Radio Test Report

Zinwave Ltd

Zinwave UNItivity 5000 Remote Unit

305-0007

47 CFR Part 90 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: 03-10383-4-18 Issue 02
supersedes Report Number: 03-10383-4-18 Issue 01

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Certificate of Test 10383-4

The equipment noted below has been fully tested by R.N. Electronics Limited and, where appropriate, conforms to the relevant subpart of FCC Part 90. 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:	03-10383-2-18 Issue 02
Test Standards:	47 CFR Part 90 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 part 90, for details of testing to other rule parts please see RN reports: 03-10383-1-18 (Parts 22E, 22H, 24E), 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:	
Approved By: Radio Approvals Manager	Digitally signed by: Daniel Sims DN: CN = Daniel Sims C = GB O = RN Electronics Ltd Date: 2018.06.14 12:30:57 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 20th April 2018	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	14th June 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
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 Private Land Mobile Radio Services under this rule part
EUT Declared Power level	+20dBm
EUT Declared Signal Bandwidths	Device supports Private Land Mobile Radio Services under this rule part
EUT Declared Channel Spacing's	Device supports Private Land Mobile Radio Services under this rule part
EUT Declared Duty Cycle	up to 100%
Unmodulated carrier available?	Yes - EUT provides at its output whatever is presented to its input
Declared frequency stability	0ppm (DAS without frequency translation)
RX Parameters	
Alignment range – receiver	As per Transmitter range
EUT Declared RX Signal Bandwidth	As per Transmitter
Receiver Signal Level (RSL)	N/A
Method of Monitoring Receiver BER	N/A

2.3 Functional description

The Remote Unit is used as part of the Zinwave UNItivity 5000 system to provide cellular and private radio services within buildings, sports arenas and similar areas.
The system is wideband in nature and can support a wide range of radio services depending upon the system that is connected to the service module of the Primary Hub.

2.4 Modes of operation

Mode Reference	Description	Used for testing
CW sweep Band 150-174 MHz	EUT being fed a swept CW signal across the band 150-174 MHz @ -5dBm amplitude level	Yes
CW sweep Band 406.1-430 MHz	EUT being fed a swept CW signal across the band 406.1-430 MHz @ -5dBm amplitude level	Yes
CW sweep Band 456-512 MHz	EUT being fed a swept CW signal across the band 456-512 MHz @ -5dBm amplitude level	Yes
CW sweep Band 758-768 MHz	EUT being fed a swept CW signal across the band 758-768 MHz @ -5dBm amplitude level	Yes
CW sweep Band 769-775 MHz	EUT being fed a swept CW signal across the band 769-775 MHz @ -5dBm amplitude level	Yes
CW sweep Band 799-805 MHz	EUT being fed a swept CW signal across the band 799-805 MHz @ -5dBm amplitude level	Yes
CW sweep Band 851-869 MHz	EUT being fed a swept CW signal across the band 851-869 MHz @ -5dBm amplitude level	Yes
CW sweep Band 935-940 MHz	EUT being fed a swept CW signal across the band 935-940 MHz @ -5dBm amplitude level	Yes
f_o Determined in Band 150-174 MHz	EUT Being fed a Signal at 174 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
f_o Determined in Band 406.1-430 MHz	EUT Being fed a Signal at 430 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
f_o Determined in Band 456-512 MHz	EUT Being fed a Signal at 511.347 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
f_o Determined in Band 758-768 MHz	EUT Being fed a Signal at 767.9 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
fo Determined in Band 769-775 MHz	EUT Being fed a Signal at 774.95 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
fo Determined in Band 799-805 MHz	EUT Being fed a Signal at 799 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
fo Determined in Band 851-869 MHz	EUT Being fed a Signal at 851.6 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
fo Determined in Band 935-940 MHz	EUT Being fed a Signal at 935 MHz @ -5dBm using AWGN modulation and 5MHz channel BW	Yes
Single Low channel band 150-174 MHz	EUT Being fed a Signal at 150.0125MHz @ -5dBm using CW (no modulation)	Yes
Single Mid channel band 150-174 MHz	EUT Being fed a Signal at 160MHz @ -5dBm using CW (no modulation)	Yes
Single High channel band 150-174 MHz	EUT Being fed a Signal at 173.3875MHz @ -5dBm using CW (no modulation)	Yes
Single Low channel band 406.1-430 MHz	EUT Being fed a Signal at 406.1125MHz @ -5dBm using CW (no modulation)	Yes

Single Mid channel band 406.1-430 MHz	EUT Being fed a Signal at 415MHz @ -5dBm using CW (no modulation)	Yes
Single High channel band 406.1-430 MHz	EUT Being fed a Signal at 429.9875MHz @ -5dBm using CW (no modulation)	Yes
Single Low channel band 456-512 MHz	EUT Being fed a Signal at 456.0125MHz @ -5dBm using CW (no modulation)	Yes
Single Mid channel band 456-512 MHz	EUT Being fed a Signal at 480MHz @ -5dBm using CW (no modulation)	Yes
Single High channel band 456-512 MHz	EUT Being fed a Signal at 511.9875MHz @ -5dBm using CW (no modulation)	Yes
Single Low channel band 758-768 MHz	EUT Being fed a Signal at 758.0125MHz @ -5dBm using CW (no modulation)	Yes
Single Mid channel band 758-768 MHz	EUT Being fed a Signal at 763MHz @ -5dBm using CW (no modulation)	Yes
Single High channel band 758-768 MHz	EUT Being fed a Signal at 767.9875MHz @ -5dBm using CW (no modulation)	Yes
Single Low channel band 769-775 MHz	EUT Being fed a Signal at 769.0125MHz @ -5dBm using CW (no modulation)	Yes
Single Mid channel band 769-775 MHz	EUT Being fed a Signal at 772MHz @ -5dBm using CW (no modulation)	Yes
Single High channel band 769-775 MHz	EUT Being fed a Signal at 774.9875MHz @ -5dBm using CW (no modulation)	Yes
Single Low channel band 799-805 MHz	EUT Being fed a Signal at 799.0125MHz @ -5dBm using CW (no modulation)	Yes
Single Mid channel band 799-805 MHz	EUT Being fed a Signal at 802MHz @ -5dBm using CW (no modulation)	Yes
Single High channel band 799-805 MHz	EUT Being fed a Signal at 804.9875MHz @ -5dBm using CW (no modulation)	Yes
single Low channel band 851-869 MHz	EUT Being fed a Signal at 851.0125MHz @ -5dBm using CW (no modulation)	Yes
single Mid channel band 851-869 MHz	EUT Being fed a Signal at 855MHz @ -5dBm using CW (no modulation)	Yes
Single High channel band 851-869 MHz	EUT Being fed a Signal at 868.9875MHz @ -5dBm using CW (no modulation)	Yes
single Low channel band 935-940 MHz	EUT Being fed a Signal at 935.0125MHz @ -5dBm using CW (no modulation)	Yes
single Mid channel band 935-940 MHz	EUT Being fed a Signal at 937.5MHz @ -5dBm using CW (no modulation)	Yes
Single High channel band 935-940 MHz	EUT Being fed a Signal at 939.9875MHz @ -5dBm using CW (no modulation)	Yes
Dual Mid channels band 150-174 MHz	EUT Being fed a Signal at 160.9625MHz & 160.9375MHz @ -5dBm using CW (no modulation)	Yes
Dual Mid channels band 406.1-430 MHz	EUT Being fed a Signal at 415.2935MHz & 415.2685MHz @ -5dBm using CW (no modulation)	Yes
Dual Mid channels band 456-512 MHz	EUT Being fed a Signal at 469.569MHz & 469.544MHz @ -5dBm using CW (no modulation)	Yes
Dual Mid channels band 758-768 MHz	EUT Being fed a Signal at 763.1805MHz & 763.1555MHz @ -5dBm using CW (no modulation)	Yes
Dual Mid channels band 769-775 MHz	EUT Being fed a Signal at 772.1805MHz & 772.1555MHz @ -5dBm using CW (no modulation)	Yes
Dual Mid channels band 799-805 MHz	EUT Being fed a Signal at 802.1805MHz & 802.1555MHz @ -5dBm using CW (no modulation)	Yes
Dual Low channels band 851-869 MHz	EUT Being fed a Signal at 856.0265MHz & 856.0015MHz @ -5dBm using CW (no modulation)	Yes

Dual High channels band 851-869 MHz	EUT Being fed a Signal at 865.0338MHz & 865.0088MHz @ -5dBm using CW (no modulation)	Yes
Dual Mid channels band 935-940 MHz	EUT Being fed a Signal at 937.1242MHz & 937.0992MHz @ -5dBm using CW (no modulation)	Yes

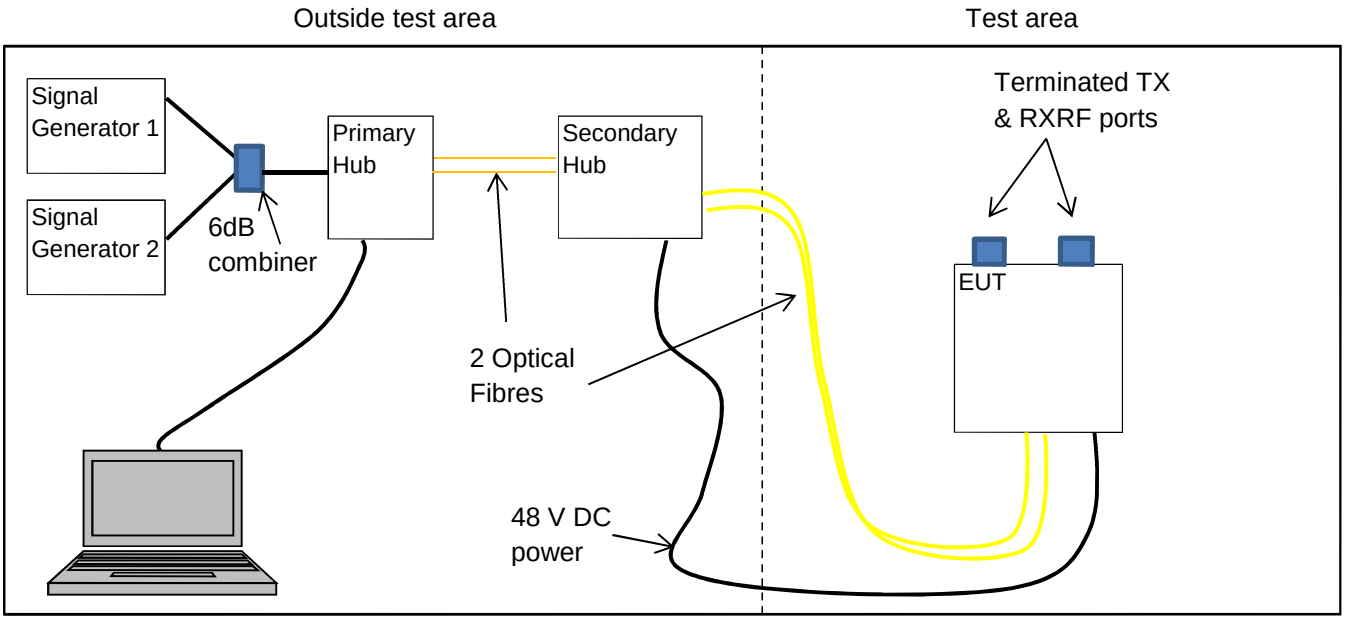
Note: This report only pertains to the operation of the equipment to 47CFR part 90, for details of testing to other rule parts please see RN reports: 03-10383-1-18 (Parts 22E, 22H, 24E)
03-10383-2-18 (Part 27)
03-10383-3-18 (Part 74H)

In addition to the test modes stated above, various channel bandwidths and modulation schemes were used in conjunction with Private Land mobile supported services, refer to specific results section for any further modes. Please see table below for services:-

Supported services table.

Frequency Band (MHz)	Service	Modulation	Channel Bandwidth	Emission designator
150 - 174	P25	C4FM (QPSK)	12.5kHz	11K2G1E
	FM	FM ±2.5kHz deviation	12.5kHz	11K2F3W
406.1 – 430.0	P25	C4FM (QPSK)	12.5kHz	11K2G1E
	FM	FM ±2.5kHz deviation	12.5kHz	11K2F3W
	FM	FM ±5.0kHz deviation	25kHz	20K0F3W
456.0 – 512.0	P25	C4FM (QPSK)	12.5kHz	11K2G1E
	FM	FM ±2.5kHz deviation	12.5kHz	11K2F3W
	FM	FM ±5.0kHz deviation	25kHz	20K0F3W
758.0 -768.0	LTE	64QAM / 4.1 MHz AWGN		
769.0 -775.0	P25	C4FM (QPSK)	6.25kHz	11K2G1E
799.0 -805.0	P25	C4FM (QPSK)	6.25kHz	11K2G1E
851.0 – 869.0	P25	C4FM (QPSK)	12.5kHz	11K2G1E
	FM & EDACS	FM ±5.0kHz deviation	25kHz	20K0F3W
935.0 – 940.0	LTE	64QAM	25 kHz	20K0W7W
854.0 – 869.0	EVDO (QPSK+QAM)	QPSK 16QAM	1.25MHz	1M25F9W 1M25W9W
	FD-LTE	QPSK 16QAM 64QAM	5 MHz	4M20F9W 4M20W9W 4M20W9W

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 an input level of -5dBm. Any attenuation introduced by the Primary/secondary hub system was also accounted for in the set-up files provided by Zinwave Ltd. Test channels and required modulations were set using the signal generators connected to the primary hub. Single channel operation was provided by generator 1 and dual channel was using two signal generators 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 land mobile services, so testing was performed with CW and modulated signals (including AWGN modulation signal as per KDB 935210 D05) where required. See supported services table and specific test results sections for further details.

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 90 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 90 Clause 90.219(e)(3) FCC Part 2 Clause 2.1051	PASSED[1]
2. RF Power Output	FCC Part 90 Clause 90.219(e)(1) FCC Part 2 Clause 2.1046	PASSED
3. Frequency stability	FCC Part 2 Clause 2.1055	NOT APPLICABLE[2]
4. Occupied bandwidth	FCC Part 90 Clause 90.219(e)(4) FCC Part 90 Clause 90.210(c) & (h) FCC Part 2 Clause 2.1049	PASSED
5. Field strength of spurious radiations	FCC Part 90 Clause 90.219(e)(3) FCC Part 2 Clause 2.1053	PASSED[1]
6. Emissions Limitations / Out Of Band emissions	FCC Part 90 Clause 90.543(c) & (f) 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
9. Noise Figure / Noise ERP	90.219(d)(6)(ii) KDB 935210 D05 Clause 4.6	PASSED[4]

[1] Spectrum investigated started at a frequency of 30MHz up to a frequency of 10GHz based on 10 times the highest channel of 939.9875MHz. Includes Intermodulation emissions (Dual channel modes)
[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] **935210 D02 Signal Boosters Certification v03section V(j)(5)**: For the remote unit of a conventional fiber-connected host/remote DAS booster system, it is acceptable to submit compliance information and test data consistent with 90.219(d)(6)(ii) (i.e., ERP of noise ≤ −43 dBm in 10 kHz RBW) for the downlink path only, in place of 90.219(e)(2) noise figure test data (i.e., NF ≤ 9 dB for both UL and DL). Test reports must provide explicit details about instrumentation and procedure used for 90.219(d)(6)(ii) testing.

Additional Notes for 769-775MHz band below:

Clause	Requirement	Comment
90.531(a)	The 763-775 MHz band may be used for base, mobile or fixed (repeater) transmissions	Device certified for operation in the 769 – 775 MHz band only
90.531(b)	band plan, narrowband segments	Device certified for operation in the 769 – 775 MHz band only. Exact channel dependant on end license

90.531(d)(1)	band plan, combining channels;	Channels may be combined subject to license
90.535(a)	All transmitters in the 769-775 MHz and 799-805 MHz frequency bands must use digital modulation	Digital modulation supported
90.541	(a) The transmitting power and antenna height of base stations must not exceed the limits given in paragraph (a) of §90.635. (b) The transmitting power of a control station must not exceed 200 watts ERP	Transmit power 100 mW Results available via reference to section 3 in this report
90.543	emission limitations, first paragraph [for booster with multi-carriers, use 90.543(c) not 90.543(a)-(b)];	See dual channel test results in section 5.1
90.543(f)	emission limitations, emissions in 1559-1610 MHz from 758-775/788-805 MHz devices.	See section 5.6 below

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 90	2017	Private Land 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

4.2 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 90 Clause 90.219(e)(3) [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 90 Clause 90.219(e)(3) [Reference 4.1.1 of this report]

5.1.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. RX port was terminated into a 50 Ohm load. EUT was tested across Low, Middle and High channels within each applicable band in a single channel input mode and 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

Setup Table

Band	150-174 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Low channel	150.0125 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
300.0109	-30.4	-17.4
450.008	-33.3	-20.3

Plots
30 – 2000 MHz range

Setup Table

Band	150-174 MHz
Power Level	20 dBm

Channel Spacing	12.5 kHz
Mod Scheme	CW
Mid channel	160.0125 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
323.9860	-25.5	-12.5
485.9808	-30.7	-17.7

Plots

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

Setup Table

Band	150-174 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
High channel	173.3875MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
348.006	-29.1	-16.1
521.9927	-29.6	-16.6

Plots

Setup Table

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Low channel	406.1125MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
812.1864	-25.9	-12.9

Plots
30 – 5000 MHz range

Setup Table

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Mid channel	415MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
835.993	-26.18	-13.2

Plots

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

Setup Table

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
High channel	429.9875MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
859.998	-26.73	-13.7

Plots

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

Setup Table

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Low channel	456.0125MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
911.985	-28	-15

Plots
30 – 5000 MHz range
5000 – 10000 MHz range

Setup Table

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Mid channel	480MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
967.9975	-27.3	-14.3

Plots

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

Setup Table

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
High channel	511.9875MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1024	-28.4	-15.4

Plots

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

Setup Table

Band	758-768 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Low channel	758.0125MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1516	-27.5	-14.5

Plots
30 – 5000 MHz range

Setup Table

Band	758-768 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Mid channel	763MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1526	-26.8	-13.8

Plots

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

Setup Table

Band	758-768 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
High channel	767.9875MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1536	-27.3	-14.3

Plots

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

Setup Table

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz

Mod Scheme	CW
Low channel	769.0125MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1538	-27.2	-14.2

Plots
30 – 5000 MHz range

Setup Table

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Mid channel	772MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1544	-27.5	-14.5

Plots

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

Setup Table

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
High channel	774.9875MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1550	-27.3	-14.3

Plots

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

Setup Table

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Low channel	799.0125MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1598	-27.0	-14.0

Plots
30 – 5000 MHz range

Setup Table

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Mid channel	802MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1604	-27.0	-14.0

Plots

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

Setup Table

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
High channel	804.9875MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1610	-26.7	-13.7

Plots

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

Setup Table

Band	851-869 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Low channel	851.0125MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1702	-26.7	-13.7

Plots
30 – 5000 MHz range

Setup Table

Band	851-869 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Mid channel	855MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1720	-26.9	-13.9

Plots

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

Setup Table

Band	851-869 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
High channel	860.9875MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1738	-27.0	-14.0

Plots

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

Setup Table

Band	935-940 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Low channel	935.0125MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1870	-27.0	-14.0

Plots
30 – 5000 MHz range

Setup Table

Band	935-940 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW
Mid channel	937.5MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1875	-27.4	-14.4

Plots

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

Setup Table

Band	935-940 MHz
Power Level	20 dBm
Channel Spacing	12.5 kHz
Mod Scheme	CW

High channel	939.9875MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1880	-27.2	-14.2

Plots

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

Note: No emissions were observed above 3GHz for any frequency of operation, only emissions within 20dB of limits are reported.

Results are also presented graphically in section 6.

LIMITS:
Parts 90.219(e)(3)
Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth

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 90 Clause 90.219(e)(1) [Reference 4.1.1 of this report]
	FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 2015 Clause 5.2 [Reference 4.1.4 of this report]
	KDB 935210 D05 Clause 3.5 / 4.5 [Reference 4.1.5 of this report]
Limits:	FCC Part 90 Clause 90.219(e)(1) [Reference 4.1.1 of this report]

5.2.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. RX port was terminated into a 50 Ohm load. EUT was tested at determined 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.
CW signals were measured using a Peak Detector and Max Hold as per KDB 935210 D05 Clause 4.5

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	150-174 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	174 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	15.85	23.85	242.7

Note: 8dBi Antenna gain used.

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	430 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	18.36	26.36	432.5

Note: 8dBi Antenna gain used.

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	511.347 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	18.72	26.72	469.9

Note: 8dBi Antenna gain used.

Band	758-768 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	767.9 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.24	28.24	666.8

Note: 8dBi Antenna gain used.

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	774.95 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.39	28.39	690

Note: 8dBi Antenna gain used.

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	799 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.42	28.42	695

Note: 8dBi Antenna gain used.

Band	851-869 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	851.6 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.36	28.36	685.5

Note: 8dBi Antenna gain used.

Band	935-940 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	935 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	19.61	27.61	576.8

Note: 8dBi Antenna gain used.

Results are also presented graphically in section 6

LIMITS:
90.219(e)(1) 5W ERP or 37 dBm 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. A peak detector was set with max hold and sweeps made comparing the input and the output signals and their -26dB bandwidth measured using the inbuilt function on the analyser. Both the amplifier input and output signals were recorded. Plots were also compared against the mask in 90.210(c) except for operation in the 851-854 MHz band where 90.210(h) was used. Refer to plots section.

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	150-174 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Test frequency	162 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.25
Output measurement	12.91	11.25
Plot reference	Occupied BW 162MHz channel	

Band	150-174 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	162 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.88	10.42

Output measurement	11.87	10.42
Plot reference	Occupied BW 162MHz channel	

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Test frequency	418 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.24
Output measurement	12.91	11.24
Plot reference	Occupied BW 418 MHz channel	

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	418 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.88	10.42
Output measurement	11.88	10.42
Plot reference	Occupied BW 418 MHz channel	

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Test frequency	484 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.24
Output measurement	12.91	11.24
Plot reference	Occupied BW 484MHz channel	

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	484 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.88	10.42
Output measurement	11.88	10.42
Plot reference	Occupied BW 484MHz channel	

Band	758-768 MHz
Power Level	20 dBm
Channel Spacing	5MHz
Mod Scheme	AWGN

Test frequency	763 MHz

	26dB BW (MHz)	Occupied BW (MHz)
Input measurement	4.66	4.12
Output measurement	4.69	4.13
Plot reference	Occupied BW 763MHz channel	

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	773 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.88	10.42
Output measurement	11.88	10.43
Plot reference	Occupied BW 773MHz channel	

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	802 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.88	10.42
Output measurement	11.88	10.43
Plot reference	Occupied BW 802MHz channel	

Band	851-869 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Tes frequency	860 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.24
Output measurement	12.91	11.24
Plot reference	Occupied BW 860MHz channel	

Band	851-869 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	851.6 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.88	10.42
Output measurement	11.88	10.43
Plot reference	Occupied BW 860MHz channel	

Band	851-869 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	AWGN
Test frequency	860 MHz

	26dB BW (MHz)	Occupied BW (MHz)
Input measurement	4.70	4.13
Output measurement	4.69	4.13
Plot reference	Occupied BW 860MHz channel	

Band	935-940 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Test frequency	937.5 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	19.45	Not captured
Output measurement	19.45	Not captured
Plot reference	Occupied BW 937.5 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 90 Clause 90.219(e)(3) [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 90 Clause 90.219(e)(3) [Reference 4.1.1 of this report]

5.5.2 Configuration of EUT

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

5.5.3 Test procedure

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

30MHz - 1GHz.
The measuring antenna was scanned 1 - 4m in both Horizontal and Vertical polarisations. Where required a Substitution method was performed using tuned dipoles / a calibrated bi-conical antenna. Measurement distance of 3metres was used.

1GHz – 10GHz.
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 – 10 GHz at 1.2metres.
Tests were performed in test sites B & M.

5.5.4 Test equipment

LPE364, E743, E624, E411, E412, E755, TMS82, E268, E428, E602, E433

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	150-174 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Low channel	150.0125 MHz

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

Low, middle and high channels of each band specified in section 2.4 modes were also tested for spurious emissions, and no emissions were observed within 20dB of limits for any combination of channel frequency, modulation scheme or Bandwidth setting.

DUAL CHANNEL RESULTS.

EUT was also set to the following combinations of channel frequencies in dual channel operation:

Channels (MHz)
160.9625 + 160.9375
415.2935 + 415.2685
469.569+ 469.544
809.4571 + 809.4321
763.1805 + 763.1555
772.1805 + 772.1555
802.1805 + 802.1555
856.0265 + 856.0015
865.0338 + 865.0088
937.1242 + 937.0992

No emissions were observed within 20dB of limits in any dual channel operational mode.

LIMITS:
90.219(e)(3) = -13dBm in any 100kHz 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: 30MHz - 1GHz ± 3.9 dB, 1 – 18 GHz ±3.5dB

5.6 Emissions Limitations / intermodulation emissions

5.6.1 Test methods

Test Requirements:	FCC Part 90 Clause 90.219(e)(3) & 90.543(f) [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 90 Clause 90.219(e)(3) & 90.543(f) [Reference 4.1.1 of this report]

5.6.2 Configuration of EUT

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

5.6.3 Test procedure

The EUT system was set up to maximum gain using the network management software provided. The input levels of the two input signals were raised until either the AGC threshold was reached or the total channel power was 3dB above that specified. Measurements were made and plots taken in the required Resolution bandwidths. Where determined f0 is at a band edge, the top two channels within the band are used instead of two channels either side of f0.

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

Setup Table

Band	150-174 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
174.0	-37.75

Setup Table

Band	406.1 – 430.0 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
430.0	-38.57

Setup Table

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
511.347	-37.94

Setup Table

Band	758-768 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
767.9	-36.27

Setup Table

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
774.95	-35.38

Setup Table

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
799.0	-35.01

Setup Table

Band	851-869 MHz
Power Level	20 dBm

Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
851.6	-35.09

Setup Table

Band	935-940 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
935.0	-34.72

Results are also presented graphically in section 6

LIMITS:
90.219(e)(3), -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:
< ± 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 150 – 174 MHz, CW sweep Band 406.1 – 430.0 MHz, CW sweep Band 456.0 - 512.0MHz, CW sweep Band 758.0 -768.0 MHz, CW sweep Band 769.0 -775.0 MHz, CW sweep Band 799.0 - 805.0 MHz, CW sweep Band 851.0 – 869.0MHz,and CW sweep Band 935.0 – 940.0 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	150-174 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined(MHz)
174.0

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

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined (MHz)
430.0

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

Band	456.0 - 512.0 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined (MHz)
511.347

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

Band	758.0 -768.0 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined (MHz)
767.9

Band	769.0 -775.0 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined(MHz)
774.95

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

Band	799.0 - 805.0 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined (MHz)
799.0

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

Band	851.0 – 869.0 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined (MHz)
851.6

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

Band	935.0 – 940.0 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined (MHz)
935.0

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

Results are also presented graphically in section 6.

LIMITS:
None.

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

5.9 Noise Figure / Noise ERP

5.9.1 Test methods

Test Requirements:	FCC Part 90 Clause 90.219(d)(6)(ii) [Reference 4.1.1 of this report]
	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.

5.9.2 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. The input to the hub was terminated with a 50 Ohm Load. EUT was measured across the pass band up to 1GHz.

5.9.3 Test procedure

Tests were made in accordance with the test method noted above using the measuring equipment listed in the 'Test Equipment' Section. Noise was measured using an RMS detector and 100 sweep averaging with the analyser set to measure 100000 sweep points. Plots were made of the noise from the system and a capture of the whole passband up to 1 GHz with 10 kHz RBW and 500 MHz span along with a capture of the 400-512 MHz UHF radio bands in 3.5 kHz steps.

5.9.4 Test equipment

E498, E642, E755

See Section 8 for more details

5.9.5 Test results

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

A maximum noise figure of -43 dBm ERP corresponds to a maximum antenna port noise figure of -48.85 dBm (-43.0 - 8.0 dBi + 2.15†)
The maximum noise figure measured for the system was over 20 dB below this.
The system is typically used to provide both cellular and non-cellular services.
Further discussion of noise mitigation is included in operation exhibit "noise discussion".

† 8 dBi exceeds the maximum antenna gain in any band of operation and the 2.15 dB is to convert EIRP to ERP.

Results are also presented graphically in section 6

LIMITS:
90.219(d)(6).
(i) In general, the ERP of intermodulation products should not exceed −30 dBm in 10 kHz measurement bandwidth.
(ii) In general, the ERP of noise within the passband should not exceed −43 dBm in 10 kHz measurement bandwidth.
(iii) In general, the ERP of noise on spectrum more than 1 MHz outside of the passband should not exceed −70 dBm in a 10 kHz measurement bandwidth.

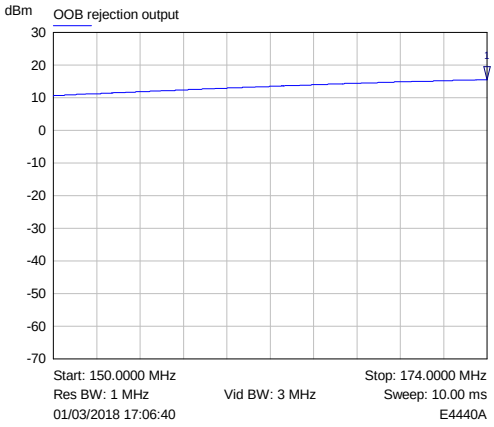
These results show that the EUT has PASSED this test.

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

6 Plots/Graphical results

6.1 Determination of f_0

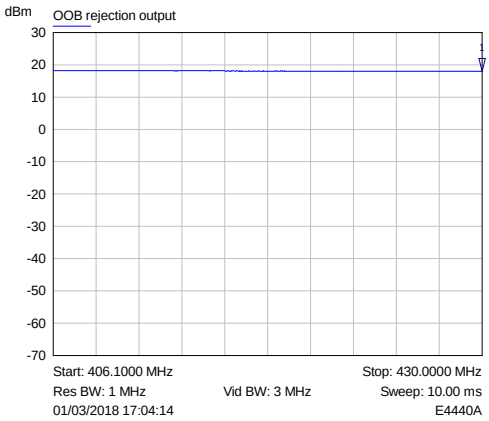
RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB rejection output	174.0000 MHz	15.50 dBm	

Plot of f0 determined in Band 150-174 MHz.

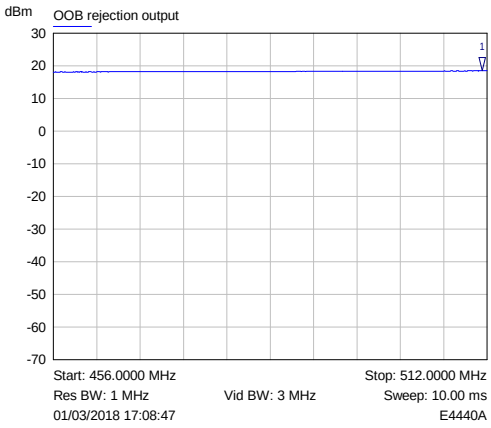
RF Parameters: Band 406.1-430 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB rejection output	430.0000 MHz	17.98 dBm	

Plot of f0 determined in Band 406.1-430 MHz.

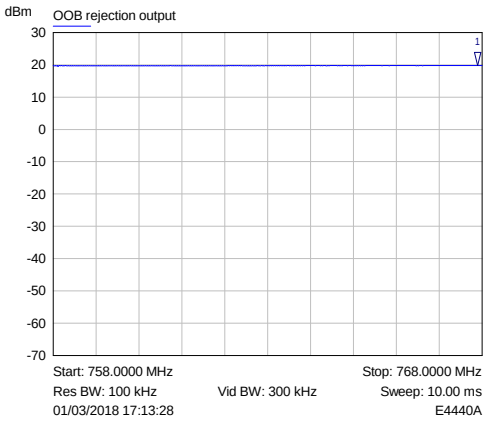
RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1	OOB rejection output	511.3467 MHz	18.50 dBm	

Plot of f0 determined in Band 456-512 MHz.

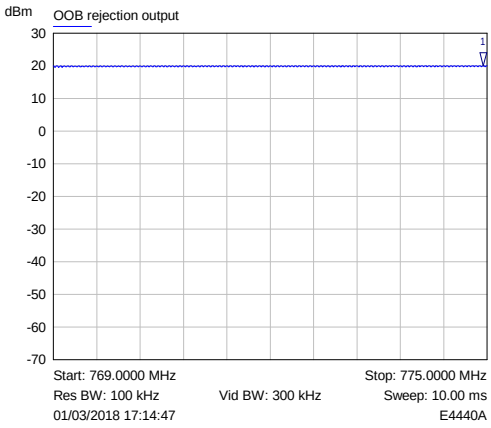
RF Parameters: Band 758-768 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB rejection output	767.9000 MHz	19.91 dBm	

Plot of f0 determined in Band 758-768 MHz.

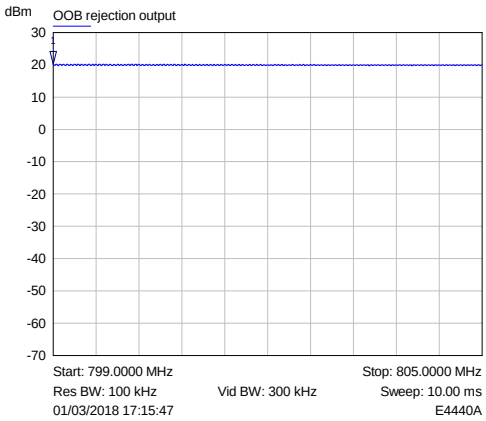
RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1	OOB rejection output	774.9500 MHz	20.03 dBm	

Plot of f0 determined in Band 769-775 MHz.

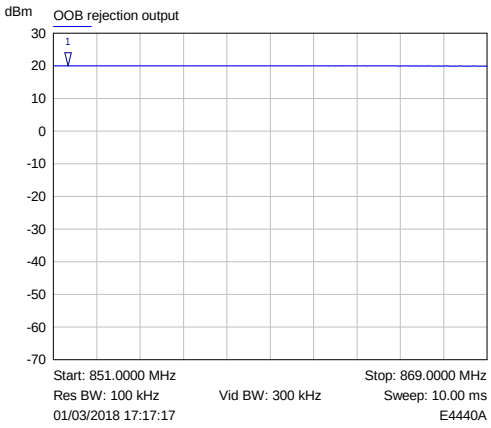
RF Parameters: Band 799-805 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB rejection output	799.0000 MHz	20.19 dBm	

Plot of f0 determined in Band 799-805 MHz.

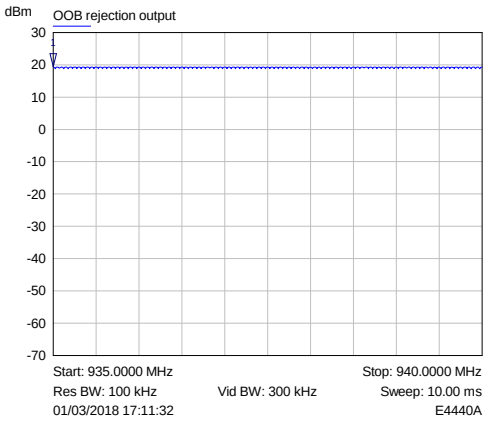
RF Parameters: Band 851-869 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1	OOB rejection output	851.6000 MHz	20.04 dBm	

Plot of f0 determined in Band 851-869 MHz.

RF Parameters: Band 935-940 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A

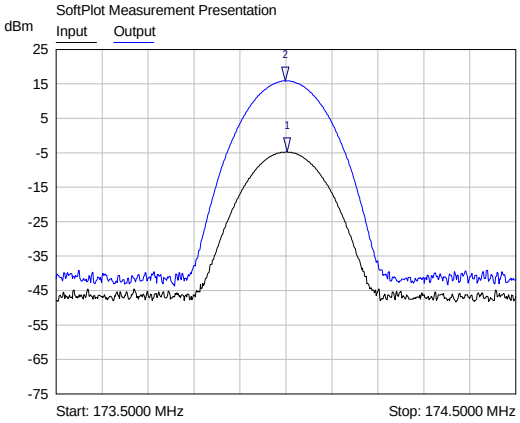


Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB rejection output	935.0000 MHz	19.43 dBm	

Plot of f0 determined in Band 935-940 MHz.

6.2 RF Power Output

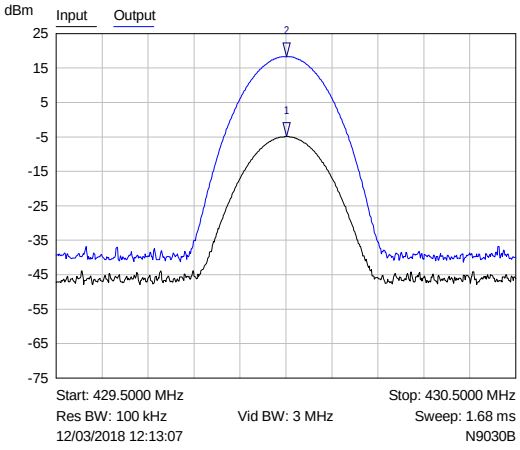
RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 174 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1	Input	174.0025 MHz	-4.74 dBm	
2	Output	173.9992 MHz	15.85 dBm	

Plot of Channel power at determined f_0 in Band 150-174 MHz

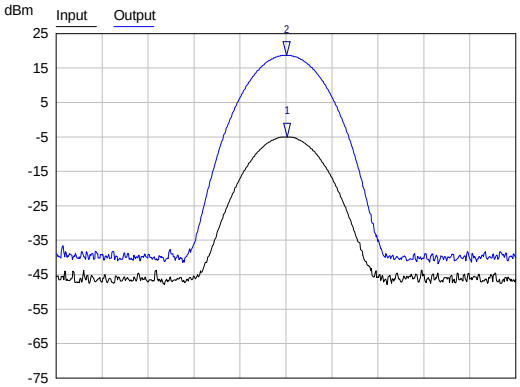
RF Parameters: Band 406.1-430 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 430 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1	Input	430.0008 MHz	-4.88 dBm	
2	Output	430.0008 MHz	18.36 dBm	

Plot of Channel power at determined f_0 in Band 406.1-430 MHz

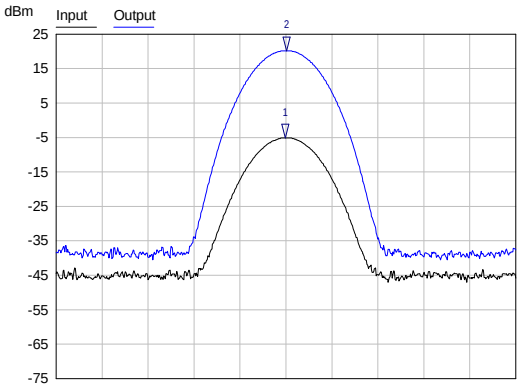
RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 511.347 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	511.3495 MHz	-4.94 dBm	
2 ▽	Output	511.3478 MHz	18.72 dBm	

Plot of Channel power at determined f_0 in Band 456-512 MHz

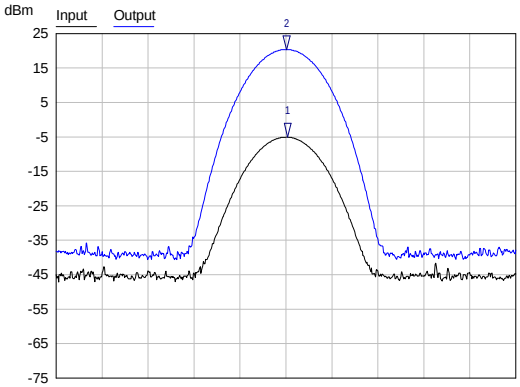
RF Parameters: Band 758-768 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 767.9 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1	Input	767.8992 MHz	-5.09 dBm	
2	Output	767.9008 MHz	20.24 dBm	

Plot of Channel power at determined f_0 in Band 758-768 MHz

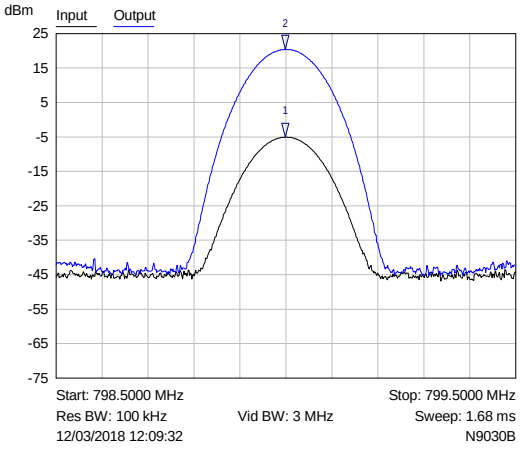
RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 774.95 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1	Input	774.9542 MHz	-5.06 dBm	
2	Output	774.9508 MHz	20.39 dBm	

Plot of Channel power at determined f_0 in Band 769-775 MHz

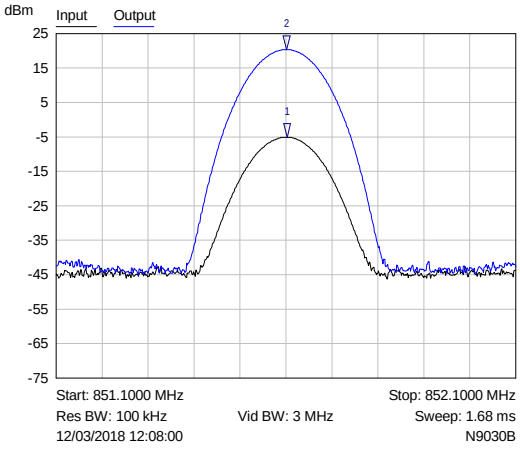
RF Parameters: Band 799-805 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 799 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1	Input	798.9992 MHz	-5.07 dBm	
2	Output	798.9992 MHz	20.42 dBm	

Plot of Channel power at determined f_0 in Band 799-805 MHz

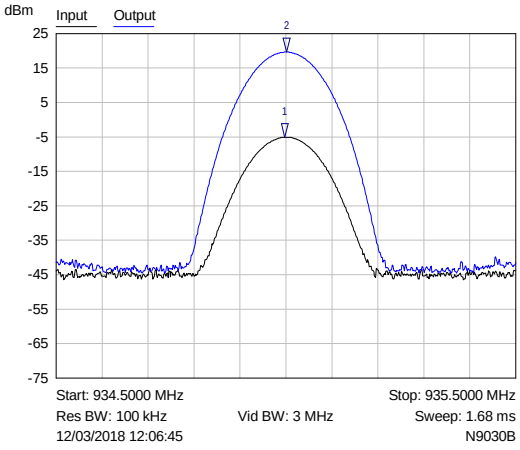
RF Parameters: Band 851-869 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 851.6 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1	Input	851.6025 MHz	-5.10 dBm	
2	Output	851.6008 MHz	20.36 dBm	

Plot of Channel power at determined f_0 in Band 851-869 MHz

RF Parameters: Band 935-940 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 935 MHz (determined f_0)



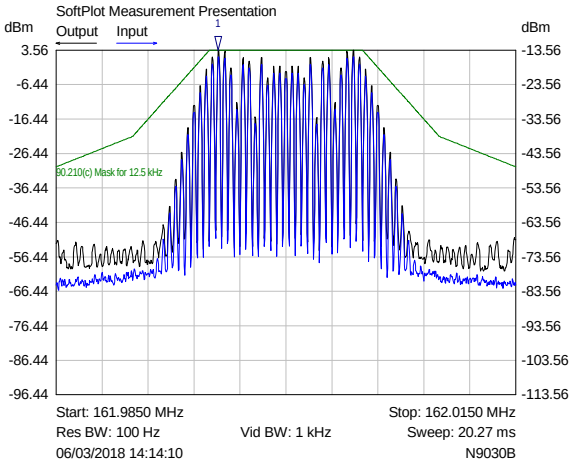
Mkr	Trace	X-Axis	Value	Notes
1	Input	934.9975 MHz	-5.10 dBm	
2	Output	935.0008 MHz	19.61 dBm	

Plot of Channel power at determined f_0 in Band 935-940 MHz

6.3 Occupied bandwidth / Input versus output signal

Note: Power in occupied Bandwidth is included by default in data capture from instrument and is not referenced and not applicable to relative bandwidth measurements here.

RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing N/A, Modulation FM, Band centre frequency



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	161.9956 MHz	3.56 dBm	

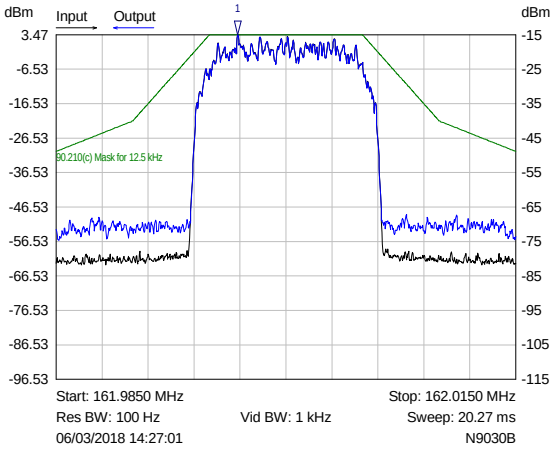
Input

Measurement Parameter	Value
Occupied Bandwidth	11.25 kHz
Power in Occupied Bandwidth	-4.60 dBm
Transmit Freq Error	-55.61 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.25 kHz
Power in Occupied Bandwidth	14.53 dBm
Transmit Freq Error	-27.17 mHz
-26.00 dB Bandwidth	12.91 kHz

RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing N/A, Modulation QPSK, Band centre frequency



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	161.9969 MHz	3.47 dBm	

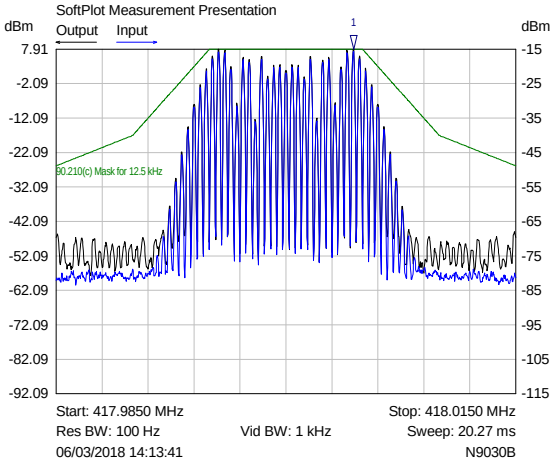
Input

Measurement Parameter	Value
Occupied Bandwidth	10.42 kHz
Power in Occupied Bandwidth	0.43 dBm
Transmit Freq Error	-32.28 Hz
-26.00 dB Bandwidth	11.88 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.42 kHz
Power in Occupied Bandwidth	18.81 dBm
Transmit Freq Error	-32.26 Hz
-26.00 dB Bandwidth	11.87 kHz

RF Parameters: Band 406.1-430 MHz, Power +20 dBm, Channel Spacing N/A, Modulation FM, Band centre frequency



Mkr	Trace	X-Axis	Value	Notes
1	Output	418.0044 MHz	7.91 dBm	

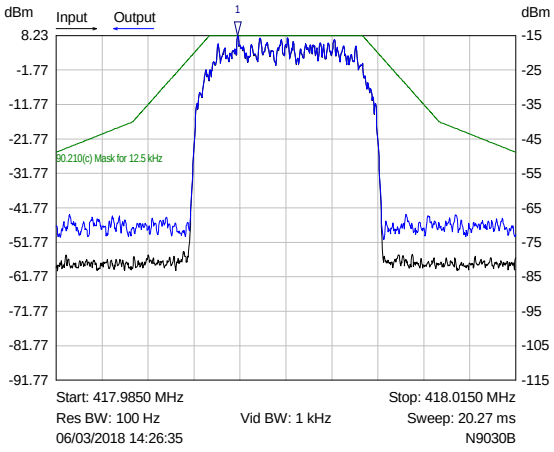
Input

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	-4.78 dBm
Transmit Freq Error	356.49 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	18.88 dBm
Transmit Freq Error	277.06 mHz
-26.00 dB Bandwidth	12.91 kHz

RF Parameters: Band 406.1-430 MHz, Power +20 dBm, Channel Spacing N/A, Modulation QPSK, Band centre frequency



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	417.9969 MHz	8.23 dBm	

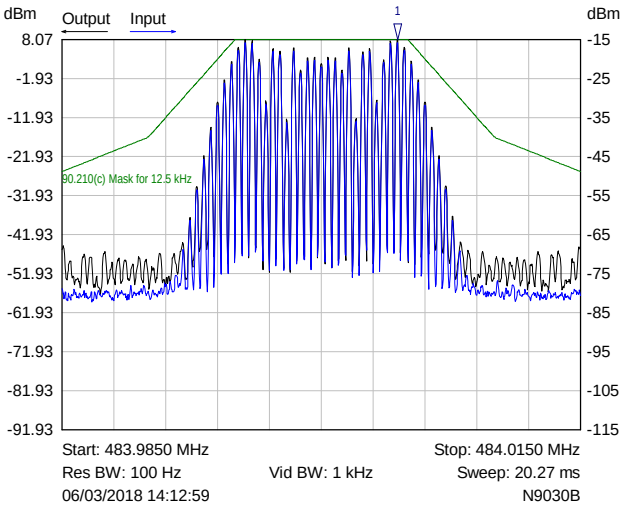
Input

Measurement Parameter	Value
Occupied Bandwidth	10.42 kHz
Power in Occupied Bandwidth	0.25 dBm
Transmit Freq Error	-32.46 Hz
-26.00 dB Bandwidth	11.88 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.42 kHz
Power in Occupied Bandwidth	23.60 dBm
Transmit Freq Error	-32.17 Hz
-26.00 dB Bandwidth	11.88 kHz

RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing N/A, Modulation FM Band centre frequency



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	484.0044 MHz	8.07 dBm	

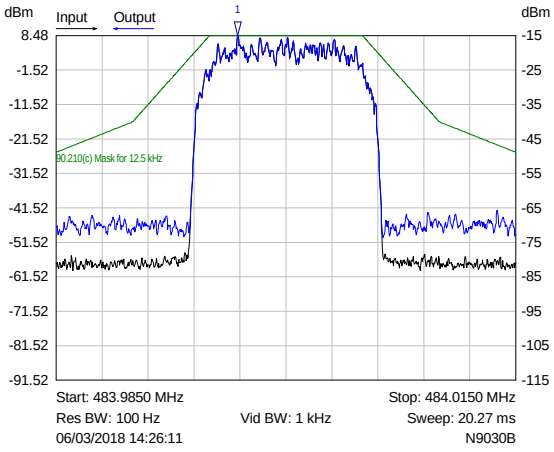
Input

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	-4.80 dBm
Transmit Freq Error	291.39 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	19.04 dBm
Transmit Freq Error	377.32 mHz
-26.00 dB Bandwidth	12.91 kHz

RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing N/A, Modulation QPSK, Band centre frequency



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	483.9969 MHz	8.48 dBm	

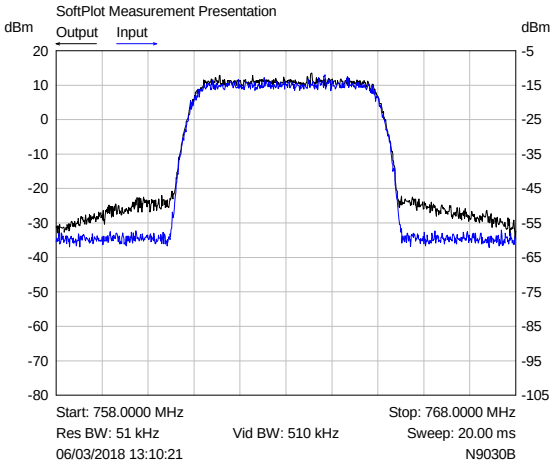
Input

Measurement Parameter	Value
Occupied Bandwidth	10.42 kHz
Power in Occupied Bandwidth	0.28 dBm
Transmit Freq Error	-31.30 Hz
-26.00 dB Bandwidth	11.88 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.42 kHz
Power in Occupied Bandwidth	23.88 dBm
Transmit Freq Error	-32.36 Hz
-26.00 dB Bandwidth	11.88 kHz

RF Parameters: Band 758-768 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Middle channel



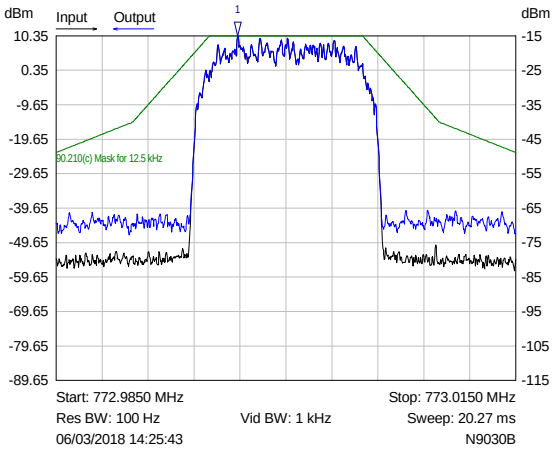
Input

Measurement Parameter	Value
Occupied Bandwidth	4.12 MHz
Power in Occupied Bandwidth	3.64 dBm
Transmit Freq Error	-6.48 kHz
-26.00 dB Bandwidth	4.66 MHz

Output

Measurement Parameter	Value
Occupied Bandwidth	4.13 MHz
Power in Occupied Bandwidth	29.57 dBm
Transmit Freq Error	-999.70 Hz
-26.00 dB Bandwidth	4.69 MHz

RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing N/A, Modulation QPSK, Middle channel



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	772.9969 MHz	10.35 dBm	

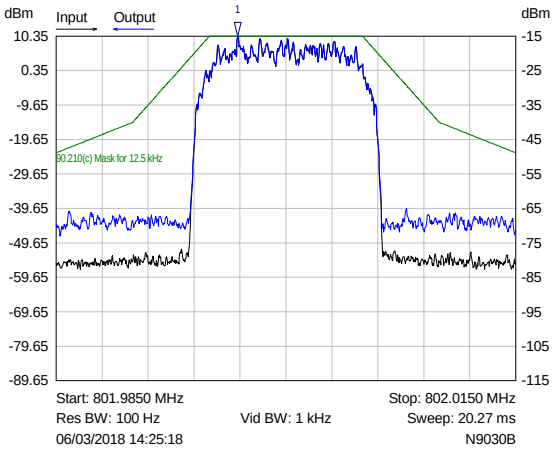
Input

Measurement Parameter	Value
Occupied Bandwidth	10.42 kHz
Power in Occupied Bandwidth	0.13 dBm
Transmit Freq Error	-32.17 Hz
-26.00 dB Bandwidth	11.88 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.43 kHz
Power in Occupied Bandwidth	25.70 dBm
Transmit Freq Error	-31.87 Hz
-26.00 dB Bandwidth	11.88 kHz

RF Parameters: Band 799-805 MHz, Power +20 dBm, Channel Spacing N/A, Modulation QPSK, Channel 802 MHz



Mkr	Trace	X-Axis	Value	Notes
1	Output	801.9969 MHz	10.35 dBm	

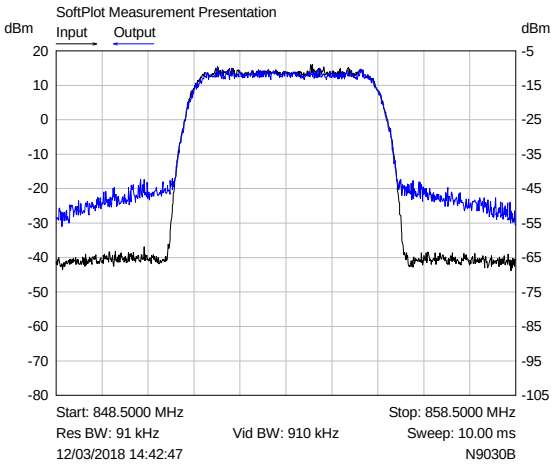
Input

Measurement Parameter	Value
Occupied Bandwidth	10.42 kHz
Power in Occupied Bandwidth	0.14 dBm
Transmit Freq Error	-32.46 Hz
-26.00 dB Bandwidth	11.88 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.43 kHz
Power in Occupied Bandwidth	25.68 dBm
Transmit Freq Error	-30.74 Hz
-26.00 dB Bandwidth	11.88 kHz

RF Parameters: Band 851-869 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN,



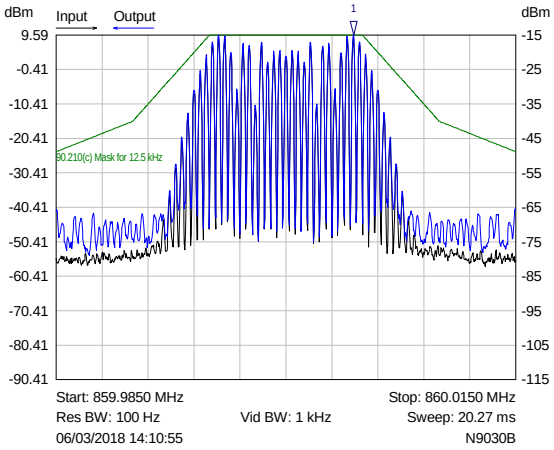
Input

Measurement Parameter	Value
Occupied Bandwidth	4.13 MHz
Power in Occupied Bandwidth	4.72 dBm
Transmit Freq Error	-4.75 kHz
-26.00 dB Bandwidth	4.70 MHz

Output

Measurement Parameter	Value
Occupied Bandwidth	4.13 MHz
Power in Occupied Bandwidth	29.13 dBm
Transmit Freq Error	-3.88 kHz
-26.00 dB Bandwidth	4.69 MHz

RF Parameters: Band 851-869 MHz, Power +20 dBm, Channel Spacing N/A, Modulation FM, Middle Channel 860 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	860.0044 MHz	9.59 dBm	

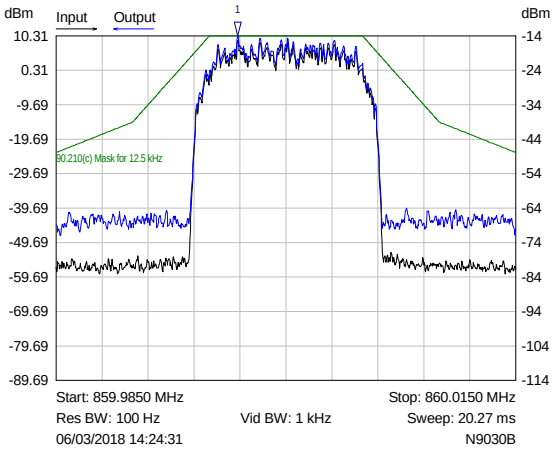
Input

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	-5.00 dBm
Transmit Freq Error	381.13 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	20.58 dBm
Transmit Freq Error	387.31 mHz
-26.00 dB Bandwidth	12.91 kHz

RF Parameters: Band 851-869 MHz, Power +20 dBm, Channel Spacing N/A, Modulation QPSK, Middle Channel, 860 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	859.9969 MHz	10.31 dBm	

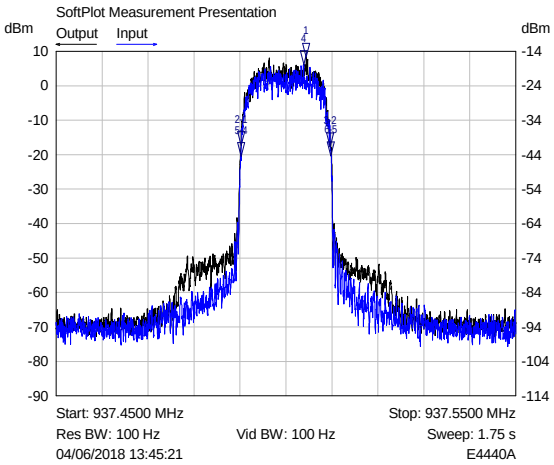
Input

Measurement Parameter	Value
Occupied Bandwidth	10.42 kHz
Power in Occupied Bandwidth	0.05 dBm
Transmit Freq Error	-31.61 Hz
-26.00 dB Bandwidth	11.88 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.43 kHz
Power in Occupied Bandwidth	25.66 dBm
Transmit Freq Error	-31.65 Hz
-26.00 dB Bandwidth	11.88 kHz

RF Parameters: Band 935-940 MHz, Power +20 dBm, Channel Spacing N/A, Modulation QPSK, Channel 937.5 MHz

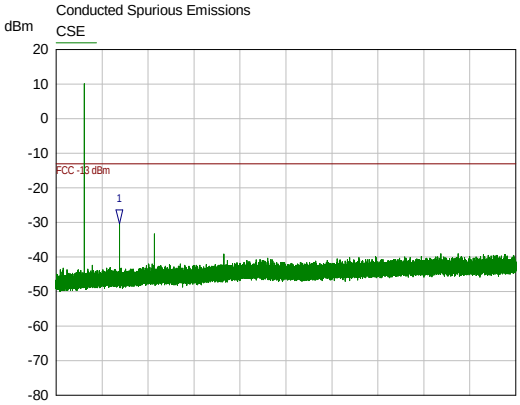


Mkr	Trace	X-Axis	Value	Notes
1	Output	937.5044 MHz	8.25 dBm	
2-1	Output	-14.2000 kHz	-25.52 dB	-26 dB
3-2	Output	19.4500 kHz	-0.34 dB	26 dB bandwidth (output)
4	Input	937.5038 MHz	-17.84 dBm	
5-4	Input	937.4903 MHz	-26.58 dB	-26 dB (input)
6-5	Input	19.4500 kHz	0.16 dB	26 dB bandwidth (input)

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 Low channel plots are included in report for each band of operation to minimise report size. All emissions were checked up to 10GHz but as no emissions were observed between 3 & 10GHz, not all plots have been included for the entire frequency range for some bands.

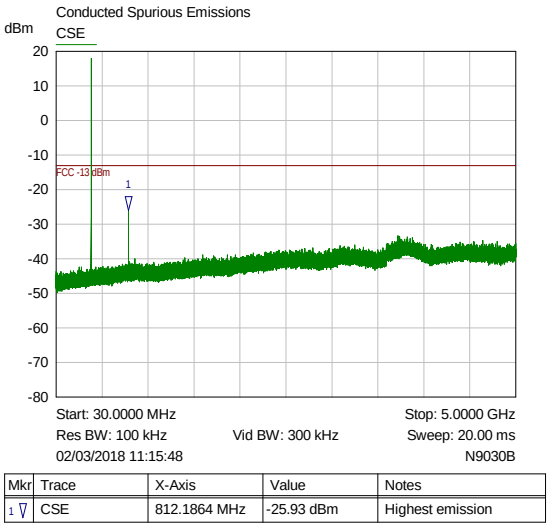
RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 150.0125 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	300.0109 MHz	-30.40 dBm	Highest emission

Plot of conducted emissions single Low channel (150.0125MHz) 30 – 2000 MHz range

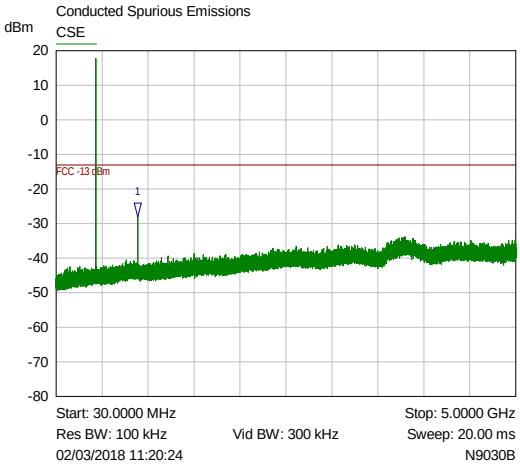
RF Parameters: Band 406.1-430 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 406.1125 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	812.1864 MHz	-25.93 dBm	Highest emission

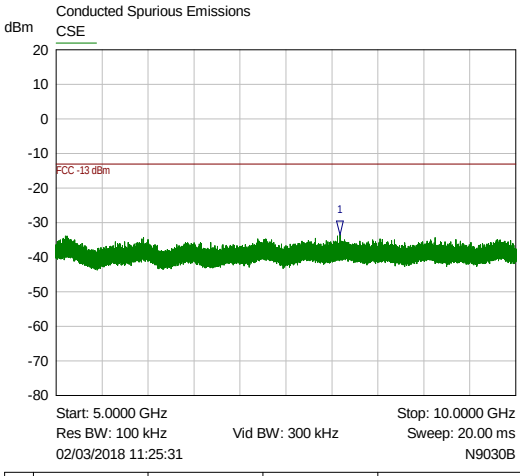
Plot of conducted emissions single Low channel (748.5MHz) 30 – 5000 MHz range

RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 456.0125 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1	CSE	911.9850 MHz	-28.03 dBm	Highest emission

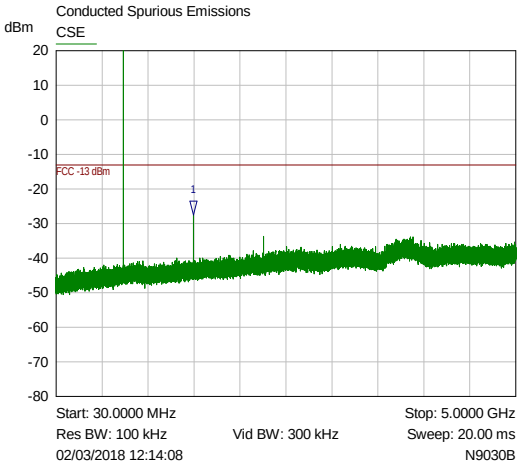
Plot of conducted emissions single Low channel (456.0125MHz) 30 – 5000 MHz range



Mkr	Trace	X-Axis	Value	Notes
1	CSE	8.0877 GHz	-33.46 dBm	Highest emission

Plot of conducted emissions single Low channel (456.0125MHz) 5000 – 10000 MHz range

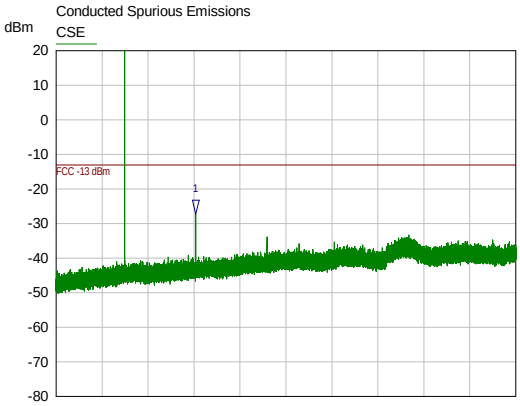
RF Parameters: Band 758-768 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 758.0125 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1	CSE	1.5160 GHz	-27.50 dBm	Highest emission

Plot of conducted emissions single Low channel (758.0125 MHz) 30 – 5000 MHz range

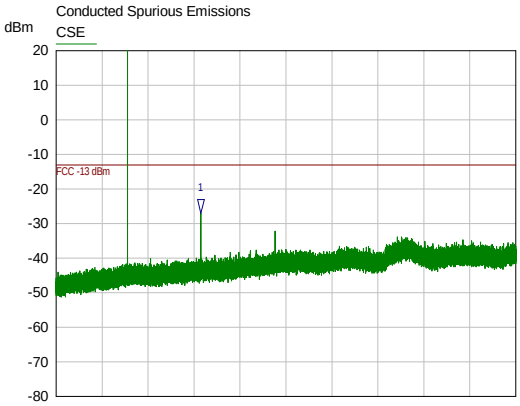
RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 769.0125 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1	CSE	1.5380 GHz	-27.22 dBm	Highest emission

Plot of conducted emissions single Low channel (769.0125 MHz) 30 – 5000 MHz range

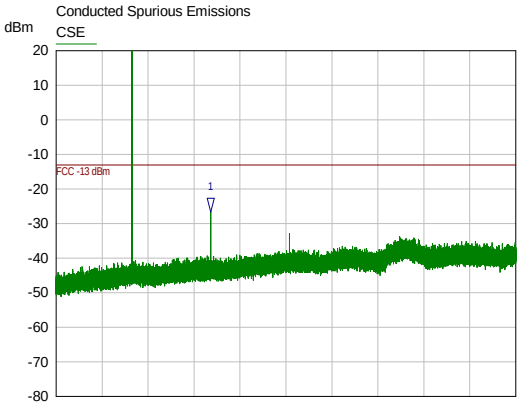
RF Parameters: Band 799-805 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 799.0125 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1 ▽	CSE	1.5980 GHz	-26.95 dBm	Highest emission

Plot of conducted emissions single Low channel (799.0125) 30 – 5000 MHz range

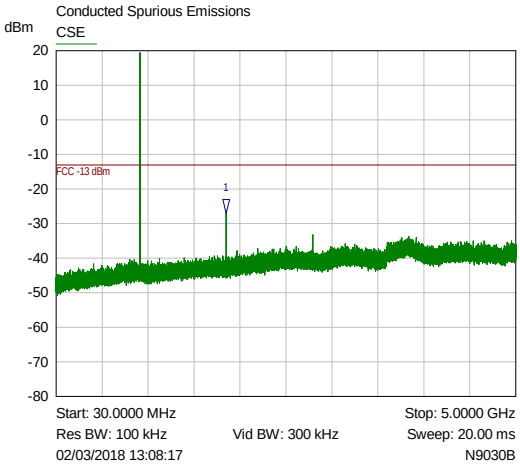
RF Parameters: Band 851-869 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 851.0125 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1	CSE	1.7020 GHz	-26.70 dBm	Highest emission

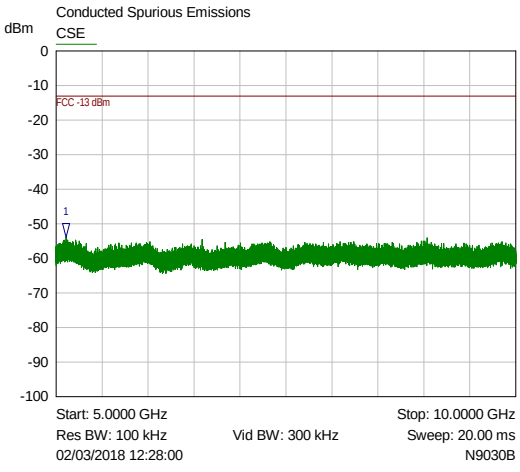
Plot of conducted emissions single Low channel (851.0125 MHz) 30 – 5000 MHz range

RF Parameters: Band 935-940 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 935.0125 MHz, Single channel mode



Mkr	Trace	X-Axis	Value	Notes
1	CSE	1.8700 GHz	-27.02 dBm	Highest emission

Plot of conducted emissions single Low channel (935.0125 MHz) 30 – 5000 MHz range

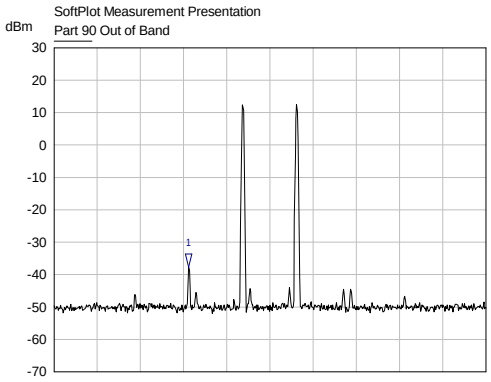


Mkr	Trace	X-Axis	Value	Notes
1	CSE	5.1056 GHz	-53.77 dBm	Highest emission

Plot of conducted emissions single Low channel (935.0125 MHz) 5000 – 10000 MHz range

6.5 Intermodulation spurious emissions

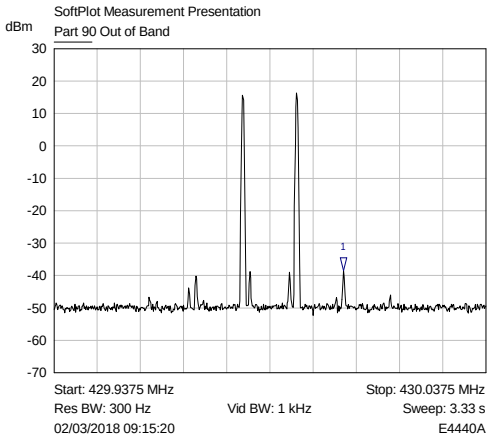
RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 174 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Part 90 Out of Band	173.9687 MHz	-37.75 dBm	Highest intermod.

Plot of Intermodulation at determined f_0 in Band 150-174 MHz

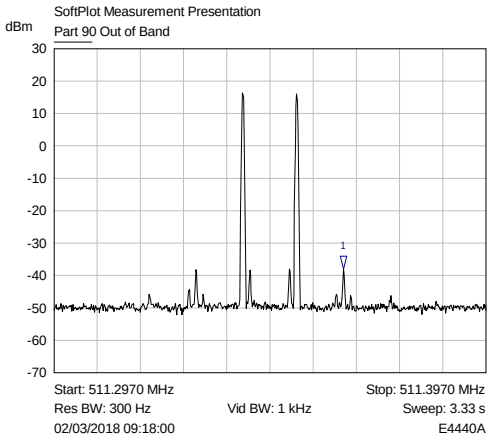
RF Parameters: Band 406.1-430 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 430 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Part 90 Out of Band	430.0045 MHz	-38.57 dBm	Highest intermod.

Plot of Intermodulation at determined f_0 in Band 406.1-430 MHz

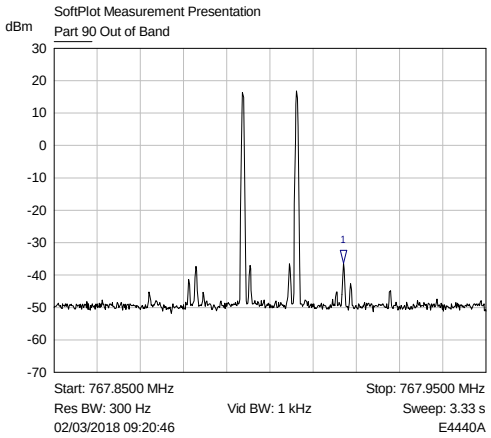
RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 511.347 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Part 90 Out of Band	511.3640 MHz	-37.94 dBm	Highest intermod.

Plot of Intermodulation at determined f_0 in Band 456-512 MHz

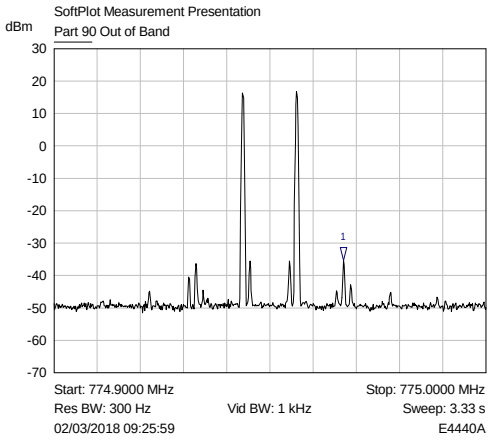
RF Parameters: Band 758-768 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 767.9 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Part 90 Out of Band	767.9170 MHz	-36.27 dBm	Highest intermod.

Plot of Intermodulation at determined f_0 in Band 758-768 MHz

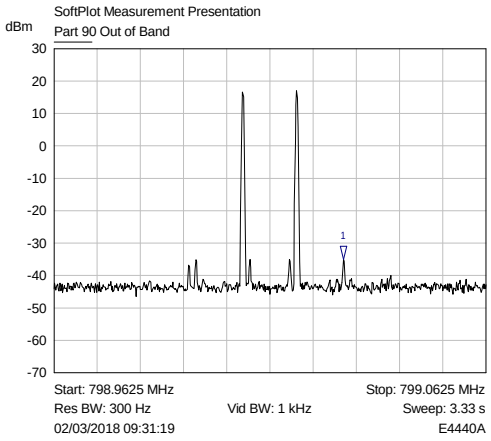
RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 774.95 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Part 90 Out of Band	774.9670 MHz	-35.38 dBm	Highest intermod.

Plot of Intermodulation at determined f_0 in Band 769-775 MHz

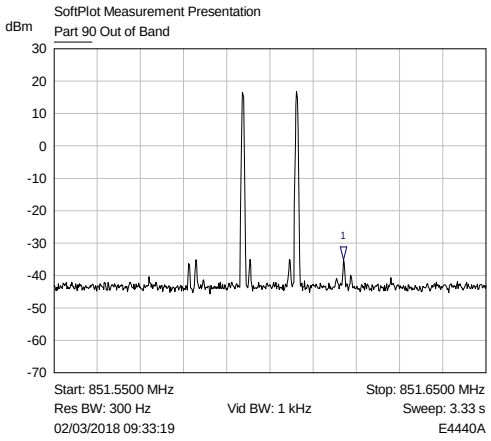
RF Parameters: Band 799-805 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 799 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Part 90 Out of Band	799.0295 MHz	-35.01 dBm	Highest intermod.

Plot of Intermodulation at determined f_0 in Band 799-805 MHz

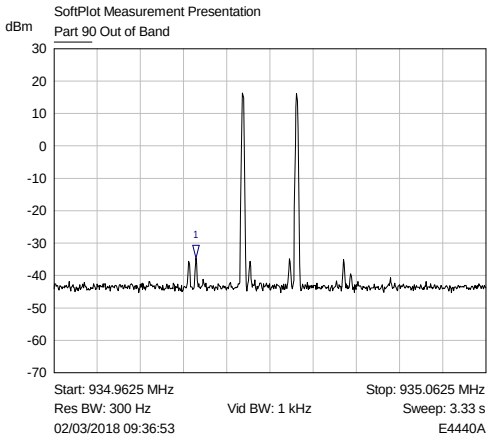
RF Parameters: Band 851-869 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 851.6 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Part 90 Out of Band	851.6170 MHz	-35.09 dBm	Highest intermod.

Plot of Intermodulation at determined f_0 in Band 851-869 MHz

RF Parameters: Band 935-940 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 935 MHz (determined f_0)



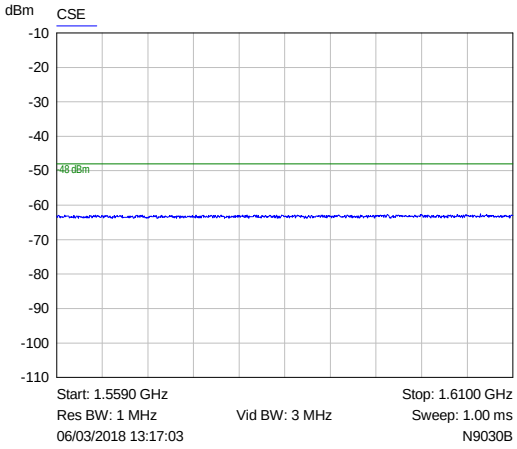
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Part 90 Out of Band	934.9953 MHz	-34.72 dBm	Highest intermod.

Plot of Intermodulation at determined f_0 in Band 935-940 MHz

6.6 Emissions limitations

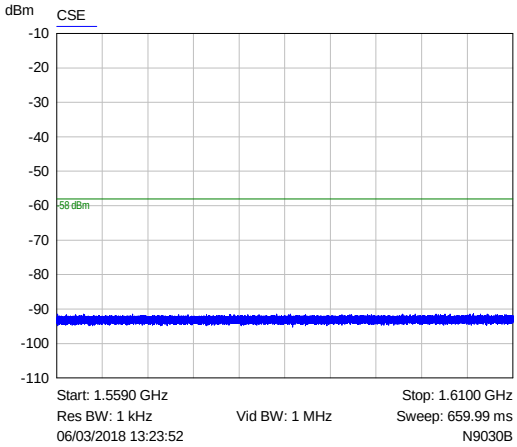
90.543(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation

RF Parameters: Band 759-768 MHz, Power +20 dBm, Channel Spacing N/A, Modulation AWGN, Channel 760. 5 MHz, Single channel mode



Plot of conducted emissions single Low channel (760.5MHz) 1559 – 1610 MHz range

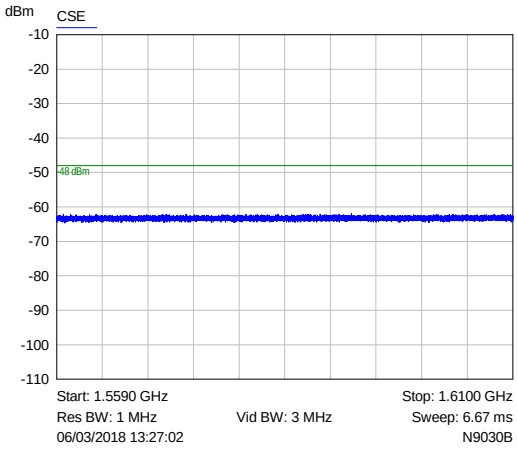
Note: -70dBW EIRP equates to a limit of -78 dBW conduced for 8dBi antenna, which is -48dBm for wideband emissions.



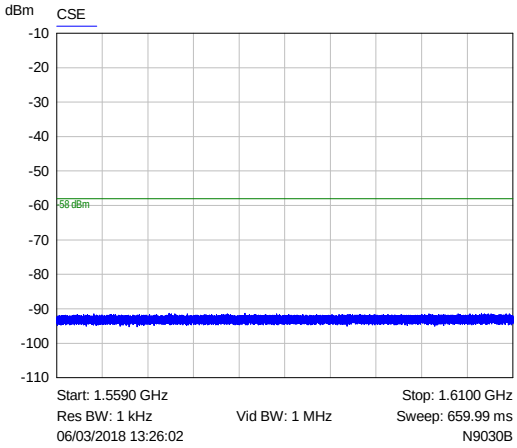
Plot of conducted emissions single Low channel 1k RBW (760.5MHz) 1559 – 1610 MHz range

Note: -80dBW EIRP equates to a limit of -88 dBW conduced for 8dBi antenna, which is -58dBm for narrowband emissions (discrete signals <700Hz bandwidth)

RF Parameters: Band 759-768 MHz, Power +20 dBm, Channel Spacing N/A, Modulation AWGN, Channel 765. 5 MHz, Single channel mode

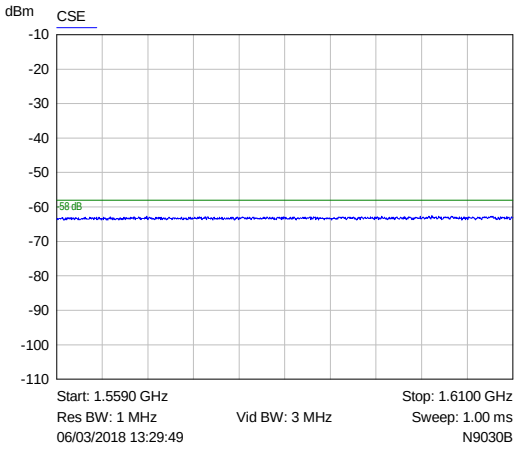


Plot of conducted emissions single Low channel (765.5MHz) 1559 – 1610 MHz range
Note: -70dBW EIRP equates to a limit of -78 dBW conduced for 8dBi antenna, which is -48dBm for wideband emissions.



Plot of conducted emissions single Low channel 1k RBW (765.5MHz) 1559 – 1610 MHz range
Note: -80dBW EIRP equates to a limit of -88 dBW conduced for 8dBi antenna, which is -58dBm for narrowband emissions (discrete signals <700Hz bandwidth)

RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 769. 01255 MHz, Single channel mode

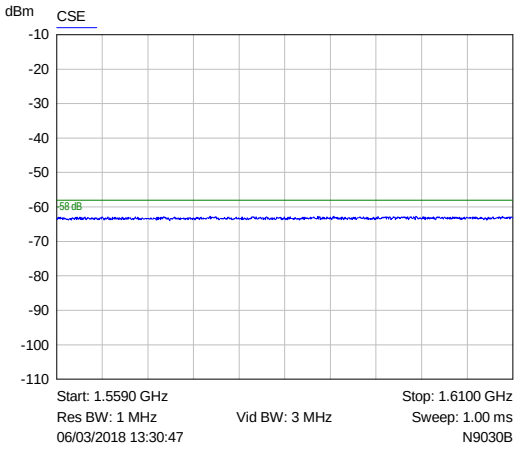


Plot of conducted emissions single Low channel (769.0125MHz) 1559 – 1610 MHz range
Note: -70dBW EIRP equates to a limit of -78 dBW conduced for 8dBi antenna, which is -48dBm for wideband emissions.

Plot not taken as emissions are below narrowband limit with wideband settings.

Note: -80dBW EIRP equates to a limit of -88 dBW conduced for 8dBi antenna, which is -58dBm for narrowband emissions (discrete signals <700Hz bandwidth)

RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 774. 9875 MHz, Single channel mode

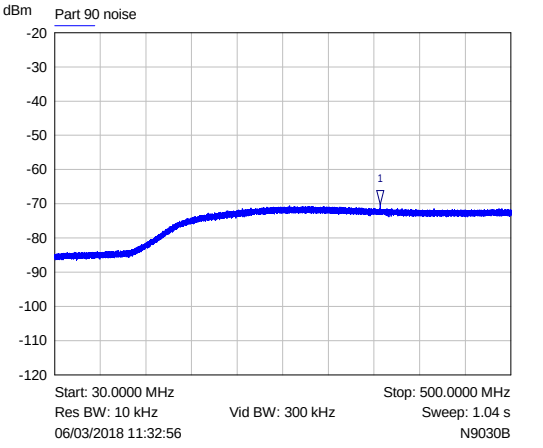


Plot of conducted emissions single Low channel (765.5MHz) 1559 – 1610 MHz range
Note: -70dBW EIRP equates to a limit of -78 dBW conduced for 8dBi antenna, which is -48dBm for wideband emissions.

Plot not taken as emissions are below narrowband limit with wideband settings.

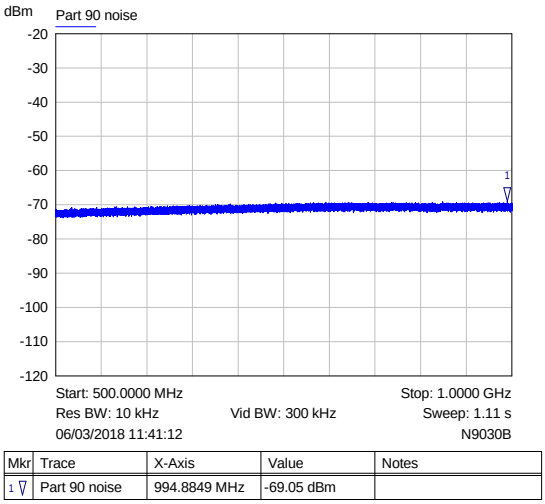
Note: -80dBW EIRP equates to a limit of -88 dBW conduced for 8dBi antenna, which is -58dBm for narrowband emissions (discrete signals <700Hz bandwidth)

6.7 Noise figure



Mkr	Trace	X-Axis	Value	Notes
1	Part 90 noise	365.3954 MHz	-70.24 dBm	

Plot of Noise power 30-500MHz



Mkr	Trace	X-Axis	Value	Notes
1	Part 90 noise	994.8849 MHz	-69.05 dBm	

Plot of Noise power 500-1000MHz

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
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
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