.5 MHz)

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
E268	BHA 9118	Horn Antenna 1-18 GHz	Schaffner	03-Apr-2017	12 months
E301	8493C	Attenuator 20dB 26.5GHz	Hewlett Packard	19-May-2017	12 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	11-Jul-2017	12 months
E412	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	10-Jul-2017	24 months
E428	HF906	Horn Antenna 1-18 GHz	Rohde & Schwarz	03-Apr-2017	12 months
E433	MG3693A	Signal Generator 30GHz	Anritsu	23-Jun-2016	24 months
E452	22240-20	Std Gain Horn Antenna 26.4 - 40.1 GHz	FMI Ltd	02-May-2017	12 months
E453	20240-20-AA	Std Gain Horn Antenna 17.6 - 26.7 GHz	FMI Ltd	02-May-2017	12 months
E454	18240-20	Std Gain Horn Antenna 11.9 - 18.0 GHz	FMI Ltd	25-Jul-2017	12 months
E498	4768-20	Attenuator 20dB 40GHz	Narda	24-May-2017	12 months
E602	MG3692A	Signal Generator 10MHz - 20GHz	Anritsu	30-Jan-2017	24 months
E624	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	09-Jan-2018	24 months
E642	E4440A	PSA 3 Hz - 26.5 GHz	Keysight	29-Nov-2017	24 months
E743	RR2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	12-Feb-2018	12 months
E755	N9030B	3Hz to 50GHz PXA	Keysight	08-May-2017	12 months
LPE364	CBL6112A	Antenna Bilog 30MHz - 2GHz	Chase Electronics Ltd	15-Jan-2018	24 months
TMS78	3160-08	Std Gain Horn Antenna 12.4-18 GHz	ETS Systems	25-Jul-2017	12 months
TMS79	3160-09	Std Gain Horn Antenna 18-26.5 GHz	ETS Systems	25-Jul-2017	12 months
TMS82	8449B	Pre Amplifier 1 - 26 GHz	Agilent Technologies	19-Dec-2017	12 months

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		TX 50 Ohm load		
5		RX 50 Ohm load		
6	305-0001	UNItivity 5000 Primary Hub	Zinwave Ltd	650100000002
7	305-0004	Zinwave Secondary Hub	Zinwave Ltd	620100000018
8	E4432B	signal generator	HP	Zinwave 000001
9	SMJ100A	signal generator	R&S	Zinwave 000094
10	SLP-550+	520MHz LPF	Mini circuits	R0029901116
11	SLP-630+	630MHz LPF	Mini circuits	3 0719
12	SLP-1200+	1000MHz LPF	Mini circuits	R8169700721
13	305-0001	UNItivity 5000 primary hub	Zinwave Ltd	00-17-68-00-13-DE
14	305-0004	Zinwave Secondary Hub	Zinwave Ltd	620100000004

9 .2 RN Electronics supplied equipment

RN No.	Model No.	Description	Manufacturer	Serial No
E401	1506A	Splitter 18 GHz 6dB	Weinschel	LT261
I224	E442-142H16	Laptop 15.6"	emachines	LXNBF02002038164171601

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 / Calibration Laboratory and anechoic chamber

Site B Semi-anechoic chamber
FCC Registration No. 293246
IC Registration No. 5612A-4

Site B1 Control Room for Site B

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
IC Registration No. 5612A-2

Site J Screened Room

Site K Screened Room (Control Room for Site M)

Site M 3m Semi-anechoic chamber (indoor OATS)
FCC Registration No. 293246
IC Registration No. 5612A-3

Site Q Fully-anechoic chamber

Site OATS 3m and 10m Open Area Test Site
FCC Registration No. 293246
IC Registration No. 5612A-1

Site R Screened Room (Conducted Immunity)

Site S Safety Laboratory

Site T Transient Laboratory

12 Abbreviations and units

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