Radio Test Report

Domo Tactical Communications

NIM2113

47 CFR Part 22 Effective Date 1st October 2018
47 CFR Part 24 Effective Date 1st October 2018
47 CFR Part 2 Effective Date 1st October 2018
Test Date: 22nd January 2019 to 25th January 2019
Report Number: 01-11147-2-19 Issue 01

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Certificate of Test 11147-2

The equipment noted below has been fully tested by R.N. Electronics Limited and, where appropriate, conforms to the relevant subpart of FCC Parts 22 and 24. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	NIM2113
Model Number:	NIM2113
Unique Serial Number:	NIM-1001
Applicant:	Domo Tactical Communications Fusion 2, 1100 Parkway Whiteley, Hampshire, PO15 7AB
Proposed FCC ID	XRF-NIM2113
Full measurement results are detailed in Report Number:	01-11147-2-19 issue 01
Test Standards:	47 CFR Part 22 Effective Date 1st October 2018 47 CFR Part 24 Effective Date 1st October 2018 47 CFR Part 2 Effective Date 1st October 2018

NOTE:
Certain tests were not performed based upon manufacturer's declarations. Certain other requirements are subject to manufacturer declaration only and have not been tested/verified. For details refer to section 3 of this report.
This report only pertains to the operation of the equipment to 47CFR parts 22 & 24, for details of testing to other rule parts please see RN report: 01-11147-1-19 (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:	22nd January 2019 to 25th January 2019
Test Engineer:	
Approved By: Radio Approvals Manager	Digitally signed by: Daniel Sims DN: CN = Daniel Sims C = GB O = RN Electronics Ltd Date: 2019.01.28 12:40:35 Z
Customer Representative:	

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1 Contents

2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Domo Tactical Communications Fusion 2, 1100 Parkway Whiteley, Hampshire PO15 7AB	
Manufacturer of EUT	Domo Tactical Communications	
Full Name of EUT	NIM2113	
Model Number of EUT	NIM2113	
Serial Number of EUT	NIM-1001	
Date Received	22nd January 2019	
Date of Test:	22nd January 2019 to 25th January 2019	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	25th January 2019	
Main Function	Vehicle mount LTE base station	
Information Specification	Height	232mm
	Width	453mm
	Depth	417mm
	Weight	27kg
	Voltage	24V DC nominal
	Current	54A (1300W)

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Vehicle mounted
Choice of model(s) for type tests	Production prototype
Antenna details	Not specified
Antenna port	Yes
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	2152.5 MHz
Lowest Signal generated in EUT	Not specified
Hardware Version	SA4336 issue 1
Software Version	GUI 6.1.30 F-30
Firmware Version	6.0 R-1 build 116 image 151
Type of Equipment	Base station
Technology Type	Cellular
Geo-location (yes/no)	
TX Parameters	
Alignment range – transmitter	869 - 894 MHz 1930 - 1990 MHz
EUT Declared Modulation Parameters	Device supports GSM (GMSK), UMTS/LTE (QPSK only)
EUT Declared Power level	+46dBm Peak
EUT Declared Signal Bandwidths	200 kHz (GMSK) 5MHz (QPSK)
EUT Declared Channel Spacing's	GSM 200kHz. UMTS/LTE 5MHz.
EUT Declared Duty Cycle	up to 100%
Unmodulated carrier available?	No
Declared frequency stability	1ppm
RX Parameters	
Alignment range – receiver	N/A
EUT Declared RX Signal Bandwidth	N/A
Receiver Signal Level (RSL)	N/A
Method of Monitoring Receiver BER	N/A

2.3 Functional description

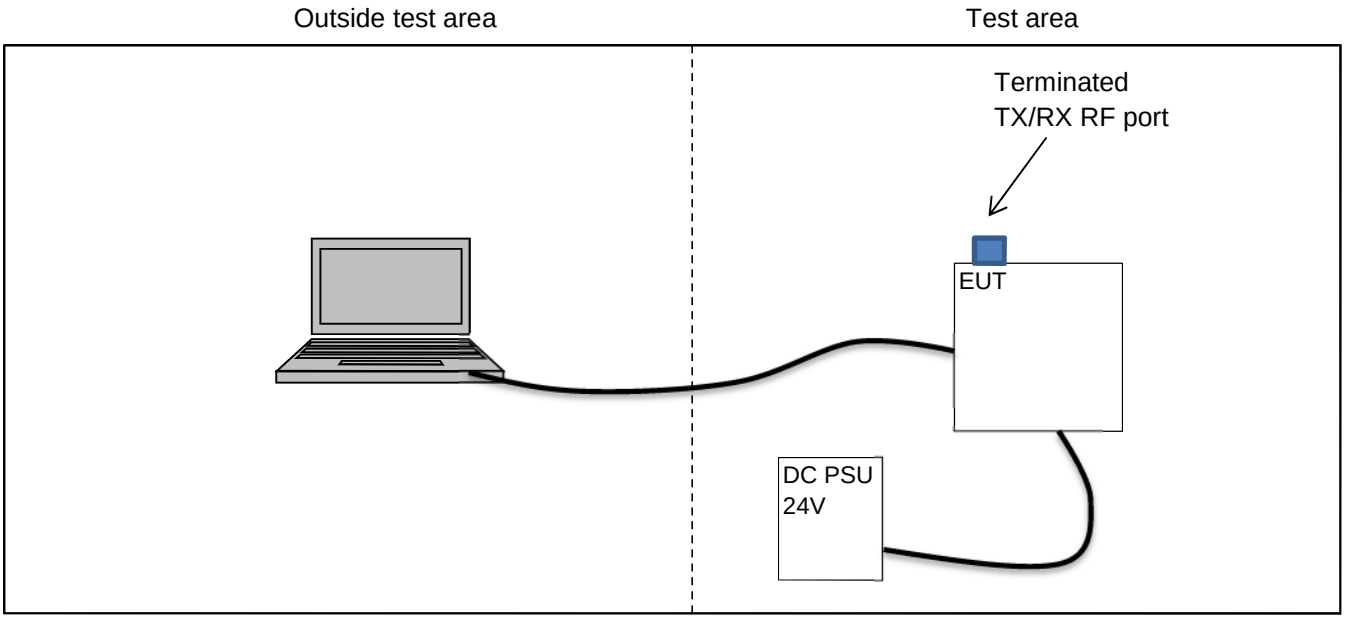
19” rack mounted device providing cellular downlink connectivity in the following bands: Band 5 GSM, band 2 UMTS and LTE, Band 4 UMTS and LTE.

2.4 Modes of operation

Mode Reference	Description	Used for testing
Mode 1	EUT generating a GSM signal of 40W @ 869.4 MHz	Yes
Mode 2	EUT generating a GSM signal of 40W @ 881.4 MHz	Yes
Mode 3	EUT generating a GSM signal of 40W @ 893.6 MHz	Yes
Mode 4	EUT generating a UMTS signal of 40W @ 1932.5 MHz	Yes
Mode 5	EUT generating a UMTS signal of 40W @ 1960 MHz	Yes
Mode 6	EUT generating a UMTS signal of 40W @ 1987.5 MHz	Yes
Mode 7	EUT generating a LTE signal of 25W @ 1937.5 MHz	Yes
Mode 8	EUT generating a LTE signal of 25W @ 1960 MHz	Yes
Mode 9	EUT generating a LTE signal of 25W @ 1982.5 MHz	Yes

Note: This report only pertains to the operation of the equipment to 47CFR part 22H and 24E, for details of testing to other rule parts please see RN reports:01-11147-1-19 (Part 27).

2.5 Emissions configuration



The unit was powered from a DC supply at 24 V DC. The unit was configured for maximum power on each of low, Middle and high channels in the relevant operating bands as listed in the modes section (2.4) and detailed below.

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. For radiated tests a suitable attenuator and load where used to terminate the TX port.

The equipment does not operate on all available channels and top, middle and bottom channels for each band and radio services are:

Mode	Cellular service	Band	Transmit power (W)	Bottom channel (MHz)	Middle channel (MHz)	Top channel (MHz)
1	GSM	Band 5	40	869.4		
2					881.4	
3						893.6
4	UMTS	Band 2	40	1932.5		
5					1960.0	
6						1987.5
7	LTE	Band 2	25	1937.5		
8					1960.0	
9						1982.5

In addition to the above table the EUT transmits the same waveform at all frequencies in all bands, and the measured duty cycles for test modes are as follows:

Band	On time (ms)	Period (ms)	Duty cycle (%)	Duty Cycle (dB)
GSM	548	566	96.8	0.14

UMTS	-	-	100.0	0
LTE	4.752	10.92	43.5	3.6

2.5.1 Signal leads

Port Name	Cable Type	Connected
Sync In	SMA	No
Sync Out	SMA	No
Power	4-pin connector	Yes
Antenna Port 1	N-type connector	Yes
Antenna Port 2-6	N-type connector	No
Ethernet Port 1	Unscreened	Yes
Ethernet Port 2-6	Unscreened	No
Data	Custom	No
Spectrum Scanner	SMA	No
WiFi Antenna Port	SMA	No
GPS Antenna Port	SMA	No
Remote port	Custom	No

Note: Ports marked not connected above are not used in this equipment configuration and application.

3 Summary of test results

The Nimbus NIM2113 was tested for compliance to the following standard(s) :

47 CFR Part 22 Effective Date 1st October 2018
47 CFR Part 24 Effective Date 1st October 2018
47 CFR Part 2 Effective Date 1st October 2018

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

Title	References	Results
Transmitter Tests		
1. Spurious emissions at antenna terminals	FCC Part 22 Clause 22.917(a)(b) FCC Part 24 Clause 24.238(a) FCC Part 2 Clause 2.1051	PASSED[1]
2. RF Power Output	FCC Part 22 Clause 22.913 FCC Part 24 Clause 24.232(a) FCC Part 2 Clause 2.1046	PERFORMED[2]
3. Frequency stability	47 CFR Part 22 Clause 22.355 FCC Part 2 Clause 2.1055	PASSED
4. Occupied bandwidth	FCC Part 24 Clause 24.238 FCC Part 2 Clause 2.1049	PASSED
5. Field strength of spurious radiations	FCC Part 22 Clause 22.917 FCC Part 24 Clause 24.238 FCC Part 2 Clause 2.1053	PASSED[1]
6. Band edge emissions	FCC Part 22 Clause 22.917(a)(b) FCC Part 24 Clause 24.238 FCC Part 2 Clause 2.1051	PASSED
7. Modulation characteristics	FCC Part 2 Clause 2.1047	PROVIDED[3]

[1] Spectrum investigated started at a frequency of 30MHz up to a frequency of 22GHz based on 10 times the highest channel of 2152.5 MHz.
[2] Power limits are referenced to ERP in the rule parts and are decided upon at time of licensing and based on geographical location.
[3] Modulation characteristics information provided in section 2.2.

4 Specifications

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

4.1 Relevant standards

Ref.	Standard Number	Version	Description
4.1.1	FCC Part 22	2018	Part 22 – Public Mobile Services
4.1.2	47CFR part 2J	2018	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations
4.1.3	KDB 971168 D01 v03	2017	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Measurement Guidance for Certification of Licensed Digital Transmitters
4.1.4	ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
4.1.5	FCC Part 24	2018	Part 24 – Personal Communications Services

4.2 Deviations

No deviations were applied.

4.3 Tests at extremes of temperature & voltage

The following test conditions were used to simulate testing at nominal or extremes.

Temperature Test Conditions		Voltage Test Conditions	
T nominal	20 °C	V nominal	24V DC
T minimum	0 °C	V minimum	20.4V DC
T maximum	50 °C	V maximum	27.6V DC

Extremes of voltage are based upon manufacturer's declaration.

Extremes of temperature are based upon FCC rules requirements and manufacturers declarations.

The ambient test conditions of humidity and pressure in the laboratory were as specified in each specific test section within this report

5 Tests, methods and results

5.1 Spurious emissions at antenna terminals

5.1.1 Test methods

Test Requirements: FCC Part 22 Clause 22.917 [Reference 4.1.1 of this report]
FCC Part 24 Clause 24.238 [Reference 4.1.6 of this report]
FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]

Test Method: ANSI C63.26 2015 Clause 5.5 [Reference 4.1.4 of this report]

Limits: FCC Part 22 Clause 22.917(a) [Reference 4.1.1 of this report]
FCC Part 24 Clause 24.238(a) [Reference 4.1.6 of this report]

5.1.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. EUT was tested using modes 1 – 9. Modes are specified in section 2.4 of this report.

5.1.3 Test procedure

Tests were made in accordance with the test method noted above using the measuring equipment listed in the 'Test Equipment' Section. The EUT was set up to transmit at full power for the appropriate band and modulation scheme (see section 2.5) using an ancillary laptop connected to the Ethernet port of the EUT. Attenuation was used between the EUT TX port and the analyser. Measurements were made and plots taken in the required Resolution bandwidths using a RMS detector and trace averaging and duty cycle offset applied. LTE measurements in the range 1910-1925 MHz and 1995-2015 MHz were made using an RMS detector and max hold

Tests were performed in test site N.

5.1.4 Test equipment

E420, E755, E777, E866

See Section 8 for more details

5.1.5 Test results

Temperature of test environment	18-23°C
Humidity of test environment	30-42%
Pressure of test environment	101kPa

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

Setup Table

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Low channel	869.4 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1738.8	-29.7	-16.7

Note: 0.14dB added to results for duty cycle correction. Plots shown as additional traces on mid channel plots.

Setup Table

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Mid channel	881.4 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1762.6	-29.4	-16.4

Note: 0.14dB added to results for duty cycle correction.

Plots
Plot of conducted emissions Mid channel (881.4 MHz) 10 MHz – 865 MHz range
Plot of conducted emissions single Mid channel (881.4 MHz) 897 MHz – 1 GHz range
Plot of conducted emissions single Mid channel (881.4 MHz) 1 GHz – 3 GHz range
Plot of conducted emissions single Mid channel (881.4 MHz) 3 GHz – 10 GHz range

Setup Table

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
High channel	893.6 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1787.1	-30.5	-17.5

Note: 0.14dB added to results for duty cycle correction. Plots shown as additional traces on mid channel plots.

Setup Table

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
Low channel	1932.5 MHz

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

Note: Plots shown as additional traces on mid channel plots.

Setup Table

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
Mid channel	1960 MHz

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

Plots
Plot of conducted emissions Mid channel (1960 MHz) 10 MHz – 1920 MHz range
Plot of conducted emissions single Mid channel (1960 MHz) 2 GHz – 3 GHz range
Plot of conducted emissions single Mid channel (1960 MHz) 3 GHz – 20 GHz range

Setup Table

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
High channel	1987.5 MHz

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

Note: Plots shown as additional traces on mid channel plots.

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Low channel	1937.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
3875.1	-18.2	-5.2

Note: Plots shown as additional traces on mid channel plots.

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Mid channel	1960 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
3919.7	-27.1	-14.1

Plots
Plot of conducted emissions Mid channel (1960 MHz) 10 MHz – 1910 MHz range
Plot of conducted emissions single Mid channel (1960 MHz) 1.910GHz – 1.925 GHz range
Plot of conducted emissions single Mid channel (1960 MHz) 1.995 GHz – 2.015 GHz range
Plot of conducted emissions single Mid channel (1960 MHz) 2.115 GHz – 3 GHz range
Plot of conducted emissions single Mid channel (1960 MHz) 3 GHz – 20 GHz range

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm

Channel Spacing	5 MHz
Mod Scheme	LTE
High channel	1982.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1995.1	-18.0	-5

Note: Plots shown as additional traces on mid channel plots.

Results are also presented graphically in section 6.

LIMITS:

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

These results show that the EUT has PASSED this test.

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

5.2 RF Power Output

5.2.1 Test methods

Test Requirements: FCC Part 22 Clause 22.913 [Reference 4.1.1 of this report]
FCC Part 24 Clause 24.232(a) [Reference 4.1.6 of this report]
FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]

Test Method: ANSI C63.26 2015 Clause 5.2 [Reference 4.1.4 of this report]

Limits: FCC Part 22 Clause 22.913 [Reference 4.1.1 of this report]
FCC Part 24 Clause 24.232(a) [Reference 4.1.6 of this report]

5.2.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. EUT was tested in modes 1 – 9.

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 was set up to transmit at full power for the appropriate band and modulation scheme (see section 2.5) using an ancillary laptop connected to the Ethernet port of the EUT. Attenuation was used between the EUT TX port and the analyser. An RMS detector was set and Channel power was measured using the channel power function, plots were taken. Additionally where required the analyser CCDF function was used to determine PAPR and the PSD function was used to determine spectral power density.

5.2.4 Test equipment

E420, E755, E777, E866

See Section 8 for more details

5.2.5 Test results

Temperature of test environment	18-23°C
Humidity of test environment	30-42%
Pressure of test environment	101kPa

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Low channel	869.4 MHz

Test conditions		Average Power (dBm)	Duty cycle offset (dB)	TX power (dBm)	TX Power (W)
Temp Ambient	Volts Nominal	44.91	0.14	45.05	32.0

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Mid channel	881.4 MHz

Test conditions	Average Power (dBm)	Duty cycle offset (dB)	TX power (dBm)	TX Power (W)

Temp Ambient	Volts Nominal	45.20	0.14	45.34	34.2

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Top channel	893.6 MHz

Test conditions		Average Power (dBm)	Duty cycle offset (dB)	TX power (dBm)	TX Power (W)
Temp Ambient	Volts Nominal	45.02	0.14	45.16	32.8

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
Low channel	1932.5 MHz

Test conditions		Average Power (dBm)	Duty cycle offset (dB)	TX power (dBm)	TX Power (W)	PK to Average Power ratio (dB)
Temp Ambient	Volts Nominal	37.7	0.0	37.7	5.9	Not measured

Note: Peak to average ratio is dependent on modulation type and not channel frequency, therefore only middle channel results are shown.

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
Mid channel	1960 MHz

Test conditions		Average Power (dBm)	Duty cycle offset (dB)	TX power (dBm)	TX Power (W)	PK to Average Power ratio (dB)
Temp Ambient	Volts Nominal	37.9	0.0	37.9	6.2	9.24

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
High channel	1987.5 MHz

Test conditions	Average Power (dBm)	Duty cycle offset (dB)	TX power (dBm)	TX Power (W)	PK to Average Power ratio (dB)

Temp Ambient	Volts Nominal	36.2	0.0	36.2	4.2	Not measured

Note: Peak to average ratio is dependent on modulation type and not channel frequency, therefore only middle channel results are shown.

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Low channel	1937.5 MHz

Test conditions		Average Power (dBm)	Duty cycle offset (dB)	TX power (dBm)	TX Power (W)	PK to Average Power ratio (dB)
Temp Ambient	Volts Nominal	33.72	3.6	37.32	5.4	Not measured

Note: Peak to average ratio is dependent on modulation type and not channel frequency, therefore only middle channel results are shown.

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Mid channel	1960 MHz

Test conditions		Average Power (dBm)	Duty cycle offset (dB)	TX power (dBm)	TX Power (W)	PK to Average Power ratio (dB)
Temp Ambient	Volts Nominal	34.29	3.6	37.89	6.2	10.53

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Low channel	1982.5 MHz

Test conditions		Average Power (dBm)	Duty cycle offset (dB)	TX power (dBm)	TX Power (W)	PK to Average Power ratio (dB)
Temp Ambient	Volts Nominal	33.15	3.6	36.75	4.7	Not measured

Note: Peak to average ratio is dependent on modulation type and not channel frequency, therefore only middle channel results are shown.

Additional PSD measurements for part 24 UMTS and LTE:

Setup Table

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
Low channel	1932.5 MHz
Mid channel	1960 MHz
High channel	1987.5 MHz

Channel	TX power density (dBm/MHz)	Duty Cycle offset (dB)	TX power density (W/MHz)
Low channel	32.19	0.0	32.19
Mid channel	31.6	0.0	31.6
High channel	31.0	0.0	31.0

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Low channel	1937.5 MHz
Mid channel	1960 MHz
High channel	1982.5 MHz

Channel	TX power density (dBm/MHz)	Duty Cycle offset (dB)	TX power density (W/MHz)
Low channel	29.3	3.6	32.9
Mid channel	29.43	3.6	33.0
High channel	27.8	3.6	31.4

Results are also presented graphically in section 6

LIMITS:
Power limits (and PSD) are referenced to ERP in the rule parts and are decided upon at time of licensing and based on geographical location. PAPR (0.1% CCDF) Limit <13dB.

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

5.3.1 Test methods

Test Requirements: FCC Part 22 Clause 22.355 [Reference 4.1.1 of this report]
FCC Part 24 Clause 24.235 [Reference 4.1.6 of this report]
FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]

Test Method: ANSI C63.26 2015 Clause 5.2 [Reference 4.1.4 of this report]

Limits: FCC Part 22 Clause 22.355 & 22.913 [Reference 4.1.1 of this report]
FCC Part 24 Clause 24.235[Reference 4.1.6 of this report]

5.3.2 Configuration of EUT

EUT was tested in an environmental oven; thermal balance was achieved before tests began. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. EUT was tested in mode 8.

5.3.3 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 was set up to transmit at 10W on centre channel of LTE band using an ancillary laptop connected to the Ethernet port of the EUT. Attenuation was used between the EUT TX port and the analyser. Thermal balance was achieved at each test temperature before results were taken. A spectrum analyser connected to an external 10 MHz reference was used to monitor the CW breakthrough of the signal and the marker frequency was recorded at each temperature. CW breakthrough was measured using min-hold.

5.3.4 Test equipment

E755, E843, E886, TMS80, S036

See Section 8 for more details

5.3.5 Test results

Temperature of test environment	20°C (nominal)
Humidity of test environment	30-42%
Pressure of test environment	101kPa

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Mid channel	1960 MHz

Test conditions		Frequency (MHz)	Error (kHz)	Error (ppm)
Temperature (°C)	Voltage (V)			
-30	24	Equipment does not operate at this temperature		
-20	24	Equipment does not operate at this temperature		
-10	24	Equipment does not operate at this temperature		
-5	24	1960.0000	0.0	0.00
0	24	1959.9990	1.0	0.51
10	24	1959.9995	0.5	0.26
20	20.6	1960.0000	0.0	0.00
20	24	1959.9990	1.0	0.51
20	27.6	1959.9995	0.5	0.26
30	24	1960.0000	0.0	0.00
40	24	1959.9990	1.0	0.51

LIMITS:
22.355, 1.5ppm.
24.235 No ppm limit, but frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

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: < ±0.0002 ppm.

5.4 Occupied bandwidth

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]

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. EUT was tested in modes 1 – 9.

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 was set up to transmit at full power for the appropriate band and modulation scheme (see section 2.5) using an ancillary laptop connected to the Ethernet port of the EUT. Attenuation was used between the EUT TX port and the analyser. An peak detector and max-hold was set and using the bandwidth function of the analyser the 99% Bandwidth was measured and indicated on the plots taken.

5.4.4 Test equipment

E420, E755, E777, E866

See Section 8 for more details

5.4.5 Test results

Temperature of test environment	18-23°C
Humidity of test environment	30-42%
Pressure of test environment	101kPa

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Low channel	869.4 MHz

	Occupied BW (kHz)
	240.33
Plot reference	11147-2 GSM Bottom

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Mid channel	881.4 MHz

	Occupied BW (kHz)
	239.68
Plot reference	11147-2 GSM middle

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
High Channel	893.6 MHz

	Occupied BW (kHz)
	239.96
Plot reference	11147-2 GSM top

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
Low channel	1932.5 MHz

	Occupied BW (MHz)
	4.155
Plot reference	11147-2 UMTS Bottom

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
Mid channel	1960 MHz

	Occupied BW (MHz)
	4.145
Plot reference	11147-2 UMTS middle

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
High Channel	1987.5 MHz

	Occupied BW (MHz)
	4.147
Plot reference	11147-2 UMTS top

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE

Low channel	1937.5 MHz

	Occupied BW (MHz)
	4.564
Plot reference	11147-2 LTE Bottom

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Mid channel	1960 MHz

	Occupied BW (MHz)
	4.579
Plot reference	11147-2 LTE middle

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
High Channel	1982.5 MHz

	Occupied BW (MHz)
	4.511
Plot reference	11147-2 LTE top

Results are also presented graphically in section 6

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

These results show that the EUT has PASSED this test.

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

5.5 Field strength of spurious radiations

5.5.1 Test methods

Test Requirements:	FCC Part 22 Clause 22.917 & 22.359(a) [Reference 4.1.1 of this report] FCC Part 24 Clause 24.238 [Reference 4.1.6 of this report] FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]
Test Method:	ANSI C63.26 2015 Clause 5.5 [Reference 4.1.4 of this report]
Limits:	FCC Part 22 Clause 22.917 & 22.359(a) [Reference 4.1.1 of this report] FCC Part 24 Clause 24.238 [Reference 4.1.6 of this report]

5.5.2 Configuration of EUT

The EUT was tested in an ALSE and ambient conditions were monitored. The EUT was examined in its declared normal use position. The transmit port was terminated into a 30dB Attenuator and a 50Ohm load. 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. 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. A Peak detector was used for measurements.

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

1GHz – 20GHz.
The measuring antenna was used in both Horizontal and Vertical polarisations. Where required a Substitution method was performed using standard gain horn antennas. Measurement distances used were: 1 – 6 GHz at 3metres, 6 – 18 GHz at 1.2metres and 18 – 20 GHz at 0.3metres.
Tests were performed in test site M.

5.5.4 Test equipment

E268, E410, E411, E453, E517, E602, E634, E743, LPE364, TMS814, TMS82

See Section 8 for more details

5.5.5 Test results

Temperature of test environment	17-20°C
Humidity of test environment	40-45%
Pressure of test environment	101kPa

Setup Table

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Low channel	869.4 MHz

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

Setup Table

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Mid channel	881.4 MHz

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

Setup Table

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
High channel	893.6 MHz

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

Setup Table

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
Low channel	1932.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
3865	-31.2	-18.2	Vertical	Normal use position
3865	-28.1	-15.1	Horizontal	Normal use position

Setup Table

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
Mid channel	1960 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
3920	-24.9	-11.9	Vertical	Normal use position
3920	-25.3	-12.3	Horizontal	Normal use position

Setup Table

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS
High channel	1987.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
3975	-22.5	-9.5	Vertical	Normal use position
3975	-26	-13	Horizontal	Normal use position

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Low channel	1937.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
3875	-29.4	-16.4	Vertical	Normal use position
3875	-30.9	-17.9	Horizontal	Normal use position

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Mid channel	1960 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
3920	-28.9	-15.9	Horizontal	Normal use position

Setup Table

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
High channel	1982.5 MHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
3965	-26.4	-13.4	Vertical	Normal use position
3965	-29.6	-16.6	Horizontal	Normal use position

LIMITS:

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

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows: 30MHz - 1GHz ± 3.9 dB, 1 – 18 GHz ±3.5dB, 18 – 27 GHz ±3.9dB

5.6 Band edge emissions

5.6.1 Test methods

Test Requirements: FCC Part 22 Clause 22.917 [Reference 4.1.1 of this report]
FCC Part 24 Clause 24.238 [Reference 4.1.6 of this report]
FCC Part 2 Clause 2.1053 [Reference 4.1.2 of this report]

Test Method: ANSI C63.26 2015 Clause 5.5 [Reference 4.1.4 of this report]

Limits: FCC Part 22 Clause 22.917 [Reference 4.1.1 of this report]
FCC Part 24 Clause 24.238 [Reference 4.1.6 of this report]

5.6.2 Configuration of EUT

EUT was tested on a bench. The EUT RF port under test was connected to a spectrum analyser via suitable attenuation. EUT was tested using modes 1 – 9. Modes are specified in section 2.4 of this report.

5.6.3 Test procedure

Tests were made in accordance with the test method noted above using the measuring equipment listed in the 'Test Equipment' Section. The EUT was set up to transmit at full power for the appropriate band and modulation scheme (see section 2.5) using an ancillary laptop connected to the Ethernet port of the EUT. Attenuation was used between the EUT TX port and the analyser. Measurements were made and plots taken in the required Resolution bandwidths using a RMS detector, trace averaging and duty cycle offset for GSM and LTE.

Tests were performed in test site N.

5.6.4 Test equipment

E420, E755, E777, E866

See Section 8 for more details

5.6.5 Test results

Temperature of test environment	18-23°C
Humidity of test environment	30-42%
Pressure of test environment	101kPa

Band	869-894 MHz
Power Level	46 dBm
Channel Spacing	200 kHz
Mod Scheme	GSM
Low channel	869.4 MHz
High channel	893.6 MHz

	Lower band edge (869MHz)	Upper band edge (894MHz)
	-18.59	-19.52
Plot reference	11147-2 GSM Bottom	11147-2 GSM Top
Plot reference 3kHz RBW	N/A	11147-2 GSM top 3kHz RBW

Note: 0.14dB added to results for duty cycle correction.

Band	1930 - 1990 MHz
Power Level	46 dBm
Channel Spacing	5 MHz
Mod Scheme	UMTS

Low channel	1932.5 MHz
High channel	1987.5 MHz

	Lower band edge (1930MHz)	Upper band edge (1990MHz)
	-16.86	-16.86
Plot reference	11147-2 UMTS bottom	11147-2 UMTS top

Band	1930 - 1990 MHz
Power Level	44 dBm
Channel Spacing	5 MHz
Mod Scheme	LTE
Low channel	1937.5 MHz
High channel	1982.5 MHz

	Lower band edge (1930MHz)	Upper band edge (1990MHz)
	-16.64	-17.51
Plot reference	11147-2 LTE bottom	11147-2 LTE top

Note: 3.6dB added to results for duty cycle correction.

Results are also presented graphically in section 6

LIMITS:
22.917 (a) & 24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

These results show that the EUT has PASSED this test.

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

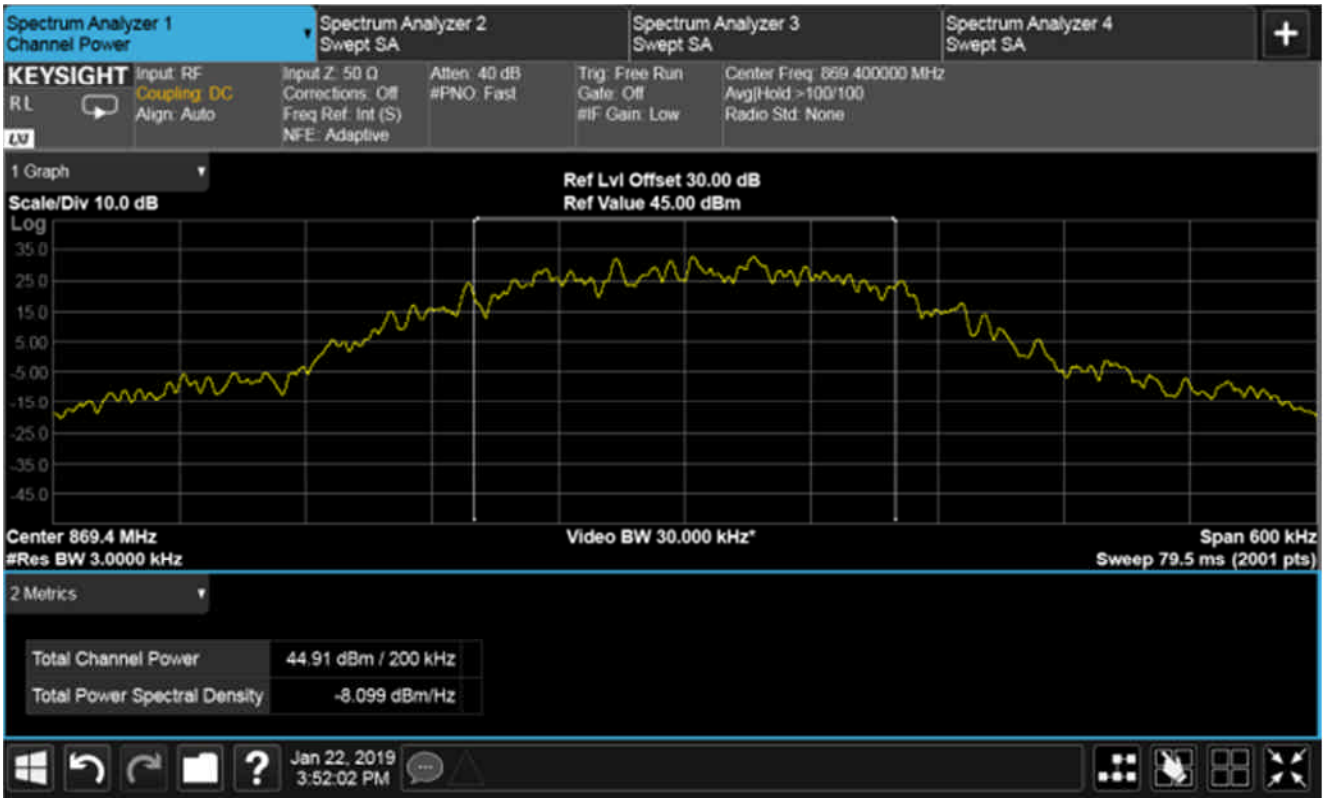
5.7 Modulation characteristics

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

6 Plots/Graphical results

6.1 RF Power Output

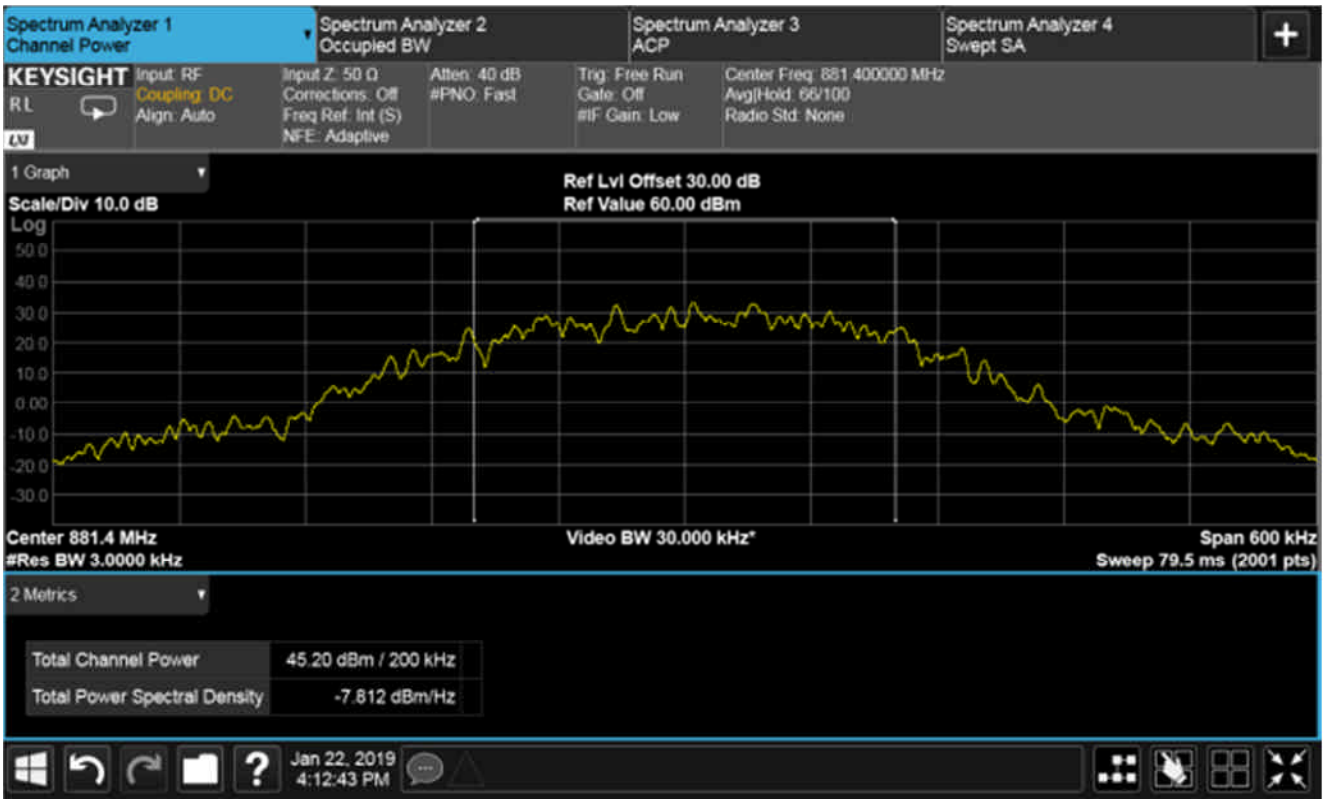
RF Parameters: Band 869-894 MHz, Power +46 dBm, Channel Spacing 200kHz, Modulation GSM, Channel 869.4 MHz



Plot of Channel power

Plot of Peak to Average power ratio

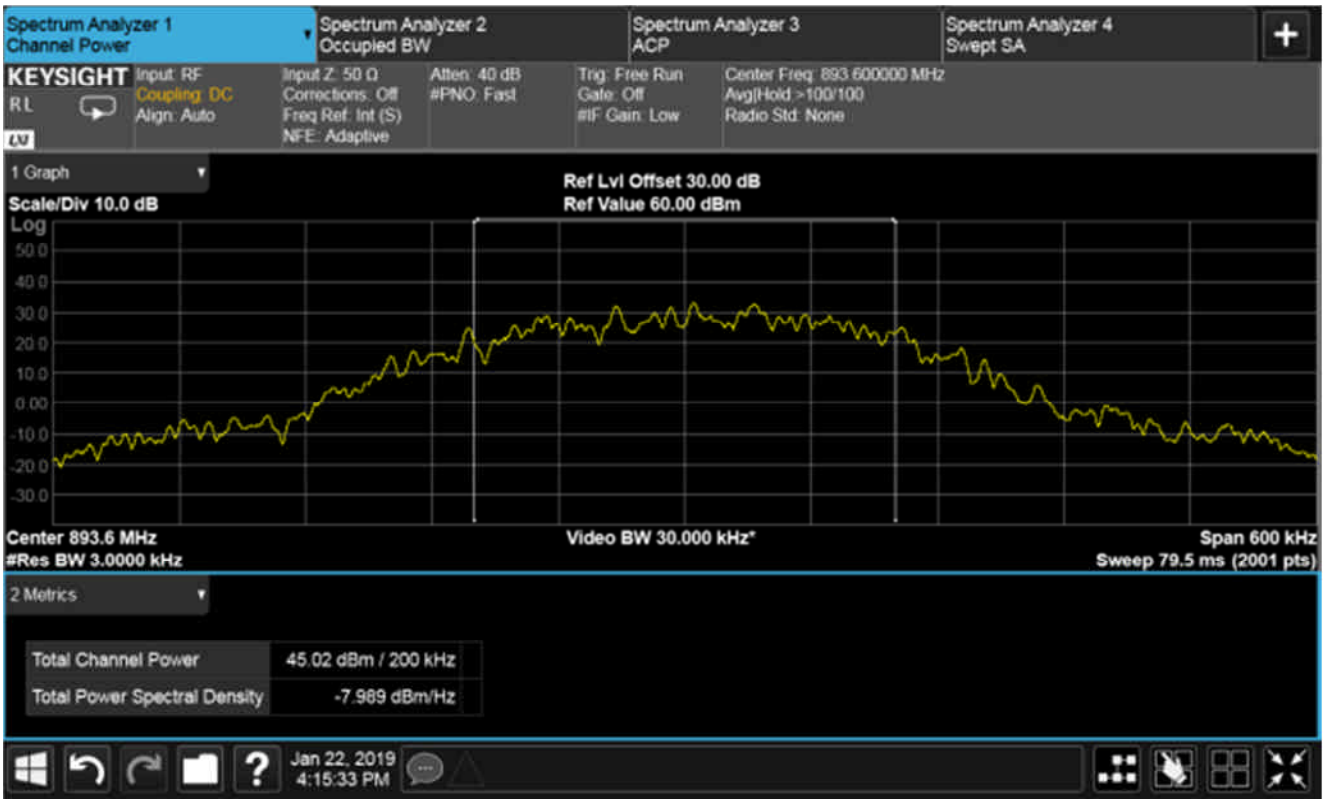
RF Parameters: Band 869-894 MHz, Power +46 dBm, Channel Spacing 200kHz, Modulation GSM, Channel 881.4 MHz



Plot of Channel power

Plot of Peak to Average power ratio

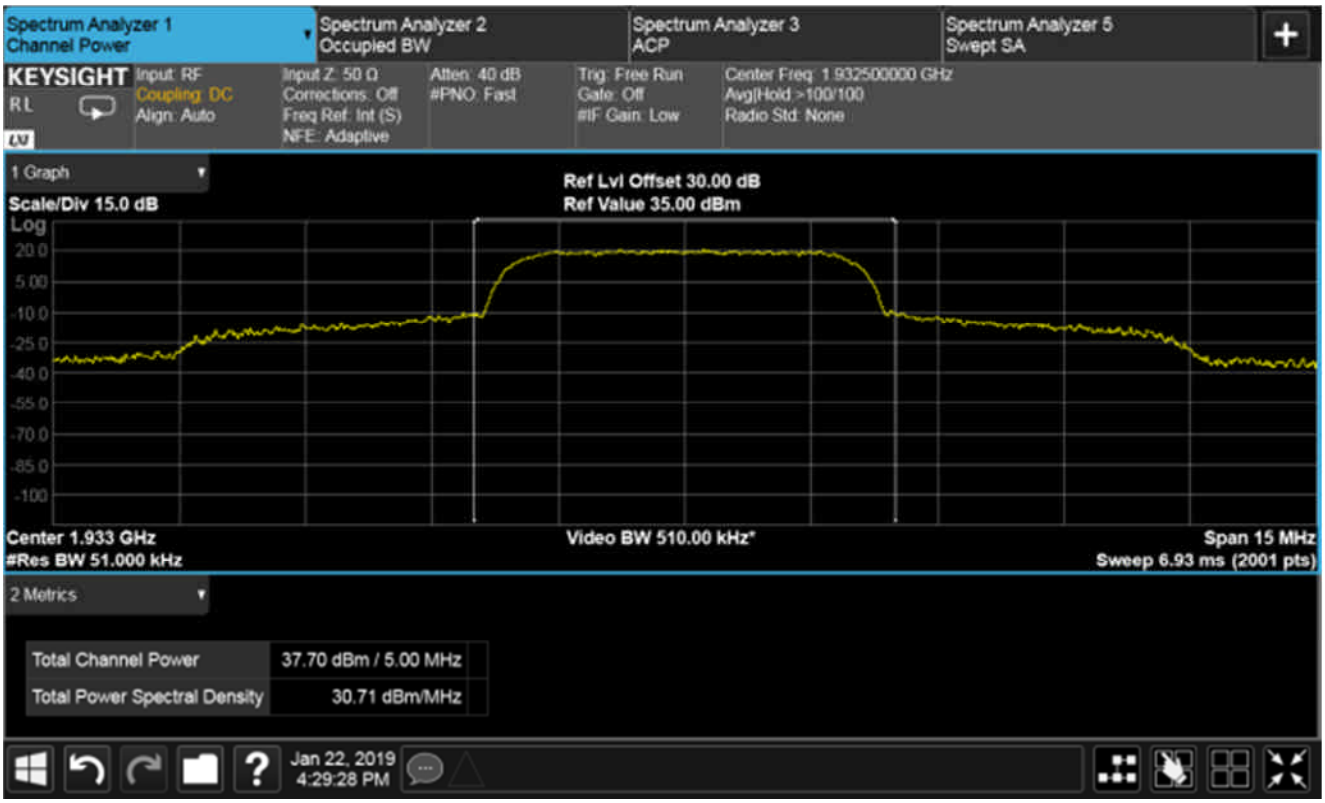
RF Parameters: Band 869-894 MHz, Power +46 dBm, Channel Spacing 200kHz, Modulation GSM, Channel 893.6 MHz



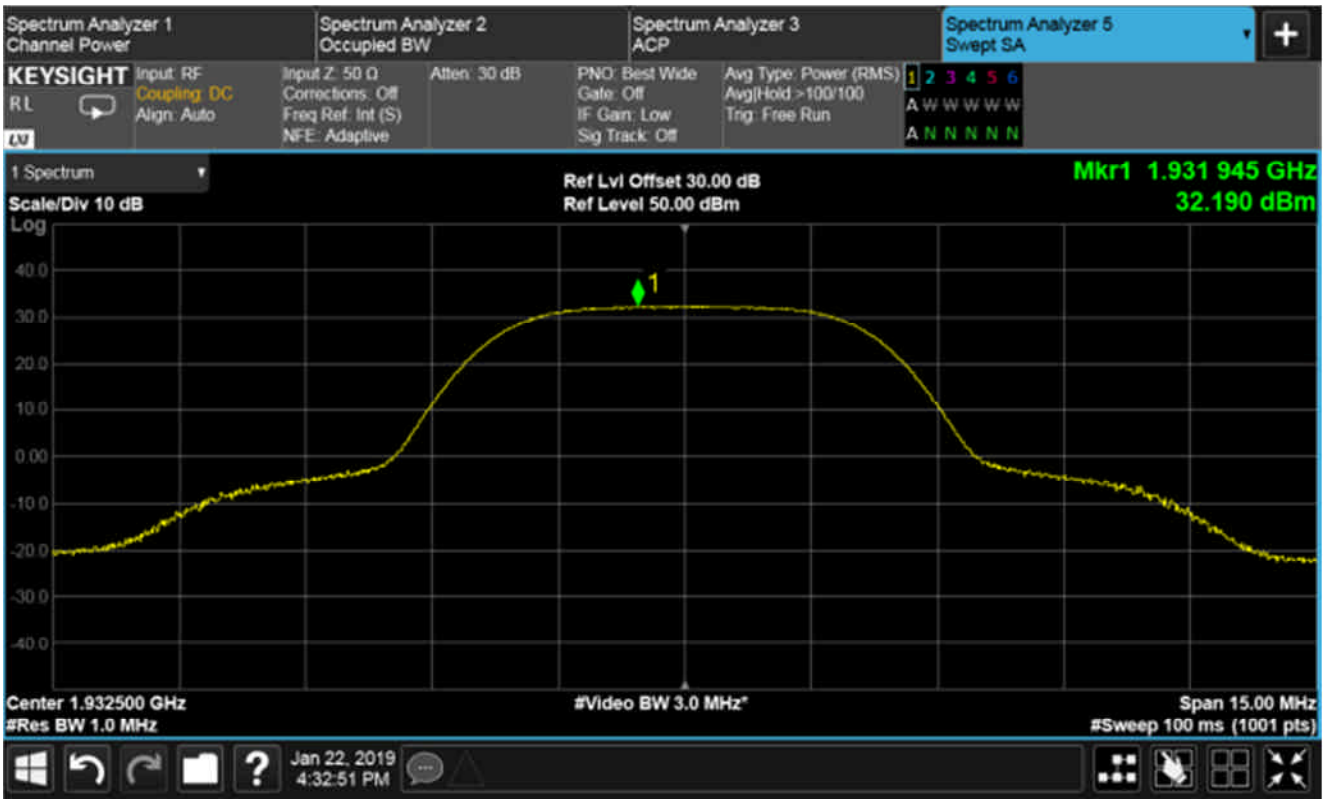
Plot of Channel power

Plot of Peak to Average power ratio

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation UMTS, Channel 1932.5 MHz

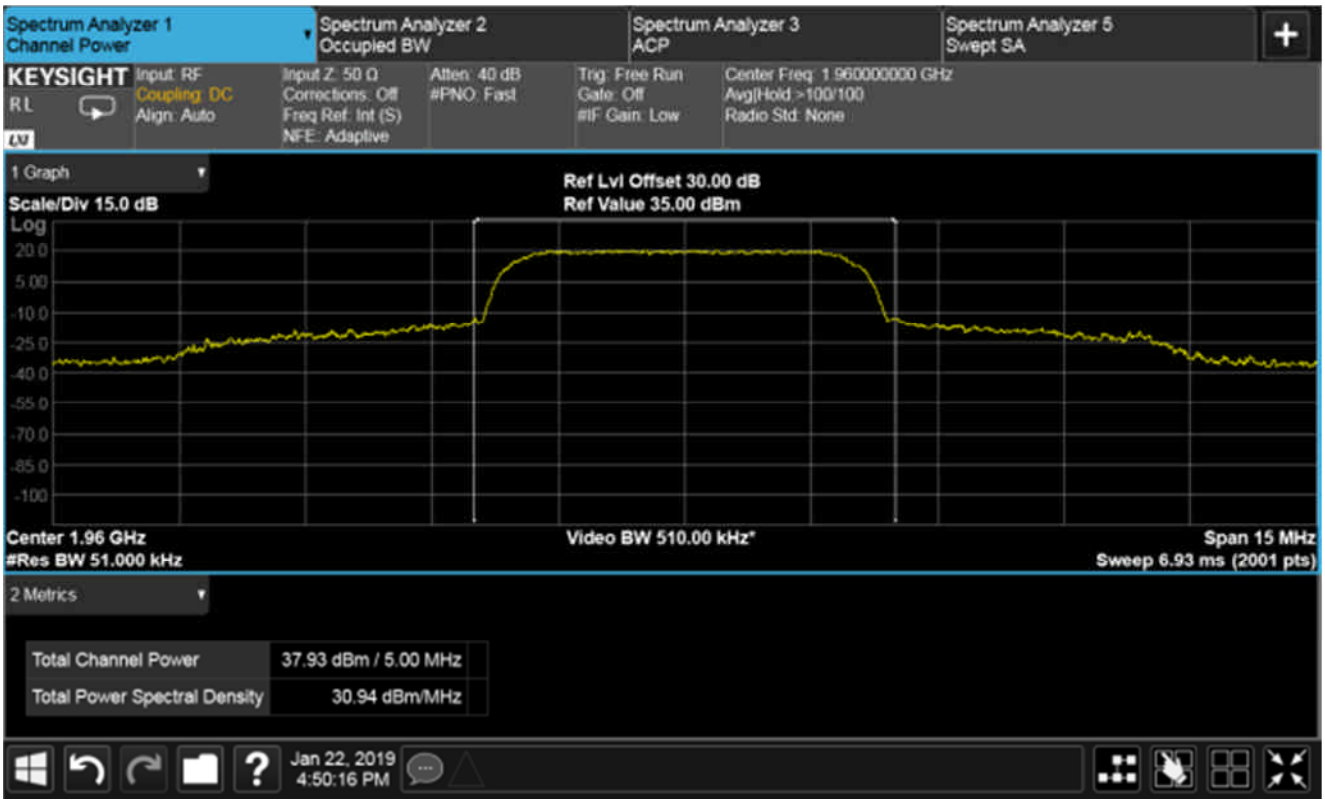


Plot of Channel power



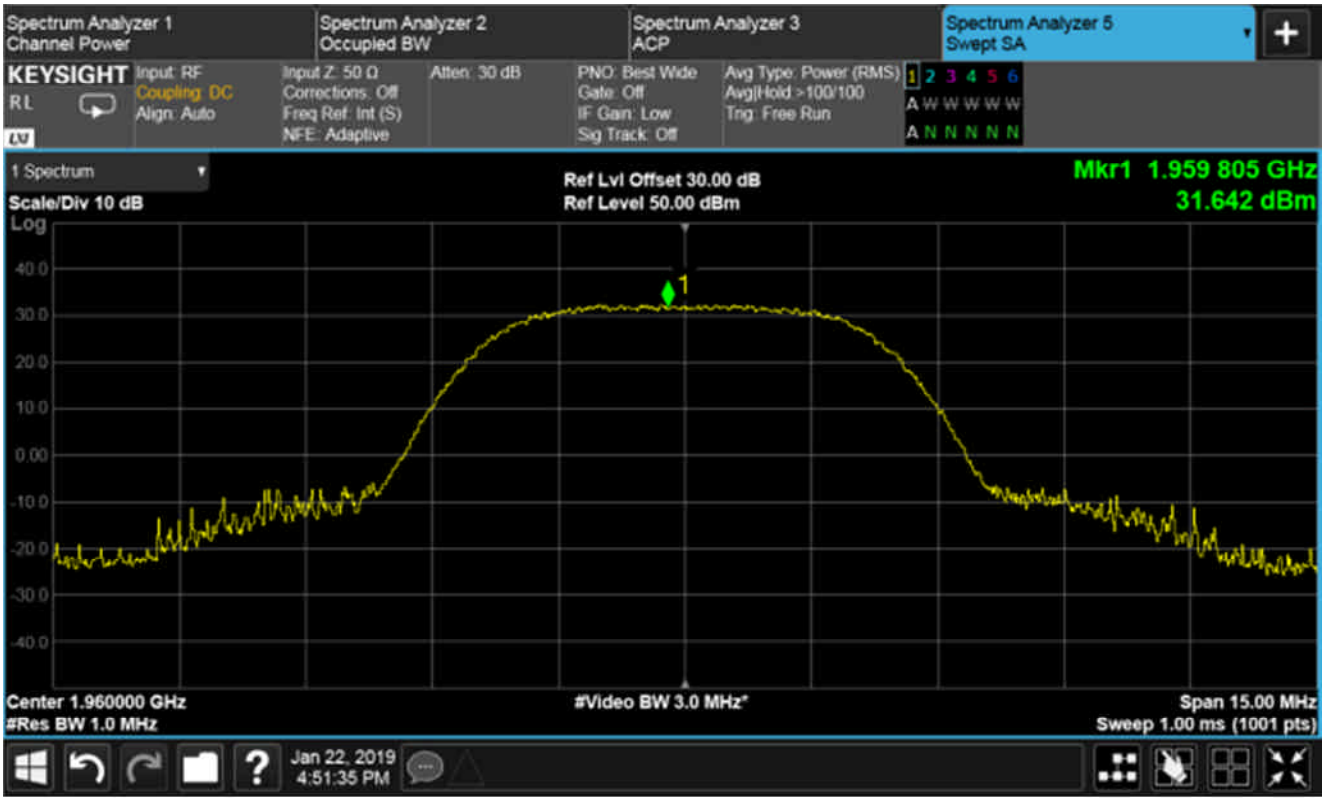
Plot of PSD

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation UMTS, Channel 1960 MHz



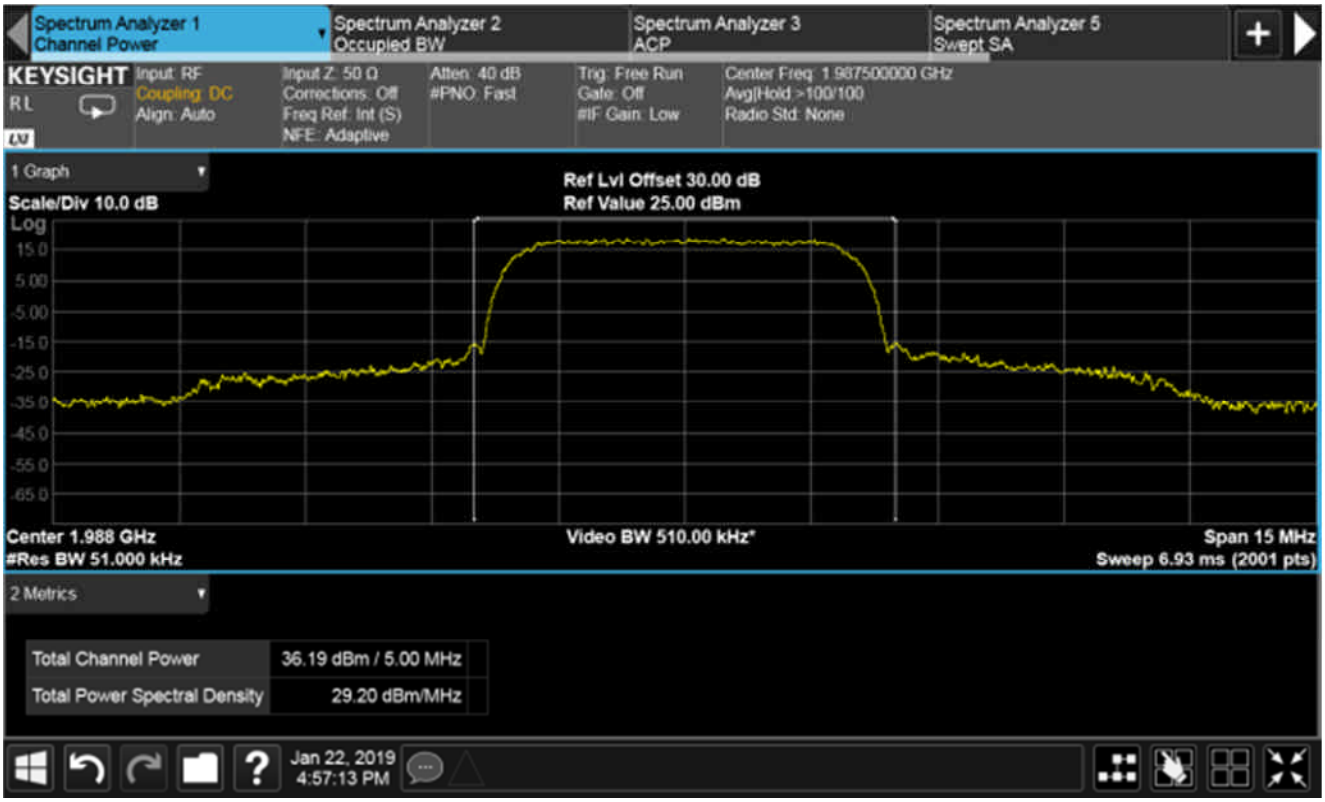
Plot of Channel power

Plot of Peak to Average power ratio

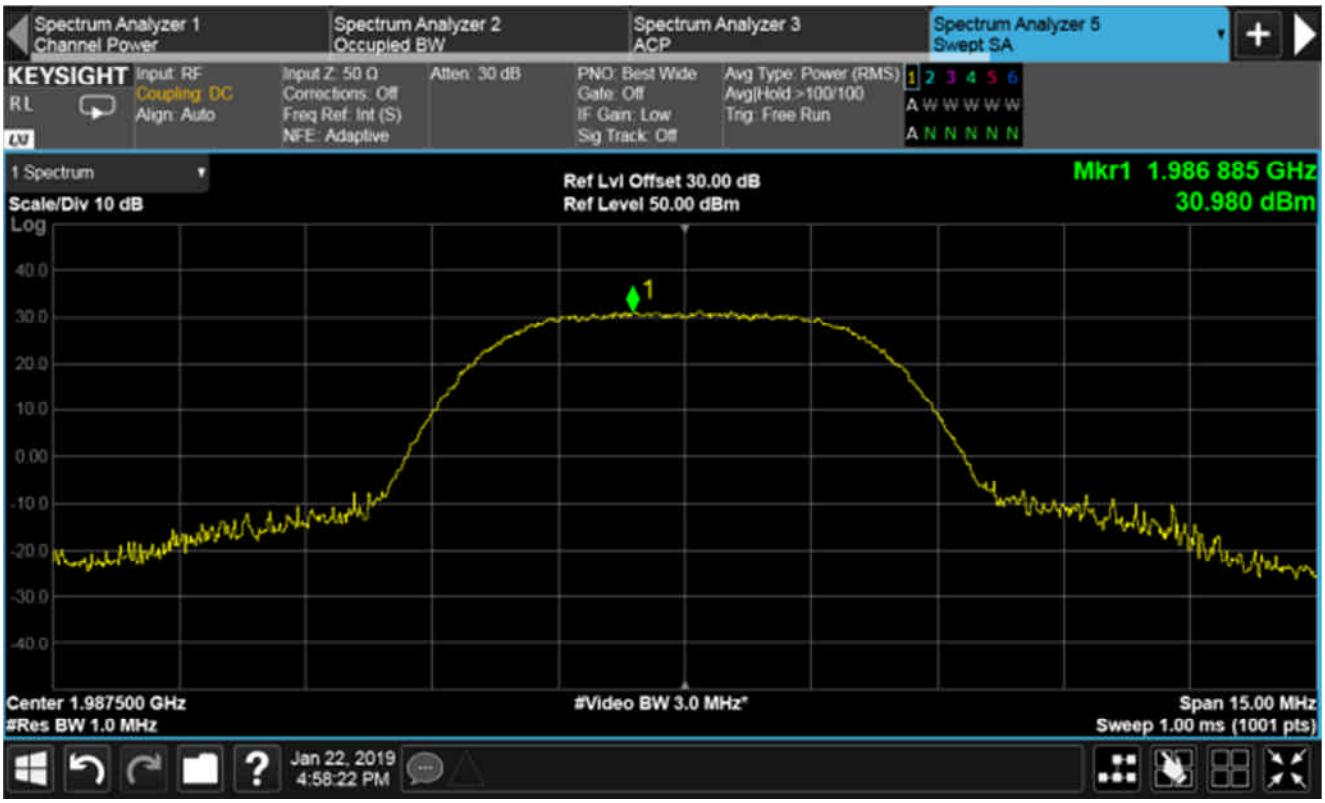

Spectrum Analyzer 1
Channel Power
Spectrum Analyzer 2
Occupied BW
Spectrum Analyzer 3
ACP
Spectrum Analyzer 5
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 30 dB
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Power (RMS)
Avg|Hold:>100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Log
Ref Lvl Offset 30.00 dB
Ref Level 50.00 dBm
Mkr1 1.959 805 GHz
31.642 dBm
40.0
30.0
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
Center 1.960000 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz*
Span 15.00 MHz
Sweep 1.00 ms (1001 pts)
Jan 22, 2019
4:51:35 PM

Plot of PSD

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation UMTS, Channel 1987.5 MHz

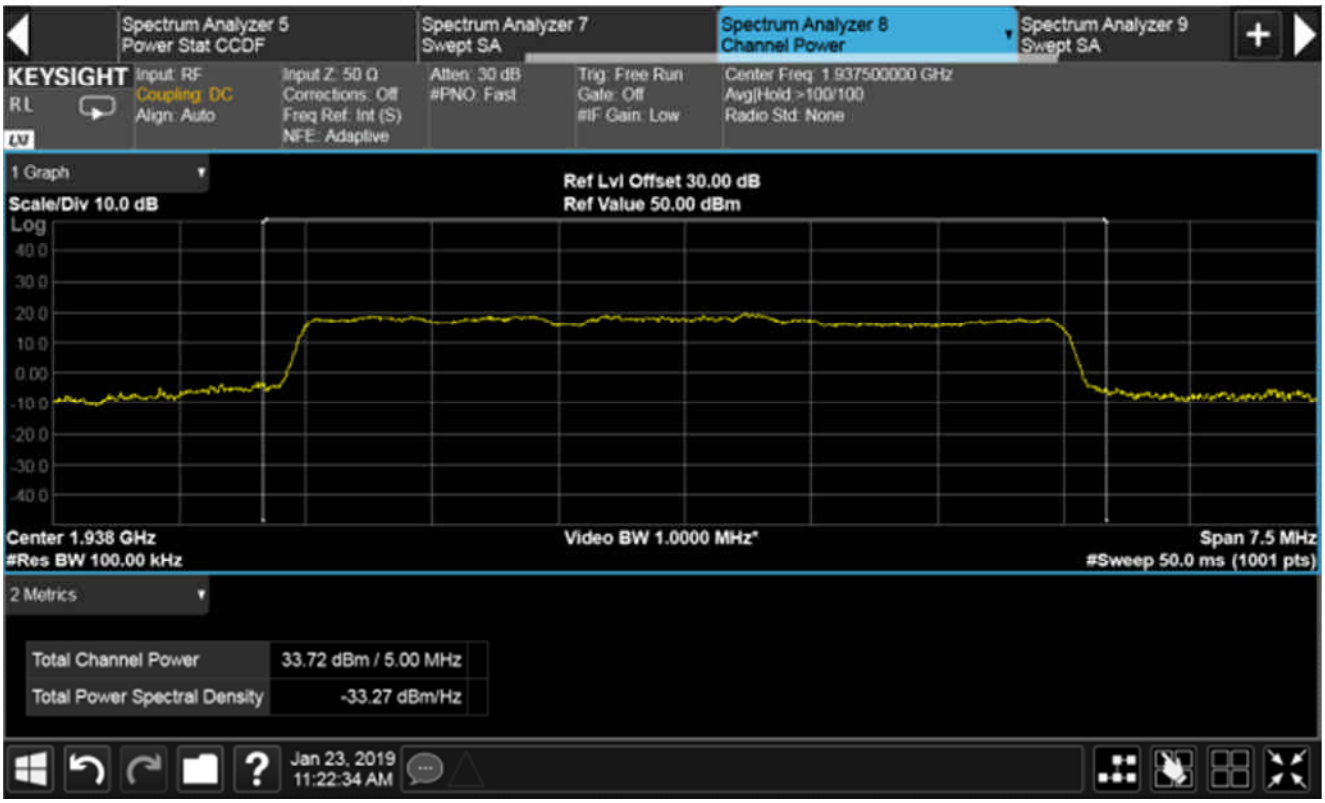


Plot of Channel power

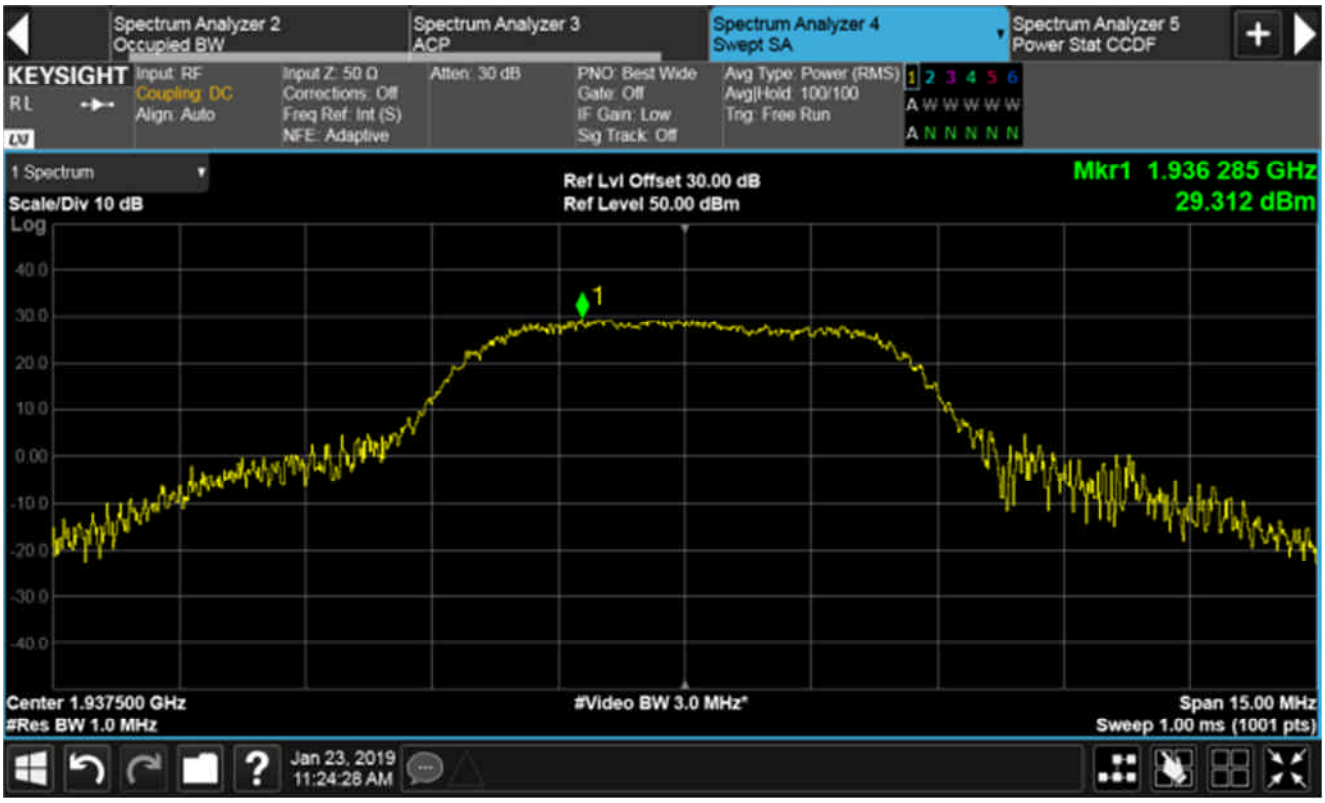


Plot of PSD

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation LTE, Channel 1937.5 MHz

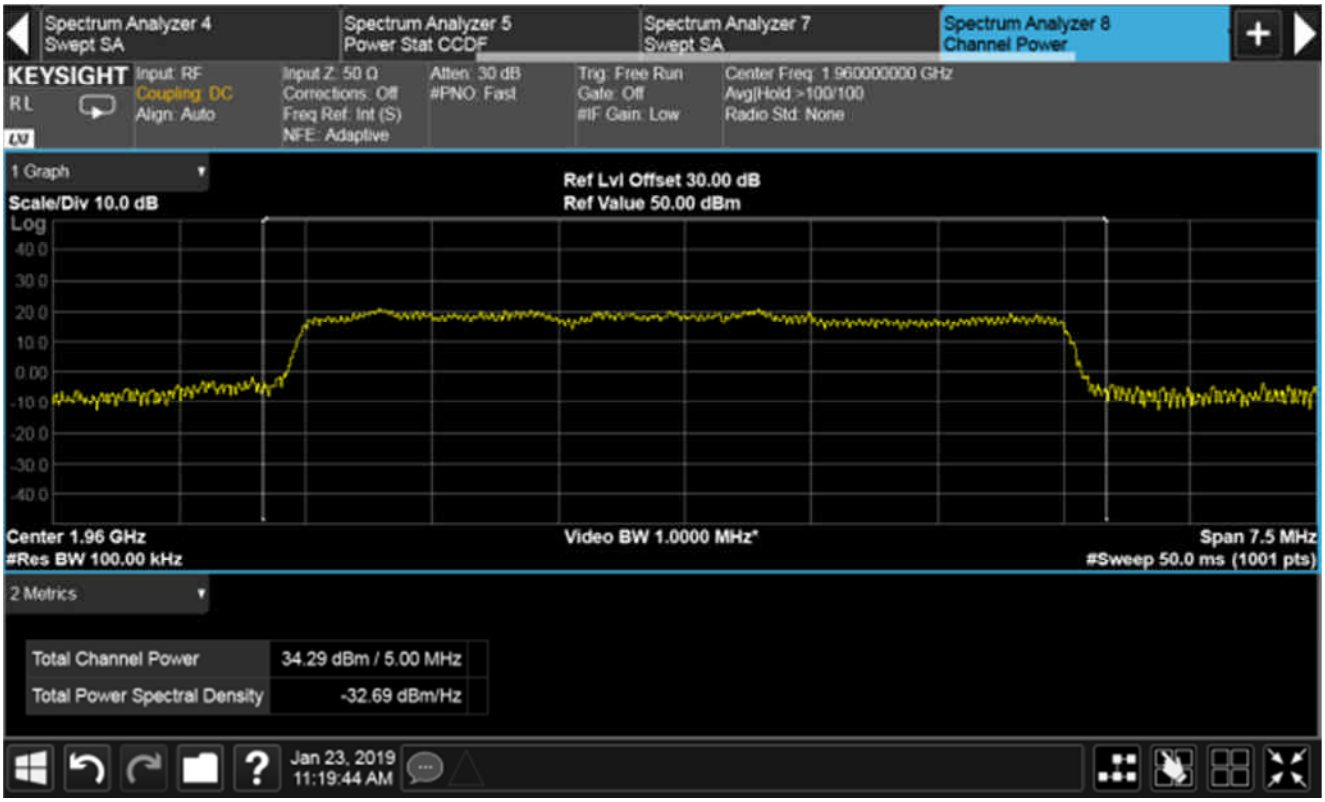


Plot of Channel power



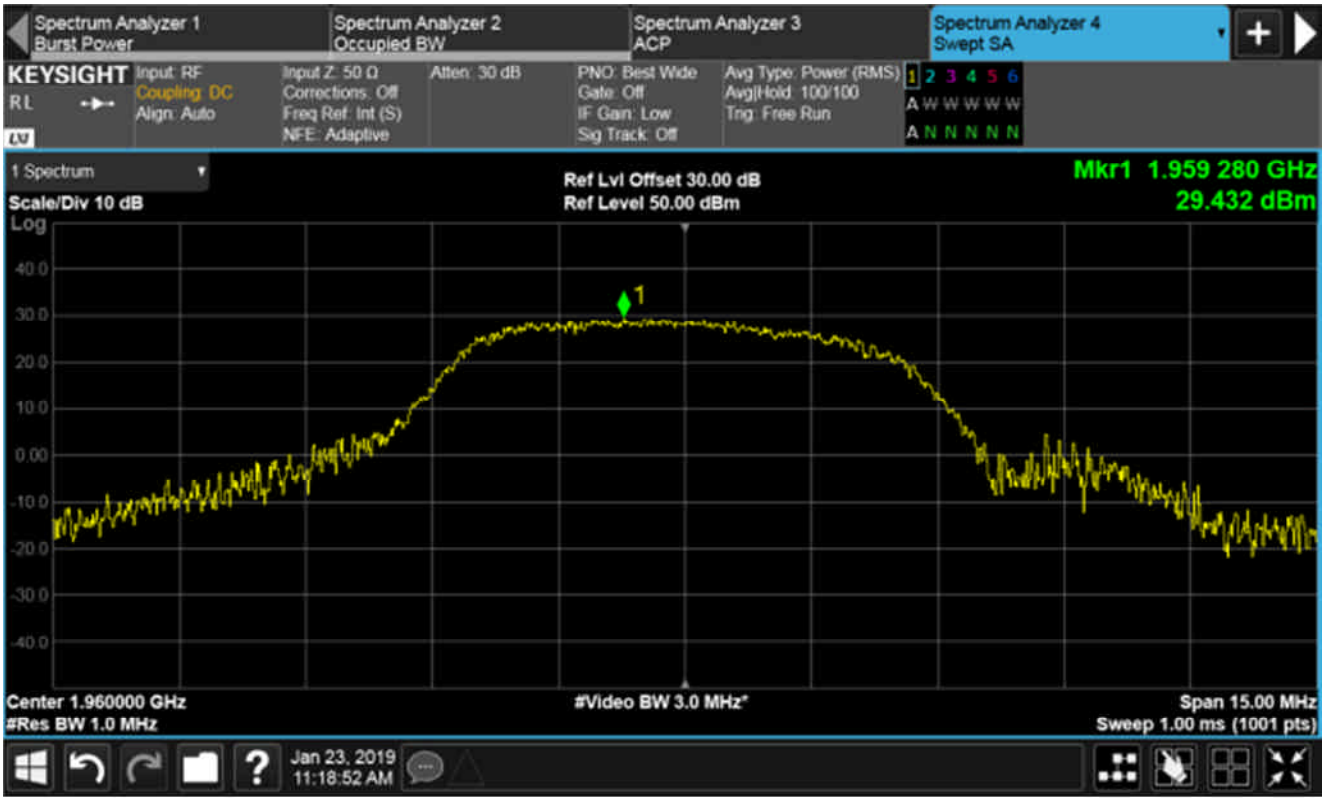
Plot of PSD

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation LTE, Channel 1960 MHz



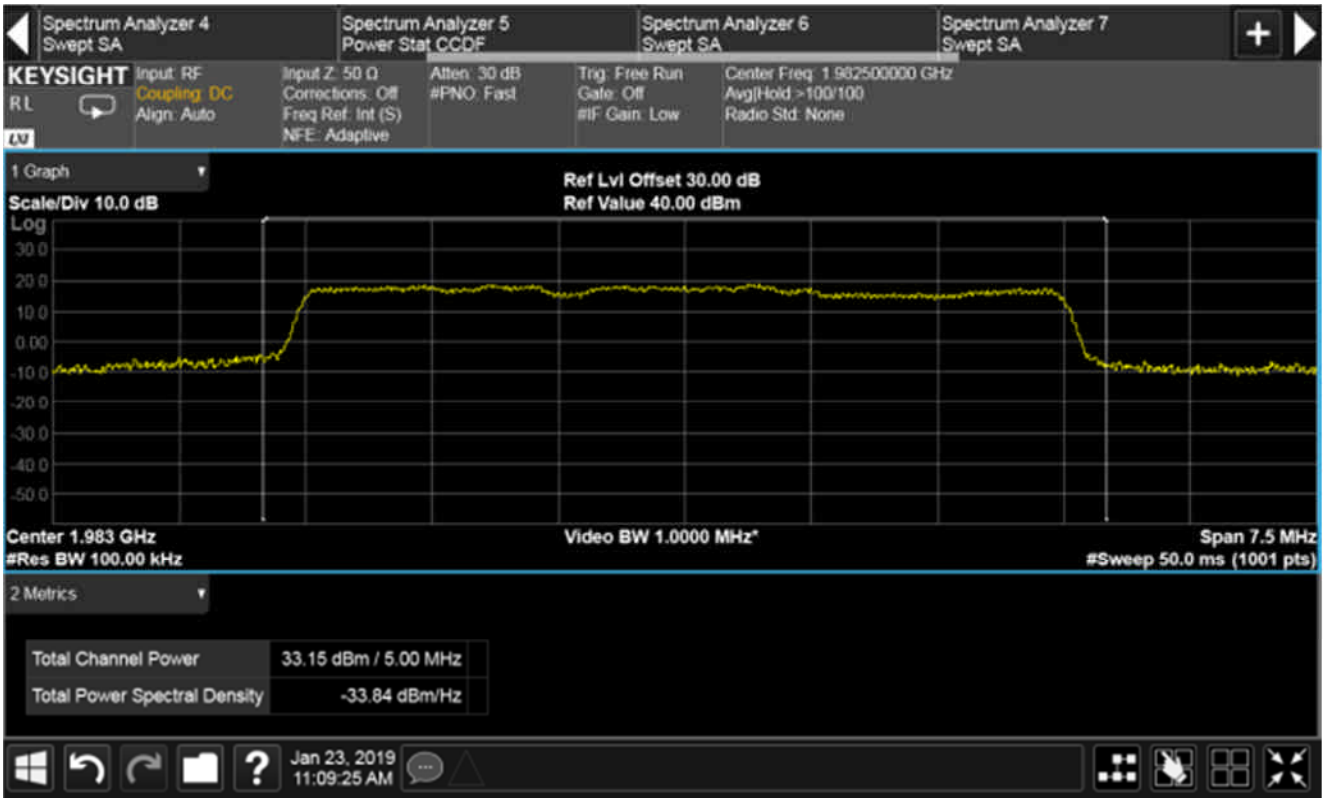
Plot of Channel power

Plot of Peak to Average power ratio

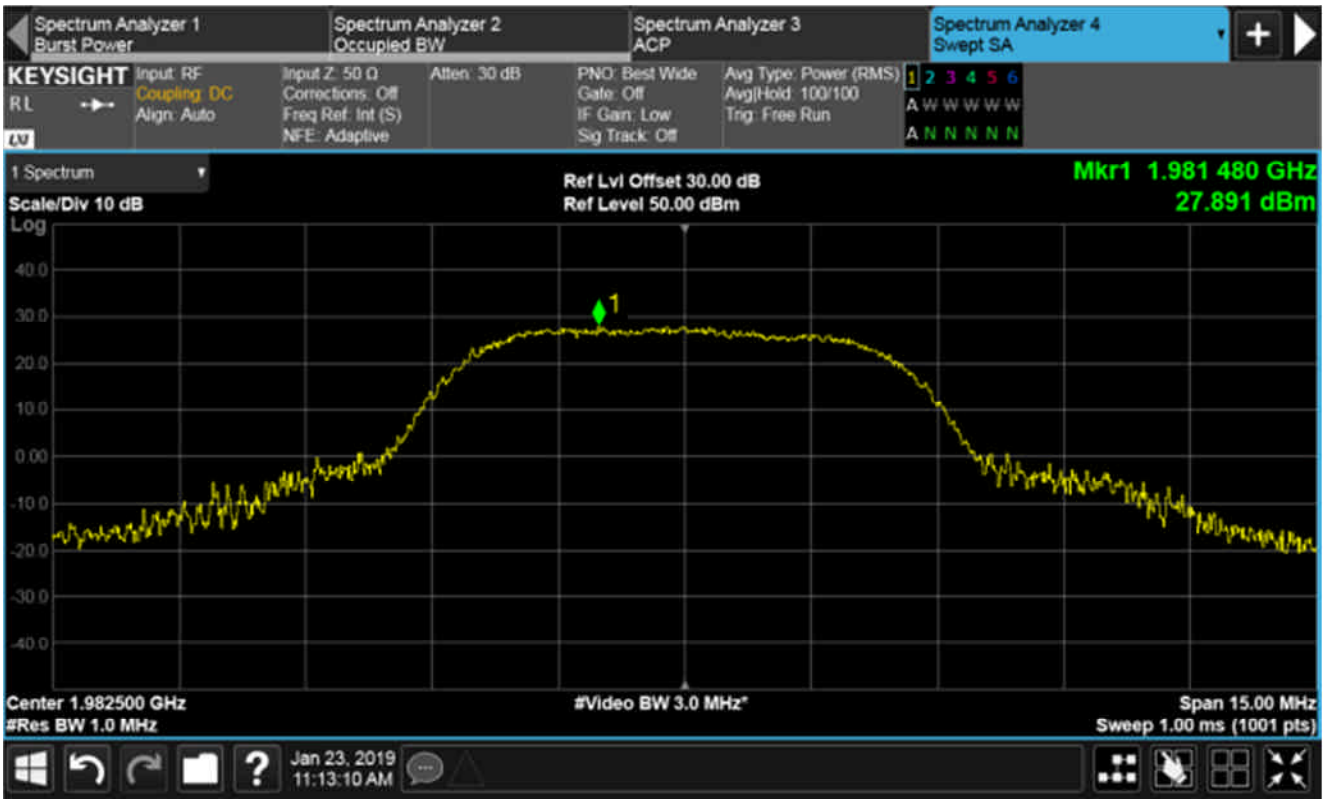

Spectrum Analyzer 1
Burst Power
Spectrum Analyzer 2
Occupied BW
Spectrum Analyzer 3
ACP
Spectrum Analyzer 4
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 30 dB
PNO: Best Wide
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Power (RMS)
Avg|Hold: 100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Log
Ref Lvl Offset 30.00 dB
Ref Level 50.00 dBm
Mkr1 1.959 280 GHz
29.432 dBm
40.0
30.0
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
Center 1.960000 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz*
Span 15.00 MHz
Sweep 1.00 ms (1001 pts)
Jan 23, 2019
11:18:52 AM

Plot of PSD

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation LTE, Channel 1982.5 MHz



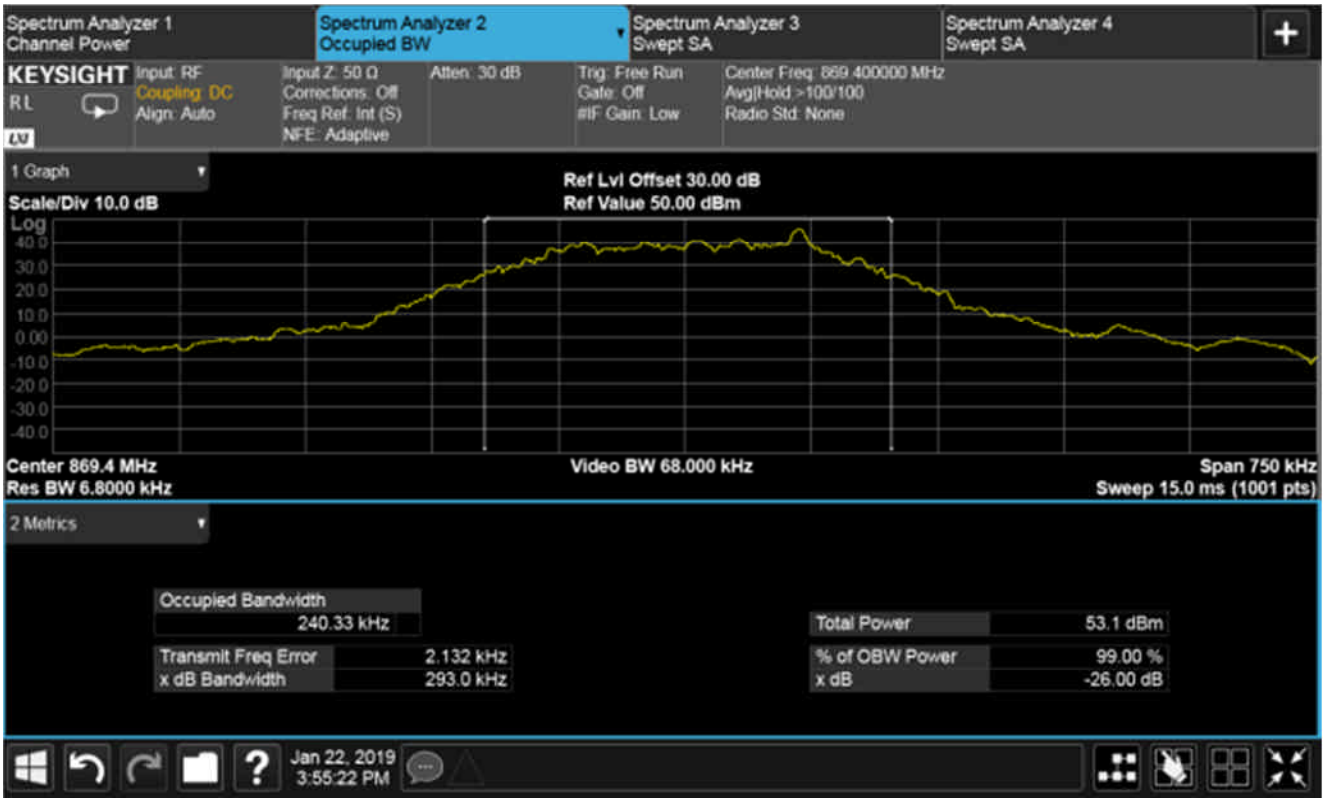
Plot of Channel power



Plot of PSD

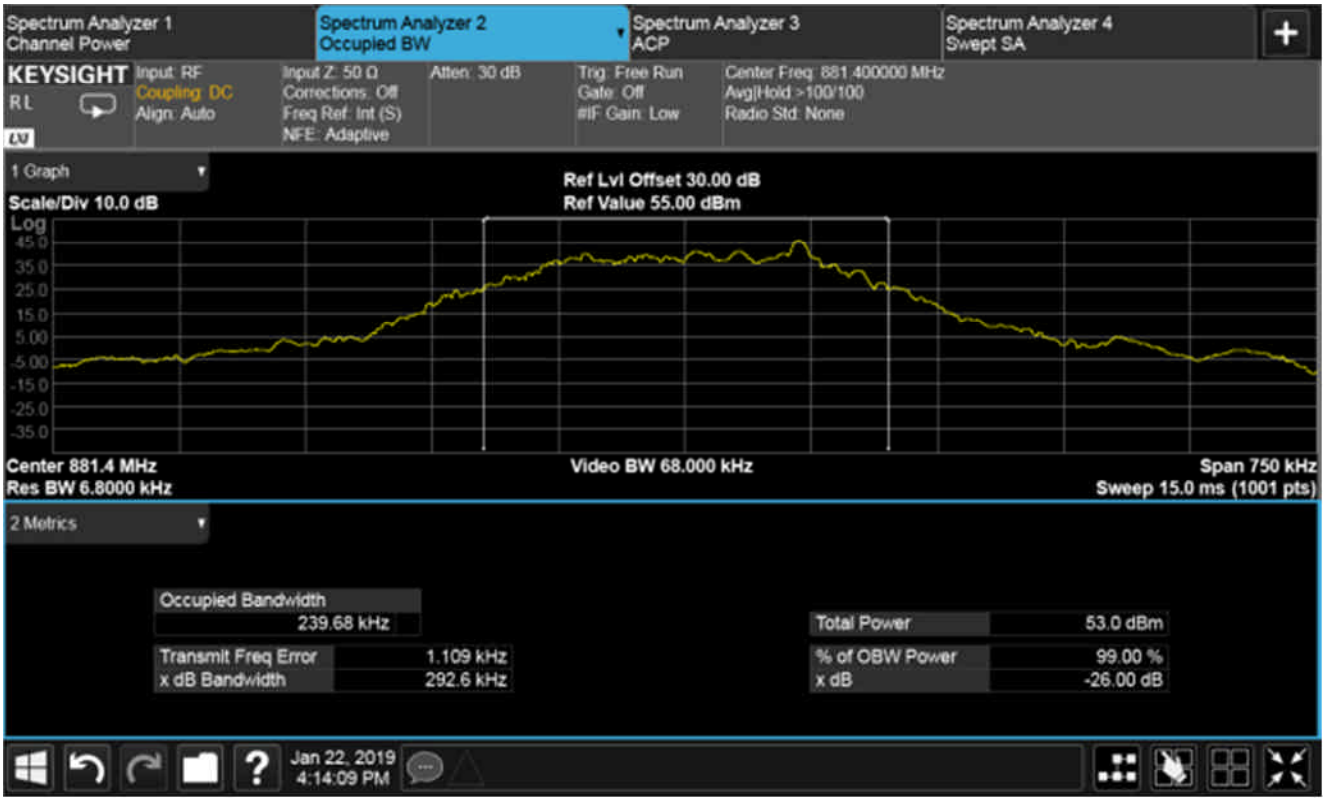
6.2 Occupied bandwidth

RF Parameters: Band 869-894 MHz, Power +46 dBm, Channel Spacing 200kHz, Modulation GSM, Channel 869.4 MHz



Plot of occupied BW

RF Parameters: Band 869-894 MHz, Power +46 dBm, Channel Spacing 200kHz, Modulation GSM, Channel 881.4 MHz

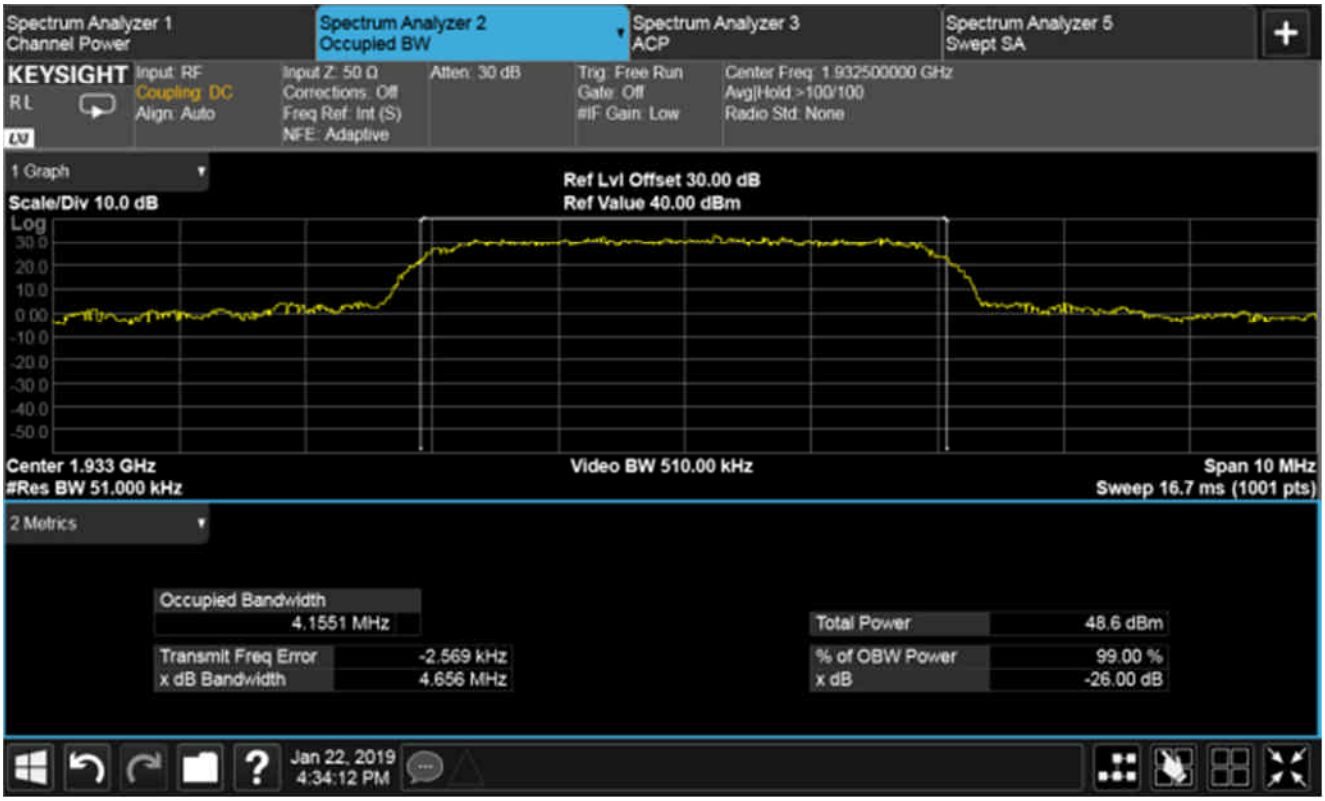


Plot of occupied BW

RF Parameters: Band 869-894 MHz, Power +46 dBm, Channel Spacing 200kHz, Modulation GSM, Channel 893.6 MHz

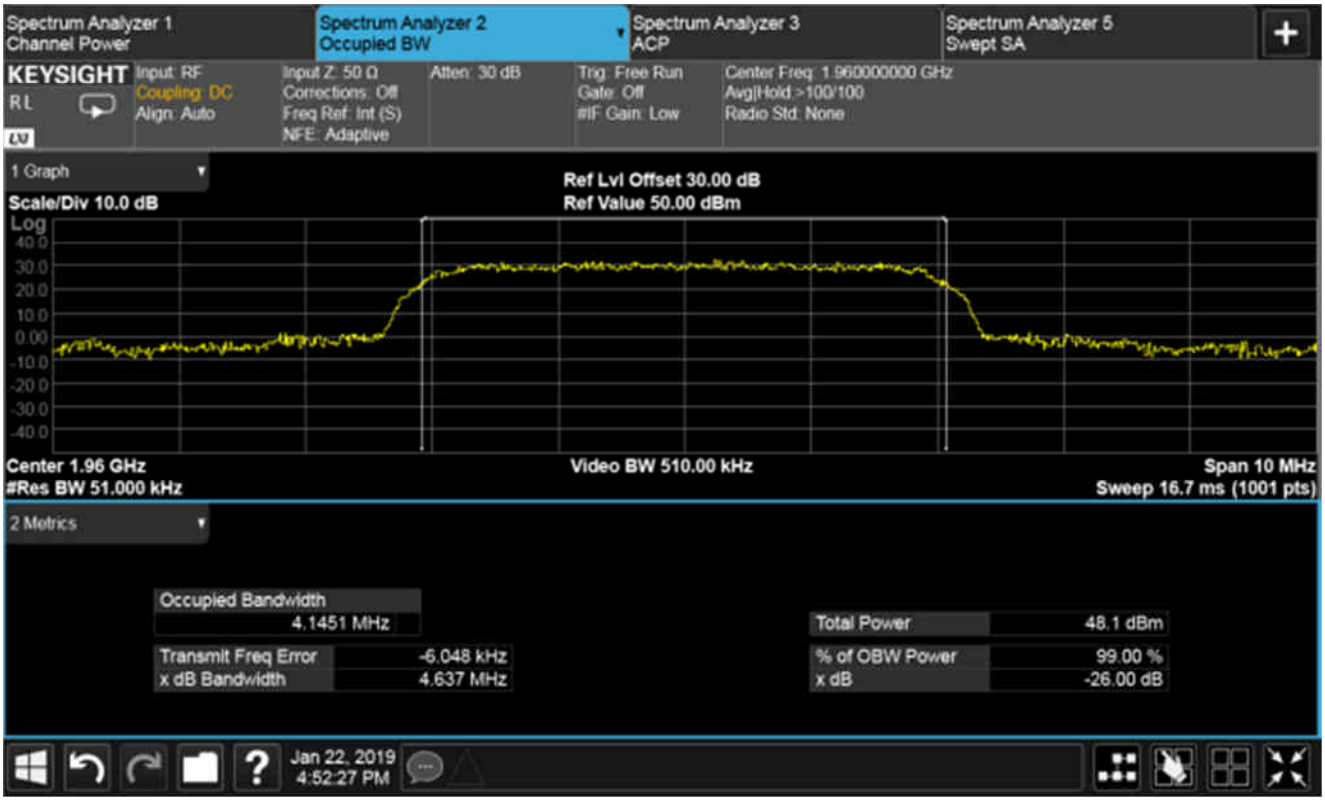
Plot of occupied BW

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation UMTS, Channel 1932.5 MHz



Plot of occupied BW

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation UMTS, Channel 1960 MHz

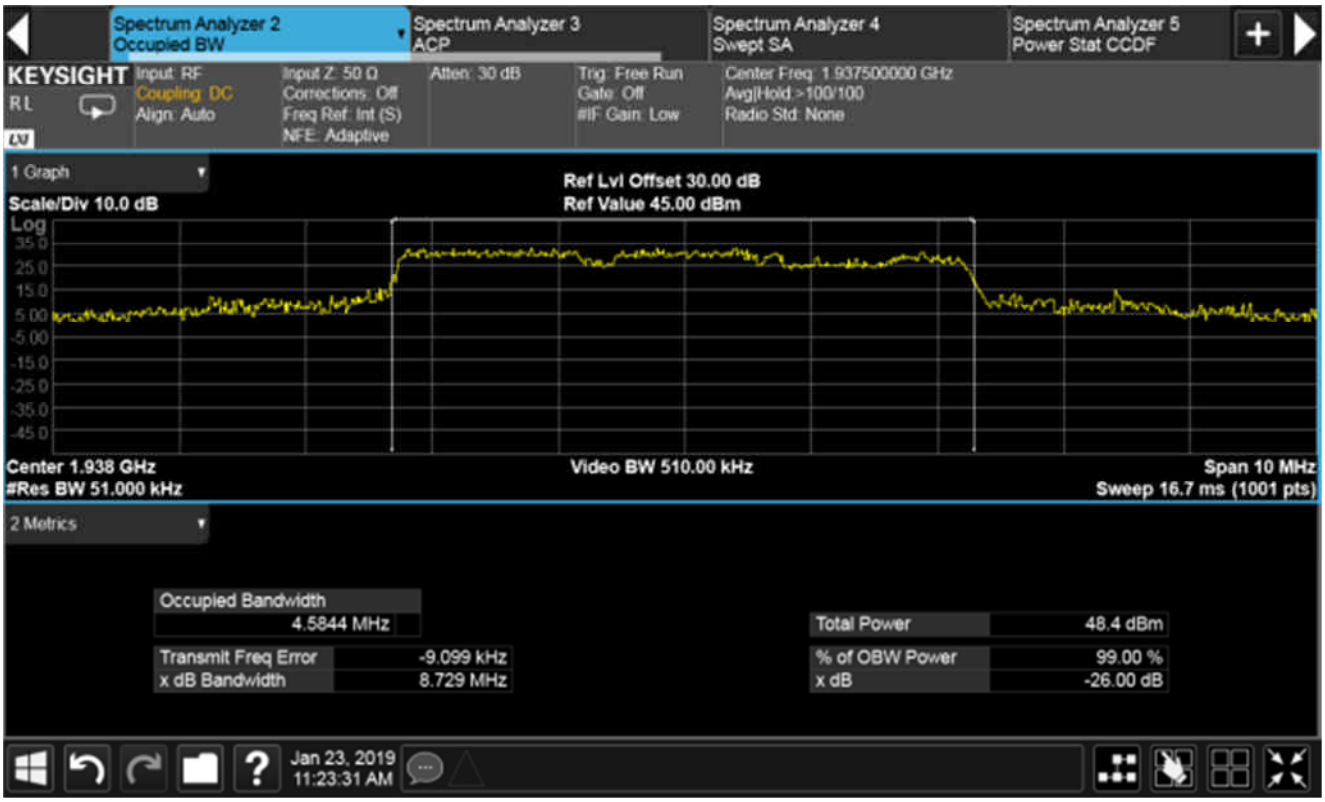


Plot of occupied BW

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation UMTS, Channel 1987.5 MHz

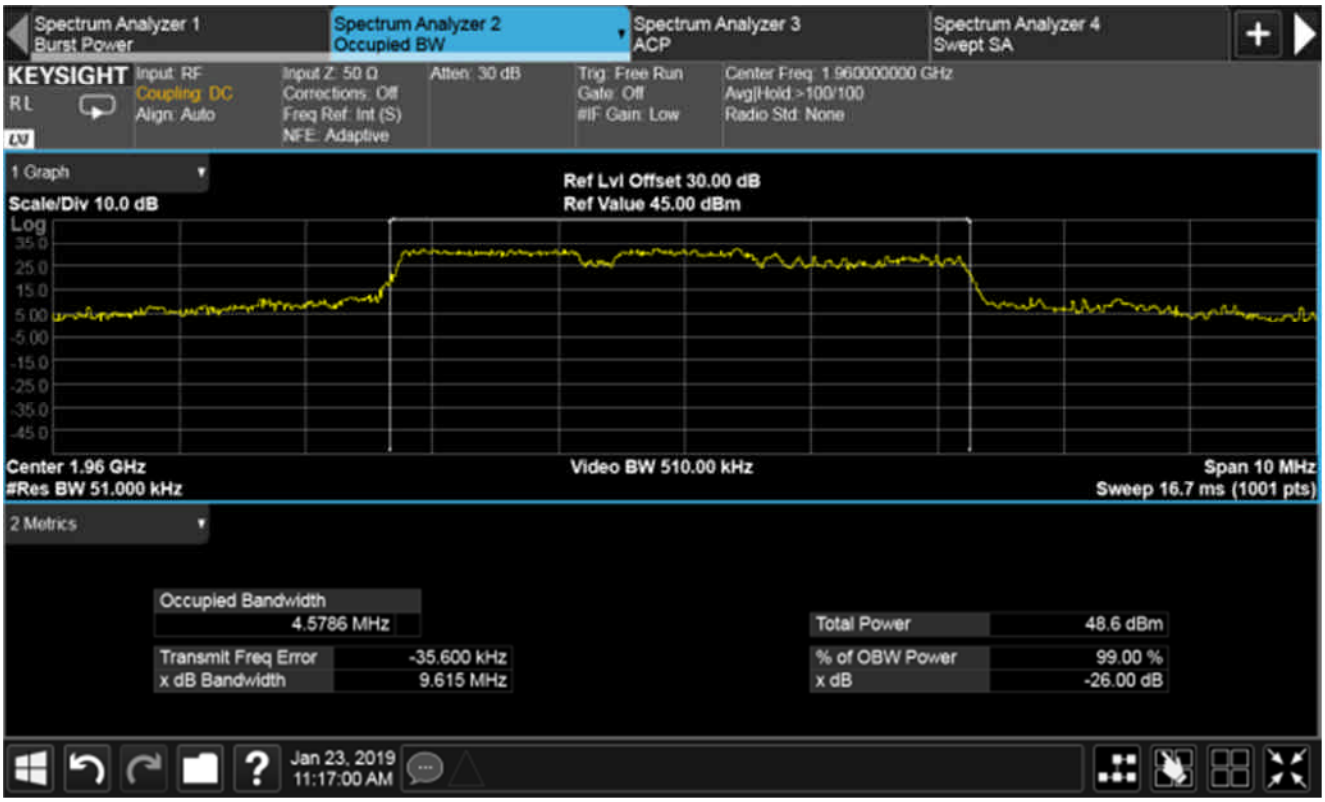
Plot of occupied BW

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation LTE, Channel 1937.5 MHz



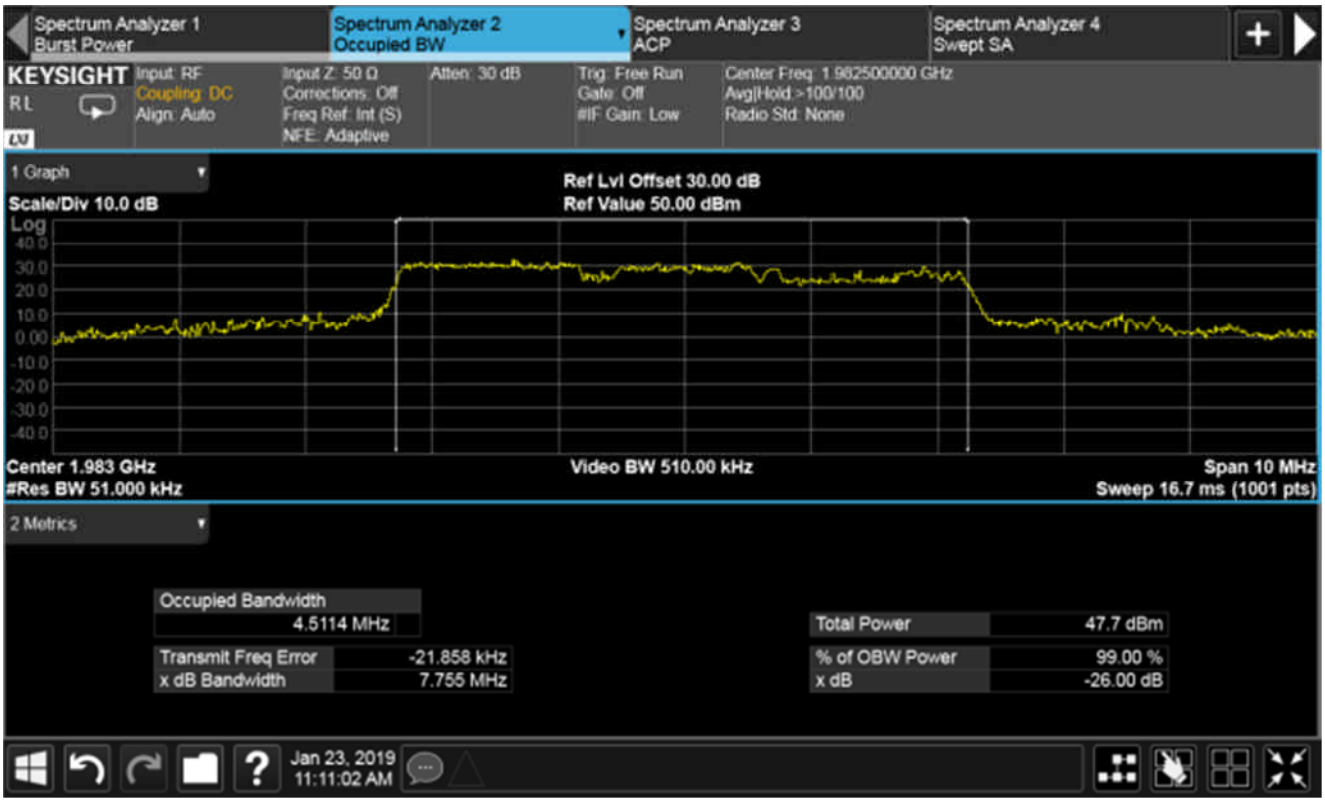
Plot of occupied BW

RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation LTE, Channel 1960 MHz



Plot of occupied BW

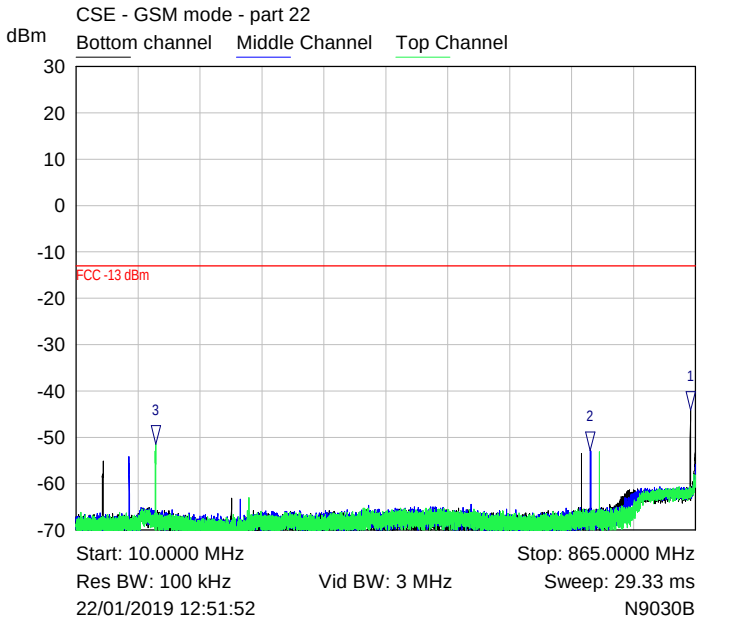
RF Parameters: Band 1930-1995 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation LTE, Channel 1982.5 MHz



Plot of occupied BW

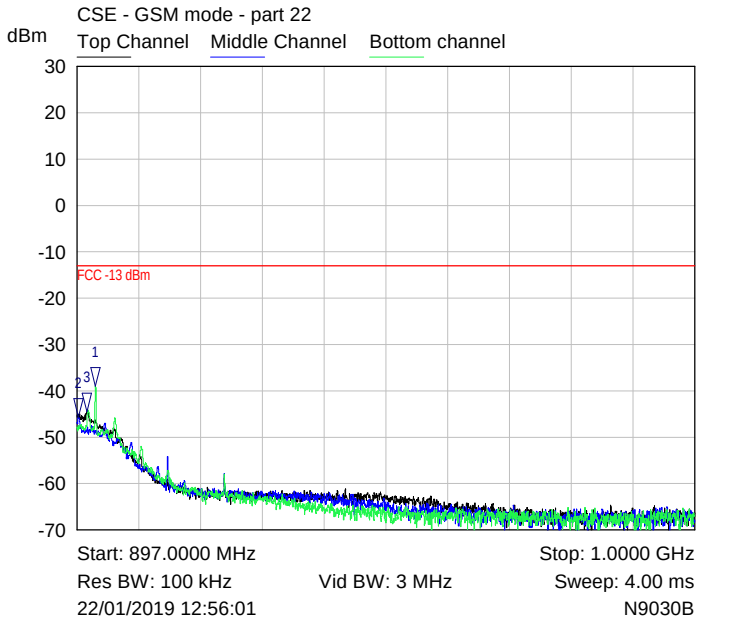
6.3 Spurious emissions at antenna terminals

RF Parameters: Band 869-894 MHz, Power +46 dBm, Channel Spacing 200kHz, Modulation GSM, Channel 869.4 MHz, Channel 881.4 MHz, & Channel 893.6 MHz



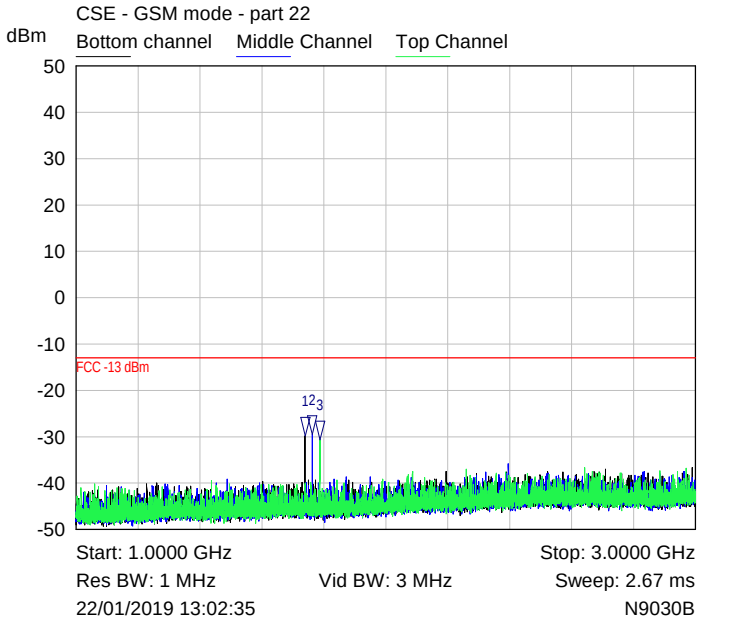
Mkr	Trace	X-Axis	Value	Notes
1	Bottom channel	858.2024 MHz	-44.10 dBm	
2	Middle Channel	720.1558 MHz	-52.81 dBm	
3	Top Channel	119.7447 MHz	-51.54 dBm	

Plot of conducted emissions 10 MHz – 865 MHz range



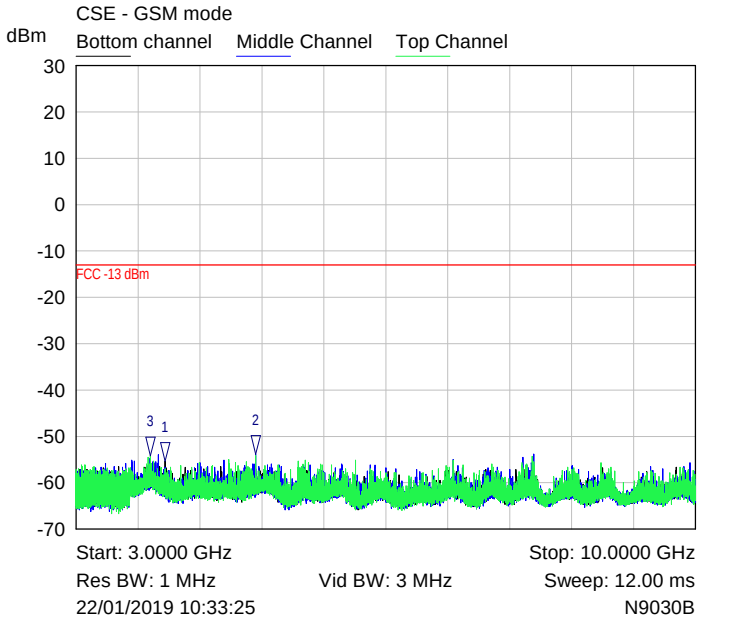
Mkr	Trace	X-Axis	Value	Notes
1	Bottom channel	900.1262 MHz	-38.96 dBm	
2	Middle Channel	897.2730 MHz	-45.61 dBm	
3	Top Channel	898.6532 MHz	-44.52 dBm	

Plot of conducted emissions 897 MHz – 1000 GHz range



Mkr	Trace	X-Axis	Value	Notes
1	Bottom channel	1.7388 GHz	-29.82 dBm	
2	Middle Channel	1.7626 GHz	-29.55 dBm	
3	Top Channel	1.7871 GHz	-30.62 dBm	

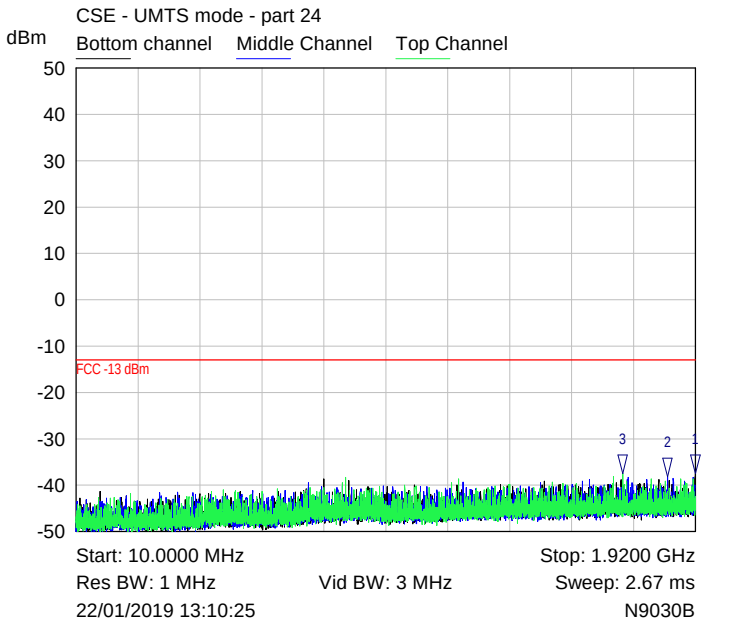
Plot of conducted emissions 1 GHz – 3 GHz range



Mkr	Trace	X-Axis	Value	Notes
1	Bottom channel	4.0048 GHz	-55.35 dBm	
2	Middle Channel	5.0315 GHz	-53.75 dBm	
3	Top Channel	3.8368 GHz	-54.17 dBm	

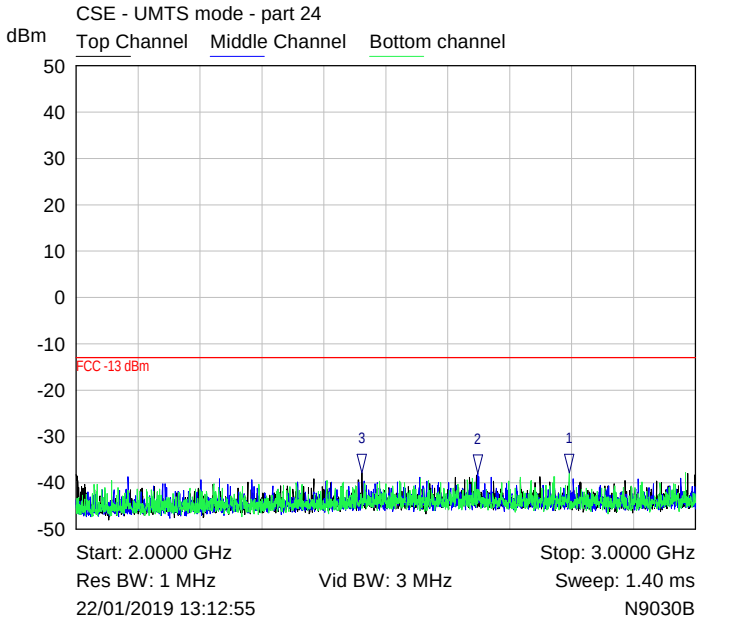
Plot of conducted emissions 3 GHz – 10 GHz range

RF Parameters: Band 1930-1990 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation UMTS, Channel 1932.5 MHz, Channel 1960 MHz, & Channel 1987.5 MHz



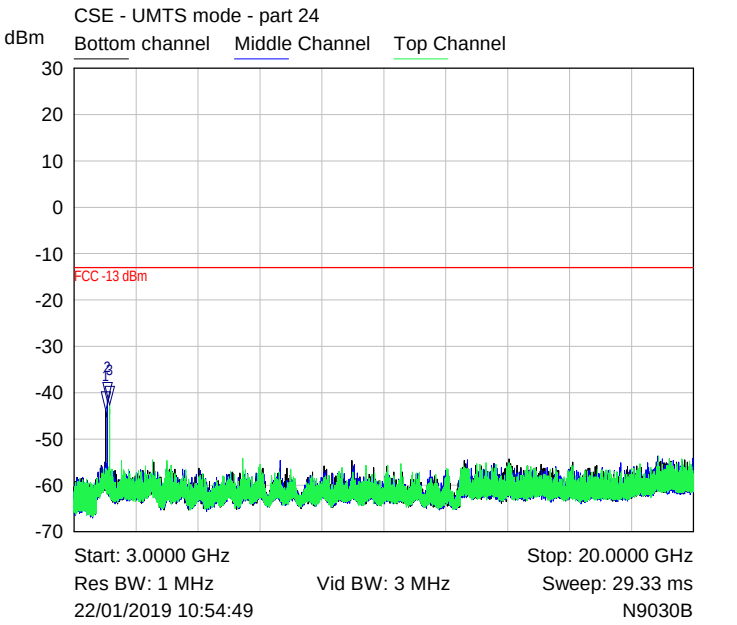
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Bottom channel	1.9191 GHz	-37.56 dBm	
2 ▽	Middle Channel	1.8332 GHz	-38.24 dBm	
3 ▽	Top Channel	1.6952 GHz	-37.57 dBm	

Plot of conducted emissions 10 MHz – 1920 MHz range



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Bottom channel	2.7963 GHz	-37.75 dBm	
2 ▽	Middle Channel	2.6482 GHz	-37.93 dBm	
3 ▽	Top Channel	2.4615 GHz	-37.79 dBm	

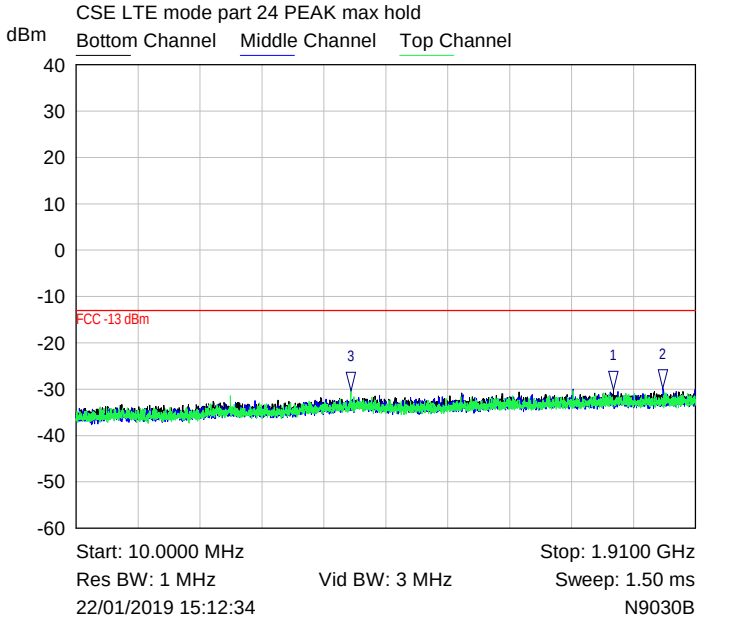
Plot of conducted emissions 2 GHz – 3 GHz range



Mkr	Trace	X-Axis	Value	Notes
1	Bottom channel	3.8649 GHz	-43.81 dBm	
2	Middle Channel	3.9197 GHz	-41.81 dBm	
3	Top Channel	3.9745 GHz	-42.67 dBm	

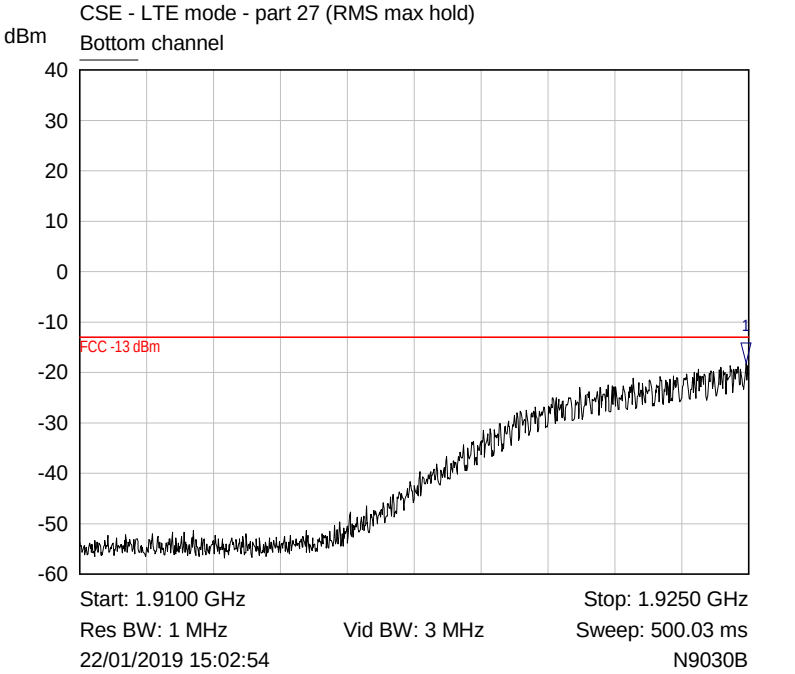
Plot of conducted emissions 3 GHz – 20 GHz range

RF Parameters: Band 1930-1990 MHz, Power +44 dBm, Channel Spacing 5MHz, Modulation LTE, Channel 1937.5 MHz, Channel 1960 MHz, & Channel 1982.5 MHz



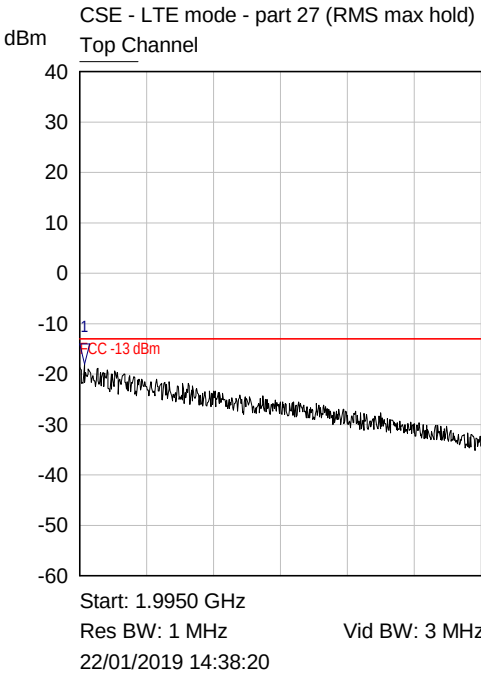
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Bottom Channel	1.6579 GHz	-30.23 dBm	
2 ▽	Middle Channel	1.8112 GHz	-29.82 dBm	
3 ▽	Top Channel	852.5206 MHz	-30.29 dBm	

Plot of conducted emissions 10 MHz – 1910 MHz range



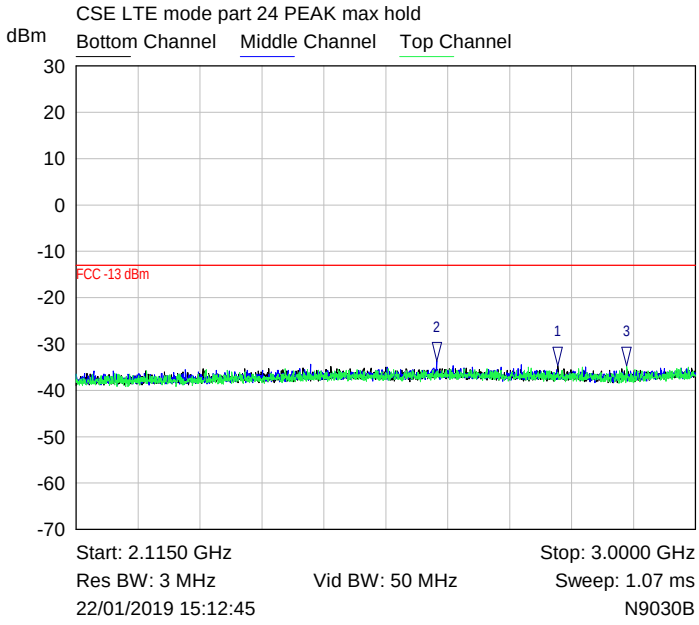
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Bottom channel	1.9249 GHz	-18.21 dBm	Worst case channel

Plot of conducted emissions 1910 MHz – 1925 MHz range



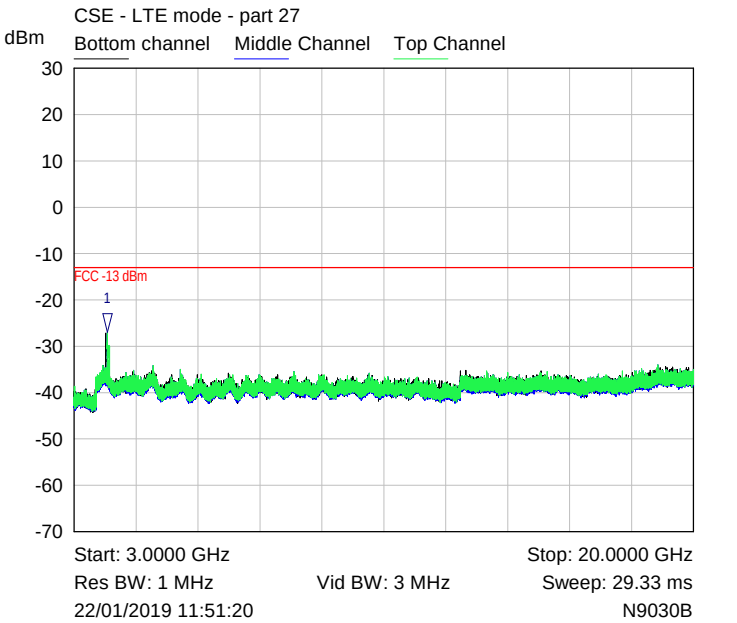
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Top Channel	1.9951 GHz	-17.97 dBm	Worst case channel

Plot of conducted emissions 1995 MHz – 2015 MHz range



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Bottom Channel	2.8034 GHz	-34.71 dBm	
2 ▽	Middle Channel	2.6303 GHz	-33.61 dBm	
3 ▽	Top Channel	2.9017 GHz	-34.66 dBm	

Plot of conducted emissions 2015 MHz – 3 GHz range



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Middle Channel	3.9197 GHz	-27.06 dBm	

Plot of conducted emissions 3 GHz – 22 GHz range

6.5 Band edge emissions

RF Parameters: Band 869-894 MHz, Power +46 dBm, Channel Spacing 200kHz, Modulation GSM, Channel 869.4 MHz,

Plot of lower band edge for Low channel

RF Parameters: Band 869-894 MHz, Power +46 dBm, Channel Spacing 200kHz, Modulation GSM, Channel 893.6 MHz,

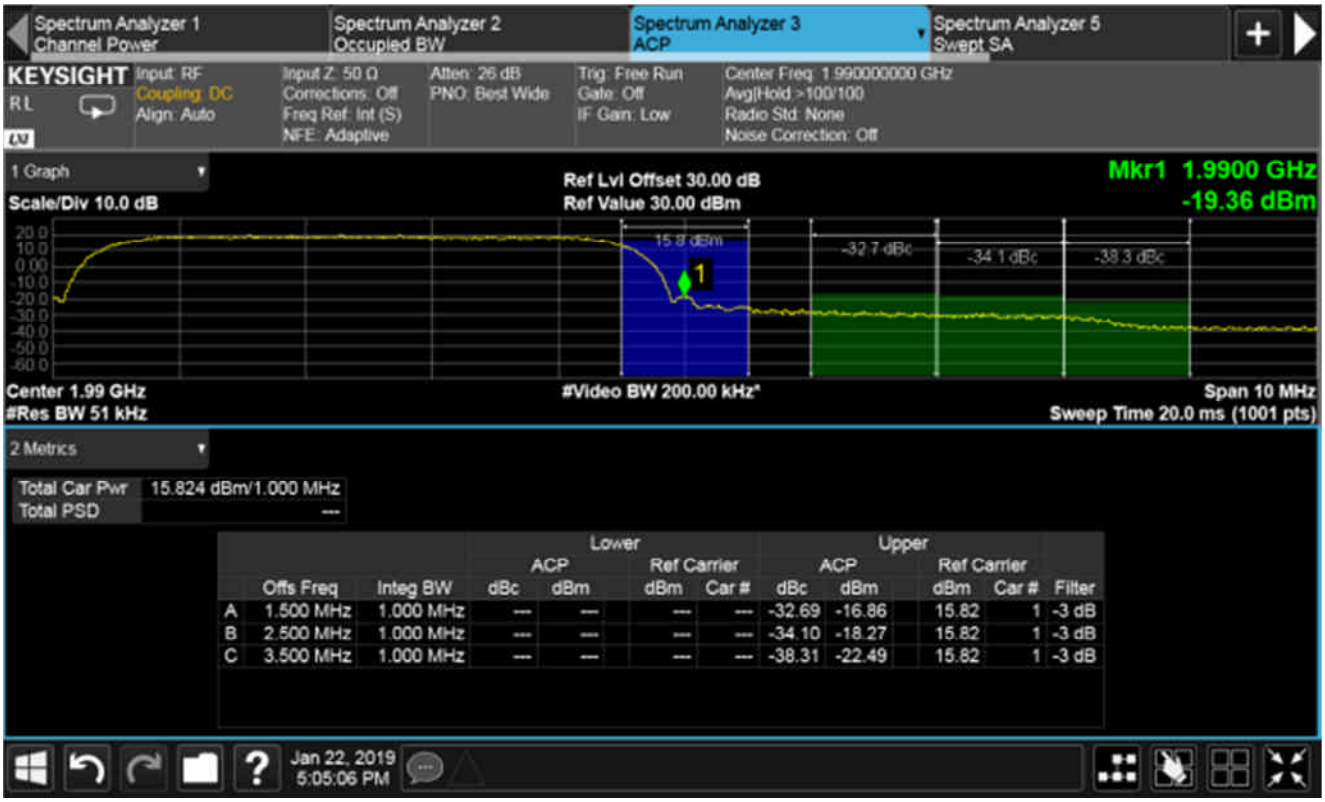
Plot of upper band edge for High channel

Plot of upper band edge for High channel, 3kHzRBW

RF Parameters: Band 1930-1990 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation UMTS, Channel 1932.5 MHz,

Plot of lower band edge for Low channel

RF Parameters: Band 1930-1990 MHz, Power +46 dBm, Channel Spacing 5MHz, Modulation UMTS, Channel 1987.5 MHz,

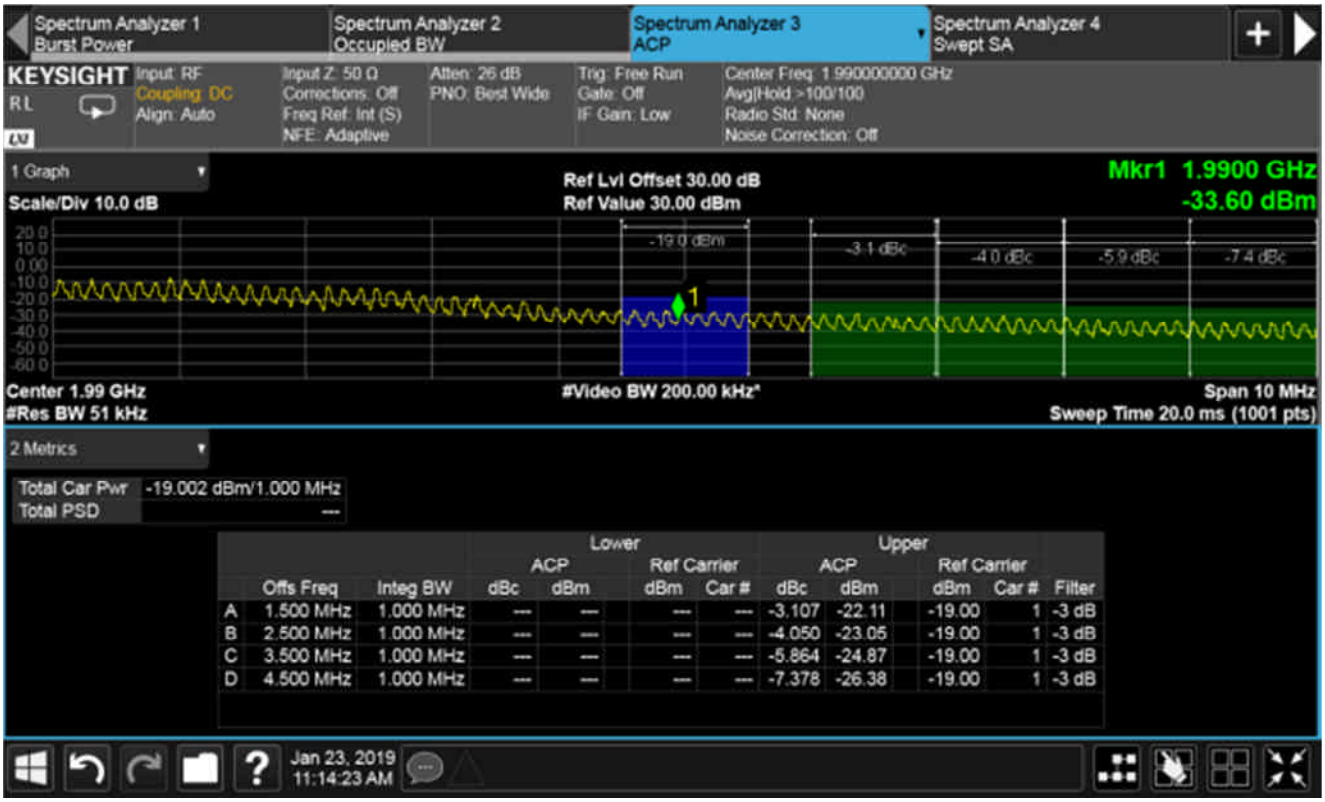


Plot of upper band edge for High channel

RF Parameters: Band 1930-1990 MHz, Power +44 dBm, Channel Spacing 5MHz, Modulation LTE, Channel 1937.5 MHz,

Plot of lower band edge for Low channel

RF Parameters: Band 1930-1990 MHz, Power +44 dBm, Channel Spacing 5MHz, Modulation LTE, Channel 1982.5 MHz,



Plot of upper band edge for High channel

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	05-Apr-2018	12 months
E410	N5181A	Signal Generator 3 GHz MXG	Agilent Technologies	13-Jul-2018	36 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	10-Jul-2018	12 months
E420	E4438C	Signal Generator 250 kHz - 3.0 GHz	Agilent Technologies	14-Aug-2017	24 months
E453	20240-20-AA	Horn Std Gain 17.6 - 26.7 GHz	FMI Ltd	29-May-2018	12 months
E517	E4421B	Signal Generator 250kHz - 3.0GHz	Hewlett Packard	30-Aug-2017	24 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
E656	75-A-MFN-06	Attenuator 6dB 75W Bi-Directional	Bird Electronics	07-Feb-2018	12 months
E743	RR2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	12-Feb-2018	12 months
E755	N9030B	PXA 3Hz to 50GHz	Keysight	04-Jun-2018	12 months
E777	MG3695B	Signal Generator 8MHz - 50GHz	Anritsu	20-Jun-2018	12 months
E843	G3RUH	10 MHz GPS Disciplined oscillator	James Miller	07-Dec-2018	3 months
E853	C-2.4PKP-1501-500mm	Cable 2.4mm to 2.92mm 50cm Yellow	Intelliconnect	21-Jan-2019	12 months
E866	42N50A	30dB 50W attenuator	Anritsu	21-Jan-2019	12 months
LPE364	CBL6112A	Antenna Bilog 30MHz - 2GHz	Chase Electronics Ltd	21-Mar-2018	24 months
S032	177	True RMS Multimeter	Fluke	26-Mar-2018	12 months
S036	FMH1 420	Temperature & Humidity Test Chamber	JTS Ltd	N/A	N/A
TMS80	206-3722	Digital Thermometer & K Probe	RS Components Ltd	21-Nov-2018	12 months
TMS814	MP627A	Antenna Doublet 200-1700 MHz	Anritsu	22-May-2018	12 months
TMS82	8449B	Pre-Amplifier 1GHz - 26.5GHz	Agilent Technologies	17-Dec-2018	12 months

9 Auxiliary and peripheral equipment

9 .1 Customer supplied equipment

Item No.	Model No.	Description	Manufacturer	Serial No.
1	XHR33-33	DC Power Supply	Xantrex	E00116403
2	GD6000	Laptop PC	General Dynamics	Dev, Dev2

9 .2 RN Electronics supplied equipment

RN No.	Model No.	Description	Manufacturer	Serial No
No ancillary RN equipment used.				

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 N Radio Laboratory

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