Radio Test Report

Zinwave Ltd

Zinwave UNItivity 5000 Remote Unit

305-1007

47 CFR Part 90 Effective Date 1st October 2020
47 CFR Part 2 Effective Date 1st October 2020
Test Date: 14th February to 28th April 2022
Report Number: 03-13344-4-22 Issue 01

R.N. Electronics Ltd.
Arnolds Court
Arnolds Farm Lane
Mountnessing
Essex
CM13 1UT
U.K.

www.RNelectronics.com

Telephone: +44 (0) 1277 352219
Email: sales@RNelectronics.com

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

Certificate of Test 13344-4

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:	305-1007
Unique Serial Number:	330100000001 (radiated unit) 330100000003 (conducted unit)
Applicant:	Zinwave Ltd Harston Mill, Royston Road Harston, Cambridge CB22 7GG
Proposed FCC ID	UPO3005-1007
Full measurement results are detailed in Report Number:	03-13344-4-22 Issue 01
Test Standards:	47 CFR Part 90 Effective Date 1st October 2020 47 CFR Part 2 Effective Date 1st October 2020

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: 03-13344-3-22 (Part 27), 03-13344-2-22 (Part 74H), and 03-13344-1-22 (Parts 22 & 24).

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:	14th February to 28th April 2022
Test Engineer:	Charlie Blackwell
Approved By: Radio Manager	Digitally signed by: Daniel Sims DN: CN = Daniel Sims C = GB O = RN Electronics Ltd Date: 2022.05.16 17:17:43 Z
Customer Representative	

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2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Zinwave Ltd Harston Mill Royston Road Harston Cambridge CB22 7GG	
Manufacturer of EUT	Zinwave Ltd	
Full Name of EUT	Zinwave UNItivity 5000 Remote Unit	
Model Number of EUT	305-1007	
Serial Number of EUT	330100000001 (radiated unit) 330100000003 (conducted unit)	
Date Received	11th February 2022	
Date of Test:	14th February 2022 to 28th April 2022	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	10th May 2022	
Main Function	Distributed Antenna remote unit	
Information Specification	Height	250mm
	Width	250mm
	Depth	50mm
	Weight	2kg
	Voltage	48 V DC
	Current	< 1 A (35W)

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2.2 Configurations for testing

General Parameters	
EUT Normal use position	Wall mounted
Choice of model(s) for type tests	Production unit
Antenna details	external max 8dBi
Antenna port	External: 1x TX; 1x RX (N-type ports)
Baseband Data port (yes/no)?	NO
Highest Signal generated in EUT	2690 MHz
Lowest Signal generated in EUT	Not stated
Hardware Version	1.0
Software Version	
Firmware Version	4.209
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
Mode 1	EUT being fed a swept CW signal across the band 150-174 MHz input level	Yes
Mode 2	Single mode Channel FM mod at f0 (173.376MHz) in band 150-174 MHz	Yes
Mode 3	Single mode Channel QPSK mod at f0 (173.376MHz) in band 150-174 MHz	Yes
Mode 4	Single mode low channel at 150.0125MHz using CW (no modulation)	Yes
Mode 5	Single mode Mid channel at 160MHz using CW (no modulation)	Yes
Mode 6	Single mode High channel at 173.3875MHz using CW (no modulation)	Yes
Mode 7	Dual mode channels at 173.370 + 173.3825 MHz CW (no modulation)	Yes
Mode 8	EUT being fed a swept CW signal across the band 406.1-430 MHz input level	Yes
Mode 9	Single mode Channel FM mod at f0 (429.928MHz) in band 406.1-430 MHz	Yes
Mode 10	Single mode Channel QPSK mod at f0 (429.928MHz) in band 406.1-430 MHz	Yes
Mode 11	Single mode low channel at 406.1125MHz using CW (no modulation)	Yes
Mode 12	Single mode Mid channel at 415MHz using CW (no modulation)	Yes
Mode 13	Single mode High channel at 429.9875MHz using CW (no modulation)	Yes
Mode 14	Dual mode channels at 429.922 + 429.9345 MHz CW (no modulation)	Yes
Mode 15	EUT being fed a swept CW signal across the band 456-512 MHz input level	Yes
Mode 16	Single mode Channel FM mod at f0 (511.888MHz) in band 456-512 MHz	Yes
Mode 17	Single mode Channel QPSK mod at f0 (511.888MHz) in band 456-512 MHz	Yes
Mode 18	Single mode low channel at 456.0125MHz using CW (no modulation)	Yes
Mode 19	Single mode Mid channel at 480MHz using CW (no modulation)	Yes
Mode 20	Single mode High channel at 511.9875MHz using CW (no modulation)	Yes
Mode 21	Dual mode channels at 511.882 + 511.8945 MHz CW (no modulation)	Yes
Mode 22	EUT being fed a swept CW signal across the band 758-768 MHz input level	Yes
Mode 23	Single mode Channel AWGN mod at f0 (767.970MHz) in band 758-768 MHz	Yes
Mode 24	Single mode low channel at 758.0125MHz using CW (no modulation)	Yes
Mode 25	Single mode Mid channel at 763MHz using CW (no modulation)	Yes
Mode 26	Single mode High channel at 767.9875MHz using CW (no modulation)	Yes
Mode 27	Dual mode channels at 767.964 + 767.9765 MHz CW (no modulation)	Yes
Mode 28	EUT being fed a swept CW signal across the band 769-775 MHz input level	Yes
Mode 29	Single mode Channel FM mod at f0 (769.084MHz) in band 769-775 MHz	Yes
Mode 30	Single mode Channel QPSK mod at f0 (769.084MHz) in band 769-775 MHz	Yes
Mode 31	Single mode low channel at 769.0125MHz using CW (no modulation)	Yes
Mode 32	Single mode Mid channel at 772MHz using CW (no modulation)	Yes
Mode 33	Single mode High channel at 774.9875MHz using CW (no modulation)	Yes
Mode 34	Dual mode channels at 804.590 + 804.6025 MHz CW (no modulation)	Yes
Mode 35	EUT being fed a swept CW signal across the band 799-805 MHz input level	Yes
Mode 36	Single mode Channel FM mod at f0 (804.549MHz) in band 799-805 MHz	Yes
Mode 37	Single mode Channel QPSK mod at f0 (804.549MHz) in band 799-805 MHz	Yes
Mode 38	Single mode low channel at 799.0125MHz using CW (no modulation)	Yes
Mode 39	Single mode Mid channel at 802MHz using CW (no modulation)	Yes
Mode 40	Single mode High channel at 804.9875MHz using CW (no modulation)	Yes
Mode 41	Dual mode channels at 804.590 + 804.6025 MHz CW (no modulation)	Yes

Mode 42	EUT being fed a swept CW signal across the band 851-861 MHz input level	Yes
Mode 43	Single mode Channel FM mod at f0 (851.030MHz) in band 851-861 MHz	Yes
Mode 44	Single mode Channel QPSK mod at f0 (851.030MHz) in band 851-861 MHz	Yes
Mode 45	Single mode low channel at 851.0125MHz using CW (no modulation)	Yes
Mode 46	Single mode Mid channel at 855MHz using CW (no modulation)	Yes
Mode 47	Single mode High channel at 860.9875MHz using CW (no modulation)	Yes
Mode 48	Dual mode channels at 851.024 + 851.0365 MHz CW (no modulation)	Yes
Mode 49	EUT being fed a swept CW signal across the band 862-869 MHz input level	Yes
Mode 50	Single mode Channel AWGN mod at f0 (862.028MHz) in band 862-869 MHz	Yes
Mode 51	Single mode low channel at 862.0125MHz using CW (no modulation)	Yes
Mode 52	Single mode Mid channel at 865MHz using CW (no modulation)	Yes
Mode 53	Single mode High channel at 868.9875MHz using CW (no modulation)	Yes
Mode 54	Dual mode channels at 862.022 + 862.0345 MHz CW (no modulation)	Yes
Mode 55	EUT being fed a swept CW signal across the band 935-940 MHz input level	Yes
Mode 56	Single mode Channel AWGN mod at f0 (935.095MHz) in band 935-940 MHz	Yes
Mode 57	Single mode low channel at 935.0125MHz using CW (no modulation)	Yes
Mode 58	Single mode Mid channel at 937.5MHz using CW (no modulation)	Yes
Mode 59	Single mode High channel at 939.9875MHz using CW (no modulation)	Yes
Mode 60	Dual mode channels at 935.089 + 935.1015 MHz CW (no modulation)	Yes

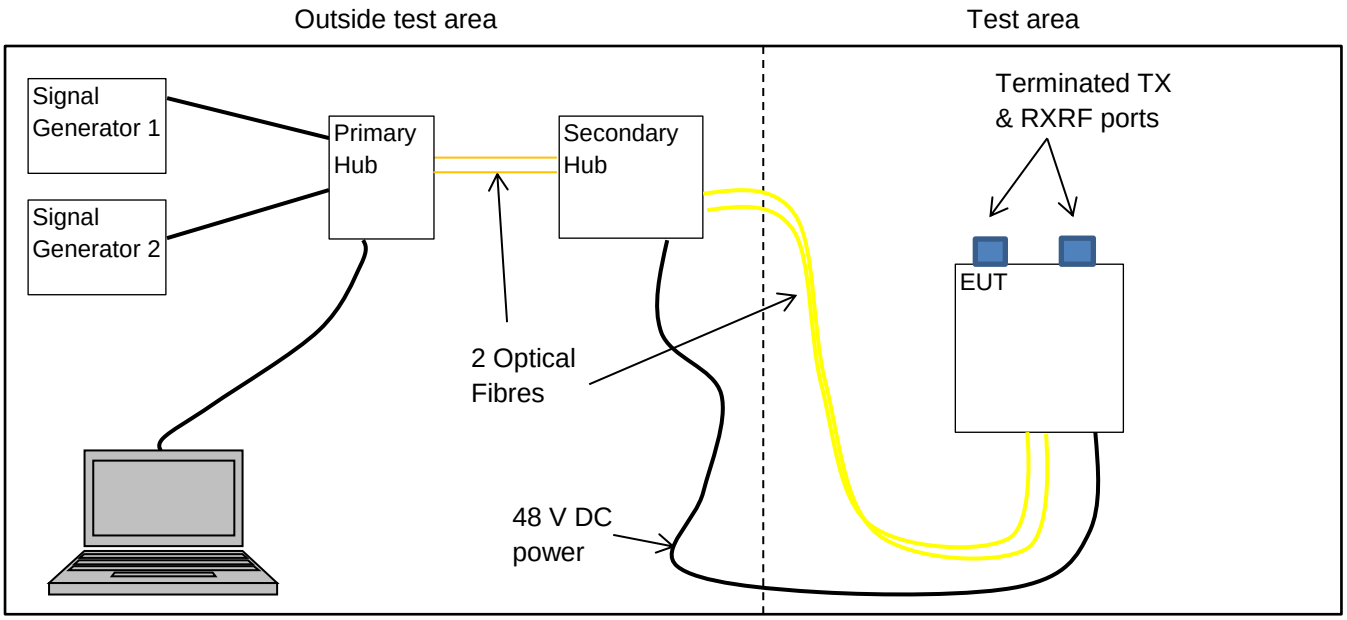
Note: This report only pertains to the operation of the equipment to 47CFR part 90, for details of testing to other rule parts please see RN reports: 03-13344-3-22 (Part 27)
03-13344-2-22 (Part 74H)
03-13344-1-22 (Parts 22 & 24).

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. 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, 305-1007 was tested for compliance to the following standard(s) :

47 CFR Part 90 Effective Date 1st October 2020
47 CFR Part 2 Effective Date 1st October 2020

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 v04r02 section 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

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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 5 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	2020	Private Land Mobile Services
4.1.2	47CFR part 2J	2020	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations
4.1.3	KDB 971168 D01 v03r01	2018	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Measurement Guidance for Certification of Licensed Digital Transmitters
4.1.4	ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
4.1.5	KDB 935210 D05 v01r04	2020	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Measurement guidance for Industrial and Non-consumer signal booster, repeater and amplifier devices

4.2 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 on Middle channel 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 N.

5.1.4 Test equipment

F078, H071, E266, E777, E602

See Section 8 for more details

5.1.5 Test results

Temperature of test environment	17-23°C
Humidity of test environment	35-58%
Pressure of test environment	100-103kPa

For band edge results please refer to section 5.6 within this report
Note – only middle channels needed as per KDB
Setup Table

Band	150-174 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Mid channel	160.0125 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
320.025	-24.79	-11.79

Plots
13344-4 150-174_MHz.png

Setup Table

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Mid channel	415MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1244.986	-31.1	-18.1

Plots
13344-4 406.1-430_MHz.png

Setup Table

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Mid channel	480MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
959.987	-34.3	-21.3

Plots
13344-4 456-512_MHz.png

Setup Table

Band	758-768 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Mid channel	763MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1526.02	-33.77	-20.7

Plots
13344-4 758-768_MHz.png

Setup Table

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Mid channel	772MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1544.02	-32.8	-19.8

Plots
13344-4 769-775_MHz.png

Setup Table

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Mid channel	802MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1604	-29.4	-16.4

Plots
13344-4 799-805_MHz.png

Setup Table

Band	851-861 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Mid channel	855MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1710.04	-32.5	-19.5

Plots
13344-4 851-861_MHz.png

Setup Table

Band	862-869 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
Mid channel	865MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1730.02	-32.3	-19.3

Plots
13344-4 862-869_MHz.png

Setup Table

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

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1874.966	-26.8	-13.8

Plots
13344-4 935-940_MHz.png

Note: only worst case harmonic for each band is tabulated.

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.
90.543(c) - ***Out-of-band emission limit.*** On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

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 CW.

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

F078, H071, E266, E777, E602

See Section 8 for more details

5.2.5 Test results

Temperature of test environment	18-23°C
Humidity of test environment	35-58%
Pressure of test environment	100-103kPa

Band	150-174 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	173.376 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	14.92	22.92	196
	Plot Ref	150-174 TX power		

Note: 8dBi Antenna gain used.

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	429.928 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	18.5	26.5	447
	Plot Ref	401-430 TX power		

Note: 8dBi Antenna gain used.

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	511.887 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	19.6	27.6	575
	Plot Ref	456-512 TX power		

Note: 8dBi Antenna gain used.

Band	758-768 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	767.970 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.16	28.16	655
	Plot Ref	758-768 TX power		

Note: 8dBi Antenna gain used.

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	769.084 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.18	28.18	658
	Plot Ref	769-775 TX power		

Note: 8dBi Antenna gain used.

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	804.549 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.43	28.43	697
	Plot Ref	799-805 TX power		

Note: 8dBi Antenna gain used.

Band	851-861 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 frequency	851.03 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.38	28.38	689
	Plot Ref	851-861 TX power		

Note: 8dBi Antenna gain used.

Band	862-869 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	862.028 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.29	28.29	675
	Plot Ref	862-869 TX power		

Band	935-940 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW
f0 frequency	935.095 MHz

Test conditions		Power (dBm)	TX power EIRP (dBm)	TX Power EIRP (mW)
Temp Ambient	Volts Nominal	20.09	28.09	644
	Plot Ref	935-940 TX power		

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

F078, H071, E266, E777, E602

See Section 8 for more details

5.4.5 Test results

Temperature of test environment 18-24°C
Humidity of test environment 35-58%
Pressure of test environment 100-103kPa

Band	150-174 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Test frequency	173.376 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.24
Output measurement	12.91	11.25
Plot reference	150-174MHz_FM	

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	10.29
Output measurement	12.00	10.27
Plot reference	150-174MHz_QPSK	

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Test frequency	429.928 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.24
Output measurement	12.91	11.24
Plot reference	406-430MHz_FM	

Band	406.1-430 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	429.928 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.88	10.5
Output measurement	11.89	10.5
Plot reference	406-430MHz_QPSK	

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Test frequency	511.88 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.24
Output measurement	12.91	11.24
Plot reference	456-512MHz_FM	

Band	456-512 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	511.88 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.93	10.3
Output measurement	11.98	10.23
Plot reference	456-512MHz_QPSK	

Band	758-768 MHz
Power Level	20 dBm
Channel Spacing	5MHz
Mod Scheme	AWGN
Test frequency	765.5 MHz

	26dB BW (MHz)	Occupied BW (MHz)
Input measurement	4.66	4.09
Output measurement	4.65	4.09
Plot reference	758-768MHz_AWGN	

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Test frequency	769.084 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.24
Output measurement	12.91	11.24
Plot reference	769-775MHz_FM	

Band	769-775 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	769.084 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.88	10.50
Output measurement	11.88	10.46
Plot reference	769-775MHz_QPSK	

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Test frequency	804.596 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.24
Output measurement	12.91	11.24
Plot reference	799-805MHz_FM	

Band	799-805 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	804.596 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.87	10.50
Output measurement	11.89	10.50
Plot reference	799-805MHz_QPSK	

Band	851-861 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	FM
Tes frequency	851.03 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	12.91	11.24
Output measurement	12.91	11.24
Plot reference	851-861MHz_FM	

Band	851-861 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	QPSK
Test frequency	851.03 MHz

	26dB BW (kHz)	Occupied BW (kHz)
Input measurement	11.87	10.49
Output measurement	11.88	10.49
Plot reference	851-861MHz_QPSK	

Band	862-869 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	AWGN
Test frequency	864.5 MHz

	26dB BW (MHz)	Occupied BW (MHz)
Input measurement	4.63	4.09
Output measurement	4.65	4.07
Plot reference	862-869MHz_AWGN	

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	4.66	4.09
Output measurement	4.66	4.09
Plot reference	935-940MHz_AWGN	

Results are also presented graphically in section 6

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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

E624, E411, LPE364, E743, E136, TMS82, E602, E268, Cal07, E463, E478, F031, E621, E412, E296-2, E330

See Section 8 for more details

5.5.5 Test results

Temperature of test environment	13-18°C
Humidity of test environment	51-68%
Pressure of test environment	100-102kPa

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 intermodulation emissions / Emissions Limitations

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(c) [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 N.

5.6.4 Test equipment

F078, H071, E266, E777, E602

See Section 8 for more details

5.6.5 Test results

Temperature of test environment	17-23°C
Humidity of test environment	35-56%
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)
173.376	-29.33

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)
429.928	-34.5

Setup Table

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

f0 (MHz)	Highest intermodulation product (dBm)
511.888	-33.3

Setup Table

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

f0 (MHz)	Highest intermodulation product (dBm)
767.97	-35.3

Setup Table

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

f0 (MHz)	Highest intermodulation product (dBm)
769.084	-33.5

Setup Table

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

f0 (MHz)	Highest intermodulation product (dBm)
804.596	-33.5

Setup Table

Band	851-861 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
851.03	-34.7

Band	862-869 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f0 (MHz)	Highest intermodulation product (dBm)
862.028	-37.5

Setup Table

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

f0 (MHz)	Highest intermodulation product (dBm)
935.095	-38.4

Note:
90.543 - Class A and Class B signal boosters retransmitting signals in the 769-775 MHz and 799-805 MHz frequency bands are exempt from the limits listed in paragraph (a) of this section when simultaneously retransmitting multiple signals and instead shall be subject to the limit listed in paragraph (c) of this section when operating in this manner.
Please refer to conducted emissions plots for this requirement.

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 9 operational bands with a CW signal to determine the frequency of highest power in the band. Test performed in modes 1, 8, 15, 22, 28, 35, 42, 49 and 55.

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

F078, H071, E266, E777, E602

See Section 8 for more details

5.8.5 Test results

Temperature of test environment	17-23°C
Humidity of test environment	35-56%
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)
173.376

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)
429.928

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)
511.887

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)
767.970

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

f_0 determined(MHz)
769.084

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)
804.549

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

Band	851.0 – 861.0 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined (MHz)
851.03

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

Band	862.0 – 869.0 MHz
Power Level	20 dBm
Channel Spacing	N/A
Mod Scheme	CW

f_0 determined (MHz)
862.028

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

f_0 determined (MHz)
935.095

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

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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.

5.9.4 Test equipment

F078, H071, E266, E777, E602

See Section 8 for more details

5.9.5 Test results

Temperature of test environment	17-23°C
Humidity of test environment	35-56%
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.

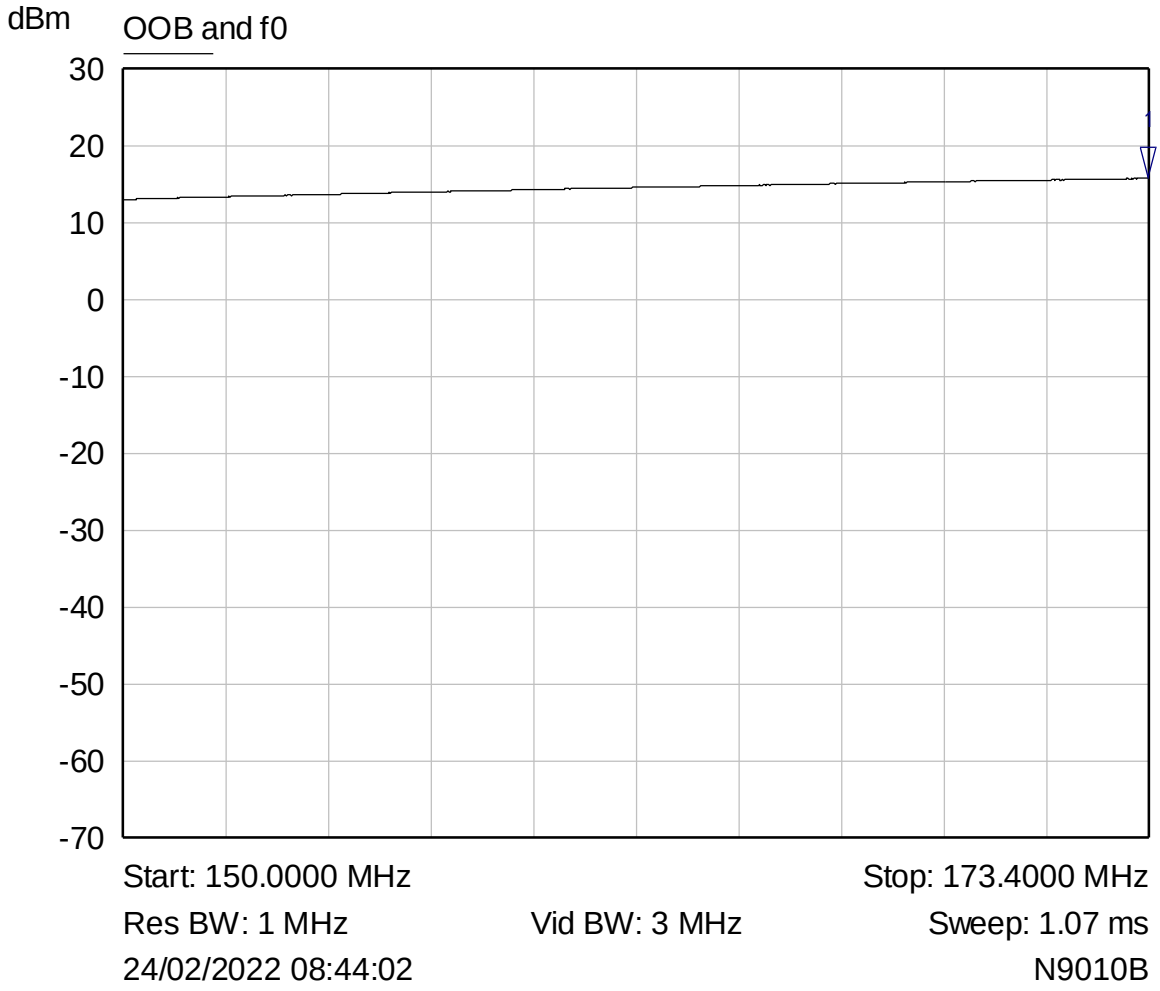
These results show that the EUT has PASSED this test.

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

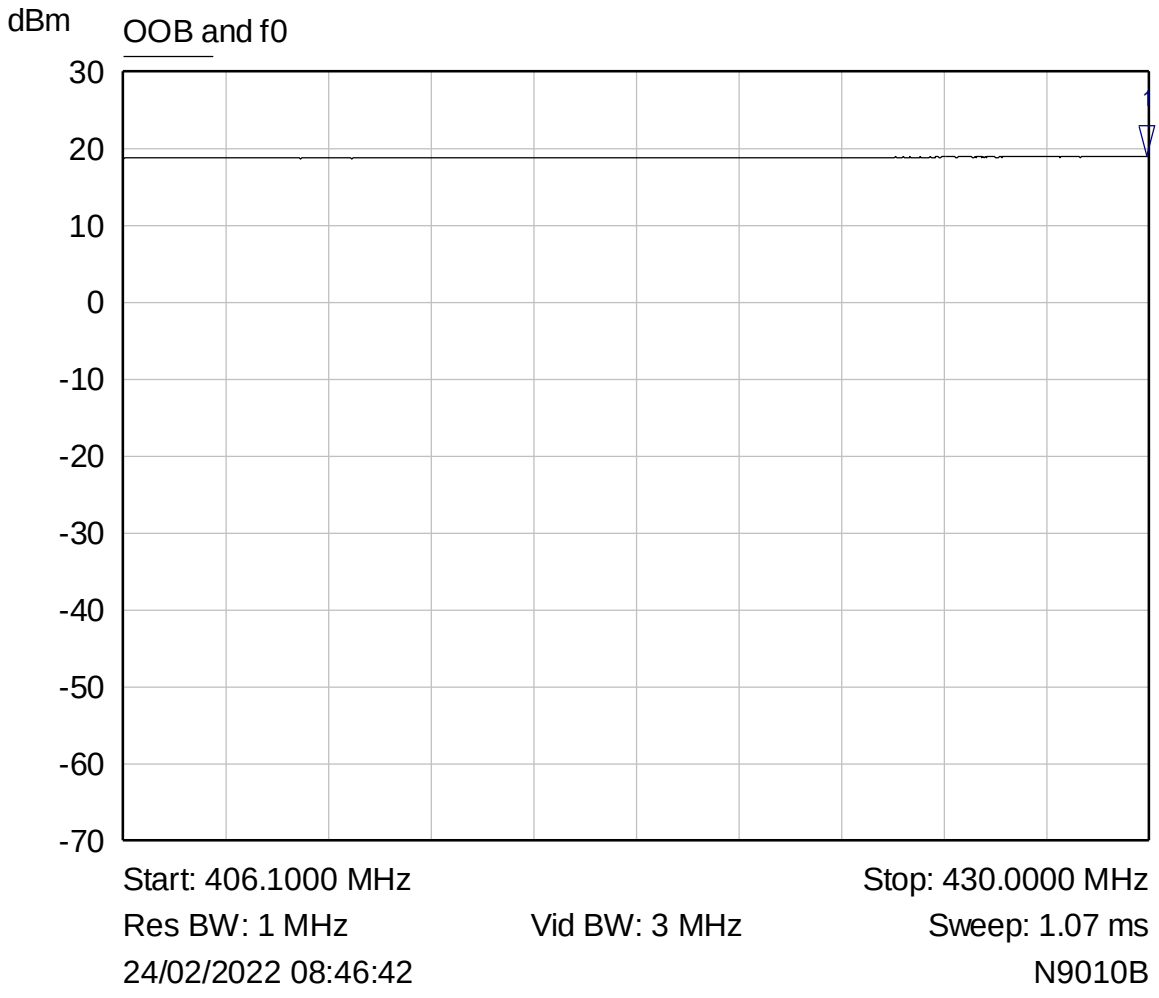
RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB and f0	173.3766 MHz	15.78 dBm	f0

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 and f0	429.9282 MHz	18.99 dBm	f0

Plot of f0 determined in Band 406.1-430 MHz.

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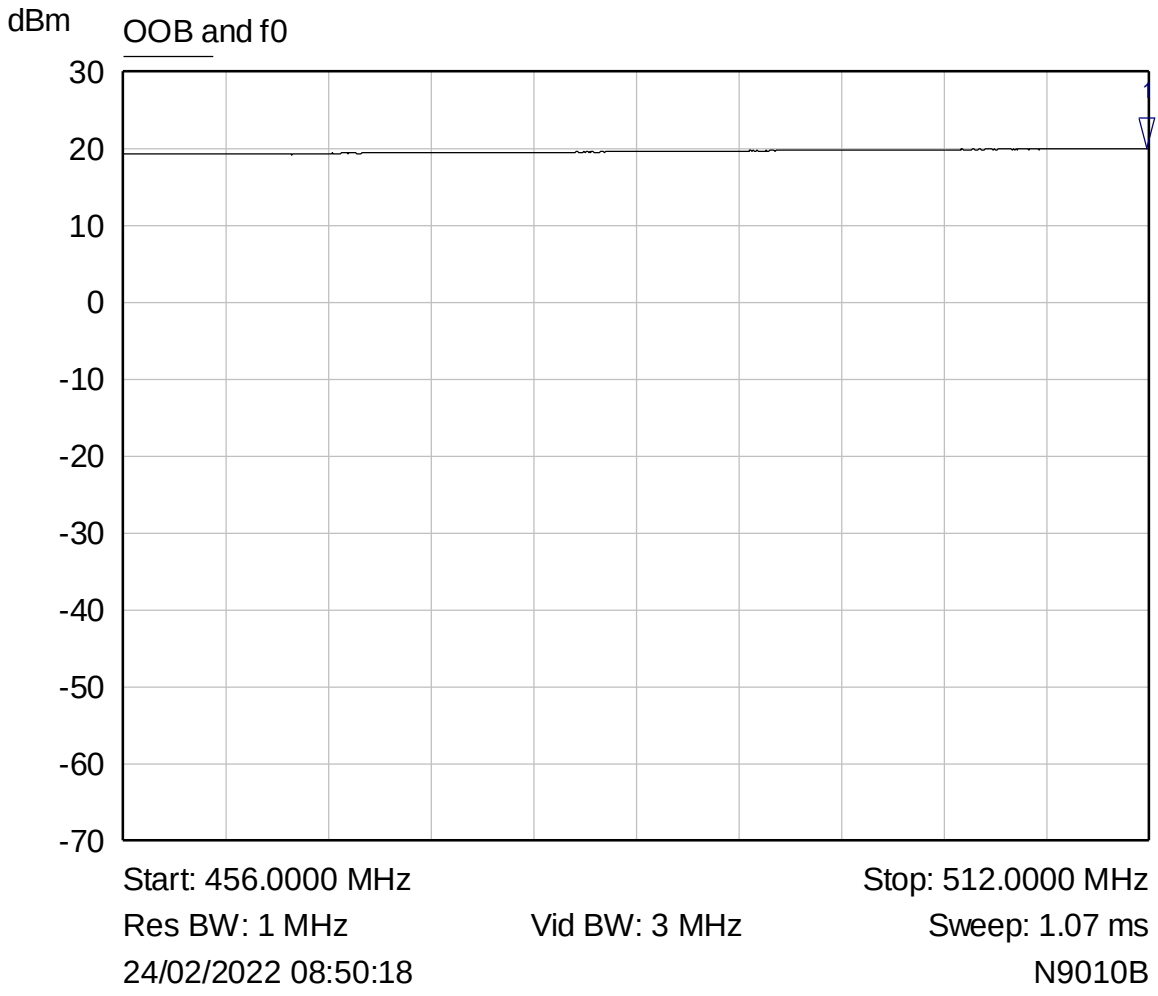
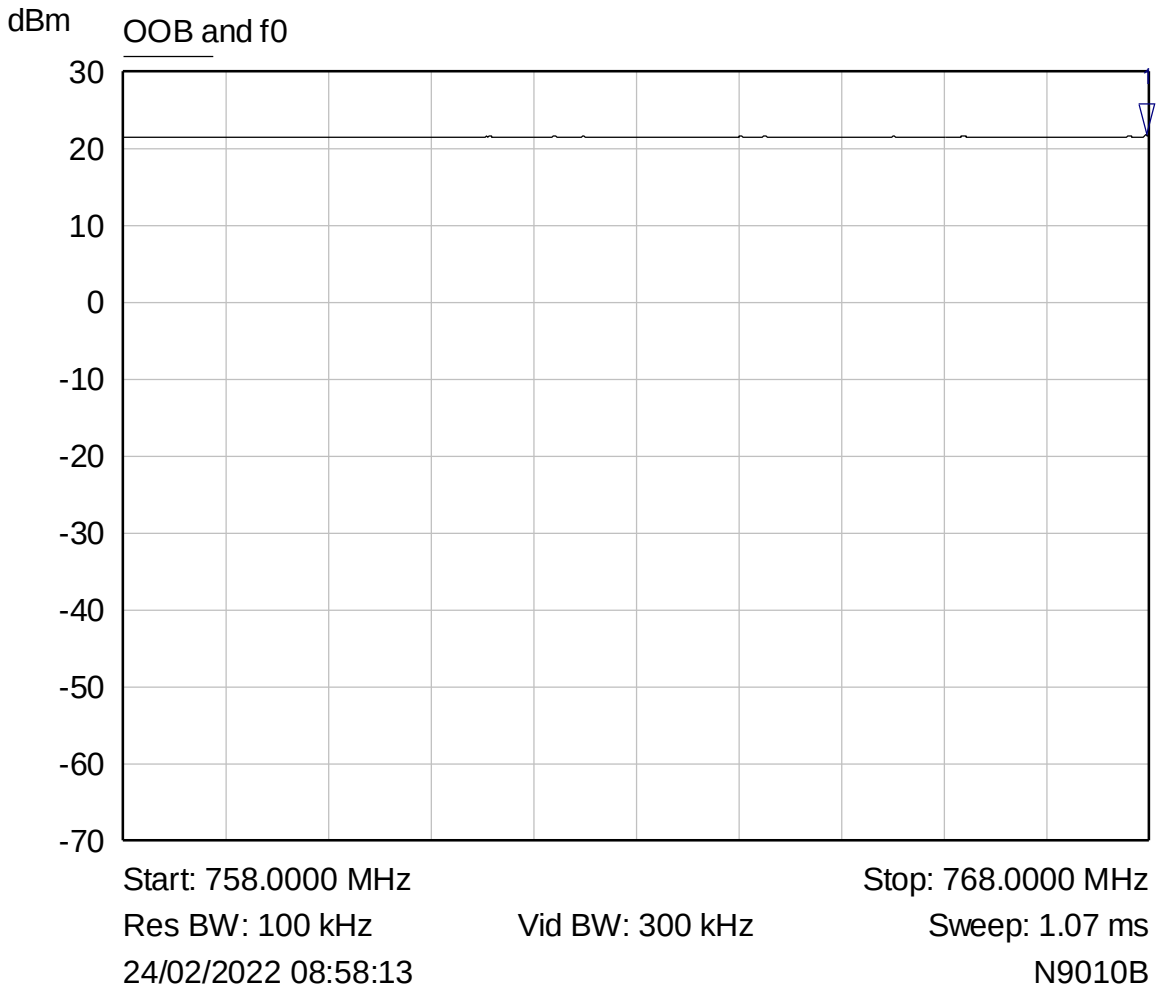
RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB and f0	511.8879 MHz	20.01 dBm	f0

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 and f0	767.9700 MHz	21.76 dBm	f0

Plot of f0 determined in Band 758-768 MHz.

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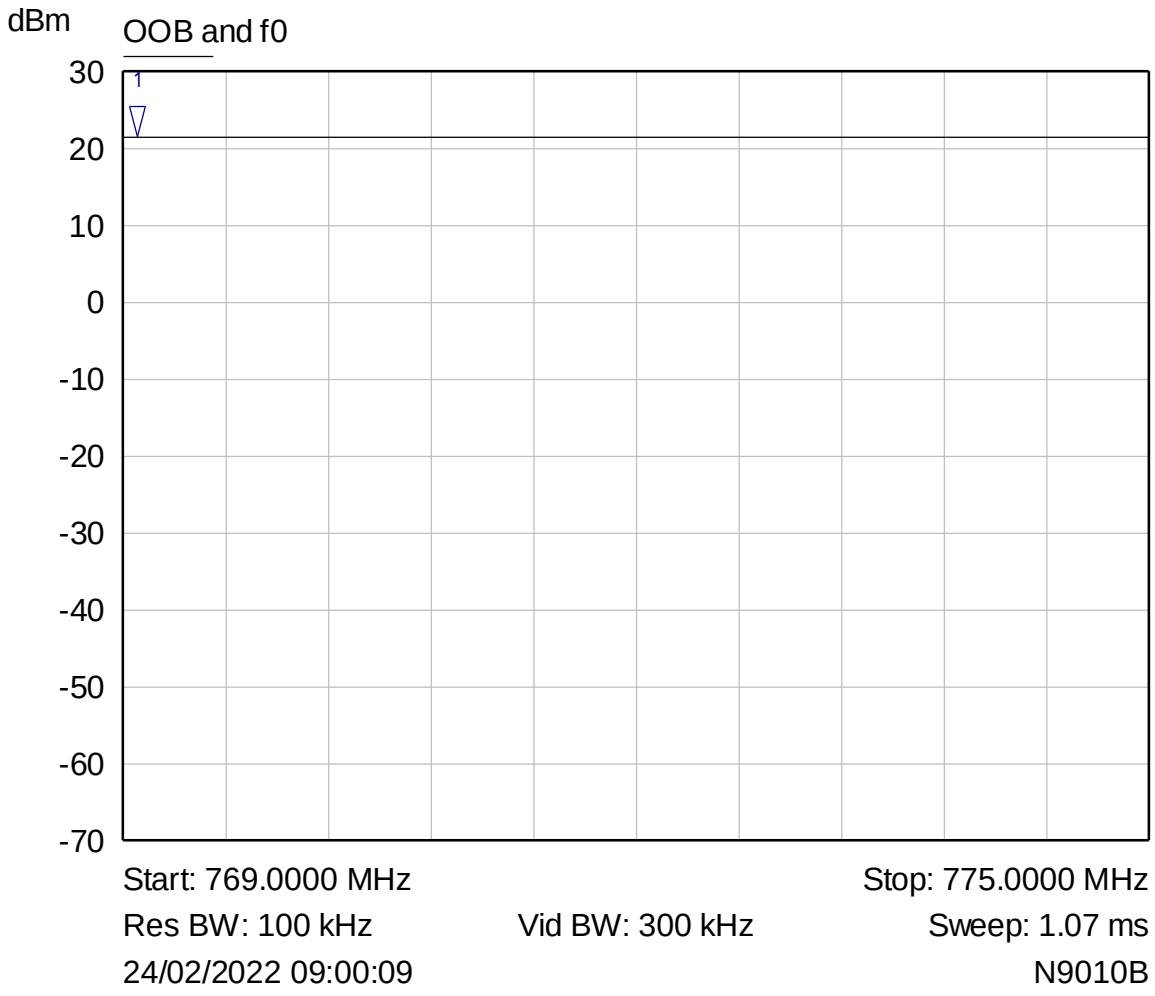
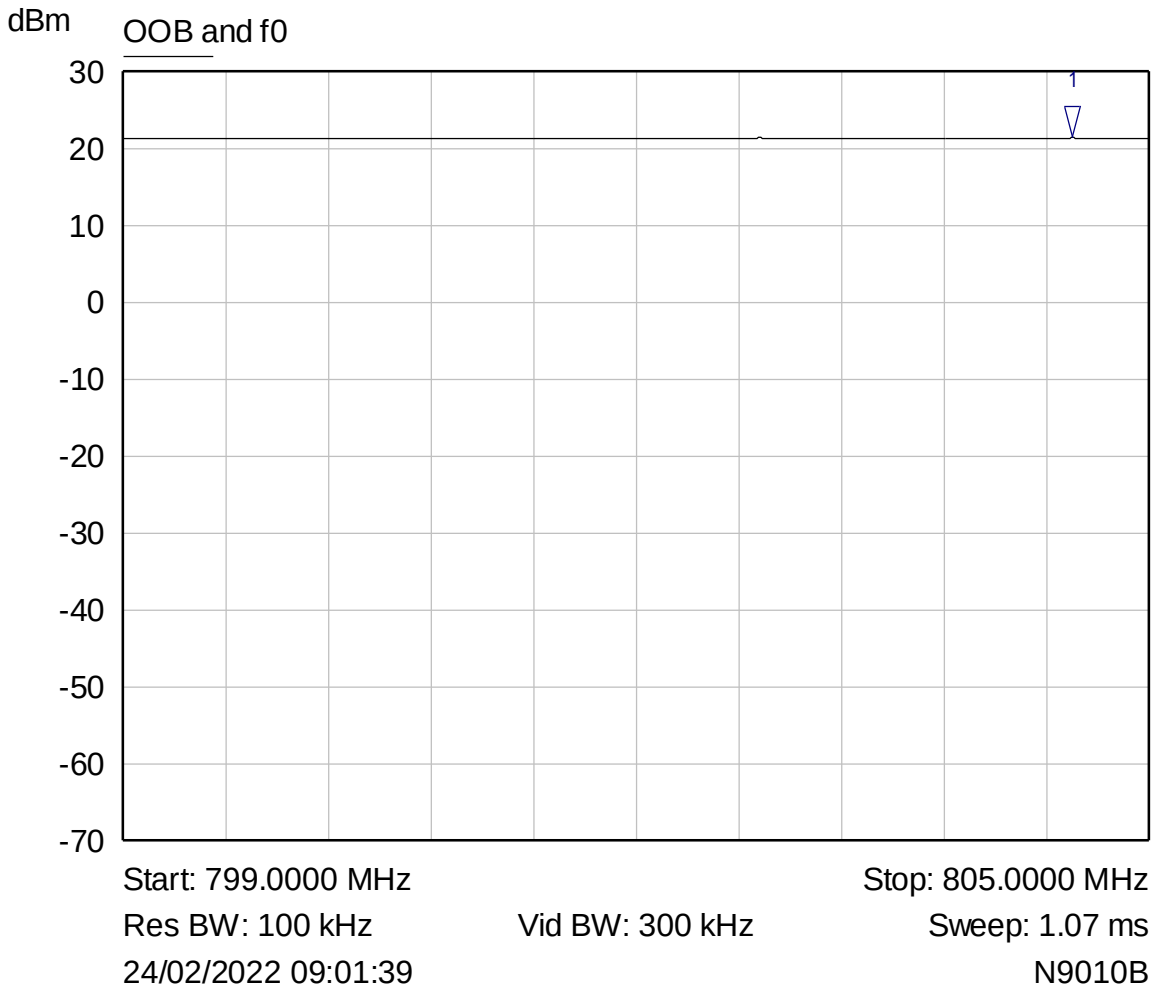
RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB and f0	769.0841 MHz	21.57 dBm	f0

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 and f0	804.5495 MHz	21.44 dBm	f0

Plot of f0 determined in Band 799-805 MHz.

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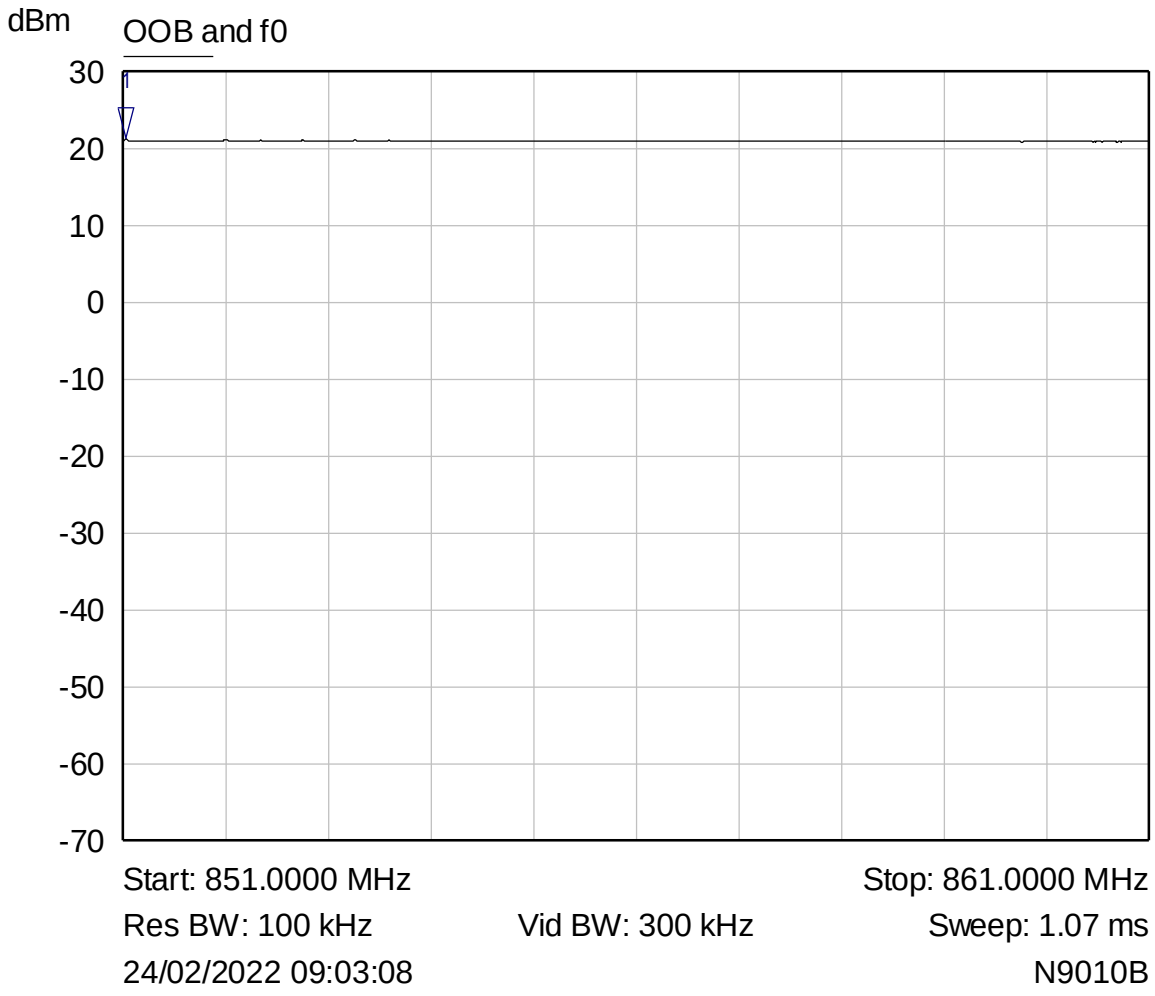
RF Parameters: Band 851-861 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1	OOB and f0	851.0300 MHz	21.30 dBm	f0

Plot of f0 determined in Band 851-861 MHz.

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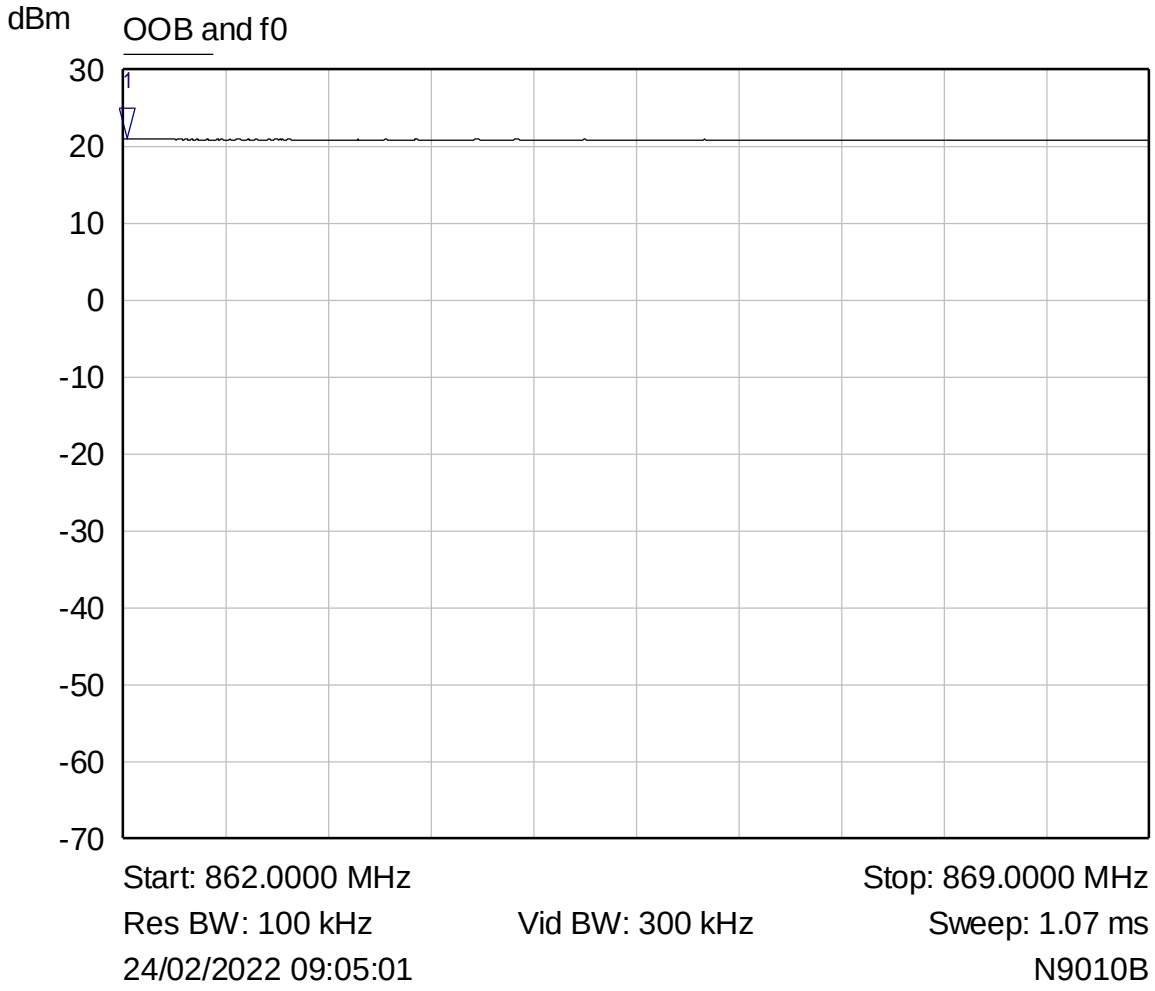
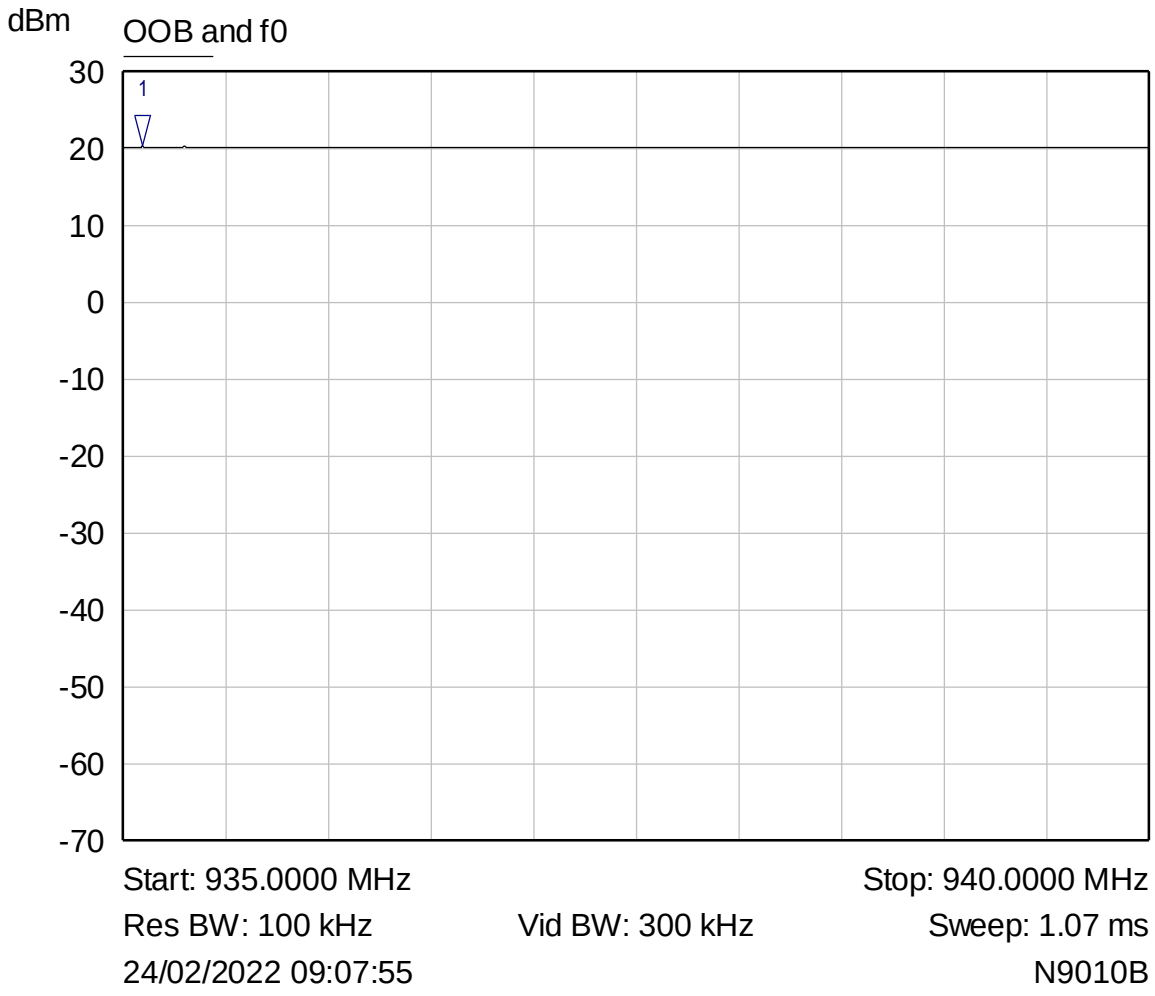
RF Parameters: Band 861-869 MHz, Power +20 dBm, Channel Spacing N/A, Modulation N/A, Channel N/A



Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB and f0	862.0280 MHz	21.02 dBm	f0

Plot of f0 determined in Band 861-869 MHz.

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

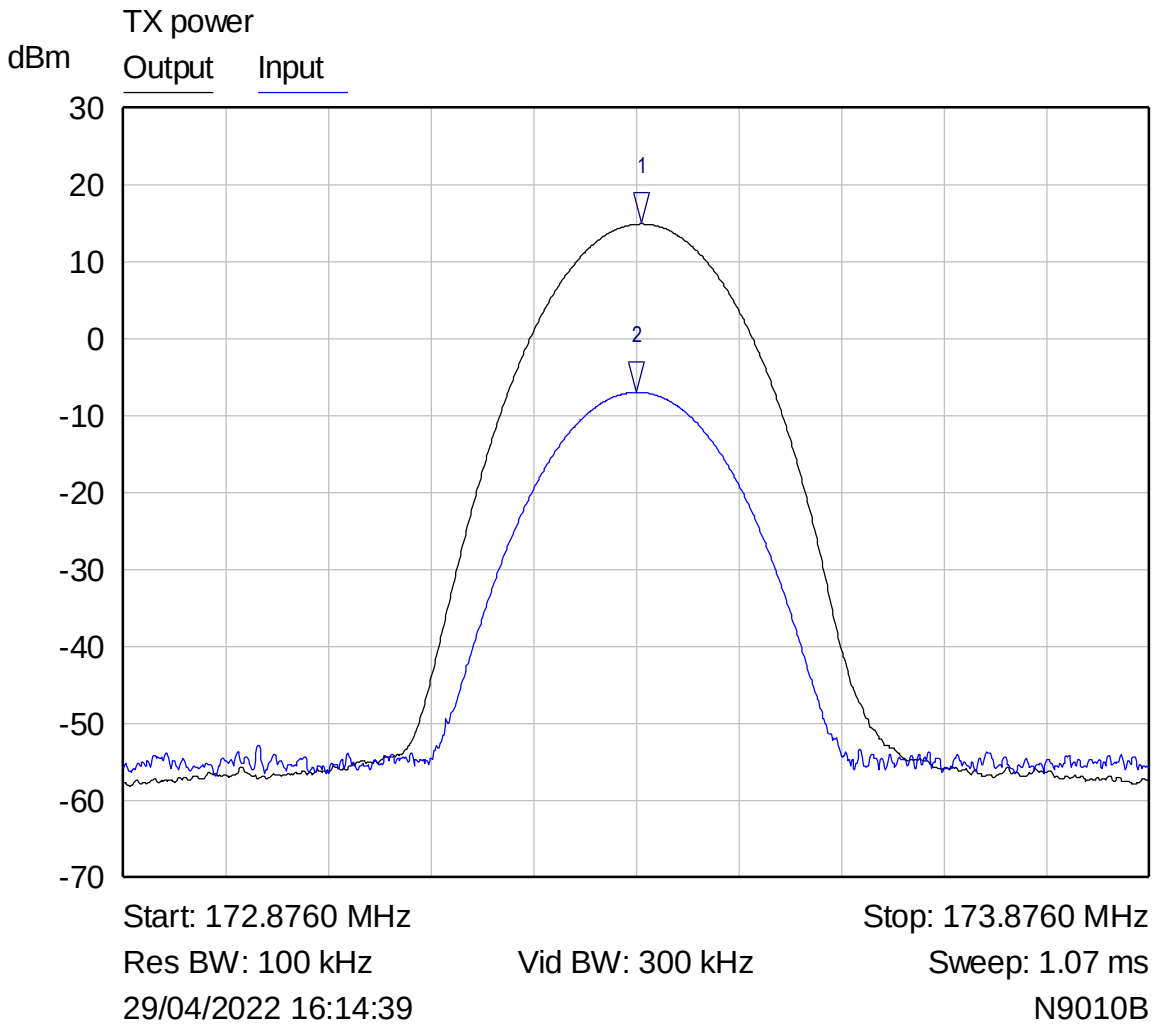


Mkr	Trace	X-Axis	Value	Notes
1 ▽	OOB and f0	935.0951 MHz	20.26 dBm	f0

Plot of f0 determined in Band 935-940 MHz.

6.2 RF Power Output

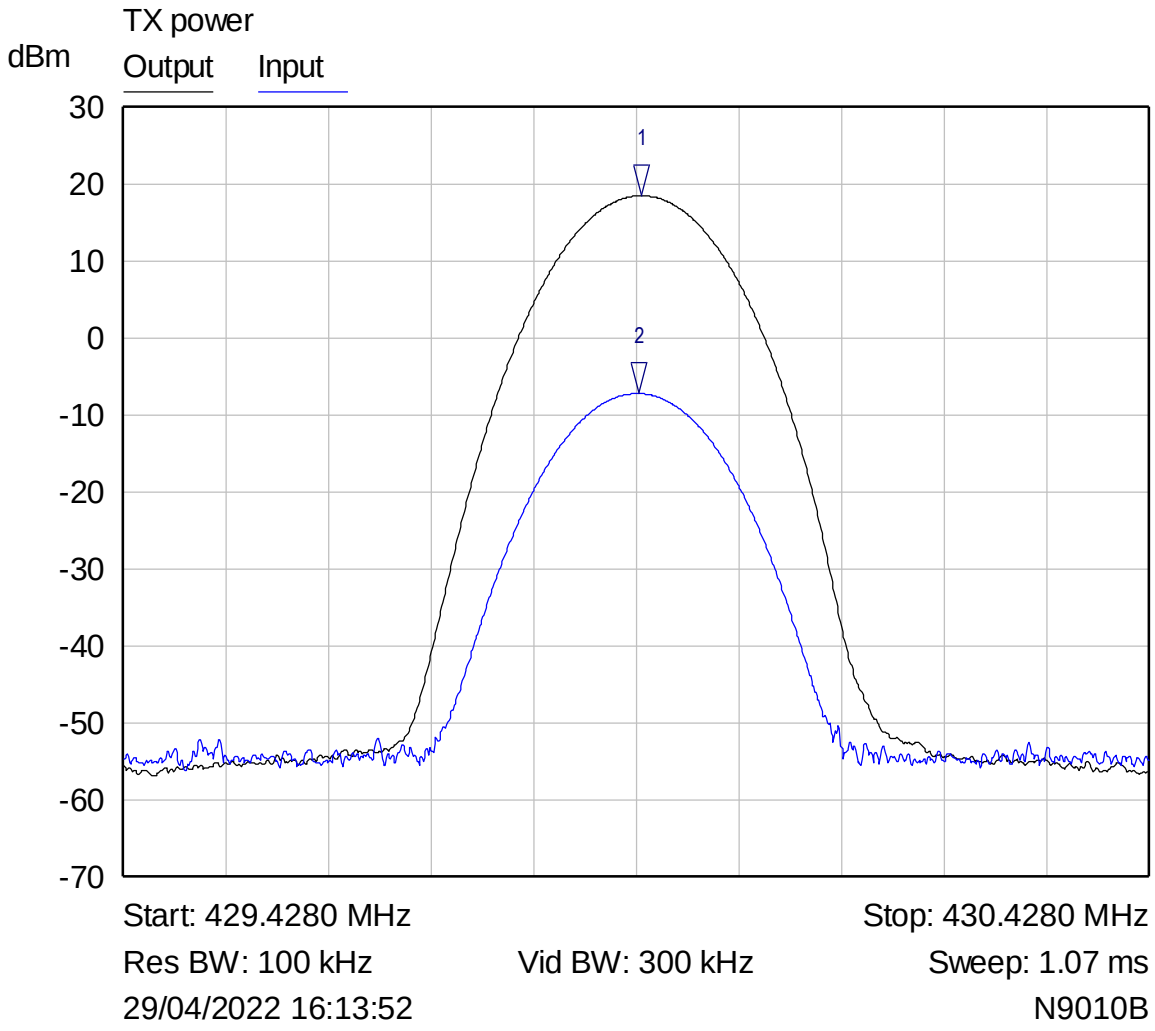
RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation CW, Channel 173.376 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	173.3805 MHz	14.92 dBm	
2 ▽	Input	173.3755 MHz	-6.95 dBm	

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

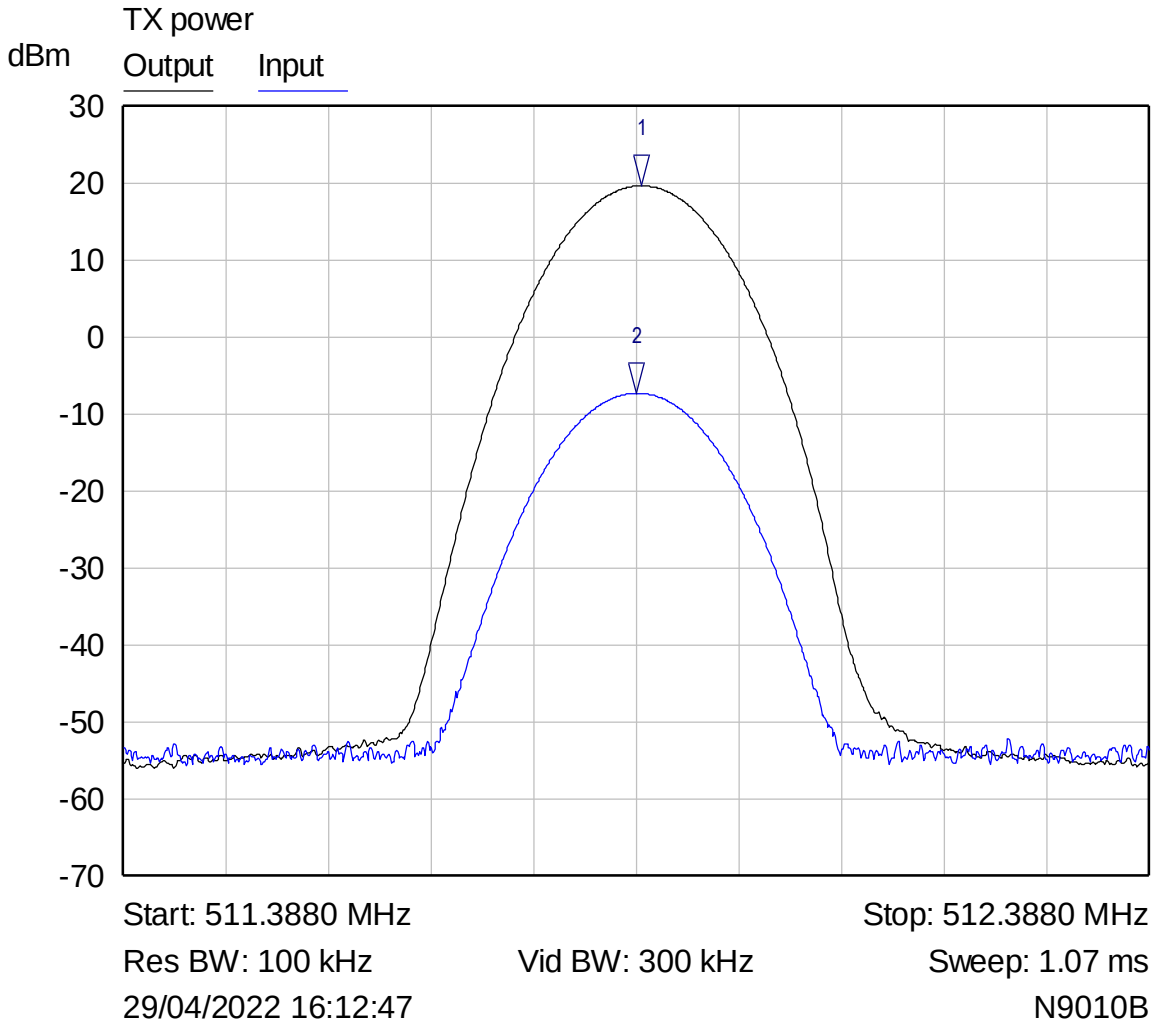
RF Parameters: Band 406.1-430 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation CW, Channel 429.928 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	429.9325 MHz	18.50 dBm	
2 ▽	Input	429.9305 MHz	-7.20 dBm	

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

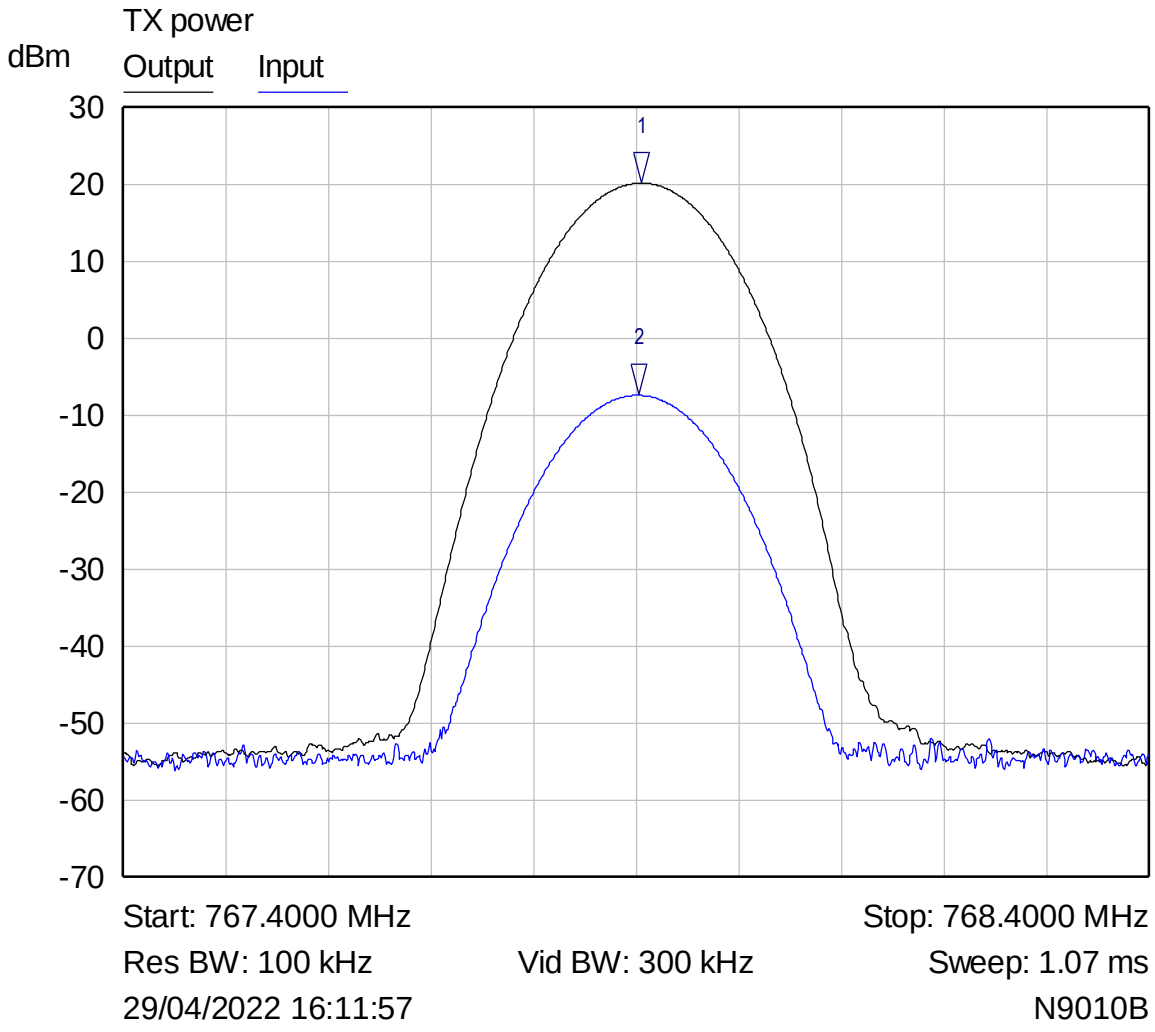
RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation CW, Channel 511.887 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	511.8925 MHz	19.66 dBm	
2 ▽	Input	511.8885 MHz	-7.26 dBm	

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

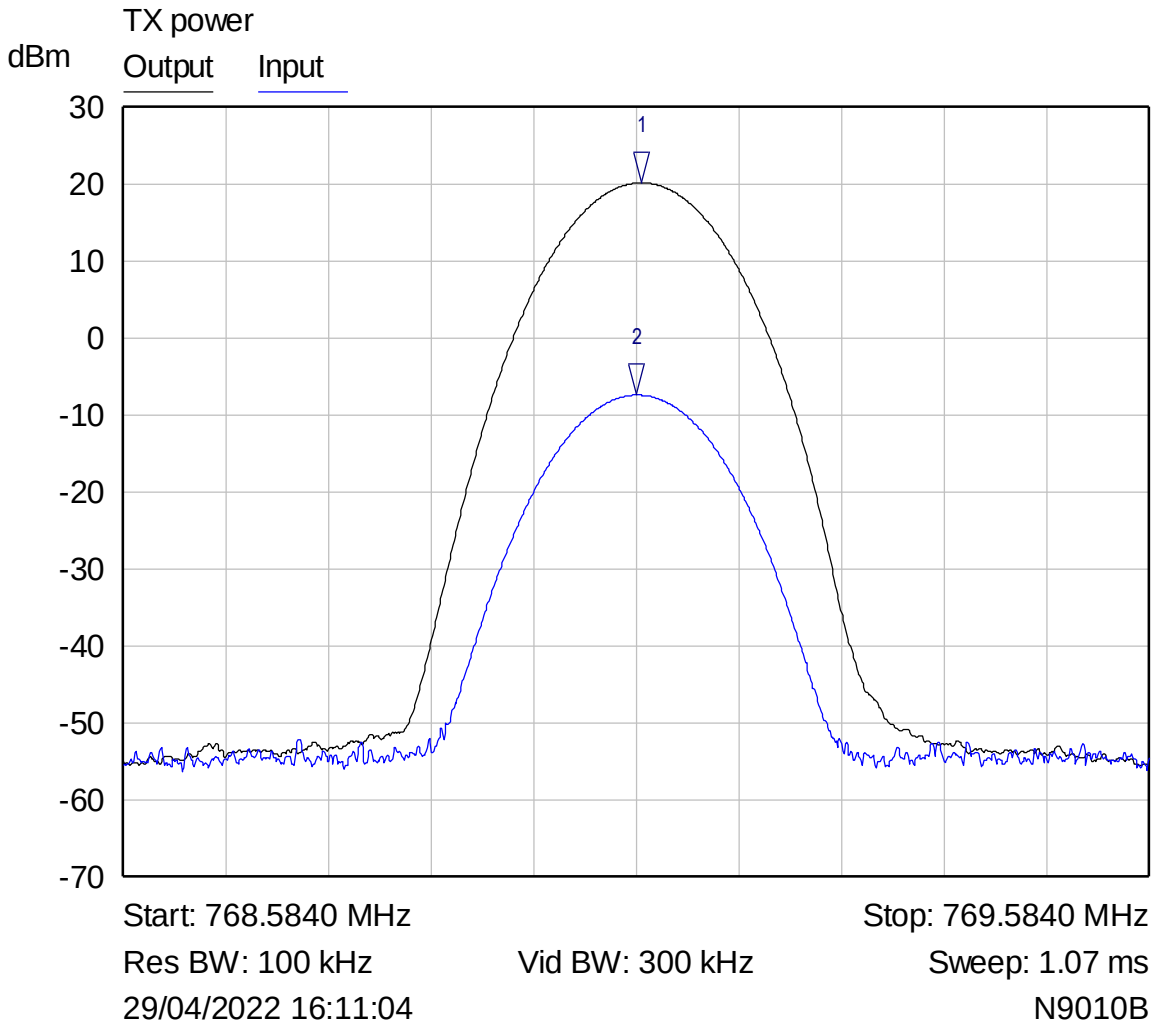
RF Parameters: Band 758-768 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation CW, Channel 767.970 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	767.9045 MHz	20.16 dBm	
2 ▽	Input	767.9025 MHz	-7.39 dBm	

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

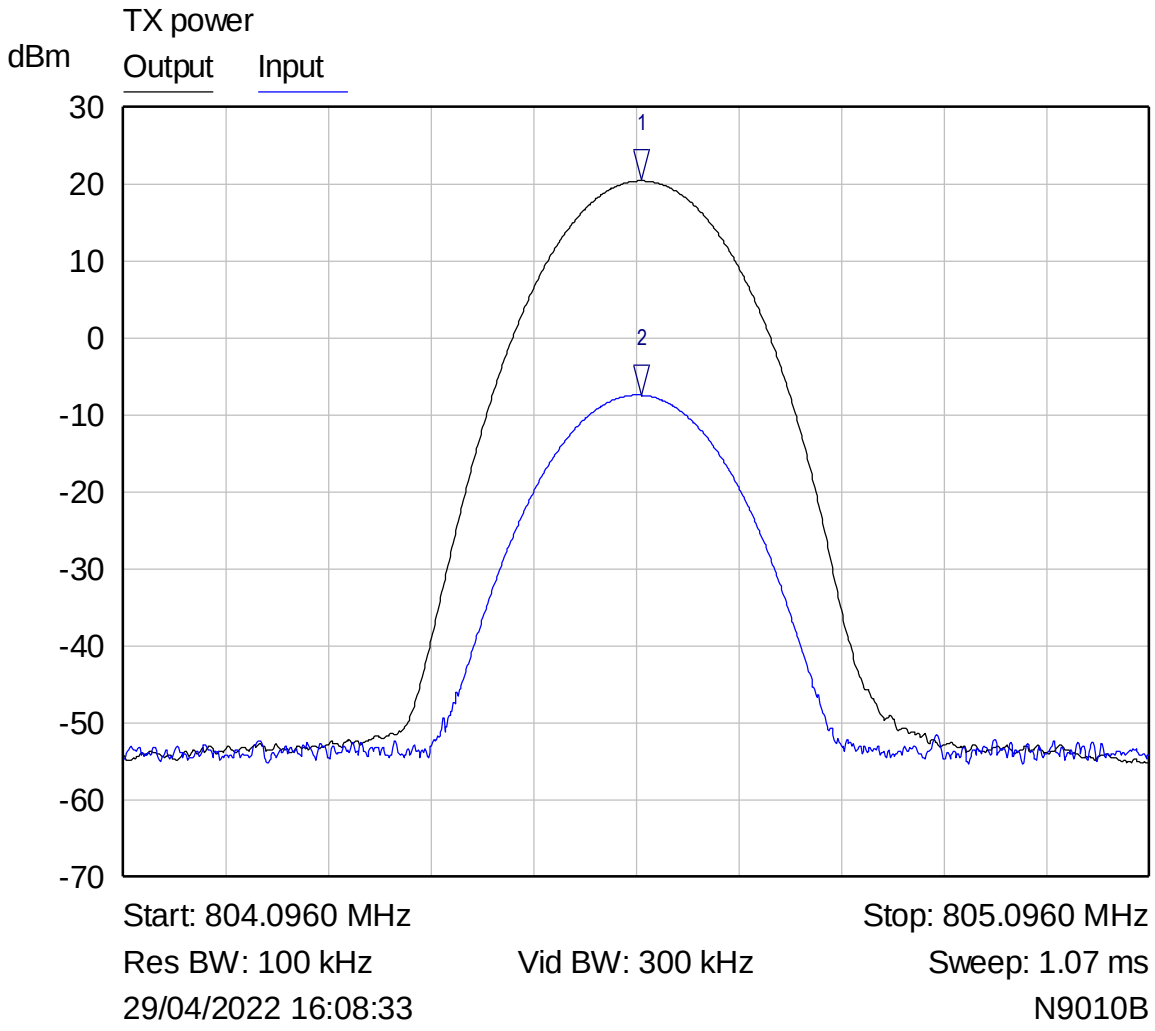
RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation CW, Channel 769.084 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	769.0885 MHz	20.18 dBm	
2 ▽	Input	769.0845 MHz	-7.40 dBm	

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

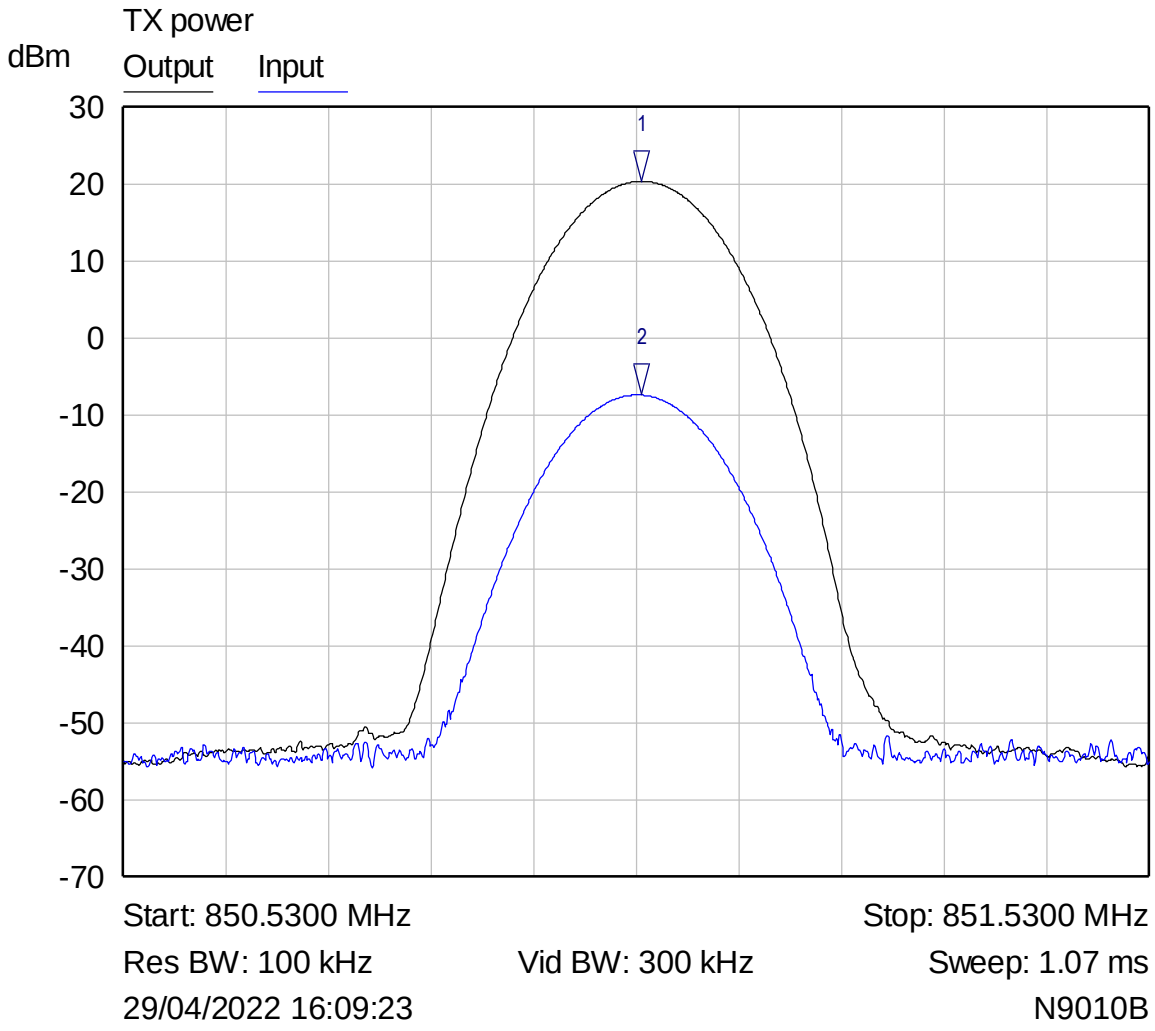
RF Parameters: Band 799-805 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation CW, Channel 804.549 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	804.6005 MHz	20.43 dBm	
2 ▽	Input	804.6015 MHz	-7.42 dBm	

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

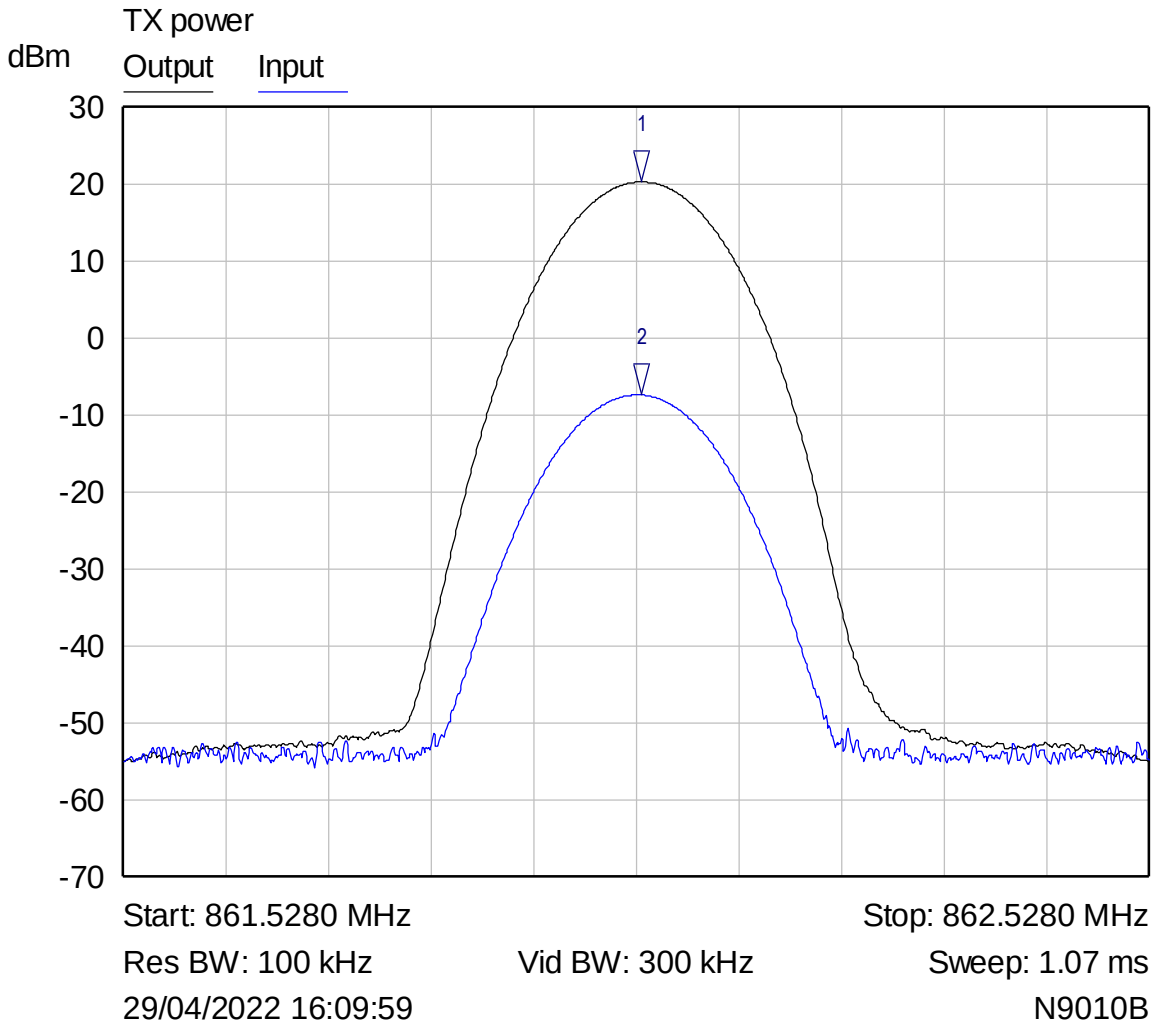
RF Parameters: Band 851-861 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation CW, Channel 851.03 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	851.0345 MHz	20.38 dBm	
2 ▽	Input	851.0355 MHz	-7.40 dBm	

Plot of Channel power at determined f_0 in Band 851-861 MHz

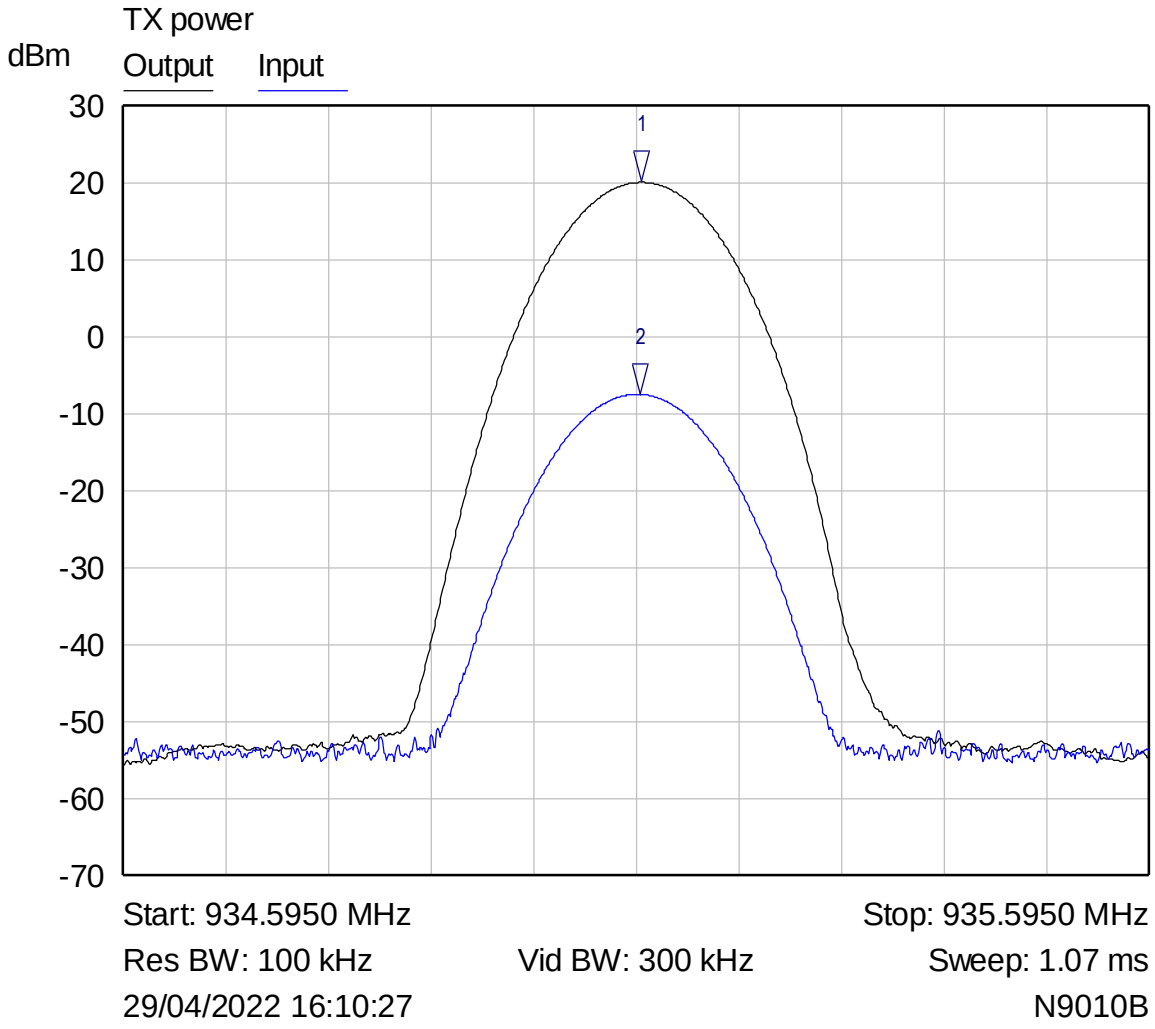
RF Parameters: Band 862-869 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 862.028 MHz (determined f_0)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	862.0325 MHz	20.29 dBm	
2 ▽	Input	862.0335 MHz	-7.39 dBm	

Plot of Channel power at determined f_0 in Band 862-869 MHz

RF Parameters: Band 935-940 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation CW, Channel 935.095 MHz (determined f_0)



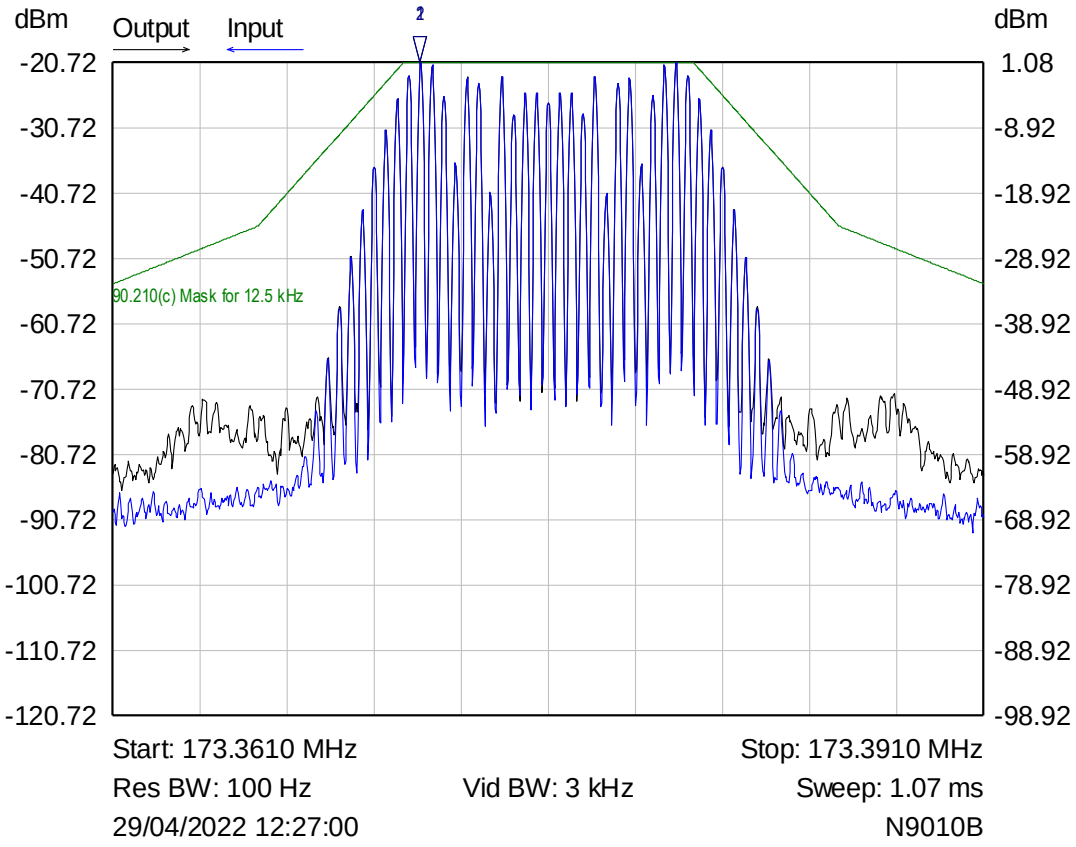
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	935.0995 MHz	20.09 dBm	
2 ▽	Input	935.0985 MHz	-7.46 dBm	

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,



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	173.3716 MHz	1.08 dBm	
2 ▽	Input	173.3716 MHz	-20.72 dBm	

Input

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	-9.75 dBm
Transmit Freq Error	-76.86 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.25 kHz
Power in Occupied Bandwidth	12.06 dBm
Transmit Freq Error	5.50 mHz
-26.00 dB Bandwidth	12.91 kHz

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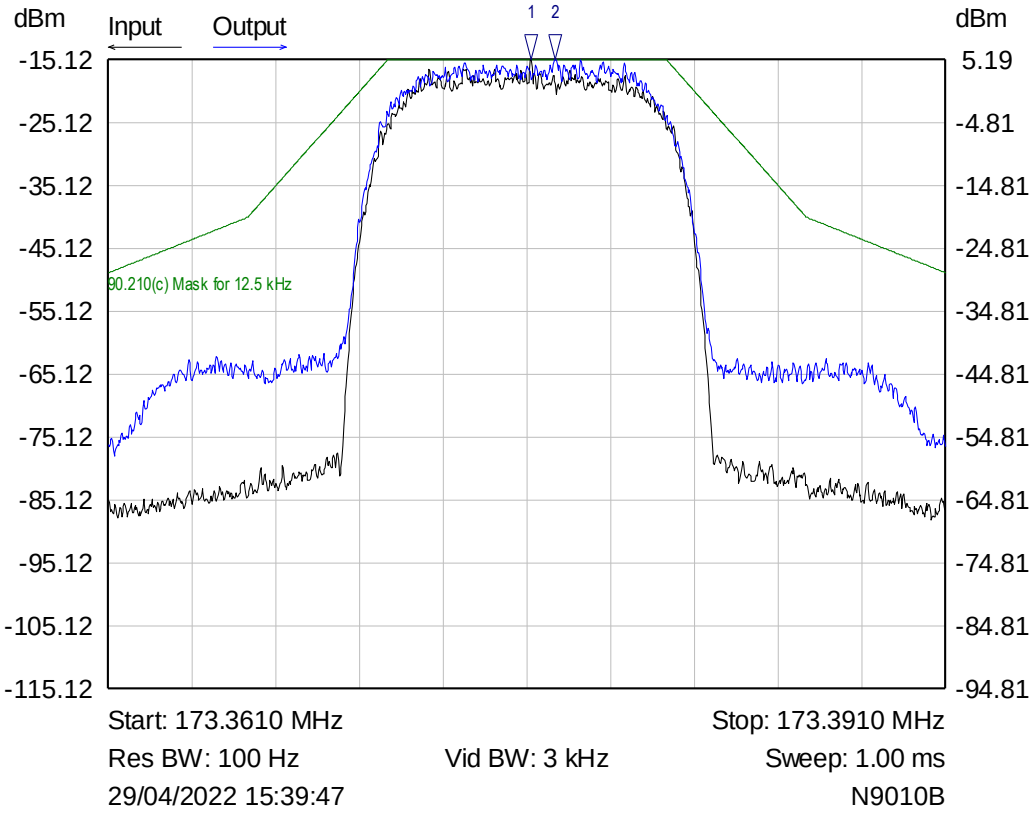
RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing N/A, Modulation QPSK,



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	173.3762 MHz	-15.12 dBm	
2 ▽	Output	173.3770 MHz	5.19 dBm	

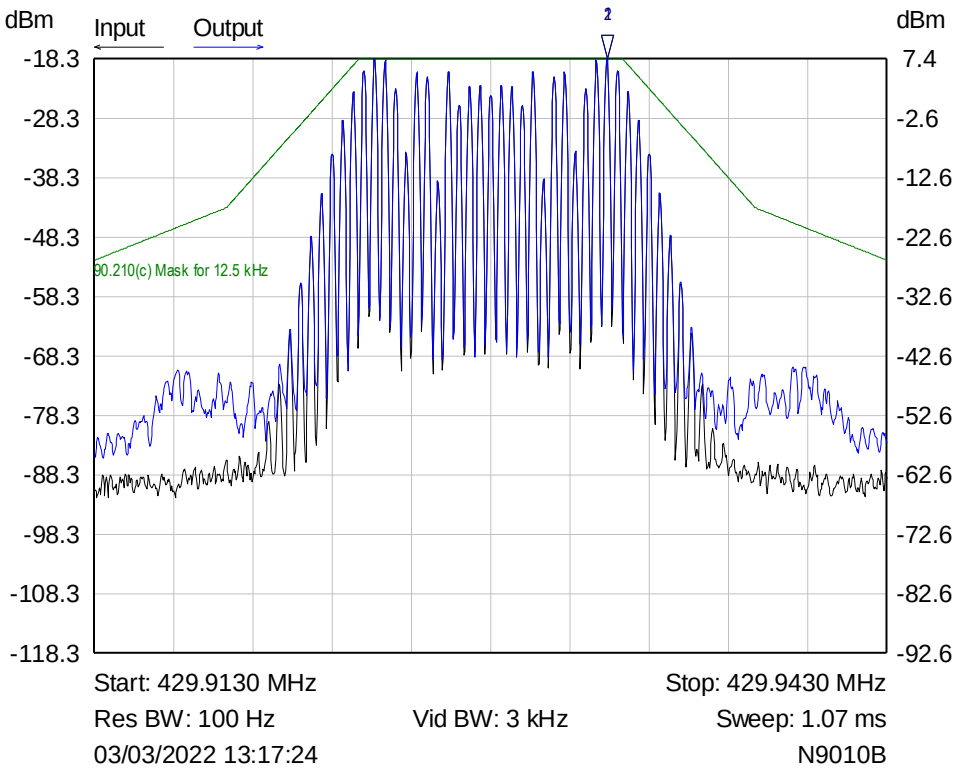
Input

Measurement Parameter	Value
Occupied Bandwidth	10.29 kHz
Power in Occupied Bandwidth	0.74 dBm
Transmit Freq Error	29.36 Hz
-26.00 dB Bandwidth	11.88 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.27 kHz
Power in Occupied Bandwidth	22.46 dBm
Transmit Freq Error	-25.98 Hz
-26.00 dB Bandwidth	12.00 kHz

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



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	429.9324 MHz	-18.27 dBm	
2 ▽	Output	429.9324 MHz	7.44 dBm	

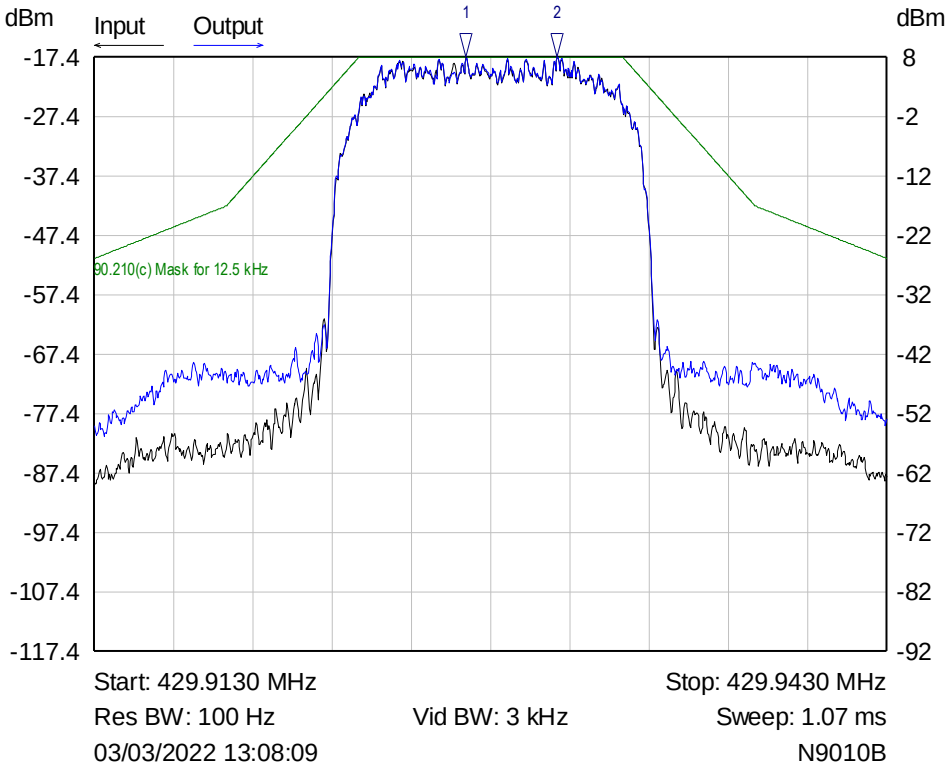
Input

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	-7.29 dBm
Transmit Freq Error	428.10 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	18.42 dBm
Transmit Freq Error	394.37 mHz
-26.00 dB Bandwidth	12.91 kHz

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



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	429.9271 MHz	-17.40 dBm	
2 ▽	Output	429.9305 MHz	8.05 dBm	

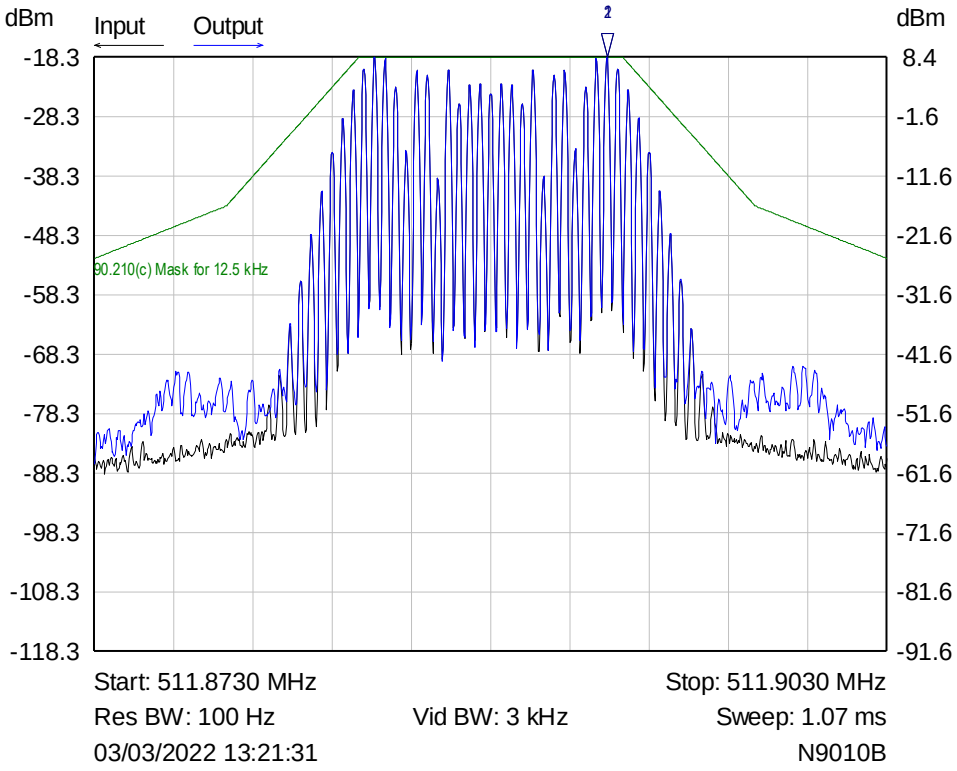
Input

Measurement Parameter	Value
Occupied Bandwidth	10.50 kHz
Power in Occupied Bandwidth	-0.49 dBm
Transmit Freq Error	45.49 Hz
-26.00 dB Bandwidth	11.88 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.50 kHz
Power in Occupied Bandwidth	25.02 dBm
Transmit Freq Error	43.32 Hz
-26.00 dB Bandwidth	11.89 kHz

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



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	511.8924 MHz	-18.27 dBm	
2 ▽	Output	511.8924 MHz	8.45 dBm	

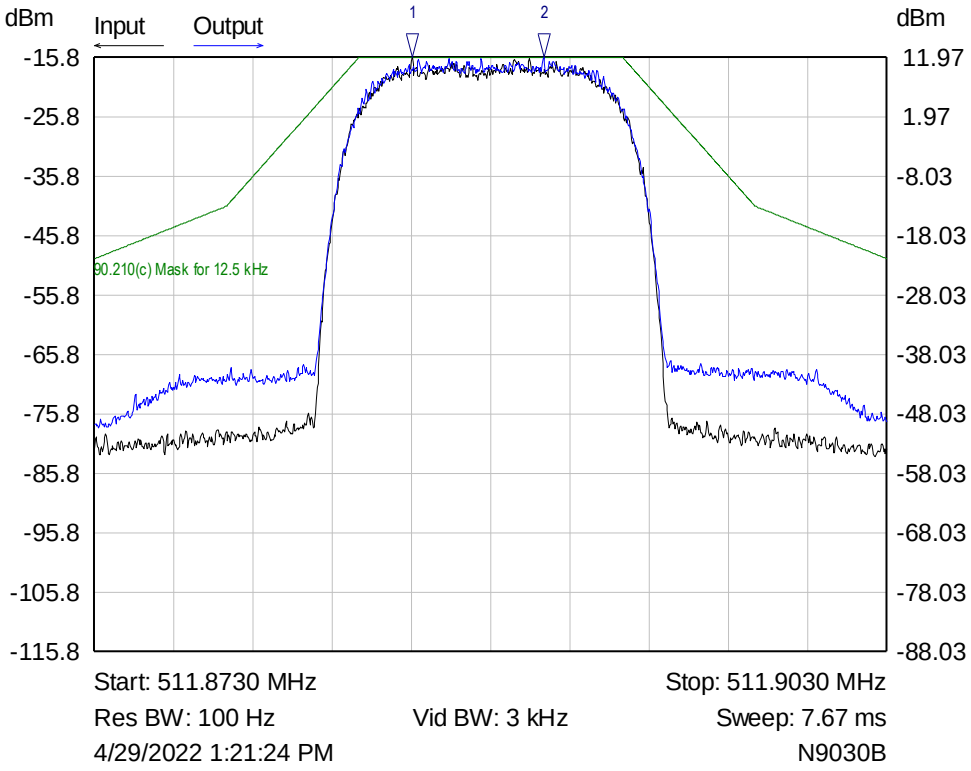
Input

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	-7.28 dBm
Transmit Freq Error	353.93 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	19.43 dBm
Transmit Freq Error	360.17 mHz
-26.00 dB Bandwidth	12.91 kHz

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



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	511.8850 MHz	-15.83 dBm	
2 ▽	Output	511.8900 MHz	11.97 dBm	

Input

Measurement Parameter	Value
Occupied Bandwidth	10.30 kHz
Power in Occupied Bandwidth	1.20 dBm
Transmit Freq Error	-1.99 Hz
-26.00 dB Bandwidth	11.93 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.23 kHz
Power in Occupied Bandwidth	29.39 dBm
Transmit Freq Error	8.59 Hz
-26.00 dB Bandwidth	11.98 kHz

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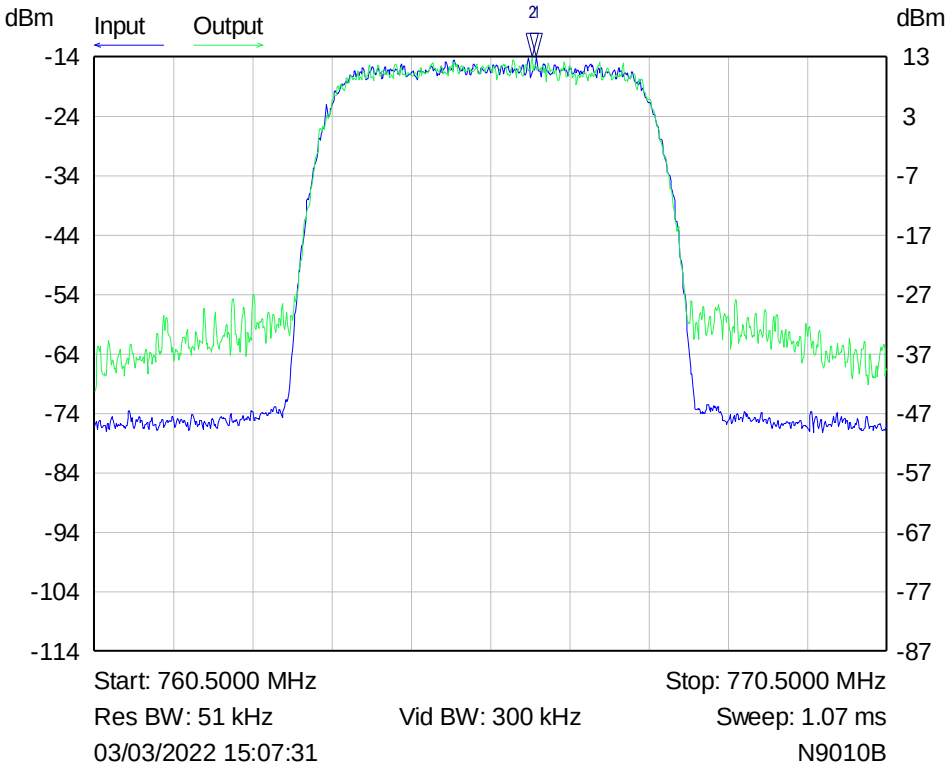
RF Parameters: Band 758-768 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN,



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	766.0800 MHz	-14.03 dBm	
2 ▽	Output	766.0200 MHz	12.98 dBm	

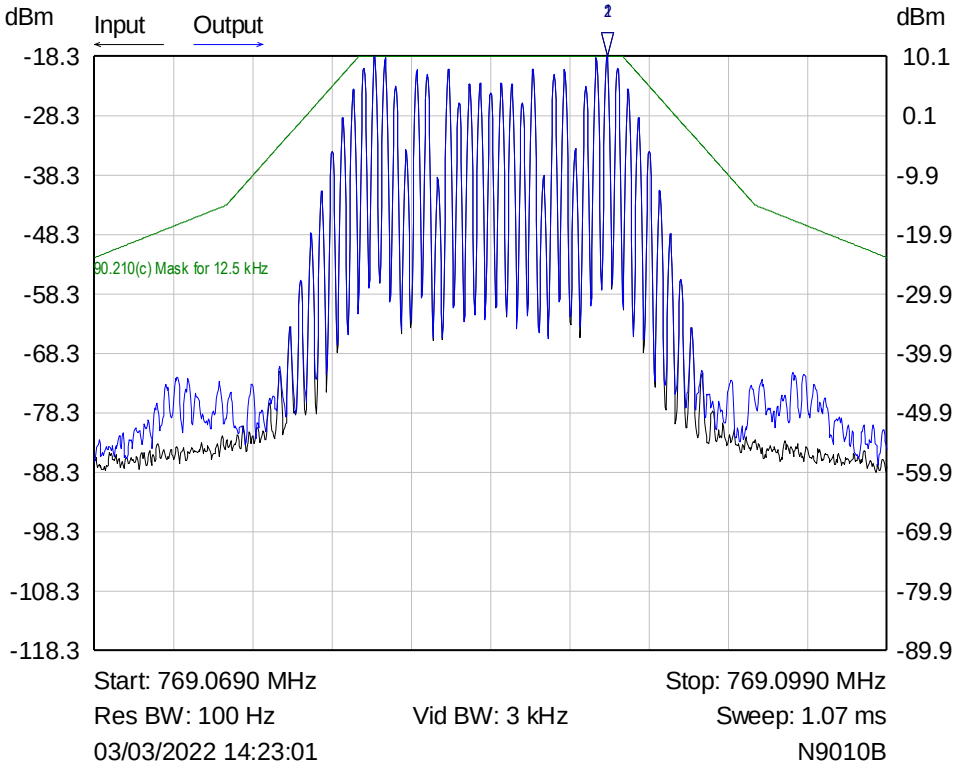
Input

Measurement Parameter	Value
Occupied Bandwidth	4.09 MHz
Power in Occupied Bandwidth	2.27 dBm
Transmit Freq Error	-8.85 kHz
-26.00 dB Bandwidth	4.66 MHz

Output

Measurement Parameter	Value
Occupied Bandwidth	4.09 MHz
Power in Occupied Bandwidth	29.16 dBm
Transmit Freq Error	-546.90 Hz
-26.00 dB Bandwidth	4.65 MHz

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



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	769.0884 MHz	-18.32 dBm	
2 ▽	Output	769.0884 MHz	10.13 dBm	

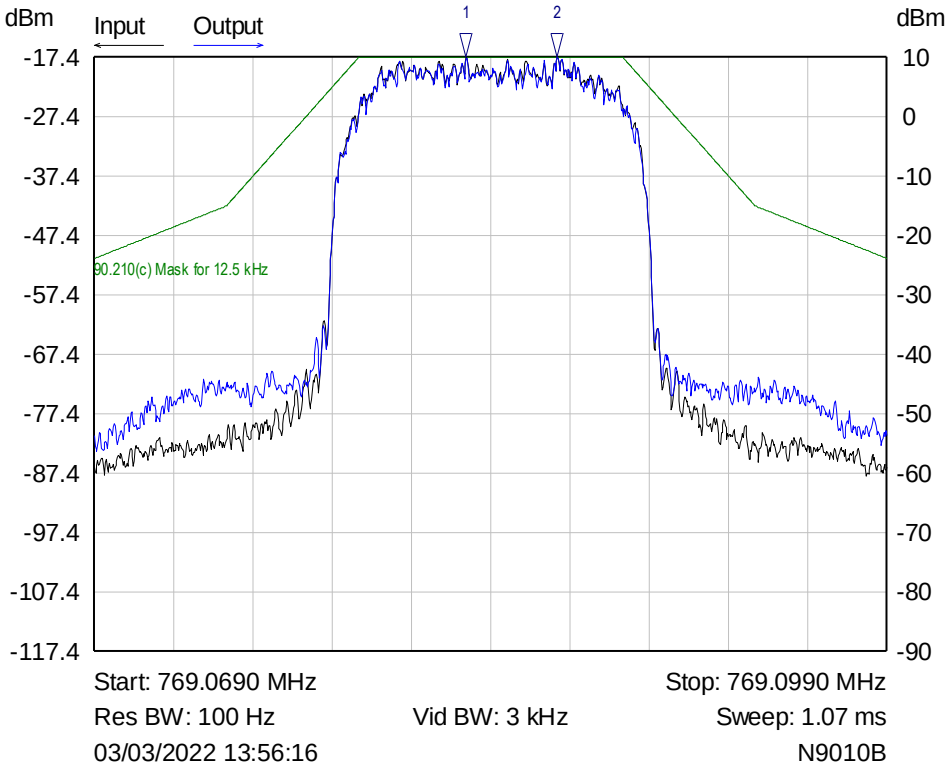
Input

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	-7.31 dBm
Transmit Freq Error	343.33 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	21.14 dBm
Transmit Freq Error	243.99 mHz
-26.00 dB Bandwidth	12.91 kHz

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



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	769.0831 MHz	-17.37 dBm	
2 ▽	Output	769.0865 MHz	9.98 dBm	

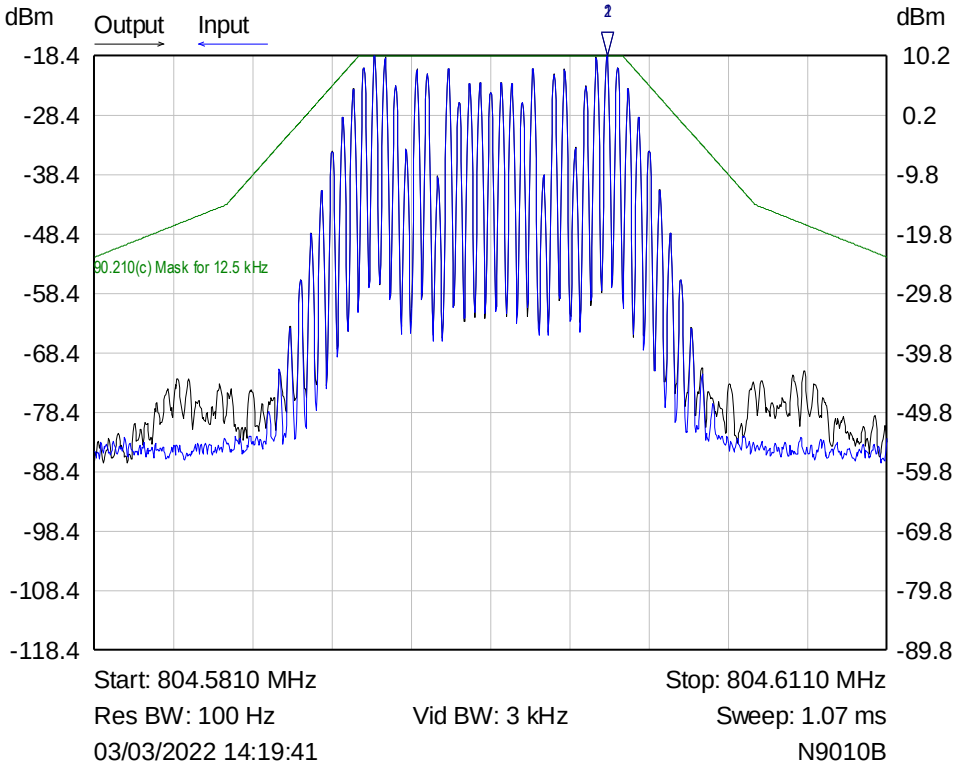
Input

Measurement Parameter	Value
Occupied Bandwidth	10.50 kHz
Power in Occupied Bandwidth	-0.52 dBm
Transmit Freq Error	45.31 Hz
-26.00 dB Bandwidth	11.88 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.46 kHz
Power in Occupied Bandwidth	26.70 dBm
Transmit Freq Error	38.13 Hz
-26.00 dB Bandwidth	11.88 kHz

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



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	804.6004 MHz	10.24 dBm	
2 ▽	Input	804.6004 MHz	-18.41 dBm	

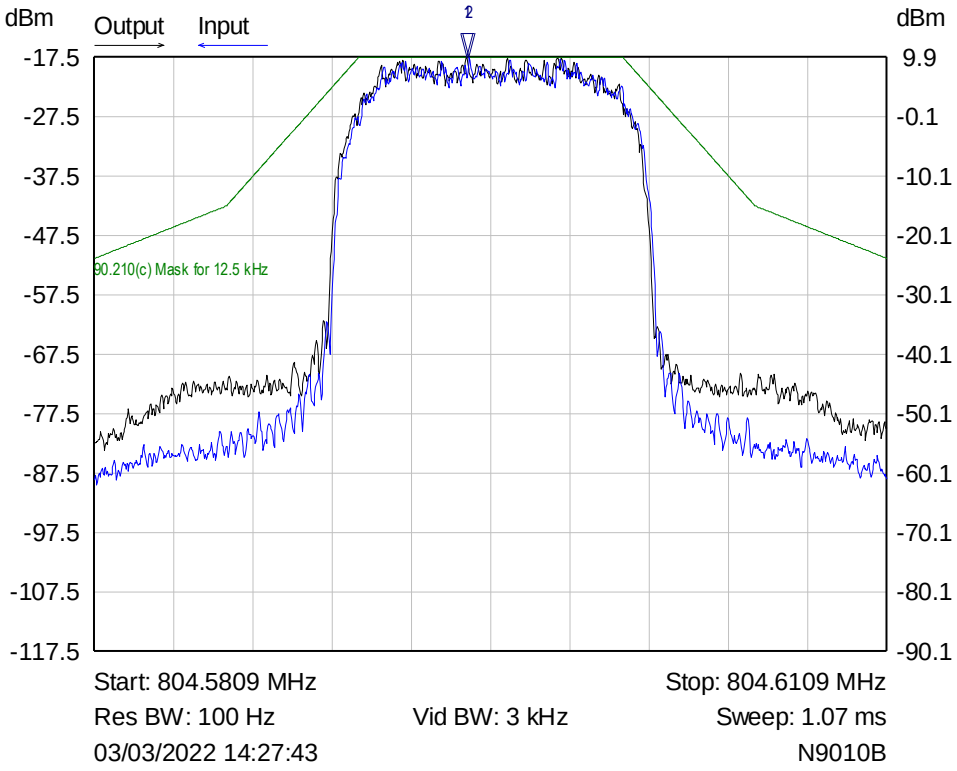
Input

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	-7.41 dBm
Transmit Freq Error	370.16 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	21.24 dBm
Transmit Freq Error	321.98 mHz
-26.00 dB Bandwidth	12.91 kHz

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



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	804.5950 MHz	9.89 dBm	
2 ▽	Input	804.5951 MHz	-17.55 dBm	

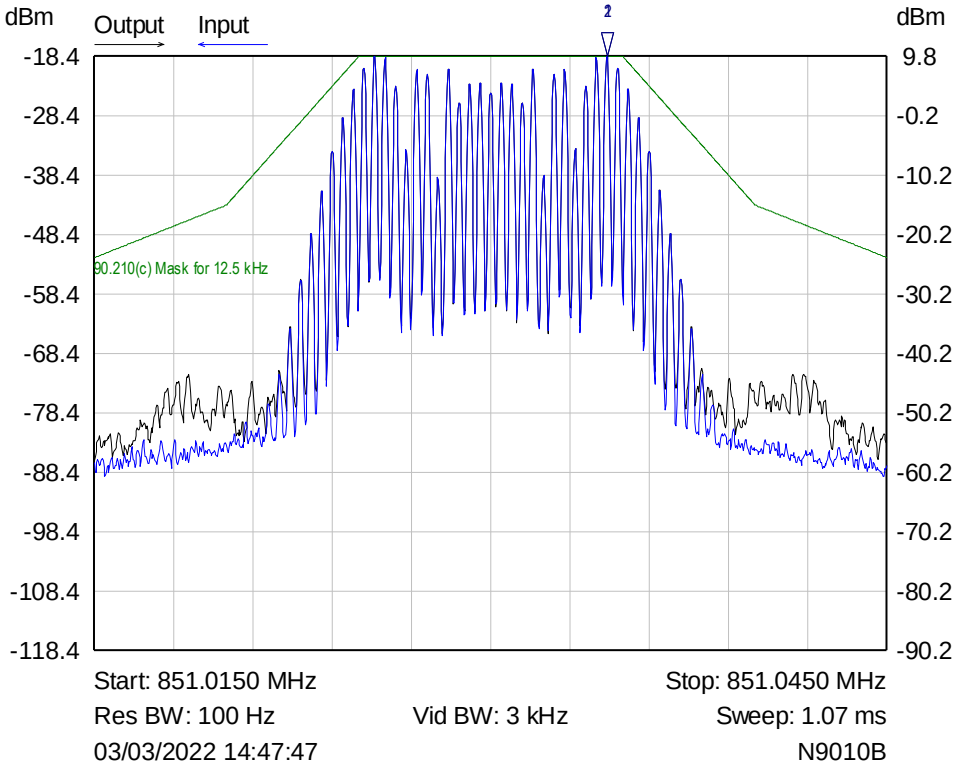
Input

Measurement Parameter	Value
Occupied Bandwidth	10.50 kHz
Power in Occupied Bandwidth	-0.77 dBm
Transmit Freq Error	158.29 Hz
-26.00 dB Bandwidth	11.87 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.50 kHz
Power in Occupied Bandwidth	26.90 dBm
Transmit Freq Error	43.64 Hz
-26.00 dB Bandwidth	11.89 kHz

RF Parameters: Band 851-861 MHz, Power +20 dBm, Channel Spacing N/A, Modulation FM



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	851.0344 MHz	9.83 dBm	
2 ▽	Input	851.0344 MHz	-18.38 dBm	

Input

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	-7.37 dBm
Transmit Freq Error	420.58 mHz
-26.00 dB Bandwidth	12.91 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	11.24 kHz
Power in Occupied Bandwidth	20.84 dBm
Transmit Freq Error	470.50 mHz
-26.00 dB Bandwidth	12.91 kHz

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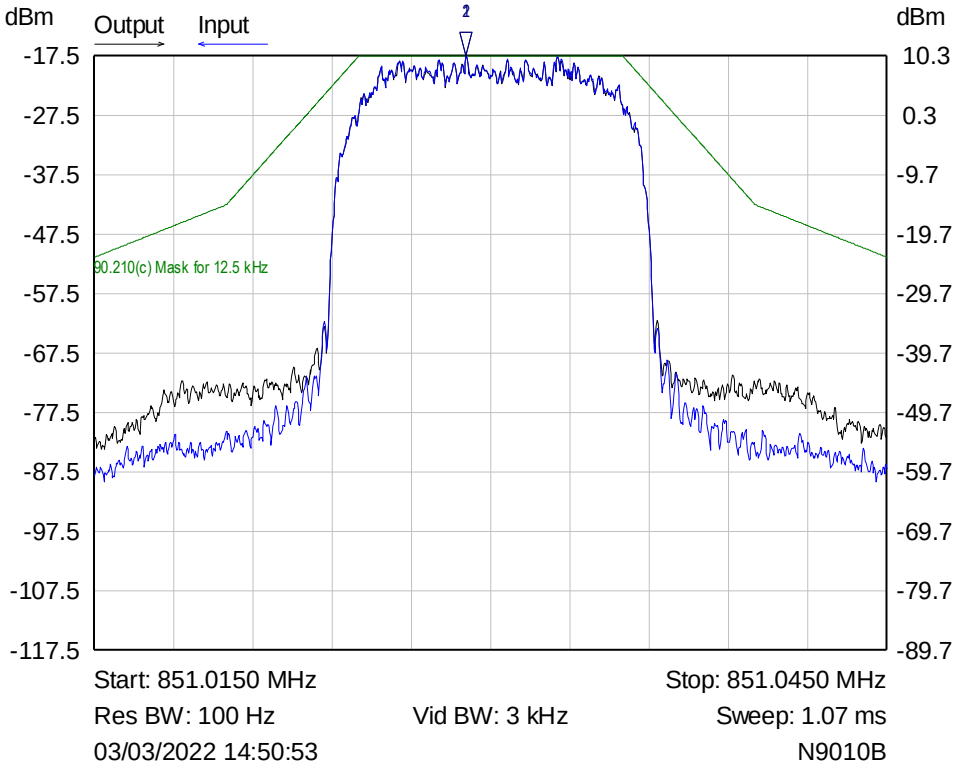
RF Parameters: Band 851-861 MHz, Power +20 dBm, Channel Spacing N/A, Modulation QPSK



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	851.0291 MHz	10.29 dBm	
2 ▽	Input	851.0291 MHz	-17.49 dBm	

Input

Measurement Parameter	Value
Occupied Bandwidth	10.49 kHz
Power in Occupied Bandwidth	-0.77 dBm
Transmit Freq Error	46.09 Hz
-26.00 dB Bandwidth	11.87 kHz

Output

Measurement Parameter	Value
Occupied Bandwidth	10.49 kHz
Power in Occupied Bandwidth	26.97 dBm
Transmit Freq Error	38.89 Hz
-26.00 dB Bandwidth	11.88 kHz

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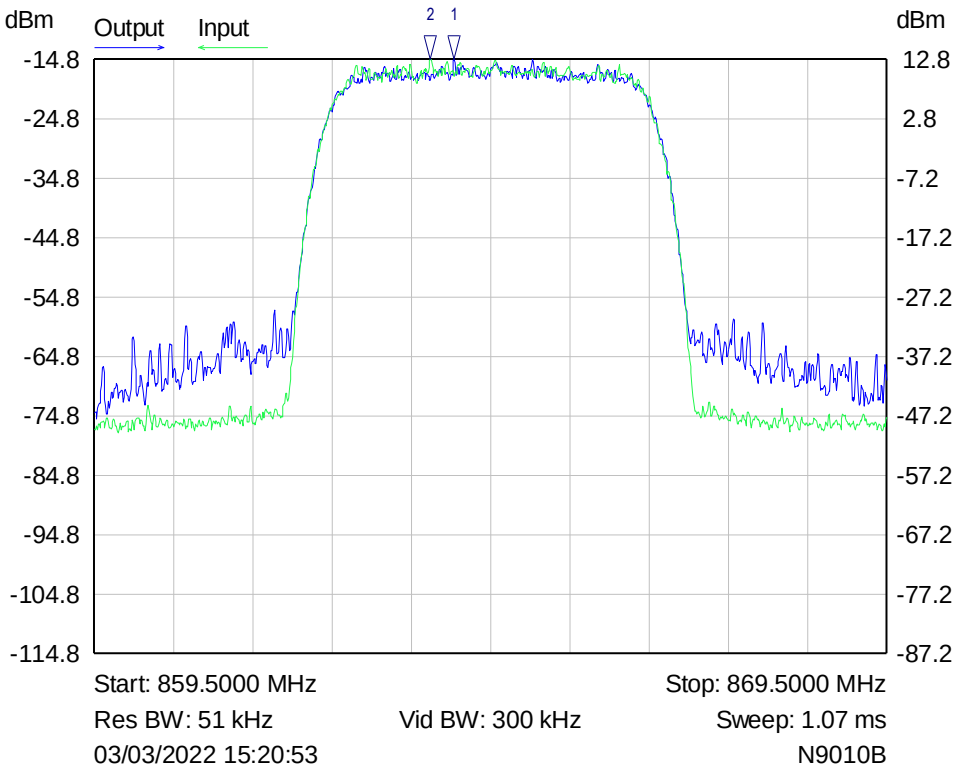
RF Parameters: Band 862-869 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel, 864.5 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Output	864.0400 MHz	12.80 dBm	
2 ▽	Input	863.7400 MHz	-14.76 dBm	

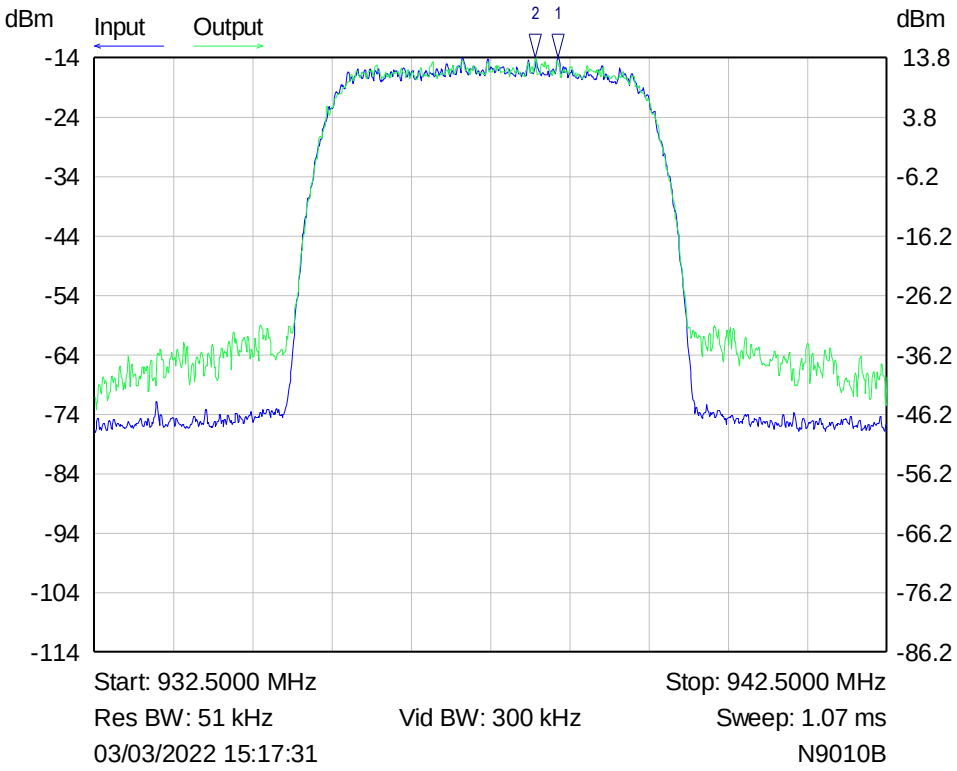
Output

Measurement Parameter	Value
Occupied Bandwidth	4.09 MHz
Power in Occupied Bandwidth	28.90 dBm
Transmit Freq Error	2.69 kHz
-26.00 dB Bandwidth	4.63 MHz

Input

Measurement Parameter	Value
Occupied Bandwidth	4.07 MHz
Power in Occupied Bandwidth	1.56 dBm
Transmit Freq Error	1.89 kHz
-26.00 dB Bandwidth	4.65 MHz

RF Parameters: Band 935-940 MHz, Power +20 dBm, Channel Spacing 5 MHz, Modulation AWGN, Channel 937.5 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Input	938.3500 MHz	-13.97 dBm	
2 ▽	Output	938.0600 MHz	13.79 dBm	

Output

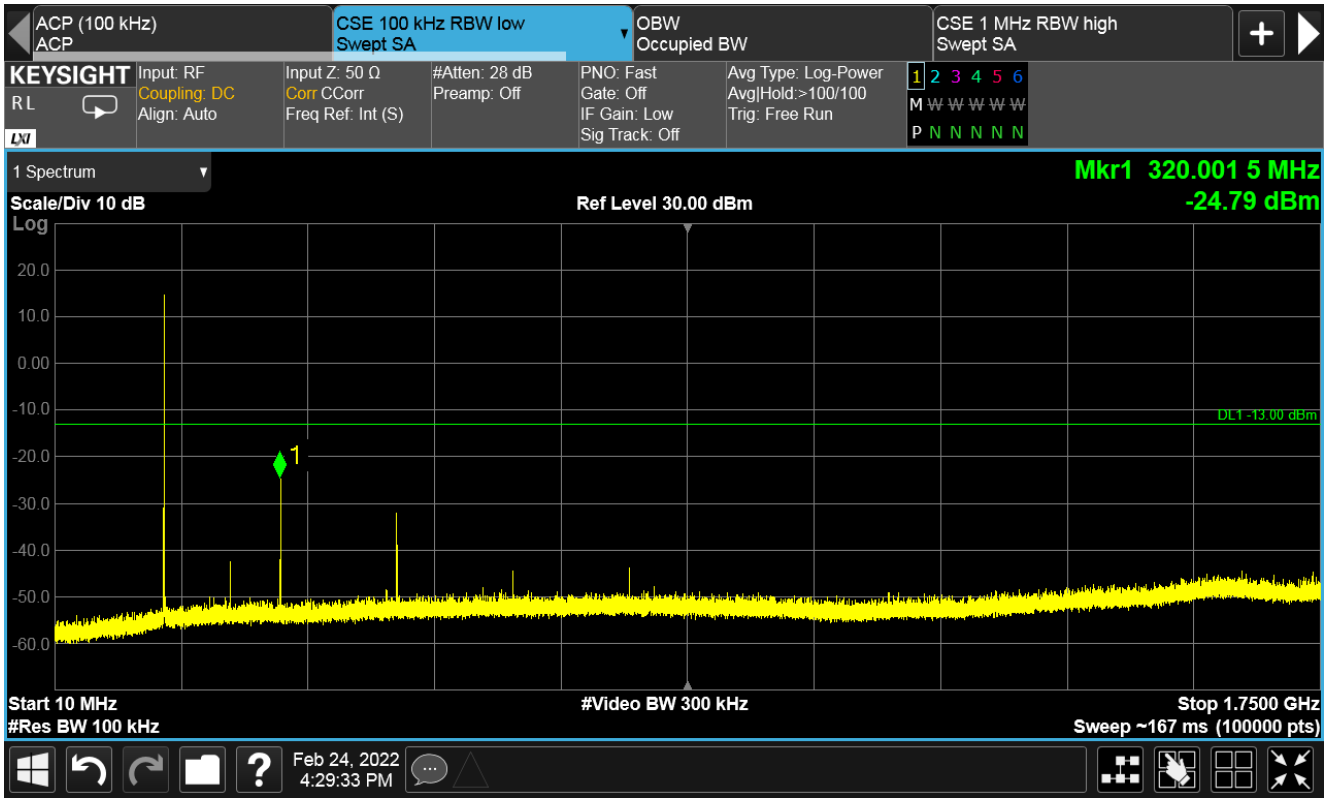
Measurement Parameter	Value
Occupied Bandwidth	4.09 MHz
Power in Occupied Bandwidth	29.98 dBm
Transmit Freq Error	-4.35 kHz
-26.00 dB Bandwidth	4.66 MHz

Input

Measurement Parameter	Value
Occupied Bandwidth	4.09 MHz
Power in Occupied Bandwidth	2.08 dBm
Transmit Freq Error	-885.48 Hz
-26.00 dB Bandwidth	4.66 MHz

6.4 Spurious emissions at antenna terminals

RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 162 MHz, Single channel mode



Plot of conducted emissions, middle channel, 10 – 1750 MHz range

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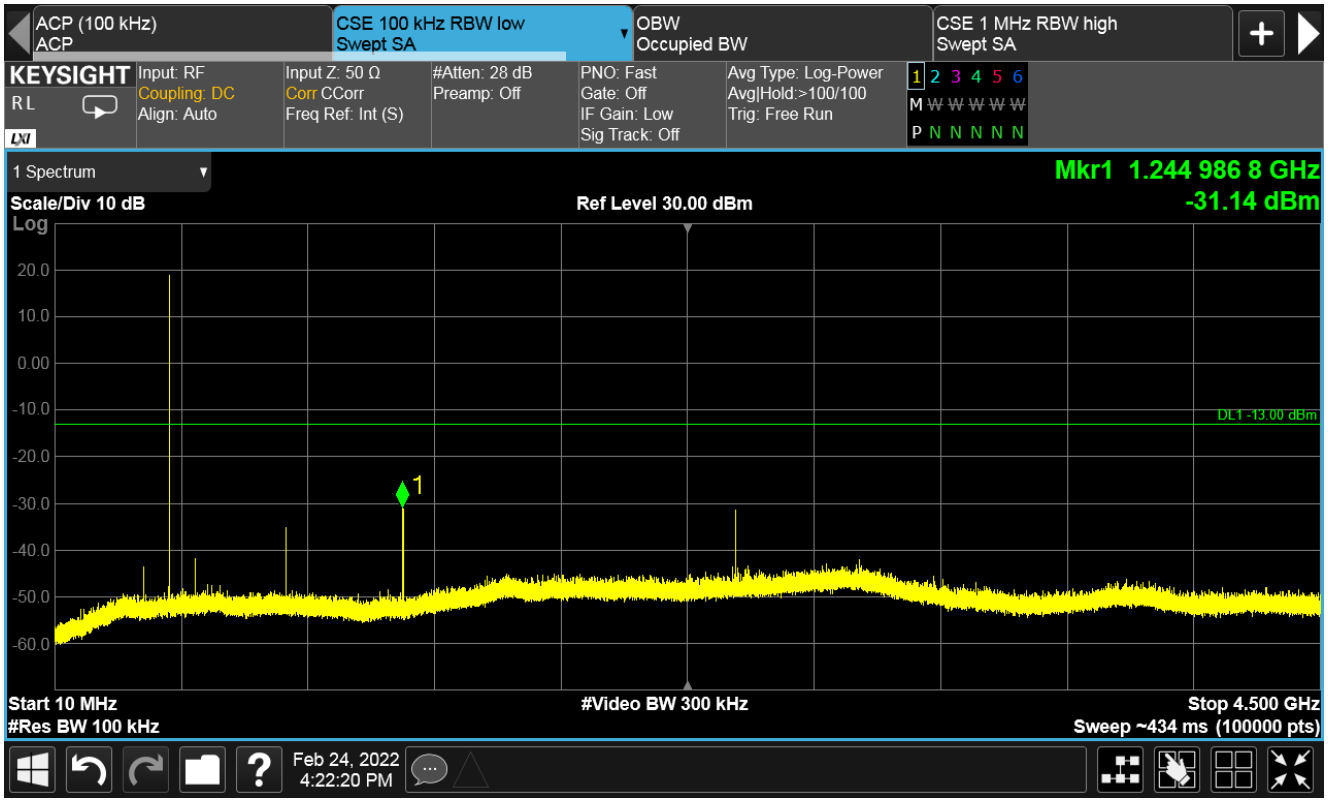
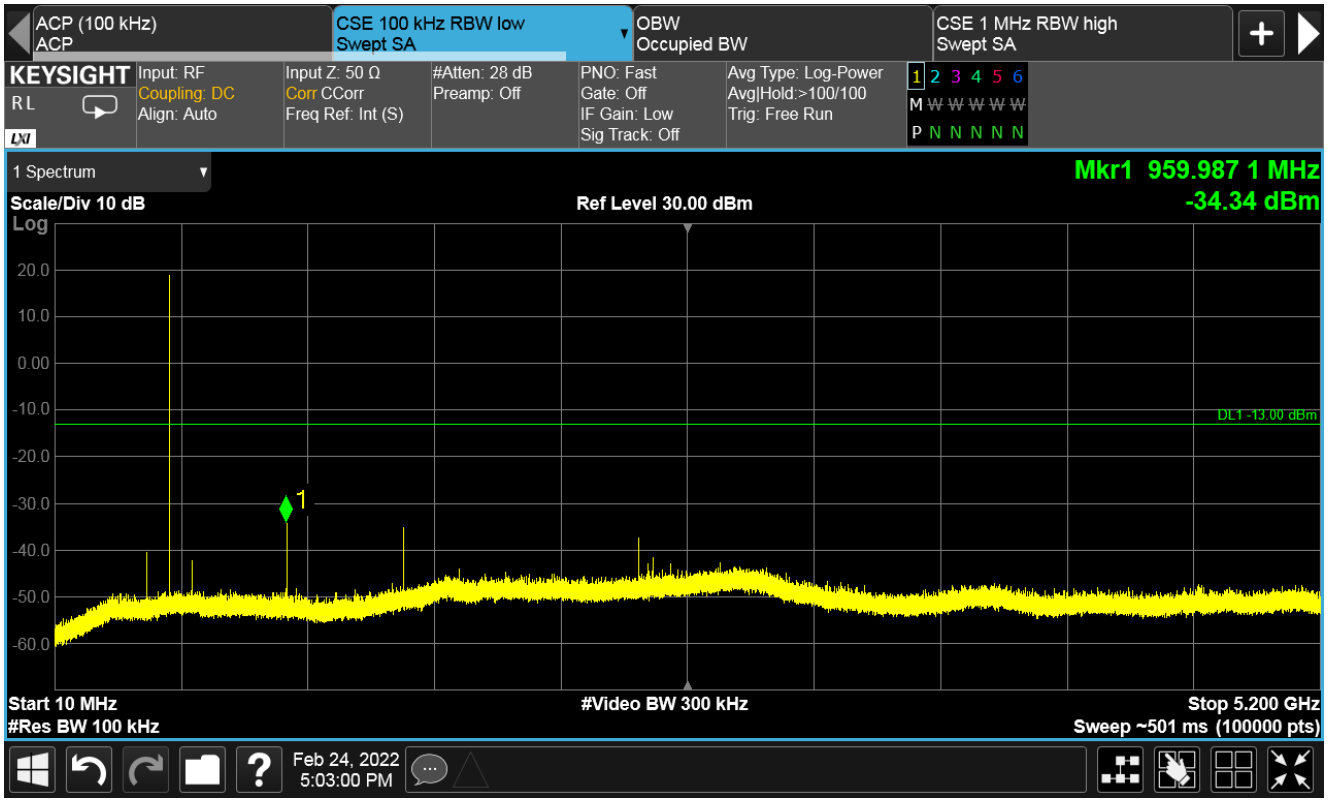
RF Parameters: Band 406.1-430 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 415 MHz, Single channel mode



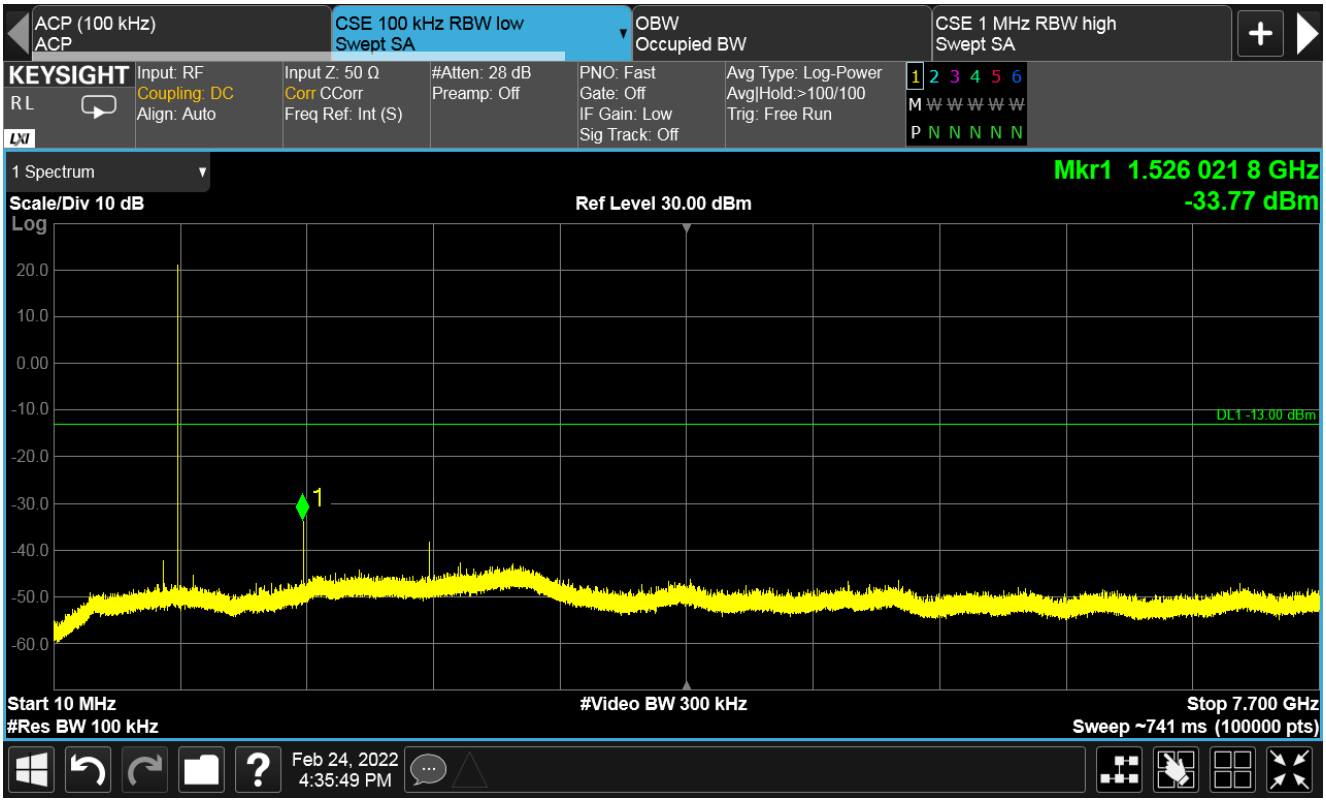
Plot of conducted emissions, middle channel, 10 – 4500 MHz range

RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 480 MHz, Single channel mode



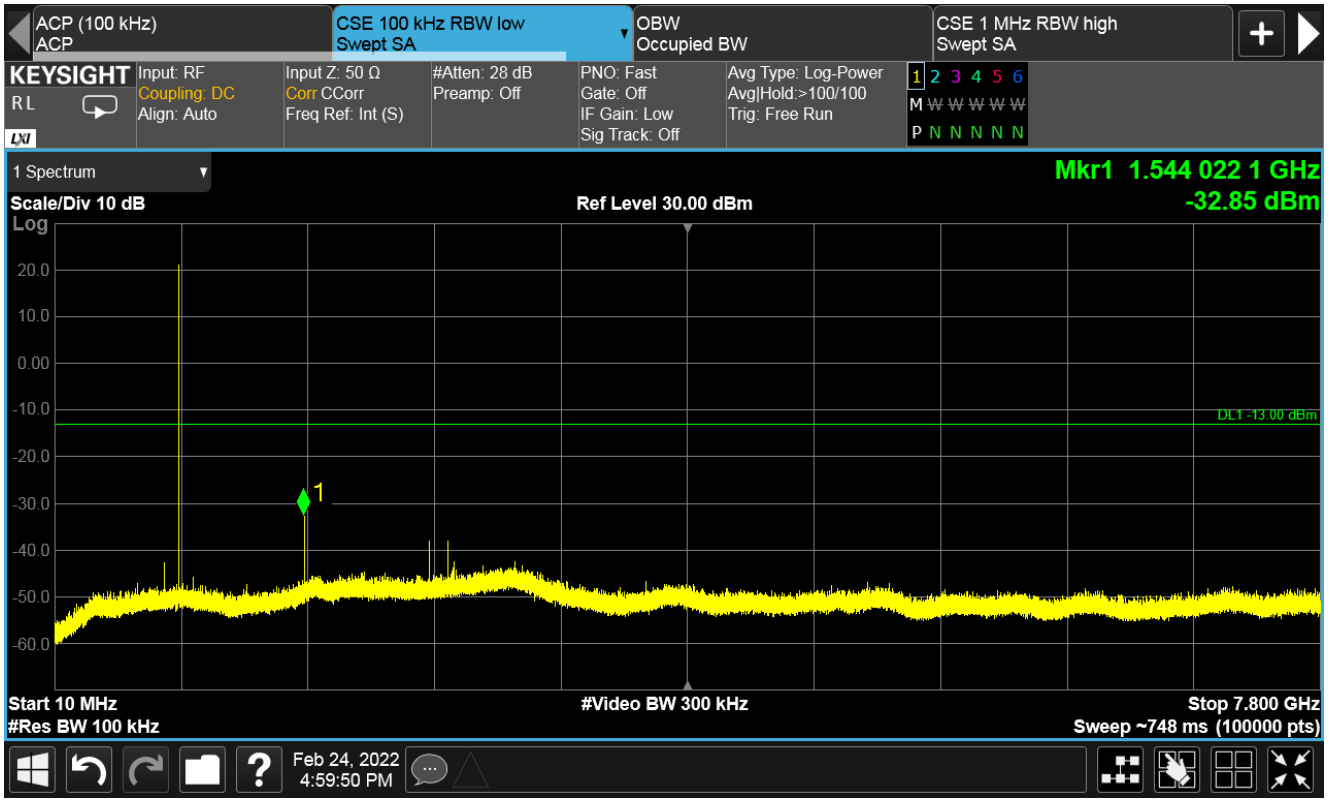
Plot of conducted emissions, middle channel, 10 – 5200 MHz range

RF Parameters: Band 758-768 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 763 MHz, Single channel mode



Plot of conducted emissions, middle channel, 10 – 7700 MHz range

RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing 5MHz, Modulation AWGN, Channel 772 MHz, Single channel mode



Plot of conducted emissions, middle channel, 10 – 7800 MHz range

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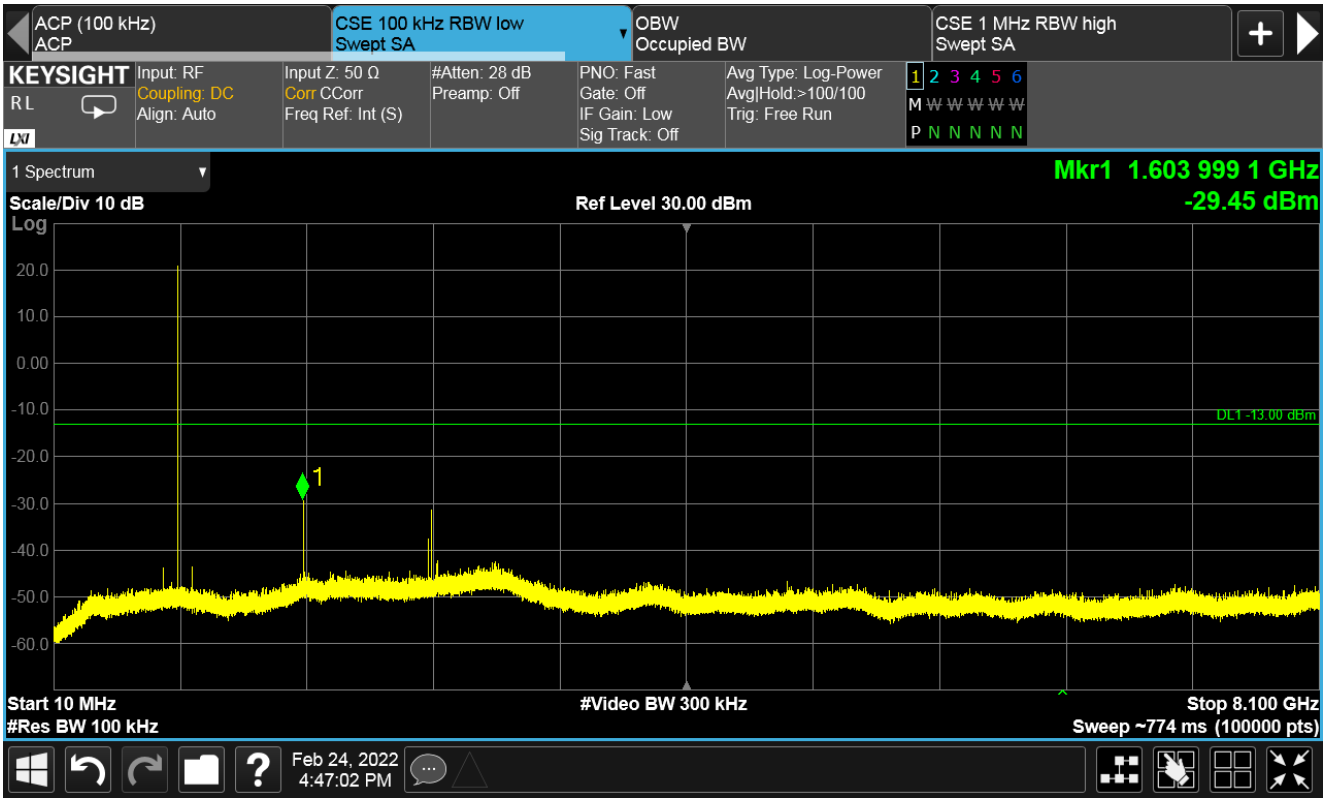
RF Parameters: Band 799-805 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 802 MHz, Single channel mode



Plot of conducted emissions, middle channel, 10 – 8100 MHz range

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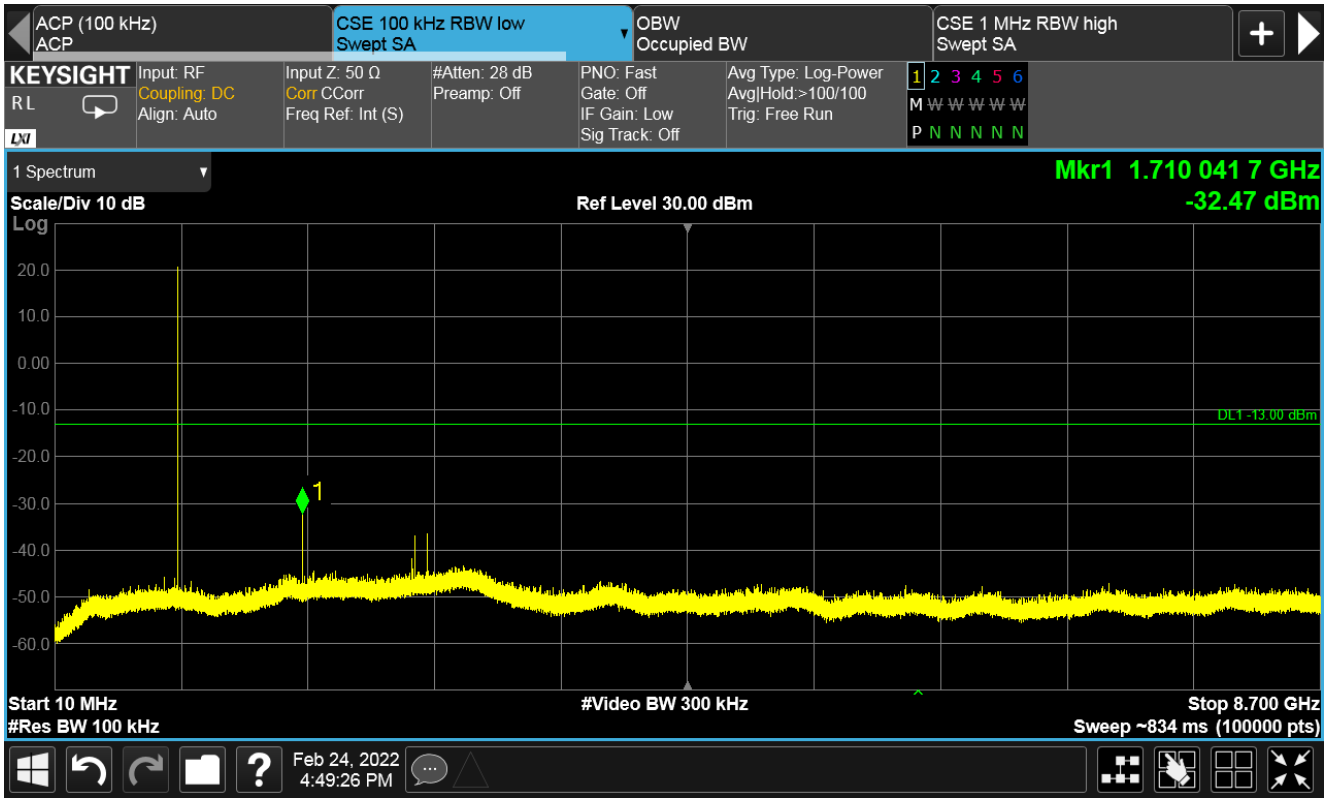
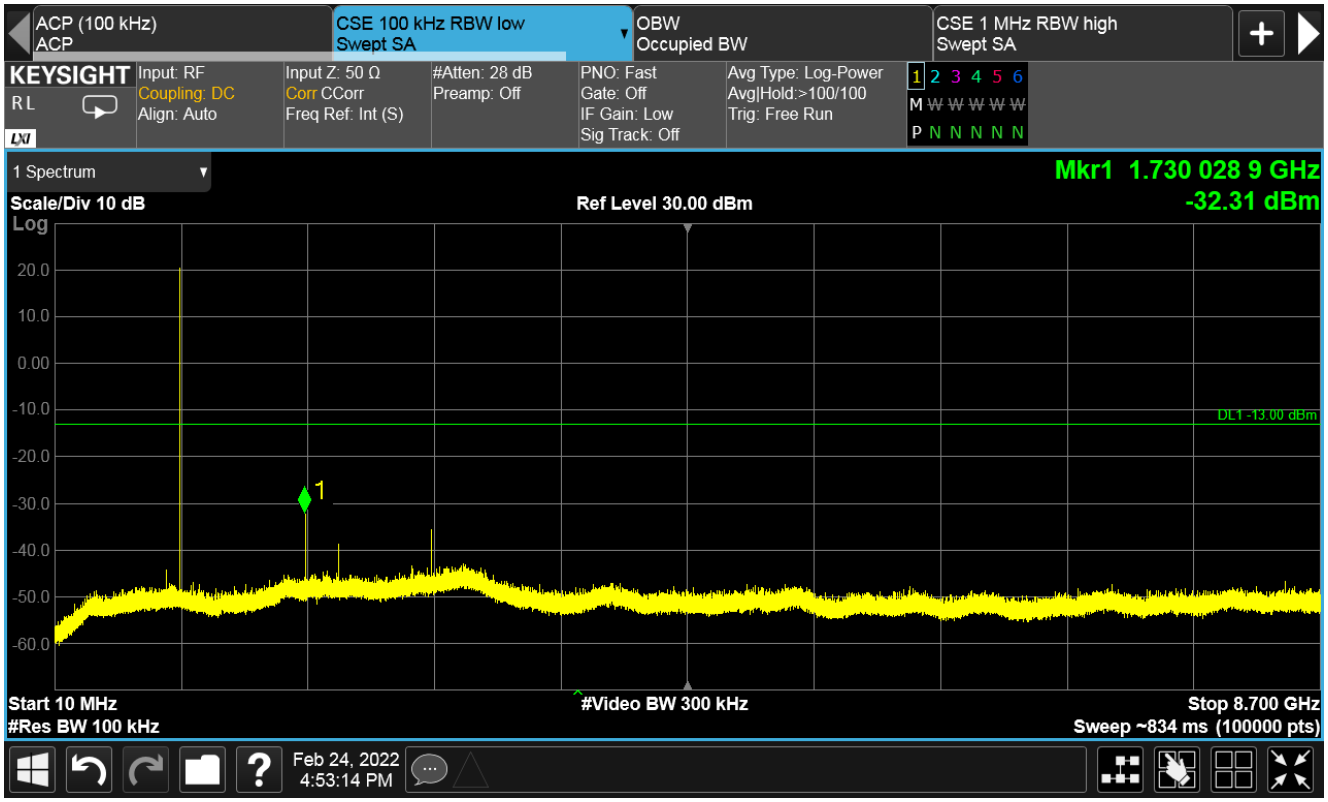
RF Parameters: Band 851-861 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 855 MHz, Single channel mode



Plot of conducted emissions, middle channel, 10 – 8700 MHz range

RF Parameters: Band 862-869 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 865 MHz, Single channel mode



Plot of conducted emissions, middle channel, 10 – 8700 MHz range

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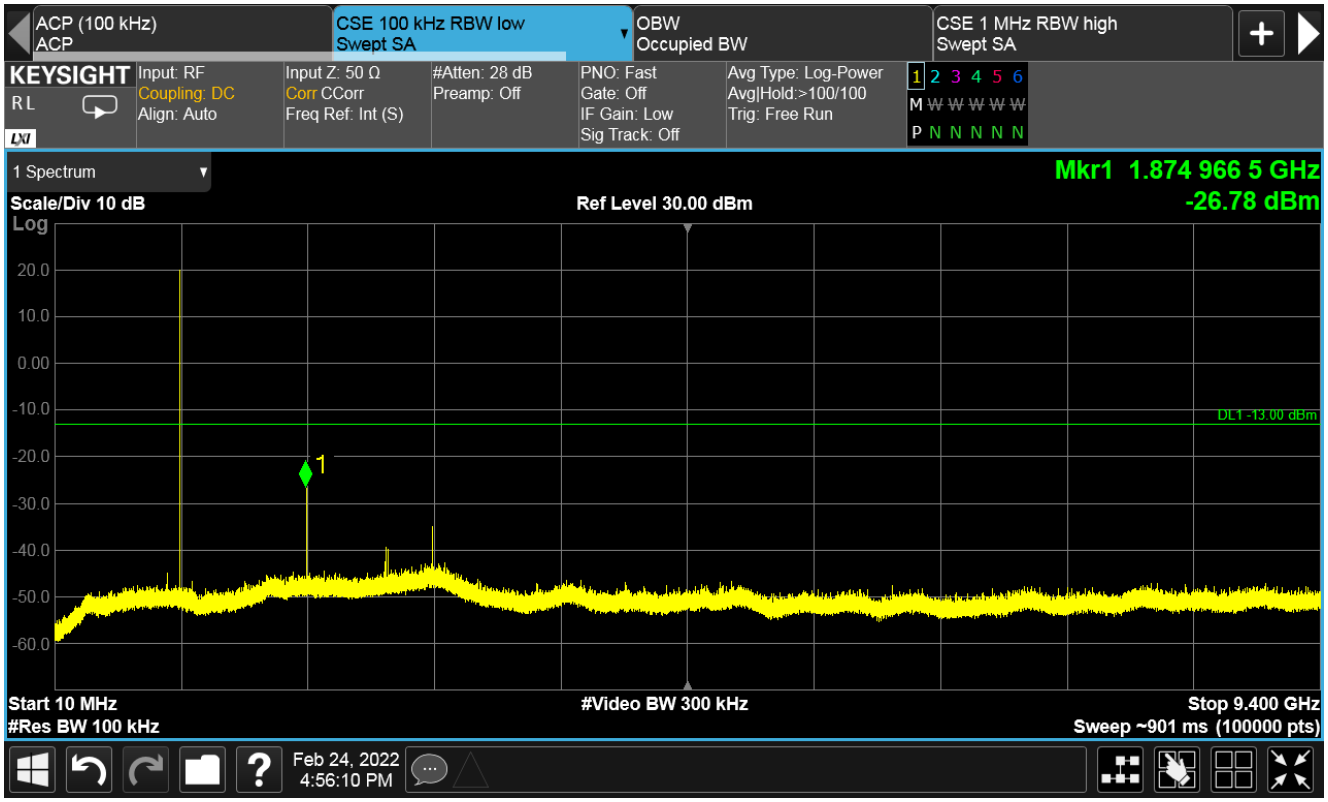
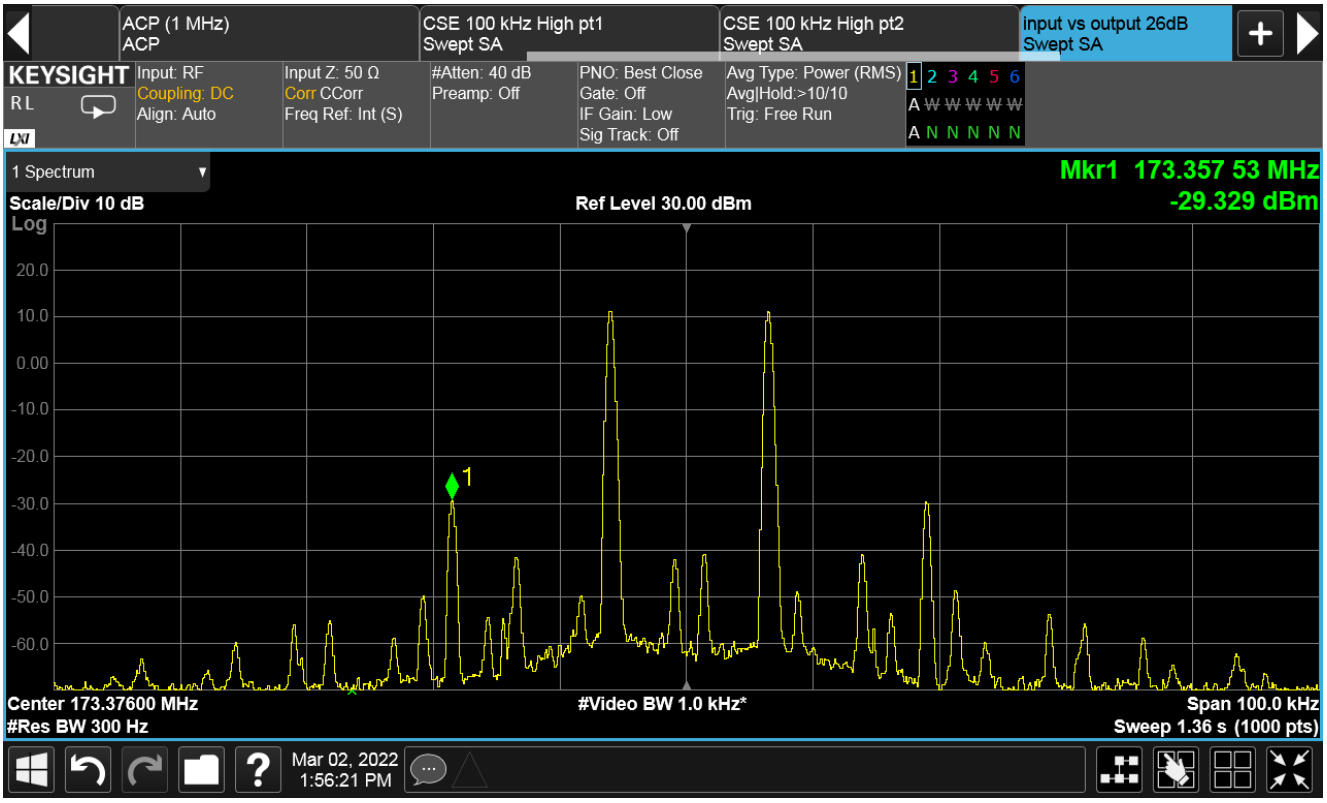
RF Parameters: Band 935-940 MHz, Power +20 dBm, Channel Spacing N/A, Modulation CW, Channel 935.0125 MHz, Single channel mode



Plot of conducted emissions, middle channel, 10 – 9400 MHz range

6.5 Intermodulation spurious emissions

RF Parameters: Band 150-174 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 173.370 + 173.3825 MHz (determined f_0)



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

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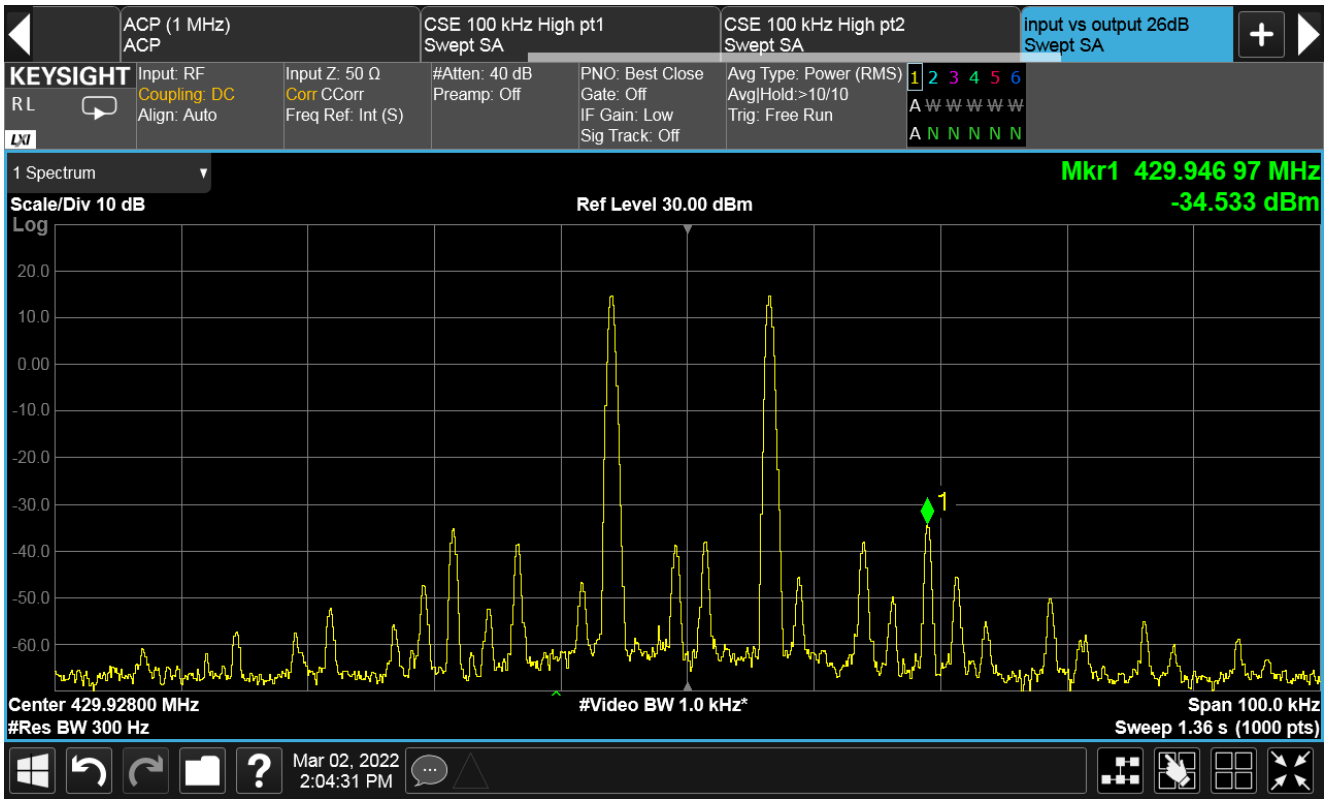
RF Parameters: Band 406.1-430 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 429.922 + 429.9345 MHz (determined f_0)



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

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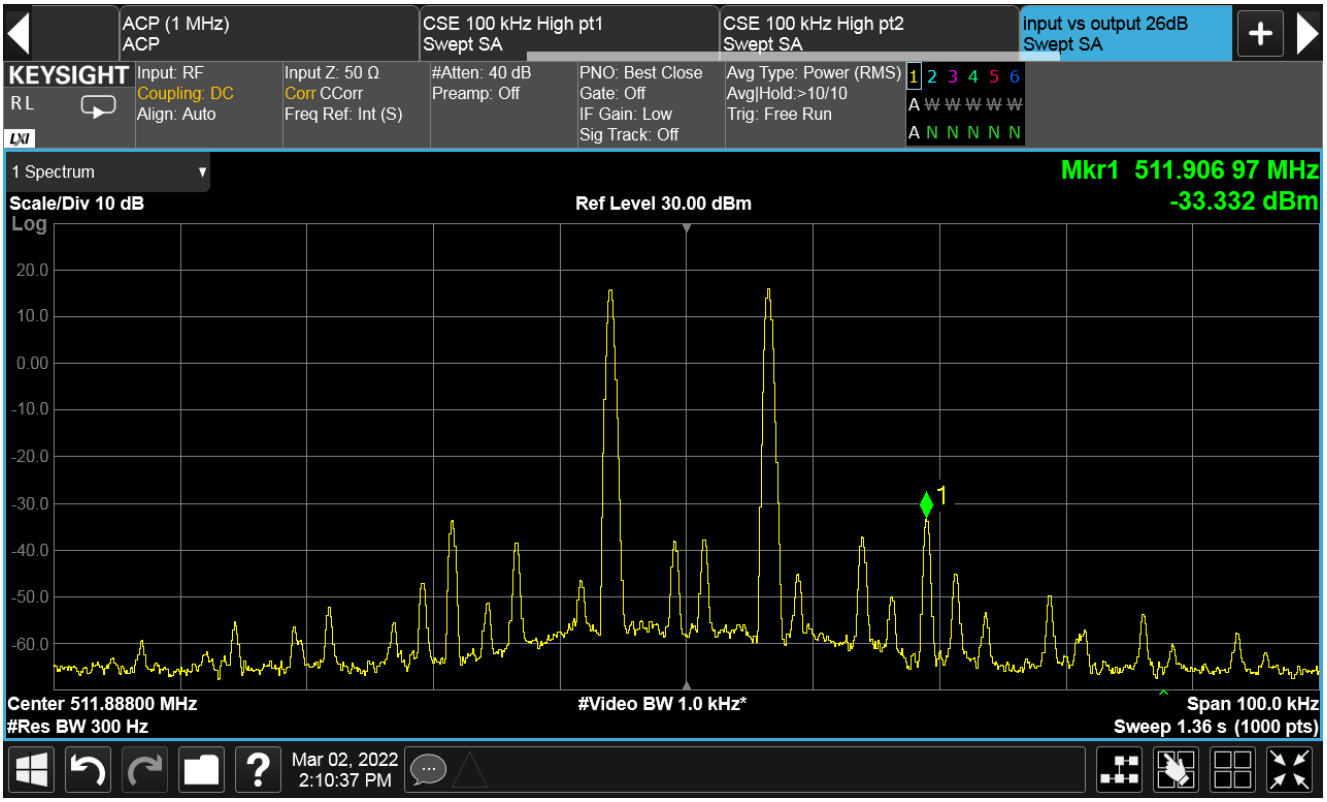
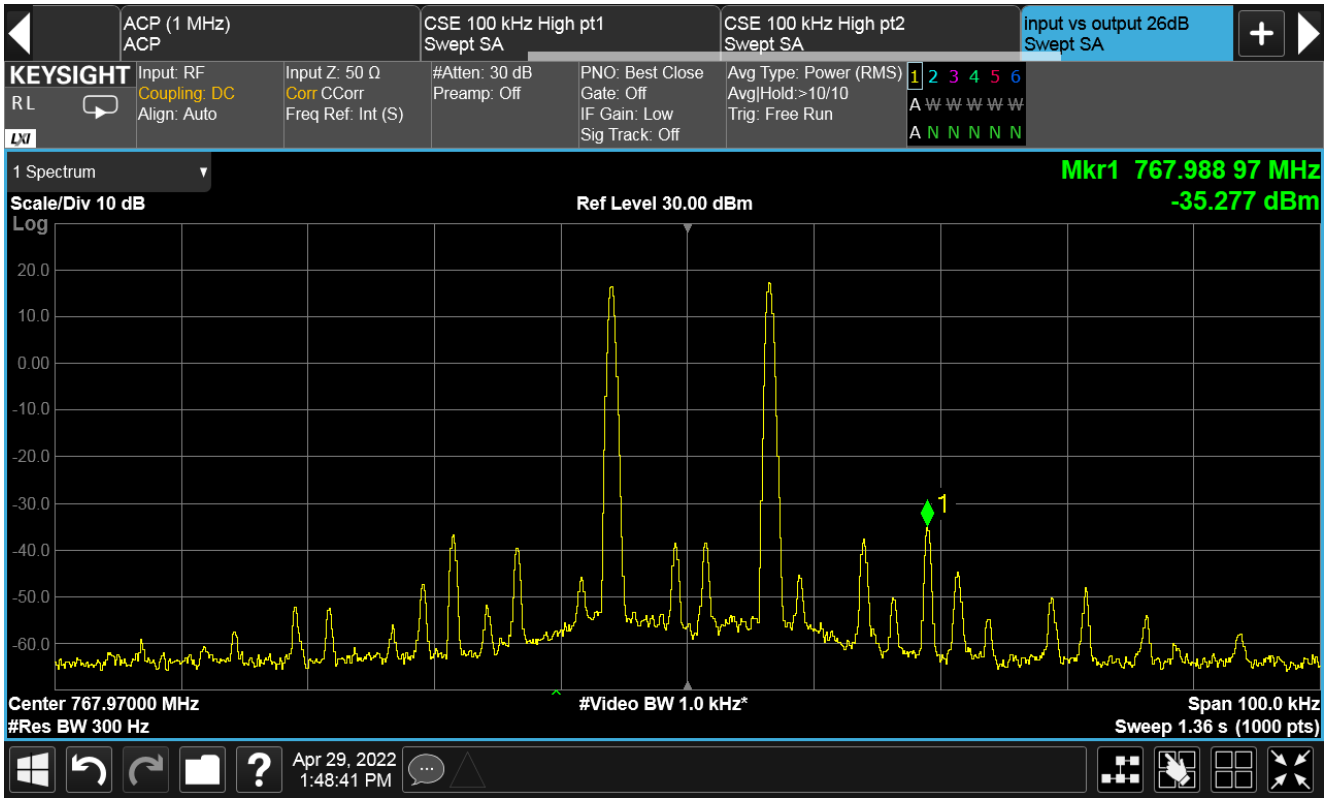
RF Parameters: Band 456-512 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 511.882 + 511.8945 MHz (determined f_0)



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 767.964 + 767.9765 MHz (determined f_0)



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

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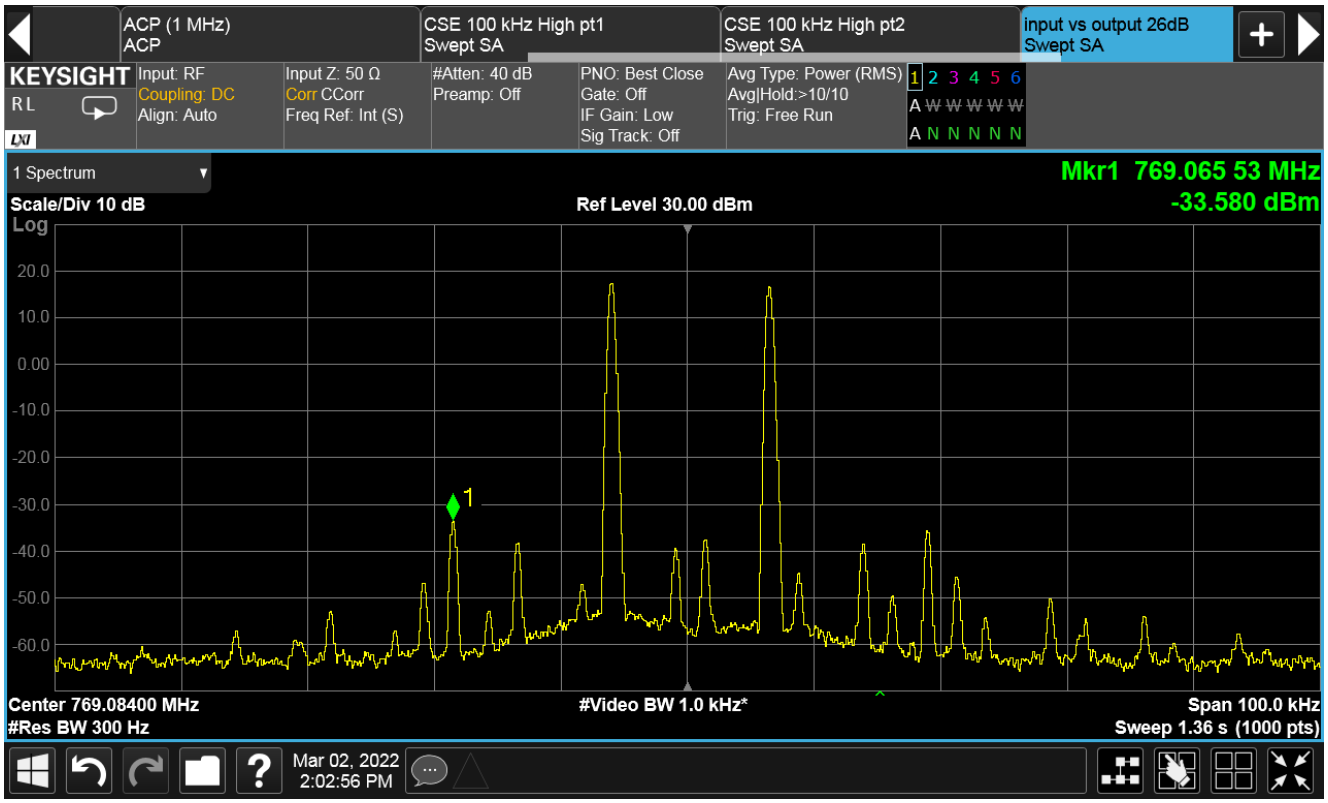
RF Parameters: Band 769-775 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 769.078 + 769.0905 MHz (determined f_0)



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

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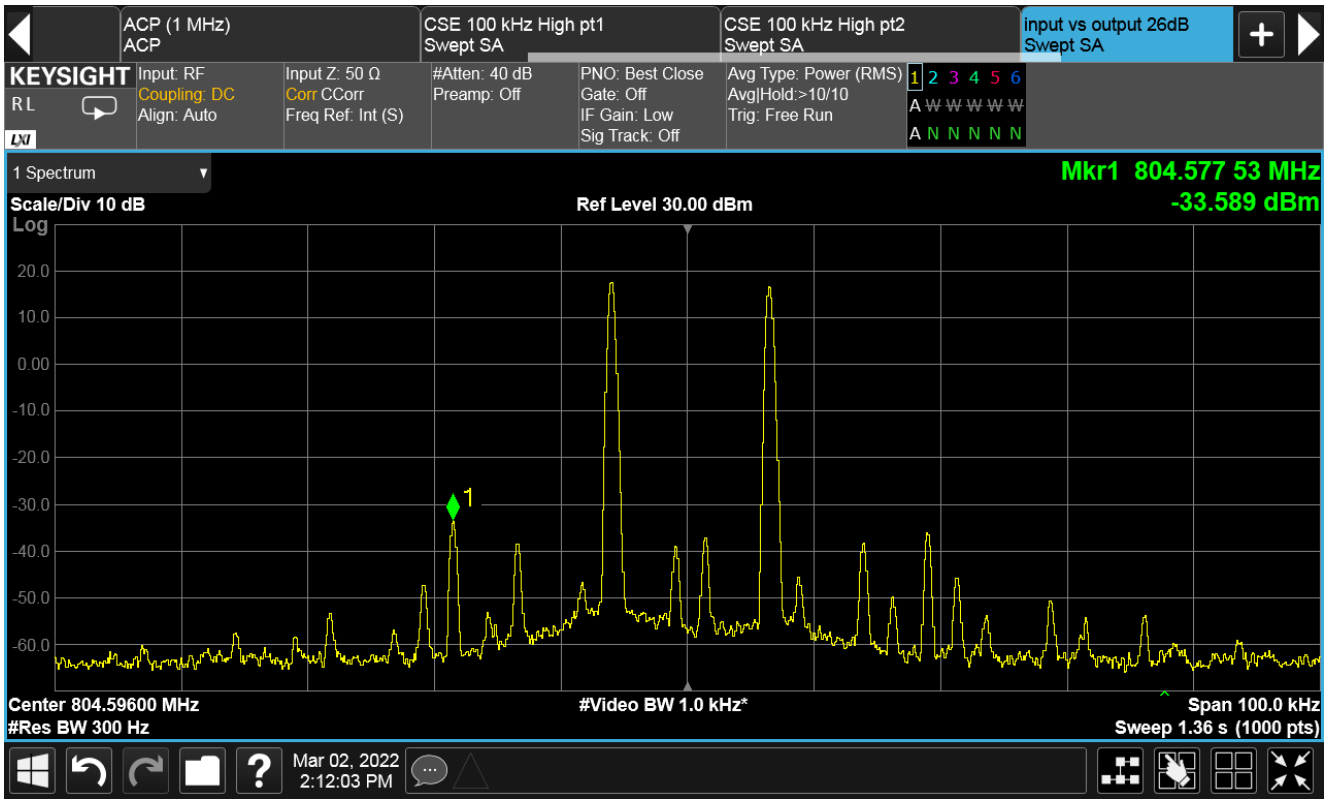
RF Parameters: Band 799-805 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 804.590 + 804.6025 MHz (determined f_0)



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

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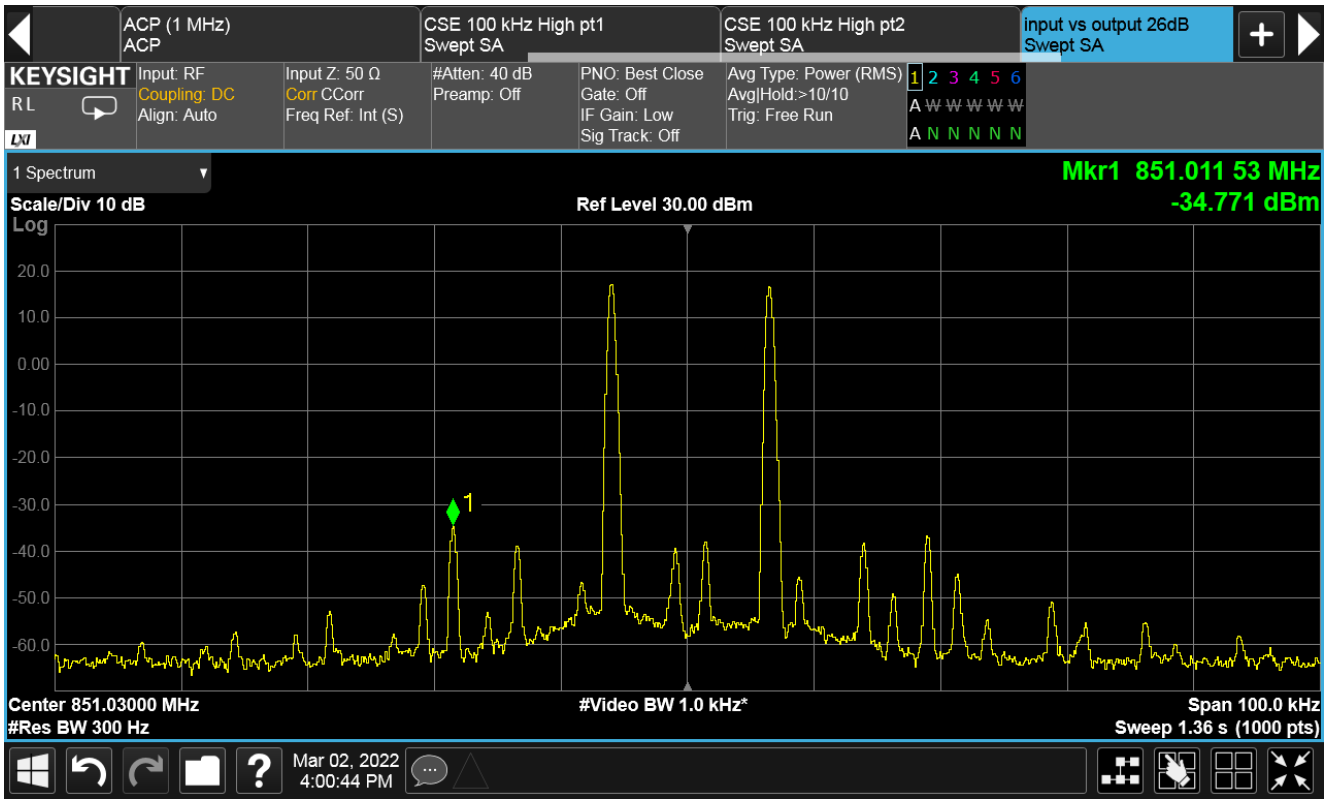
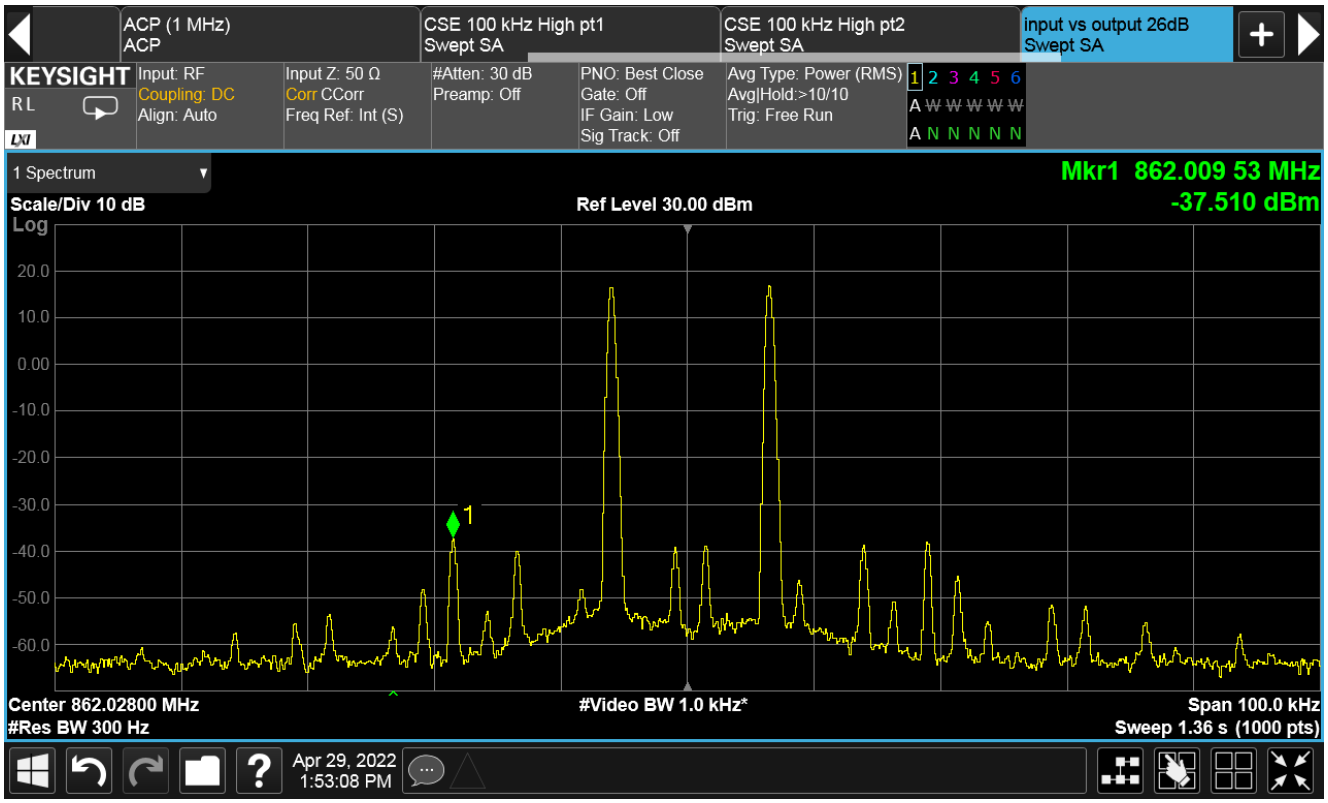
RF Parameters: Band 851-861 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 851.024 + 851.0365 MHz (determined f_0)



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

RF Parameters: Band 862-869 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel. 862.022 + 862.0345 MHz (determined f_0)



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

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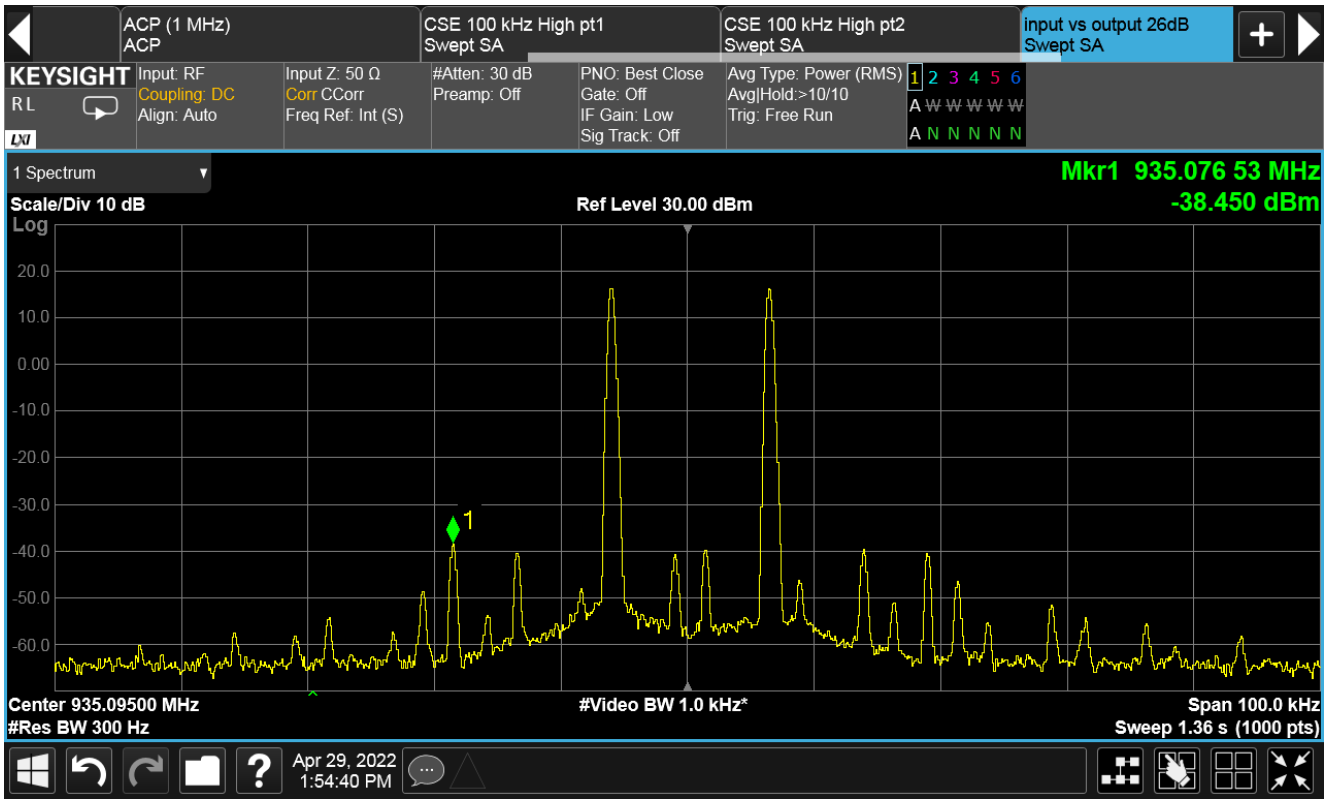
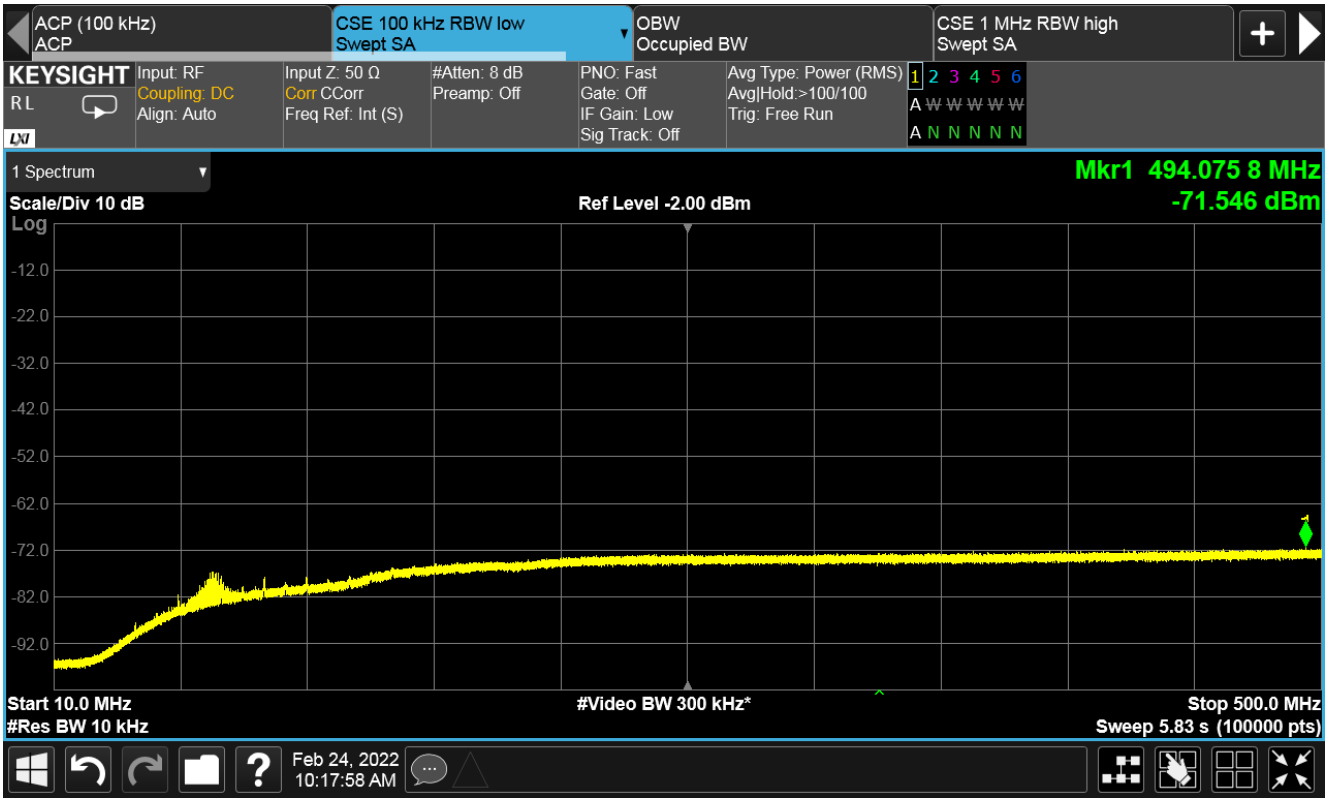
RF Parameters: Band 935-940 MHz, Power +20 dBm, Channel Spacing 12.5kHz, Modulation CW, Channel 935.089 + 935.1015 MHz (determined f_0)

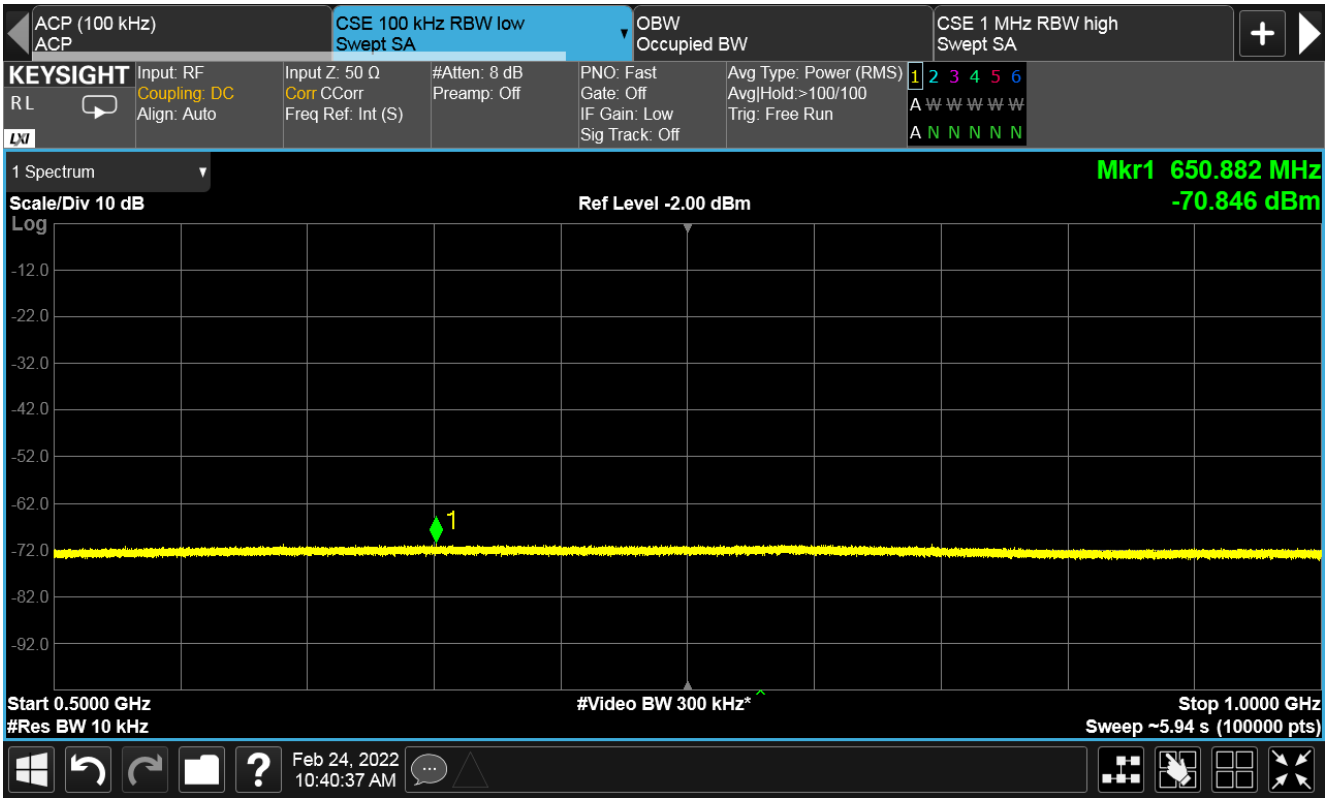


Plot of Intermodulation at determined f_0 in Band 935-940 MHz

6.6 Noise figure



Plot of Noise power 30-500MHz



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
CAL07	MWX221	Cable N Type to SMA Blue 2m	Junflon	14-Dec-2021	6 months
E136	3105	Horn Antenna 1 - 12.5 GHz	EMCO	#02-Apr-2022	12 months
E266	2032	Signal Generator 10kHz - 5.4GHz	Marconi Instruments	24-Jan-2022	12 months
E268	BHA 9118	Horn Antenna 1 - 18 GHz	Schaffner	#02-Apr-2022	12 months
E296-2	11970A	Harmonic Mixer 26.5-40GHz	Hewlett Packard	07-Jul-2021	12 months
E330	2224-20	Horn Antenna 26.5-40GHz	Flann (FMI)	#22-Apr-2022	12 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	08-Jul-2021	12 months
E412	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	30-Jun-2020	24 months
E463	8431A	Filter Band pass 2-4 GHz	Hewlett Packard	25-Oct-2021	12 months
E478	LQ2992/H	Filter Band pass 1-3GHz	RACAL-MESL	#11-Mar-2022	12 months
E602	MG3692A	Signal Generator 10 MHz - 20 GHz	Anritsu	#21-Feb-2022	12 months
E621	360B	Filter Low Pass Filter 1200 MHz	Hewlett Packard	N/A	N/A
E624	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	08-Jul-2021	24 months
E743	2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	#10-Mar-2022	12 months
E777	MG3695B	Signal Generator 8 MHz - 50 GHz	Anritsu	14-Jun-2021	12 months
F031	X6L120-1250-0017-0001-00	Filter Low Pass 1250MHz	K&L Microwave Inc	N/A	N/A
F078	AA18-10H	Attenuator SMA 10dB 18GHz	AtlanTecRF	30-Jul-2021	12 months
H071	N9010B	EXA Signal Analyser 10 Hz to 44 GHz	Keysight Technologies	09-Nov-2020	24 months
LPE364	CBL6112A	Antenna BiLog 30MHz - 2GHz	Chase Electronics Ltd	#28-Mar-2022	24 months
TMS82	8449B	Pre-Amplifier 1GHz - 26.5GHz	Agilent Technologies	16-Dec-2021	12 months

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

9 Auxiliary and peripheral equipment

9 .1 Customer supplied equipment

Item No.	Model No.	Description	Manufacturer	Serial No.
1	N5172B	EXG signal generator	Agilent	MY53050810
2	N5172B	EXG signal generator	Keysight	MY53050728
3	15542	30 dB attenuator	Mini-Circuits	VUU78901032
4	UNAT-20+	20 dB attenuator	Mini-Circuits	-
5	UNAT-20+	20 dB attenuator	Mini-Circuits	-
6	305-0001	UNItivity 5000 Primary Hub	Zinwave Ltd	650110010101
7	305-0004	Zinwave Secondary Hub	Zinwave Ltd	621100002218
8	E4433B	ESG-D signal generator	Keysight	GB38450326
9	E4433B	ESG-D signal generator	Keysight	GB39340714
10	-	Dual long fibre optic cables	-	-
11	-	DC power cable	-	-
12	-	Male to Male N RF cables (x4)	-	-
13	305-0001	UNItivity 5000 primary hub	Zinwave Ltd	650110010102
14	305-0004	Zinwave Secondary Hub	Zinwave Ltd	620110000204

9 .2 RN Electronics supplied equipment

RN No.	Model No.	Description	Manufacturer	Serial No
E558	18N20W-30dB	Attenuator 30dB 20W	Inmet	-
E592	190-5-5EE	Tuneable BPF	Telonic Berkeley Inc.	971168-3
F030	X6L120-1250-0017-000	1250MHz LPF	K&L Microwave Inc.	J212-3
-	WLK590C13/805S	Filter	Wainwright	101554

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.

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11 Description of test sites

Site A Radio Laboratory and Anechoic Chamber

Site B Semi-Anechoic Chamber and Control Room
FCC Registration No. 293246, ISED Registration No. 5612A-4

Site C Transient Laboratory

Site D Screened Room (Conducted Immunity)

Site E Screened Room (Control Room for Site D)

Site F Screened Room (Conducted Emissions)

Site G Screened Room (Control Room for Site H)

Site H 3m Semi-Anechoic Chamber (indoor OATS)
FCC Registration No. 293246, ISED Registration No. 5612A-2, VCCI Registration No. 4065

Site J Transient Laboratory

Site K Screened Room (Control Room for Site M)

Site M 3m Semi-Anechoic Chamber (indoor OATS)
FCC Registration No. 293246, ISED Registration No. 5612A-3

Site N Radio Laboratory

Site Q Fully-Anechoic Chamber

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

Site R Screened Room (Conducted Immunity)

Site S Safety Laboratory

Site T Transient Laboratory

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

12 Abbreviations and units

%	Percent
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