Element Materials Technology
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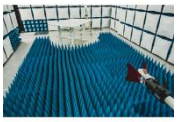

PART 24 MEASUREMENT REPORT

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
04/11/2024 - 07/31/2024
Test Report Issue Date:
8/1/2024
Test Site/Location:
Element Materials Technology, Morgan Hill, CA, USA
Test Report Serial No.:
1C2405230021-04.BCG

FCC ID:	**BCG-A3001**
Applicant Name:	**Apple Inc.**

Application Type:	Certification
Model:	A3001, A3002
EUT Type:	Watch
FCC Classification:	PCS Licensed Transmitter Worn on Body (PCT)
FCC Rule Part:	24
Test Procedure(s):	ANSI C63.26-2015, TIA-603-E-2016, KDB 971168 D01 v03r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RJ Ortanez
Executive Vice President

Prepared by: WKR0000006184

Reviewed by: WKR0000006164

ACCREDITED
CERT #2041.02

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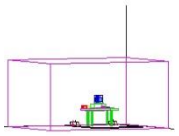
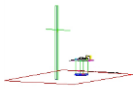


PART 24 MEASUREMENT REPORT



Mode	Bandwidth	Modulation	Tx Frequency Range [MHz]	OBW [MHz]	PAR at 0.1% [dB]	EIRP		Emission Designator
						Max. Power [mW]	Max. Power [dBm]	
WCDMA1900	5 MHz	Spread Spectrum	1852.4 - 1907.6	4.1025	3.28	11.350	10.55	4M10F9W
Band 2	1.4 MHz	QPSK	1850.7 - 1909.3	1.1058	5.92	13.032	11.15	1M11G7W
		16QAM	1850.7 - 1909.3	1.1039	6.54	11.722	10.69	1M10D7W
	3 MHz	QPSK	1851.5 - 1908.5	2.7080	5.86	13.062	11.16	2M71G7W
		16QAM	1851.5 - 1908.5	2.7146	6.54	11.561	10.63	2M71D7W
	5 MHz	QPSK	1852.5 - 1907.5	4.5407	5.88	13.552	11.32	4M54G7W
		16QAM	1852.5 - 1907.5	4.5431	6.52	11.803	10.72	4M54D7W
	10MHz	QPSK	1855 - 1905	9.0463	5.70	12.912	11.11	9M05G7W
		16QAM	1856 - 1905	5.2136	6.44	11.749	10.70	5M21D7W
	15 MHz	QPSK	1857.5 - 1902.5	13.5472	5.88	13.614	11.34	13M5G7W
		16QAM	1857.5 - 1902.5	5.5928	6.42	11.749	10.70	5M59D7W
	20 MHz	QPSK	1860 - 1900	18.1808	5.56	13.583	11.33	18M2G7W
		16QAM	1860 - 1900	7.0361	6.42	11.749	10.70	7M04D7W
Band 25	1.4 MHz	QPSK	1850.7 - 1914.3	1.1058	5.74	12.942	11.12	1M11G7W
		16QAM	1850.7 - 1914.3	1.1039	6.42	11.508	10.61	1M10D7W
	3 MHz	QPSK	1851.5 - 1913.5	2.7080	5.88	13.032	11.15	2M71G7W
		16QAM	1851.5 - 1913.5	2.7146	6.66	11.588	10.64	2M71D7W
	5 MHz	QPSK	1852.5 - 1912.5	4.5407	5.88	13.521	11.31	4M54G7W
		16QAM	1852.5 - 1912.5	4.5431	6.52	12.023	10.80	4M54D7W
	10 MHz	QPSK	1855 - 1910	9.0463	5.70	12.912	11.11	9M05G7W
		16QAM	1855 - 1910	5.2136	6.44	11.885	10.75	5M21D7W
	15 MHz	QPSK	1857.5 - 1907.5	13.5472	5.88	13.583	11.33	13M5G7W
		16QAM	1857.5 - 1907.5	5.5928	6.42	11.722	10.69	5M59D7W
	20 MHz	QPSK	1860 - 1905	18.1808	5.56	13.459	11.29	18M2G7W
		16QAM	1860 - 1905	7.0361	6.40	11.641	10.66	7M04D7W

EUT Overview

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 Element Materials Technology Test Location

These measurement tests were conducted at the Element Materials Technology facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at Element Materials Technology

- Element Materials Technology is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Materials Technology TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- Element Materials Technology facility is a registered (22831) test laboratory with the site description on file with ISED.

- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Agreements (MRAs).

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Watch FCC ID:BCG-A3001**. The test data contained in this report pertains only to the emissions due to the EUT's licensed transmitters that operate under the provisions of Part 24.

Test Device Serial No.: KFW756T66W, GC5JC74LHJ, Y36KY3D40J, DLCH2T0002300006QM, DLCH5R000GR00006QM

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n WLAN, 802.11a/n UNII, 802.15.4ab-NB, Bluetooth (1x, EDR, HDR4, HDR8, LE1M, LE2M), NFC, UWB, 60.5GHz Transmitter.

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

Simultaneous Tx Config	Antenna FCM					
	WLAN	Bluetooth	802.15.4ab - NB	LTE/WCDMA	UNII	UWB
	802.11b/g/n	BDR, EDR, HDR4/8, LE1/2M	O-QPSK	Mid/High Band	802.11a/n	Ch.5/Ch.9
Config 1	✓	×	×	✓	×	✓
Config 2	×	✓	×	✓	×	✓
Config 3	×	✓	✓	✓	×	×
Config 4	✓	×	✓	✓	×	×
Config 5	×	✓	×	✓	✓	×
Config 6	×	✓	×	✓	×	✓
Config 7	✓	×	×	✓	×	×
Config 8	✓	×	✓	×	×	×
Config 9	✓	×	×	×	×	✓
Config 10	×	✓	×	×	✓	×
Config 11	×	✓	×	✓	×	×
Config 12	×	✓	✓	×	×	×
Config 13	×	✓	×	×	×	✓
Config 14	×	×	✓	✓	×	×
Config 15	×	×	×	✓	✓	×
Config 16	×	×	×	✓	×	✓

Table 2-1. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

Note:

All the above simultaneous transmission configurations have been tested and the worst case configuration was found to be config 5 and reported in RF UNII, RF Bluetooth and RF Part 27b test reports.

2.3 Antenna Description

The following antenna gains provided by the manufacturer were used for testing.

Frequency [MHz]	Antenna Gain [dBi]
	Antenna FCM
LTE Band 25/2	-13.1
WCDMA 1900	-13.1

Table 2-2. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple Macbook	Model:	A1398	S/N:	FVFDHG8TP3XY
	w/AC/DC Adapter	Model:	A1435	S/N:	N/A
2	Apple USB-C cable	Model:	N/A	S/N:	N/A
	w/ Charging Dock	Model:	A2921	S/N:	DQ812910BZZ08V222
	w/ Cradle	Model:	N/A	S/N:	CYV11630817A2SE03MEV1
3	Apple Magnetic Charger	Model:	A2515	S/N:	DLC217301501NR112
	Apple Magnetic Charger	Model:	A2515	S/N:	DLC217301EZ1NR11A
4	Pathfinder Mocha X3100	Model:	920-13353-01	S/N:	DLCGMW0007G00000N7
	SiP Socket	Model:	P1 N20X S PF 271	S/N:	FN6GTE0005G00000HS
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A
6	Store Sample Wristband	Model:	N/A	S/N:	DLC316300CU1QGKA2

Table 2-3. Test Support Equipment

2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015, TIA-603-E-2016 and KDB 971168 D01 v03r01. See Section 7.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

The worst case configuration was investigated for the various types of wristbands, metal and non-metal wristbands. The EUT was also investigated with and without wireless charger. The worst case configuration found was used for all testing.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz and above 18GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions were reported in this test report.

This device only supports 27RBs or less for 16-QAM uplink.

2.6 Software and Firmware

The test was conducted with firmware watchOS 11 installed on the EUT.

2.7 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the documents titled "American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services" (ANSI C63.26-2015 and TIA-603-E-2016) and "Procedures for Compliance Measurement of the Fundamental Emission Power of Licensed Wideband (> 1 MHz) Digital Transmission Systems" (KDB 971168 D01 v03r01) were used in the measurement of the EUT.

Deviation from Measurement Procedure.....None

3.2 Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:

$$E_{[dB\mu V/m]} = \text{Measured amplitude level}_{[dBm]} + 107 + \text{Cable Loss}_{[dB]} + \text{Antenna Factor}_{[dB/m]}$$

And

$$EIRP_{[dBm]} = E_{[dB\mu V/m]} + 20\log D - 104.8;\ \text{where D is the measurement distance in meters.}$$

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014.

Per KDB 414788 D01 v01r01, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was used while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

Radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015 and TIA-603-E-2016.

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.23-2012.All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	2.07
Radiated Disturbance (<30MHz)	4.12
Radiated Disturbance (30MHz-1GHz)	4.85
Radiated Disturbance (1-18GHz)	5.08
Radiated Disturbance (>18GHz)	5.22

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	3/14/2024	Annual	3/14/2025	T058701-01
ESPEC	SU-241	Tabletop Temperature Chamber	11/17/2023	Annual	11/17/2024	92009574
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	4/9/2024	Annual	4/9/2025	00218555
Fairview Microwave	FMCA1975-36	30MHz-40GHz Conducted Cable *	6/10/2024	Annual	6/10/2025	-
Fairview Microwave	M2CP1122-10	30MHz-40GHz Conducted Coupler *	6/10/2024	Annual	6/10/2025	1946
Rohde & Schwarz	ESW44	EMI Test Receiver	5/1/2024	Annual	5/1/2025	101867
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	5/29/2024	Annual	5/29/2025	101619
Rohde & Schwarz	FSW67	Signal and Spectrum Analyzer (2Hz-67GHz)	7/5/2024	Annual	7/5/2025	101366
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	8/15/2023	Annual	8/15/2024	101639
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	11/30/2023	Annual	11/30/2024	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	12/27/2023	Annual	12/27/2024	164715
Rohde & Schwarz	HFH2-Z2	Loop Antenna	6/21/2024	Annual	6/21/2025	100519
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	6/10/2024	Annual	6/10/2025	100057
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	7/3/2024	Annual	7/3/2025	102356
Schwarzbeck	VULB 9162	Bilog Antenna (30MHz - 6GHz)	4/29/2024	Annual	4/29/2025	00304

Table 5-1. Test Equipment

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

2. * denotes passive equipment that have been internally verified/calibrated.

6.0 SAMPLE CALCULATIONS

Emission Designator

WCDMA Emission Designator

Emission Designator = 4M16F9W
WCDMA BW = 4.16 MHz
F = Frequency Modulation
9 = Composite Digital Info
W = Combination (Audio/Data)

QPSK Modulation

Emission Designator = 8M62G7W
BW = 8.62 MHz
G = Phase Modulation
7 = Quantized/Digital Info
W = Combination of Any

QAM Modulation

Emission Designator = 8M45D7W
BW = 8.45 MHz
D = Amplitude/Angle Modulated
7 = Quantized/Digital Info
W = Combination of Any

Spurious Radiated Emission

Example: Spurious emission at 3700.40 MHz

The receive spectrum analyzer reading at 3 meters with the EUT on the turntable was –81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of –81.0 dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 3700.40 MHz. So 6.1 dB is added to the signal generator reading of –30.9 dBm yielding –24.80 dBm. The fundamental EIRP was 25.50 dBm so this harmonic was 25.50 dBm – (-24.80) = 50.3 dBc.

7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCG-A3001

FCC Classification: PCS Licensed Transmitter Worn on Body (PCT)

Mode(s): WCDMA/LTE

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Reference
CONDUCTED	Occupied Bandwidth	2.1049	N/A	N/A	Section 7.2
	Conducted Band Edge / Spurious Emissions	2.1051, 24.238(a)	-13 dBm at Band Edge and for all out-of-band emissions	PASS	Sections 7.3, 7.4
	Peak-Average Ratio	24.232(d)	< 13 dB	PASS	Section 7.5
	Transmitter Conducted Output Power	2.1046	N/A	N/A	See RF Exposure Report
	Frequency Stability	2.1055, 24.235	Fundamental emissions stay within authorized frequency block over the temperature and voltage range as tested	PASS	Section 7.8
	Equivalent Isotropic Radiated Power	24.232(c)	< 2 Watts max. EIRP	PASS	Section 7.6
RADIATED	Radiated Spurious Emissions	2.1053, 24.238(a)	-13 dBm for all out-of-band emissions	PASS	Section 7.7

Table 7-1. Summary of Test Results

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. The analyzer plots were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
3. All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
4. All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is EMC Software Tool v1.1.
5. For radiated emission measurements, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "Chamber Automation," Version 3.0.0.

7.2 Occupied Bandwidth

§2.1049

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 4.2

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

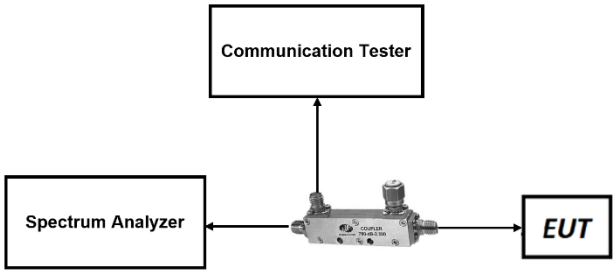
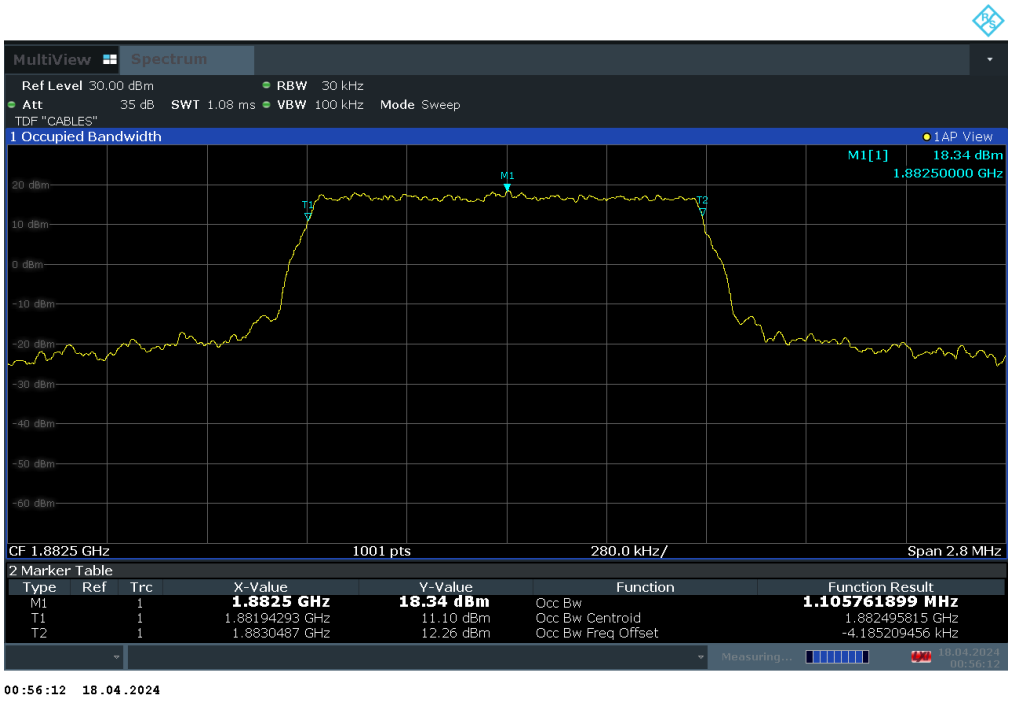


Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None.

LTE Band 25/2



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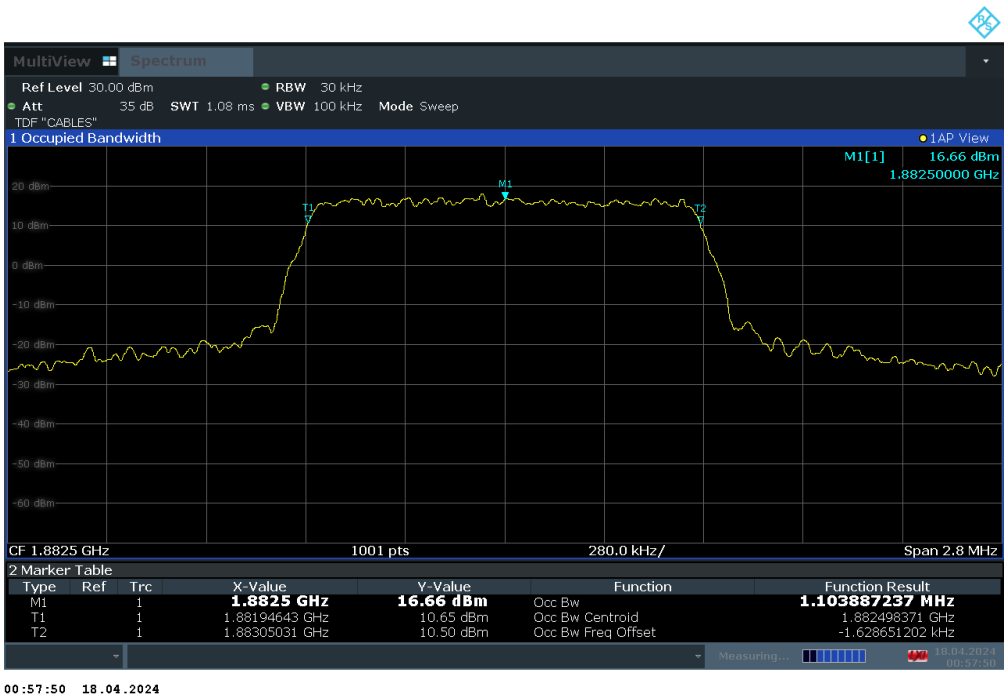
Plot 7-1. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz QPSK - Full RB Configuration)



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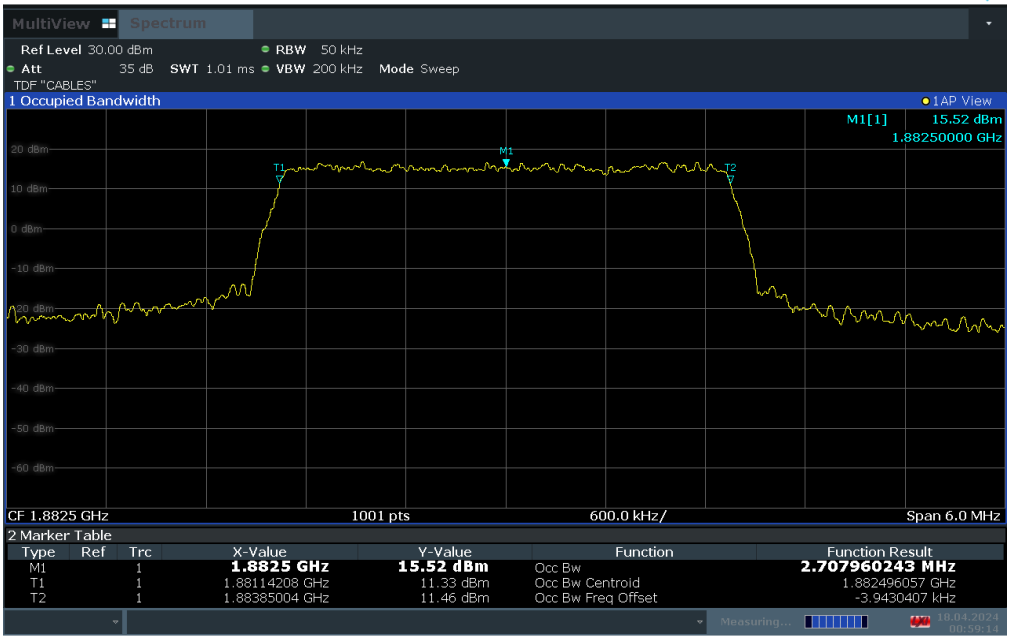
Plot 7-2. Occupied Bandwidth Plot (LTE Band 25/2 - 1.4MHz 16-QAM - Full RB Configuration)



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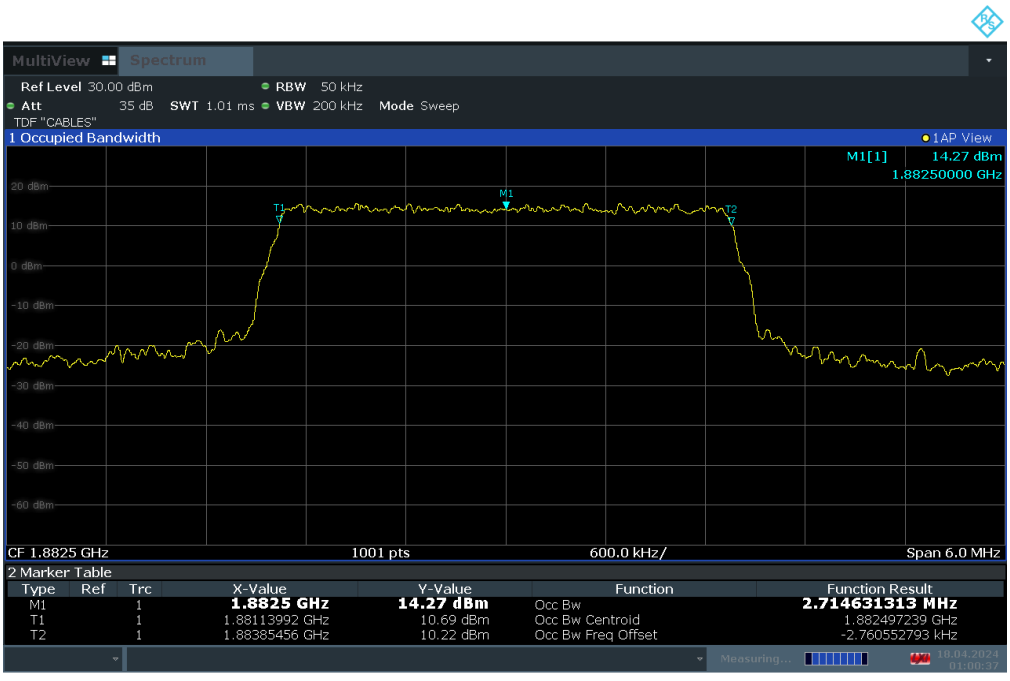
Plot 7-3. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz QPSK - Full RB Configuration)



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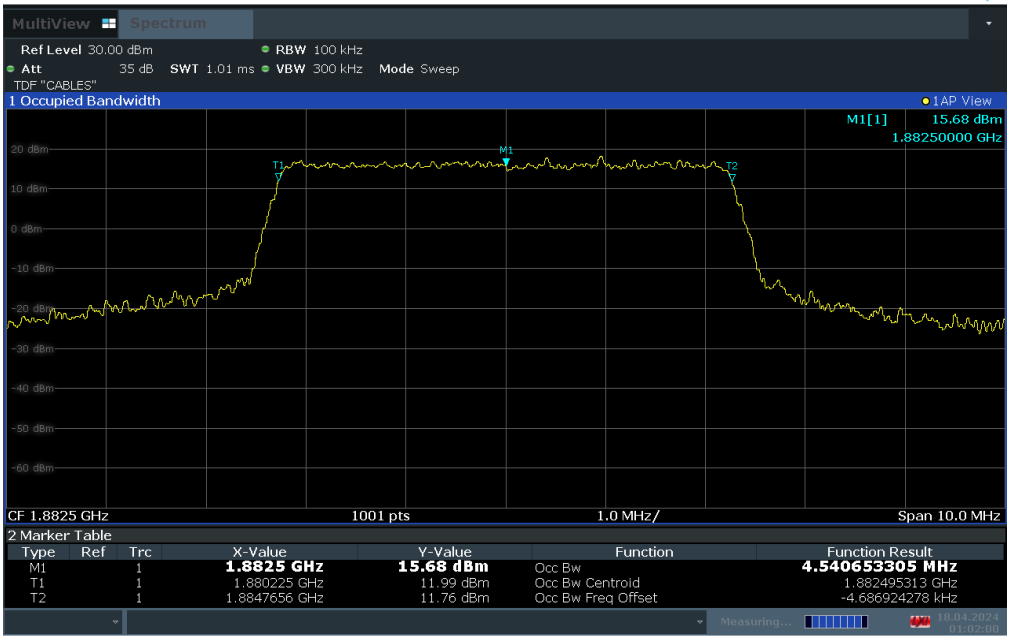
Plot 7-4. Occupied Bandwidth Plot (LTE Band 25/2 - 3MHz 16-QAM - Full RB Configuration)



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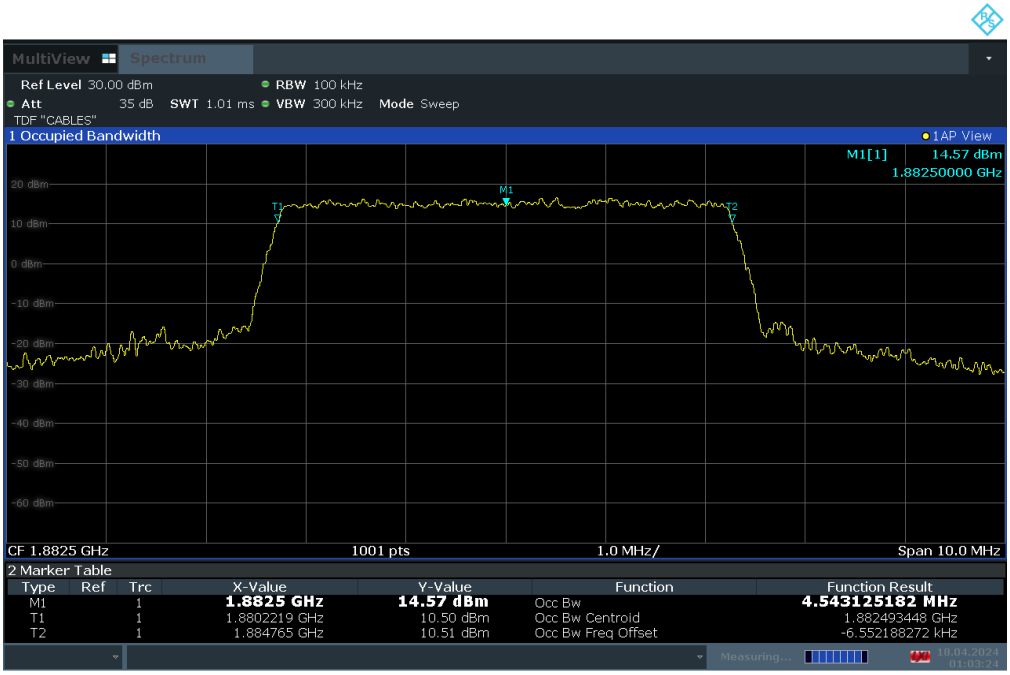
Plot 7-5. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz QPSK - Full RB Configuration)



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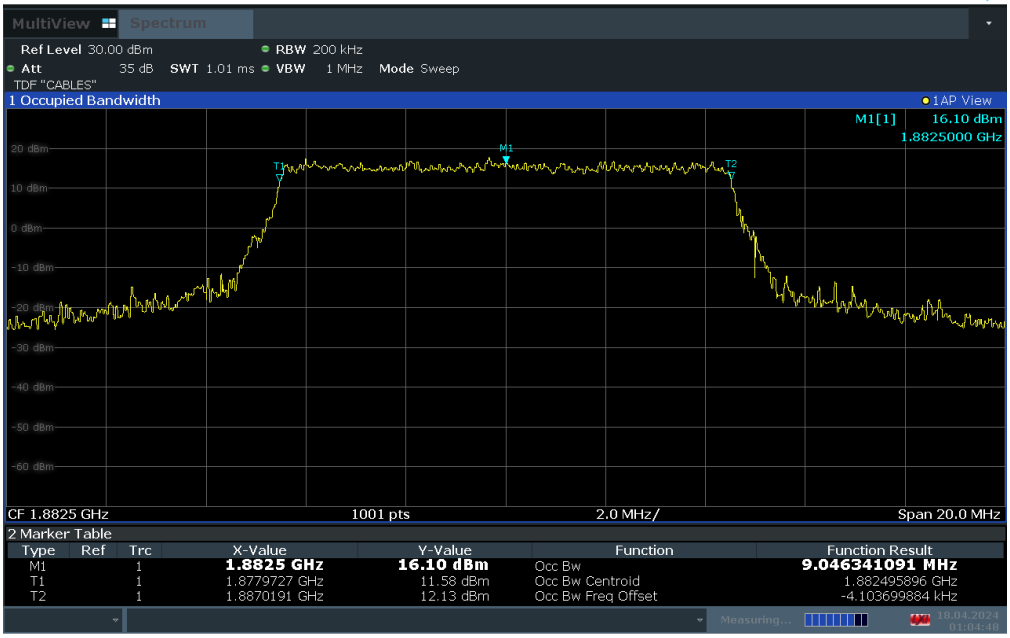
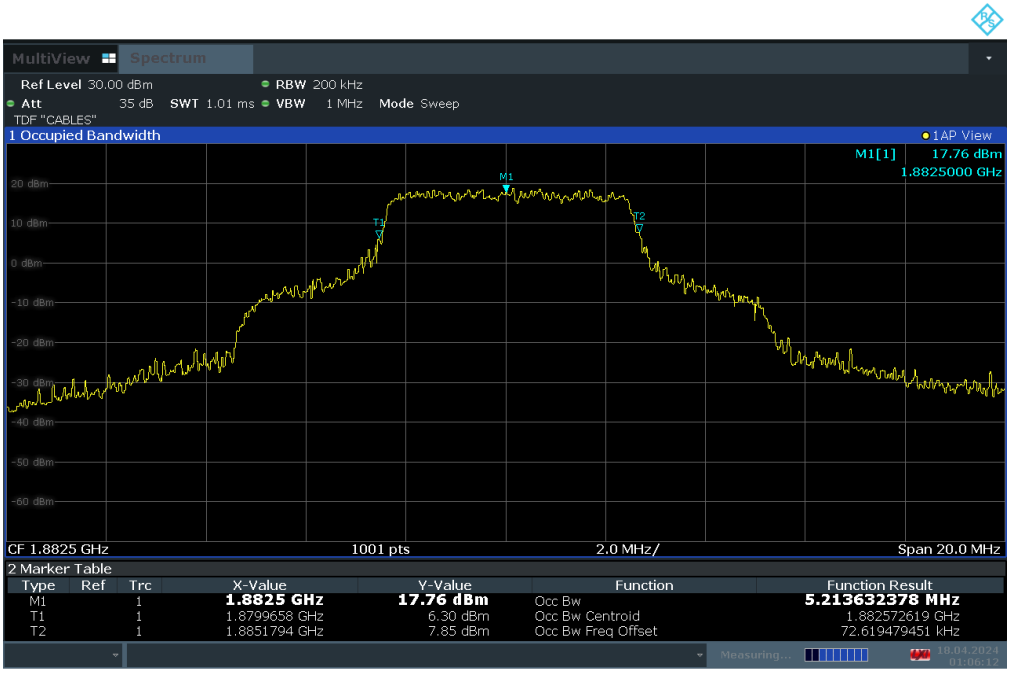
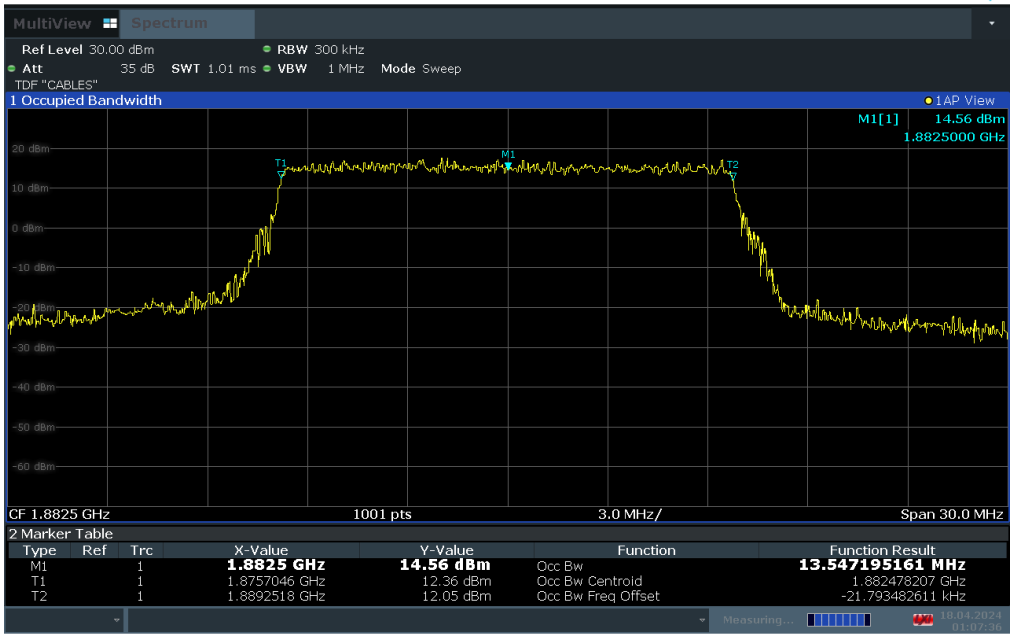
Plot 7-6. Occupied Bandwidth Plot (LTE Band 25/2 - 5MHz 16-QAM - Full RB Configuration)



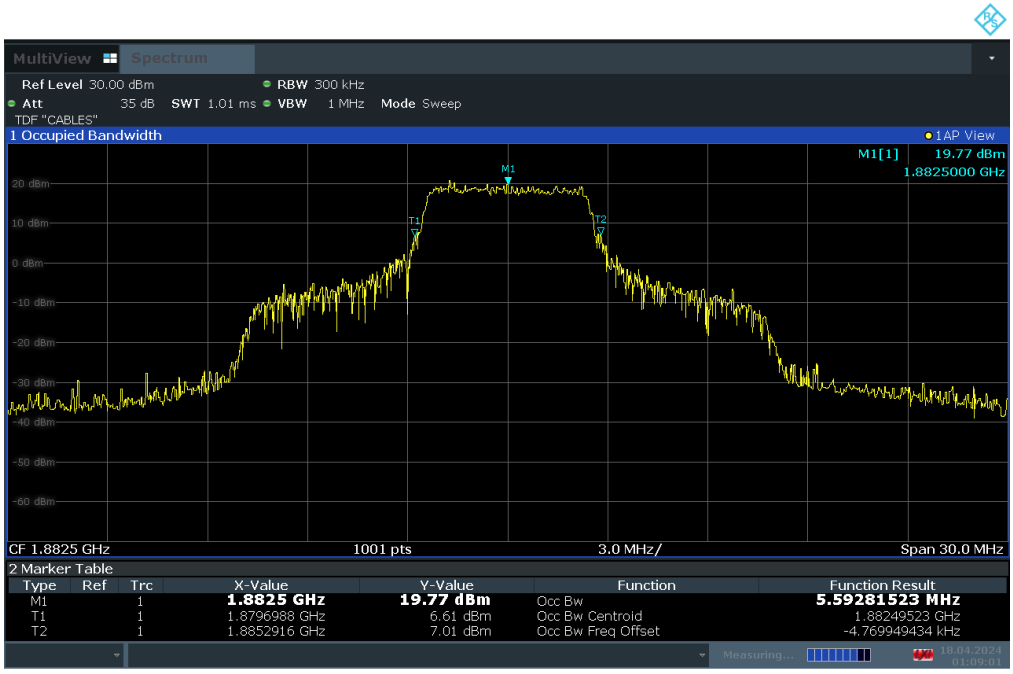
Plot 7-7. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz QPSK - Full RB Configuration)



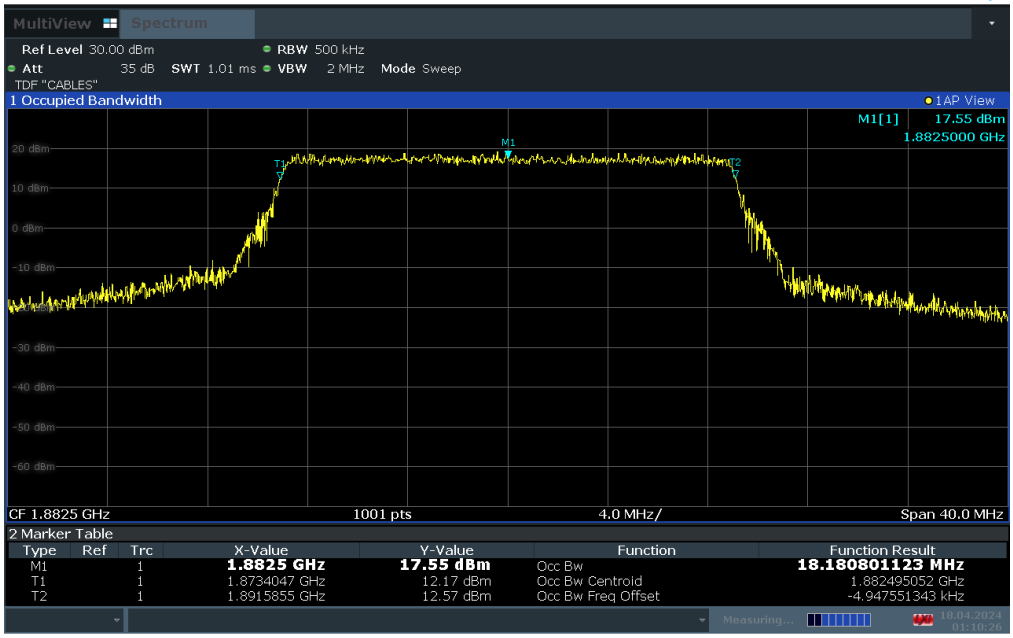
Plot 7-8. Occupied Bandwidth Plot (LTE Band 25/2 - 10MHz 16-QAM - Full RB Configuration)



Plot 7-9. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz QPSK - Full RB Configuration)

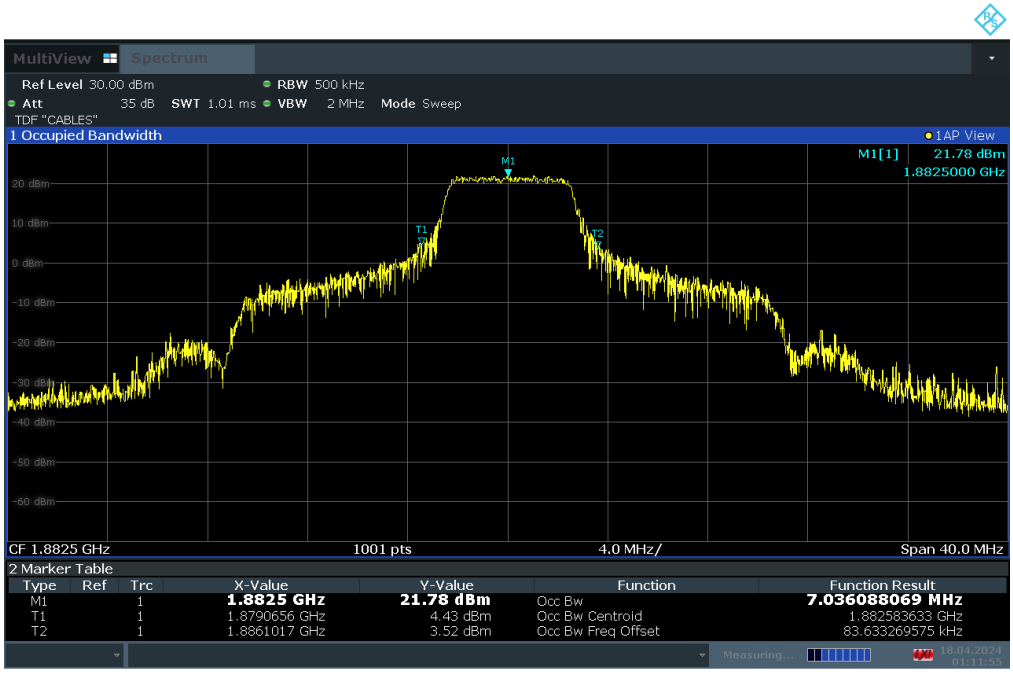


Plot 7-10. Occupied Bandwidth Plot (LTE Band 25/2 - 15MHz 16-QAM - Full RB Configuration)



01:10:26 18.04.2024

Plot 7-11. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz QPSK - Full RB Configuration)

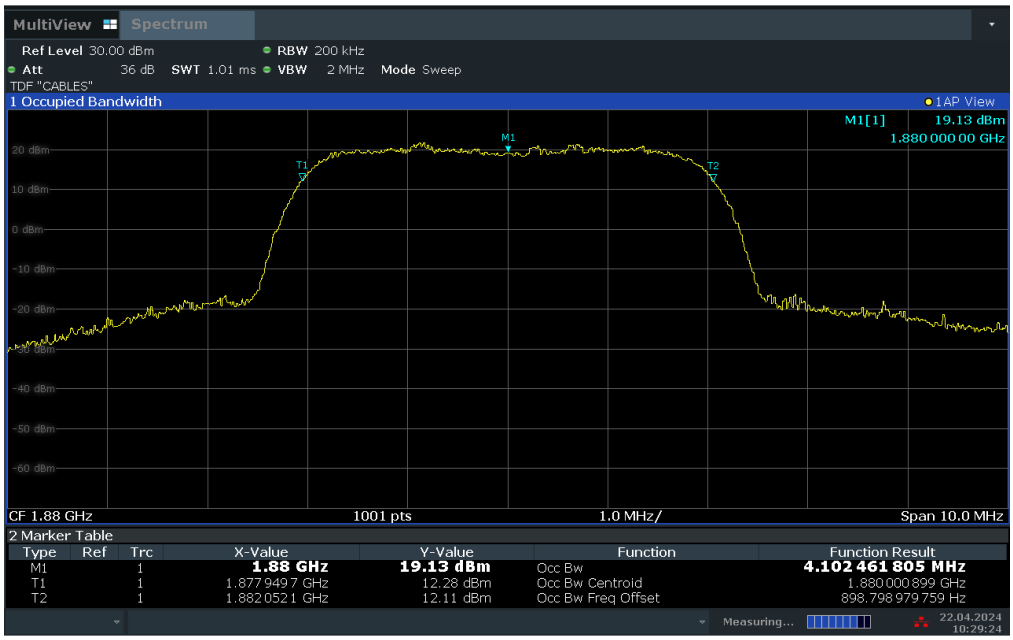


01:11:55 18.04.2024

Plot 7-12. Occupied Bandwidth Plot (LTE Band 25/2 - 20MHz 16-QAM - Full RB Configuration)

WCDMA PCS

Peak



10:29:25 22.04.2024

Plot 7-13. Occupied Bandwidth Plot (WCDMA, Ch. 9400)

7.3 Spurious and Harmonic Emissions at Antenna Terminal

§2.1051, §24.238(a)

Test Overview and Limit

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is 43 + 10 $log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 20GHz (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

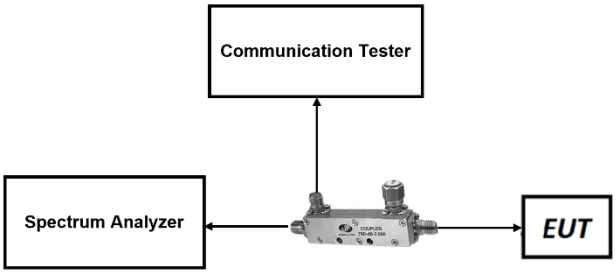
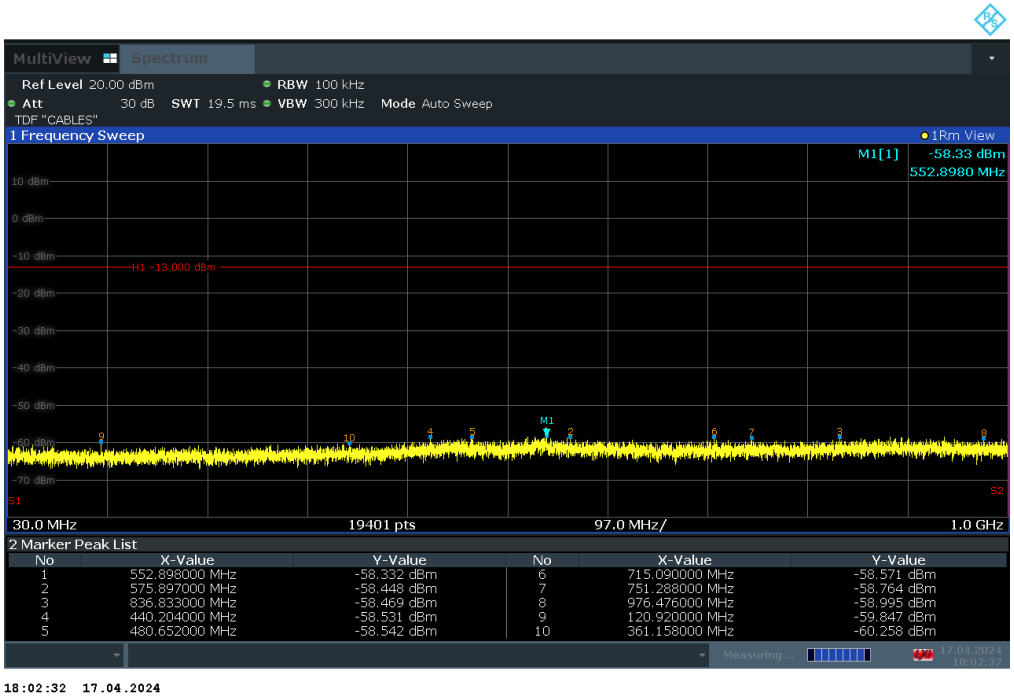


Figure 7-2. Test Instrument & Measurement Setup

Test Notes

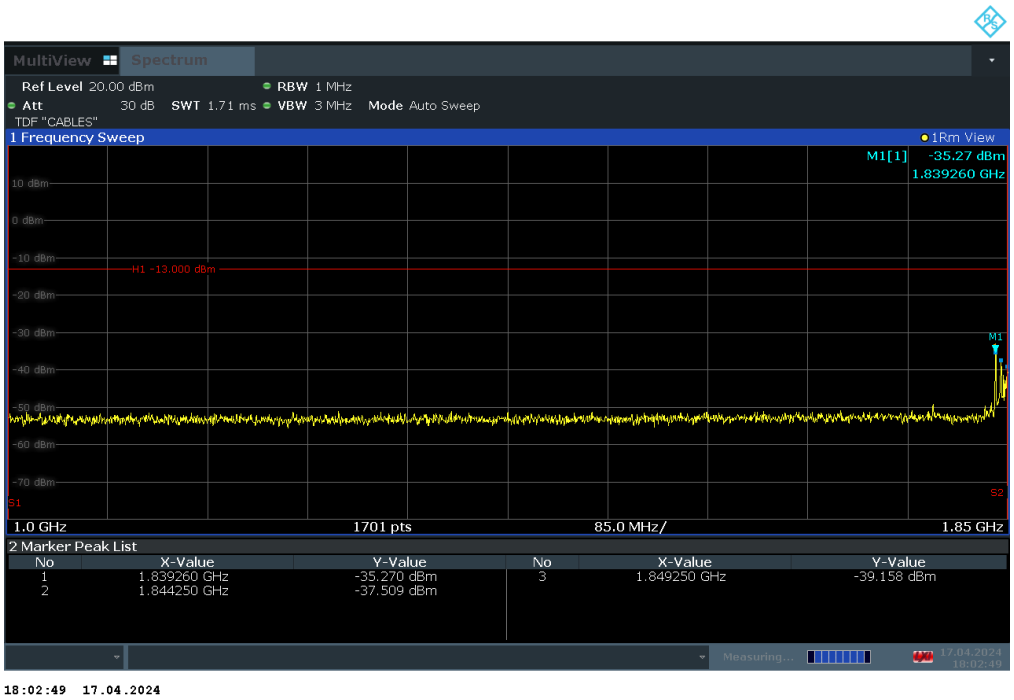
1. Per Part 24, compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth 100 kHz or greater for measurements below 1GHz. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

LTE Band 25/2



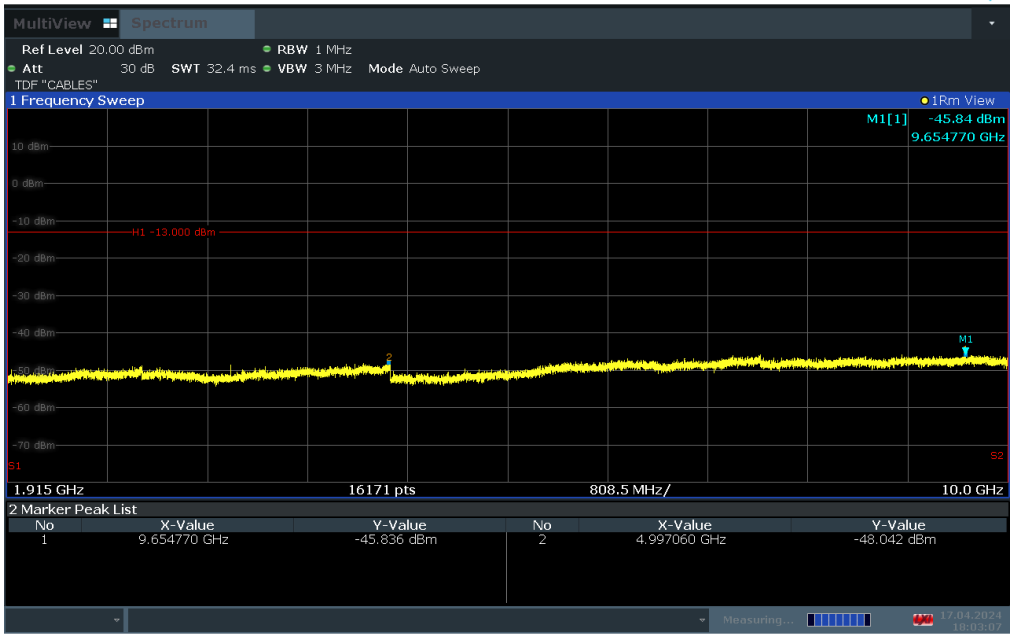
18:02:32 17.04.2024

Plot 7-14. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)

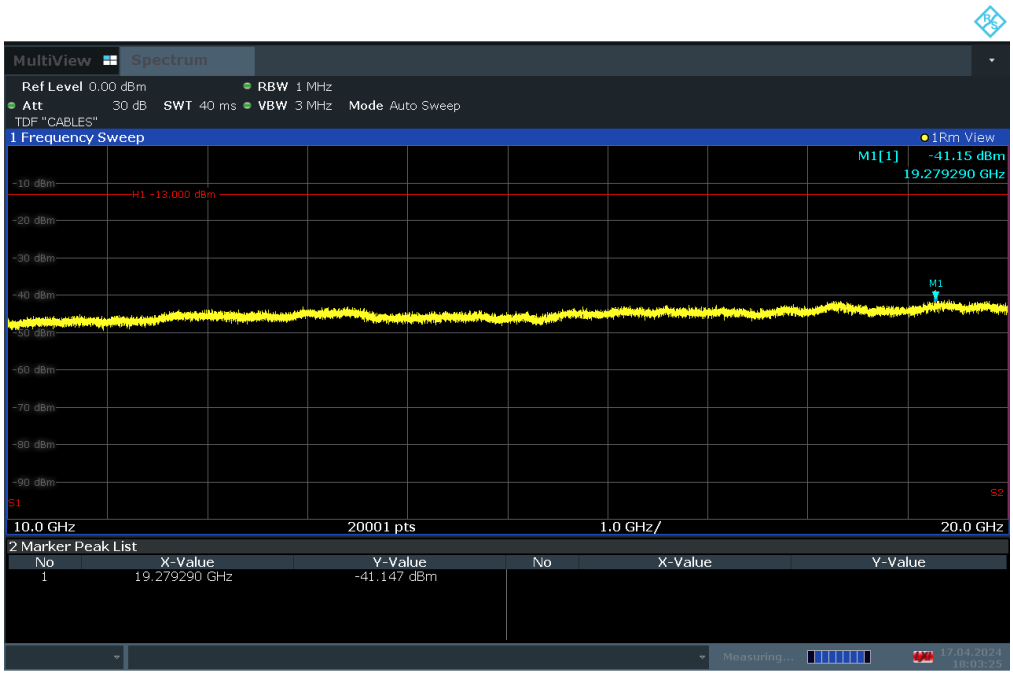


18:02:49 17.04.2024

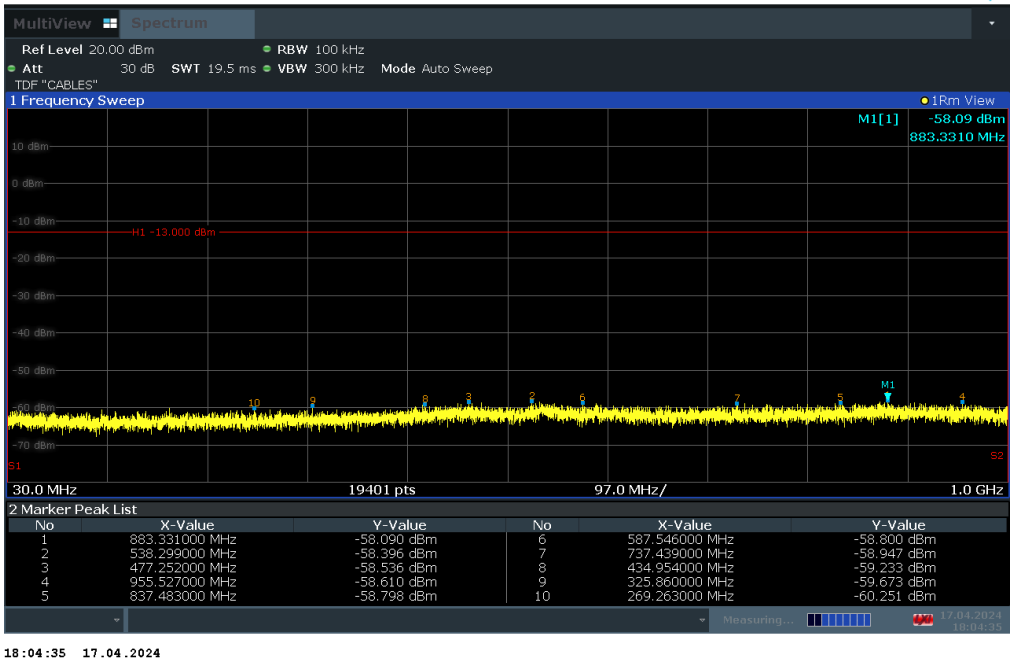
Plot 7-15. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



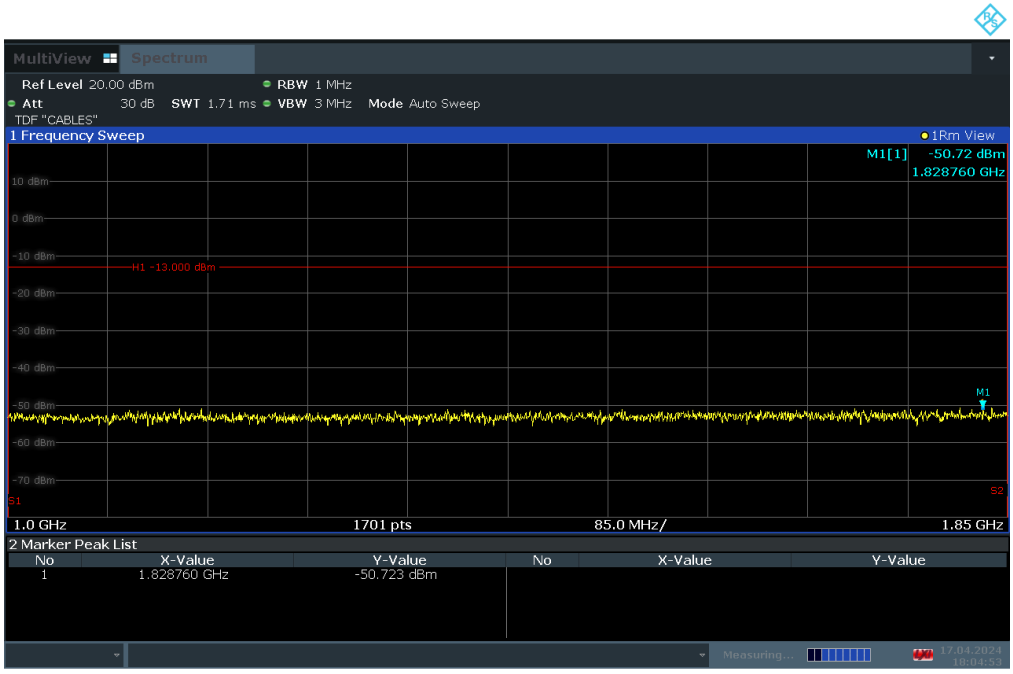
Plot 7-16. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



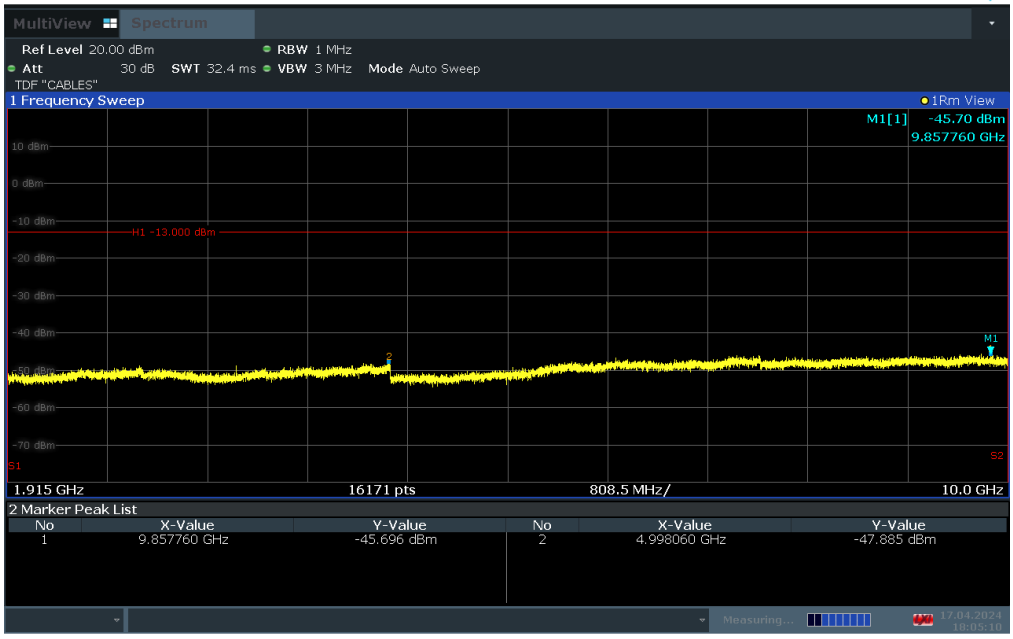
Plot 7-17. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Low Channel)



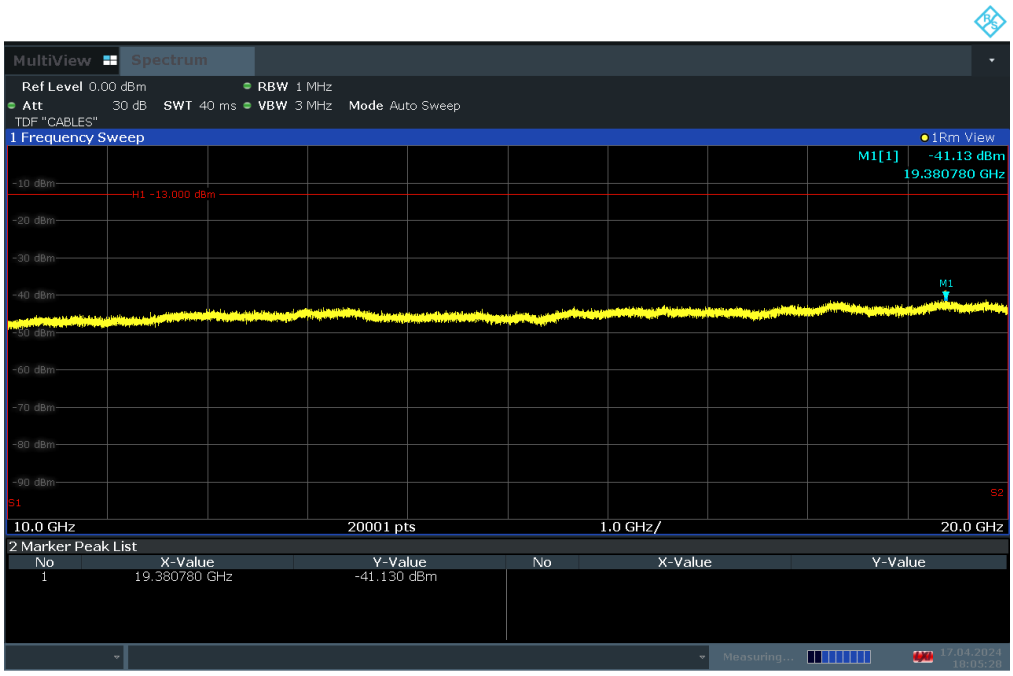
Plot 7-18. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



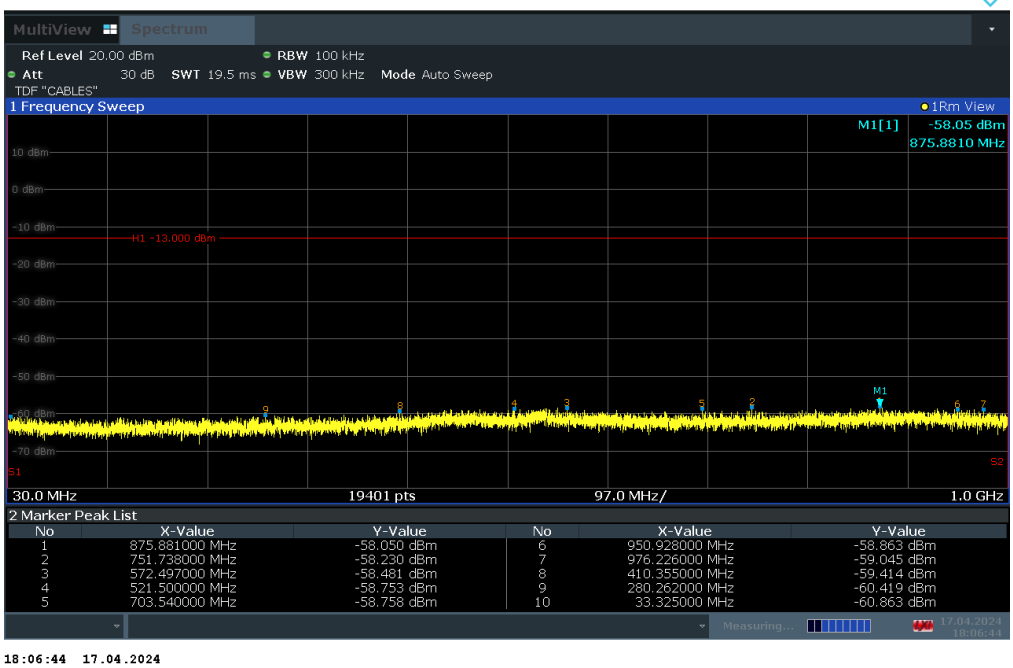
Plot 7-19. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



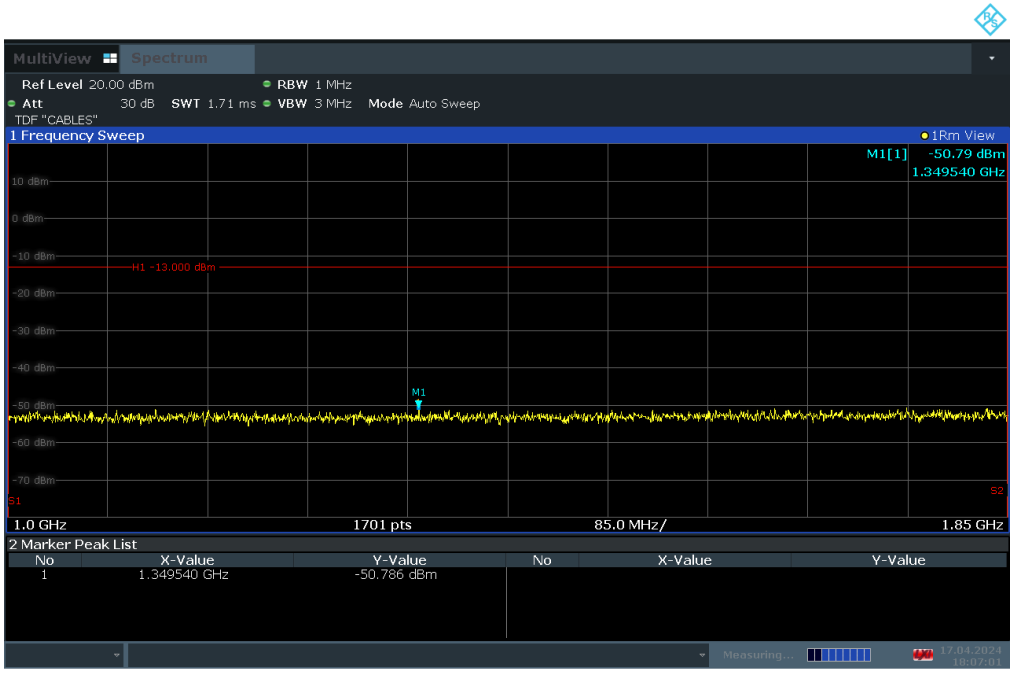
Plot 7-20. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



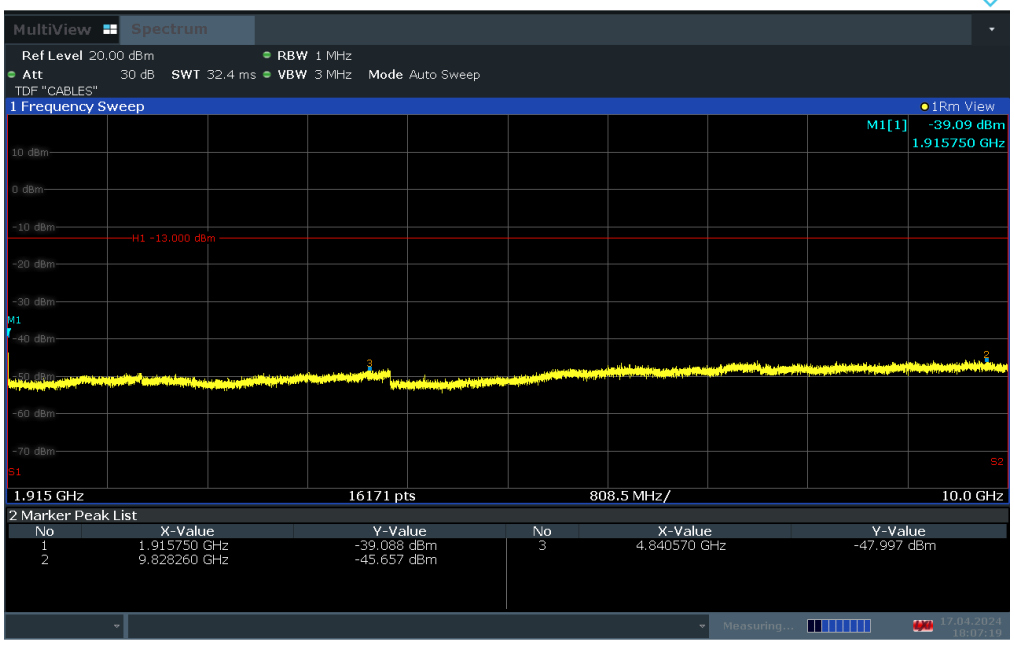
Plot 7-21. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - Mid Channel)



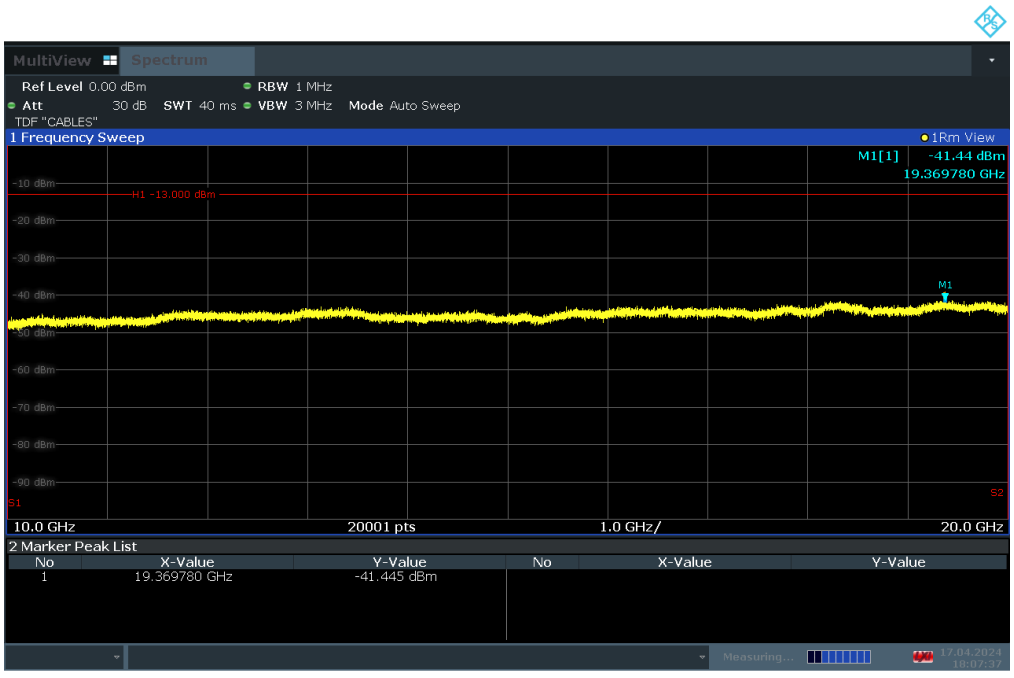
Plot 7-22. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-23. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



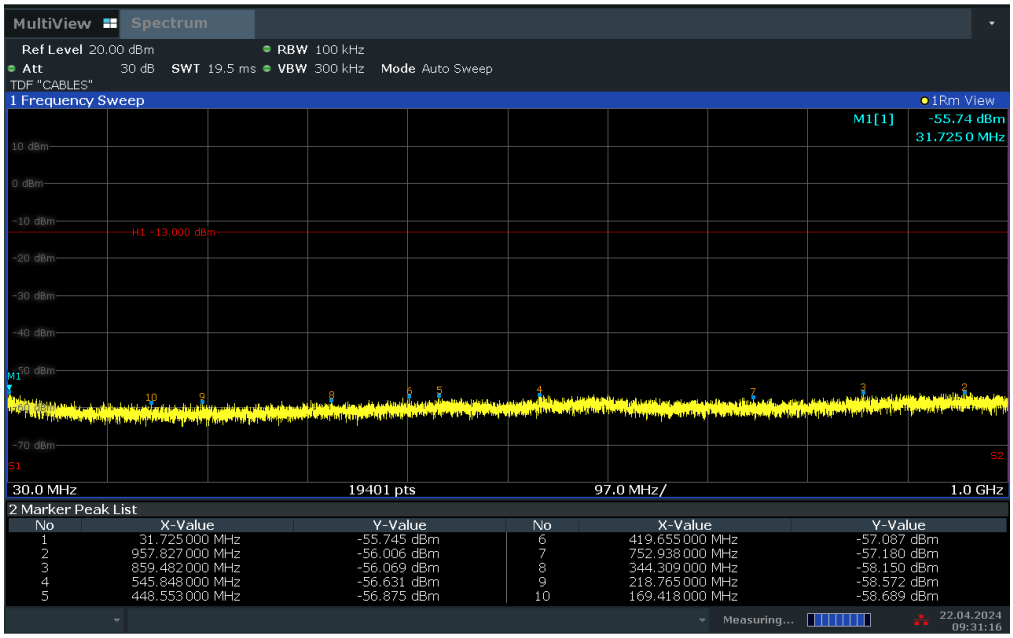
Plot 7-24. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)



Plot 7-25. Conducted Spurious Plot (LTE Band 25/2 - 20MHz QPSK - RB Size 1, RB Offset 0 - High Channel)

WCDMA PCS

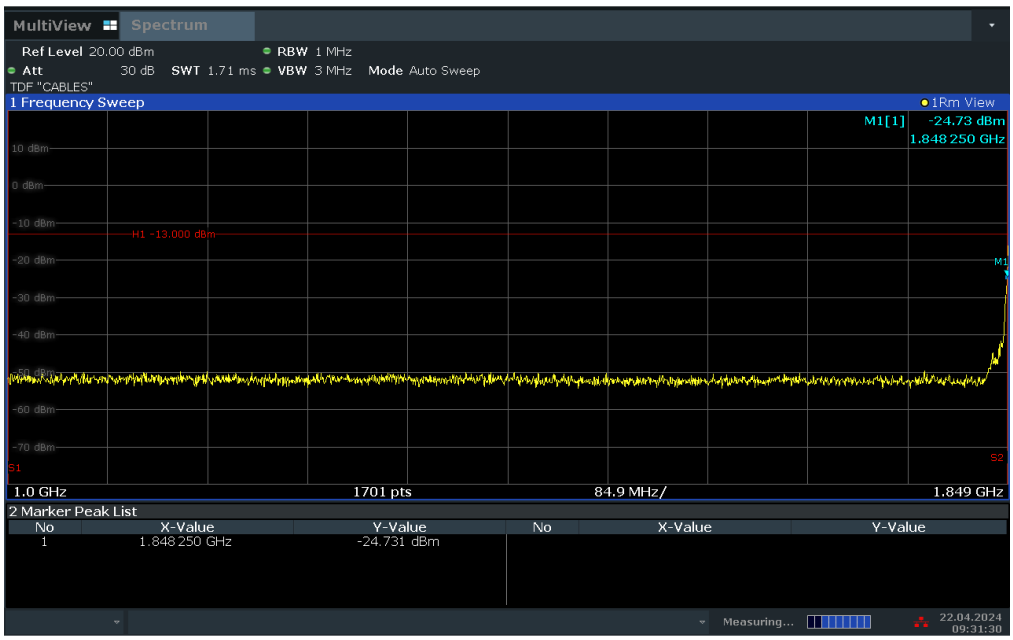
Peak



09:31:16 22.04.2024

Plot 7-26. Conducted Spurious Plot (WCDMA Ch. 9262)

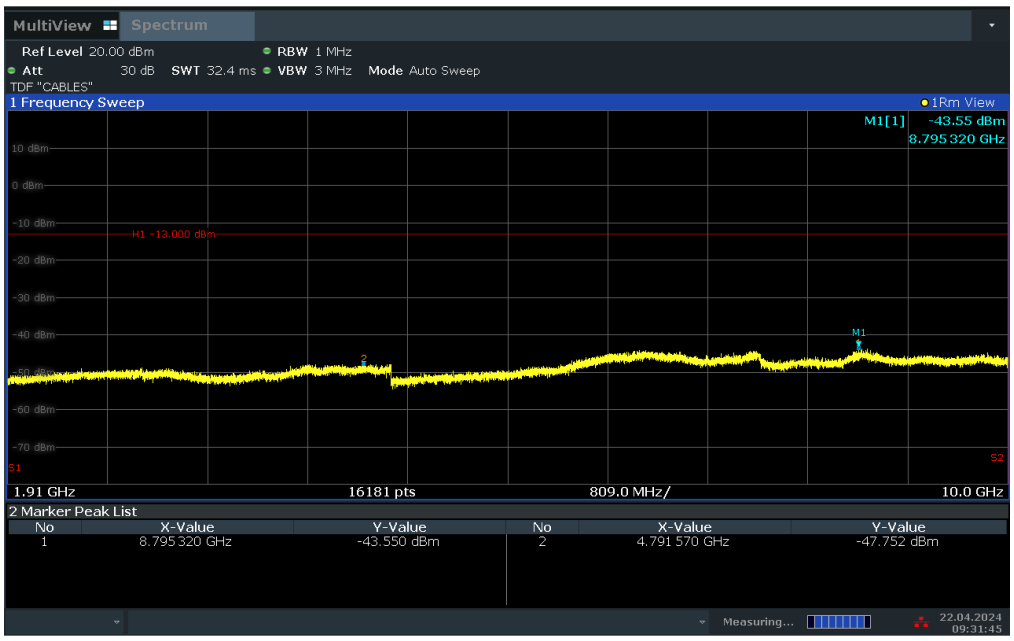
Peak



09:31:31 22.04.2024

Plot 7-27. Conducted Spurious Plot (WCDMA Ch. 9262)

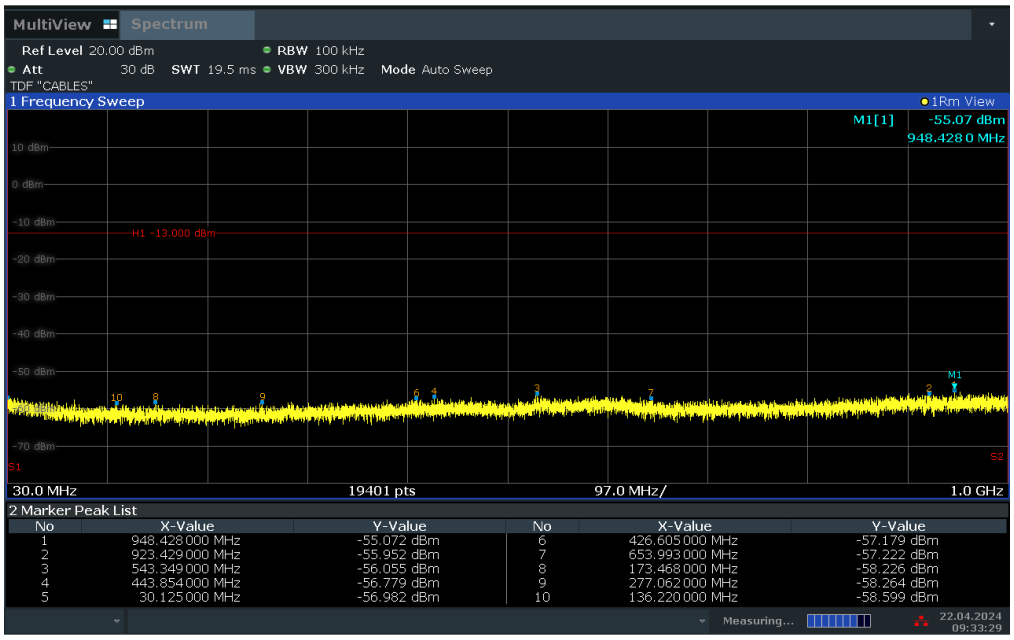
Peak



09:31:46 22.04.2024

Plot 7-28. Conducted Spurious Plot (WCDMA Ch. 9262)

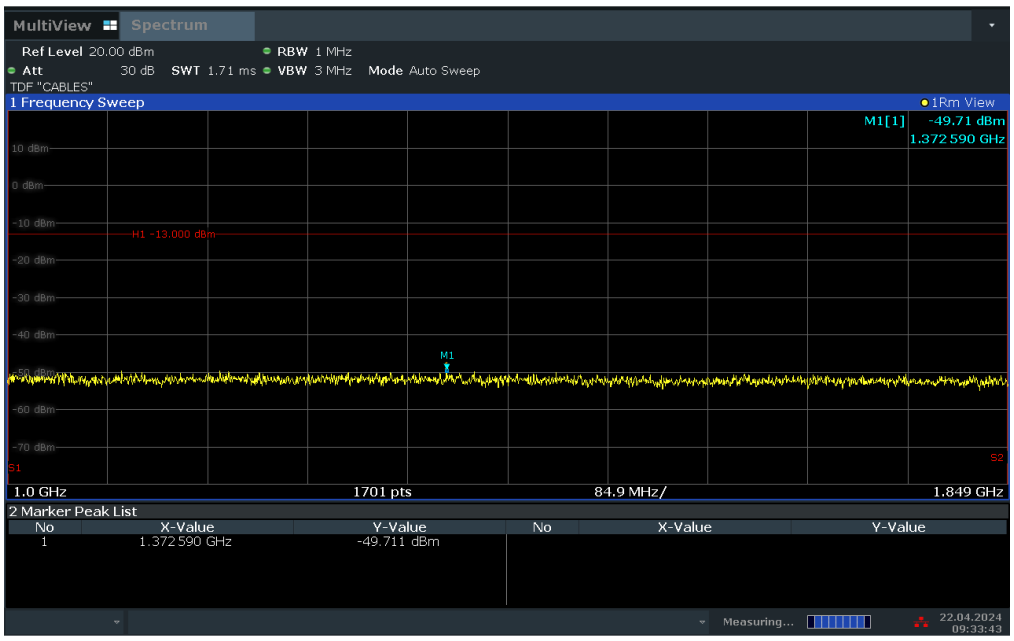
Peak



09:33:29 22.04.2024

Plot 7-29. Conducted Spurious Plot (WCDMA Ch. 9400)

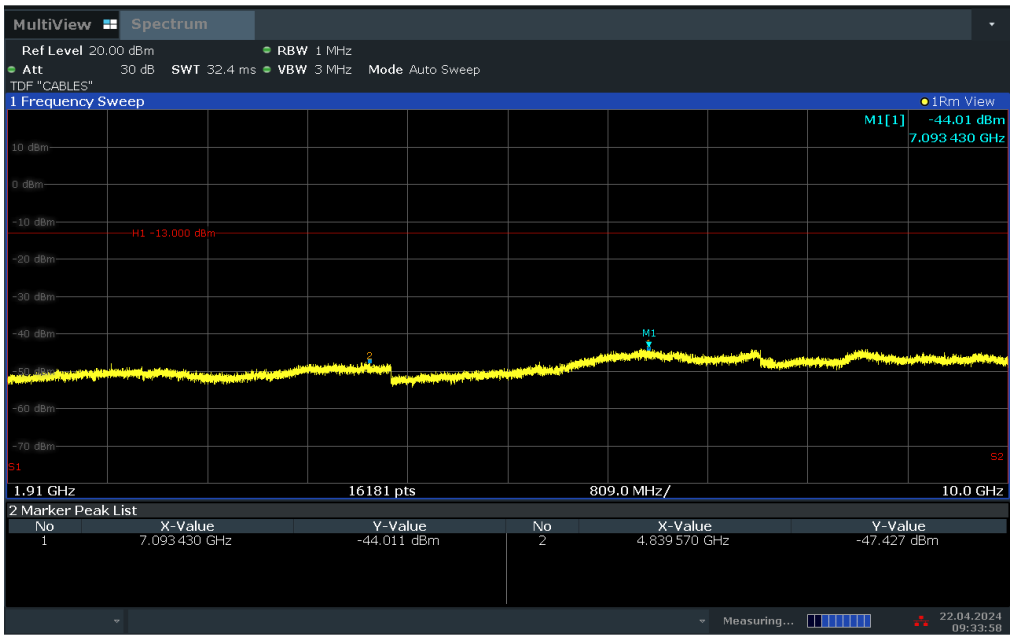
Peak



09:33:44 22.04.2024

Plot 7-30. Conducted Spurious Plot (WCDMA Ch. 9400)

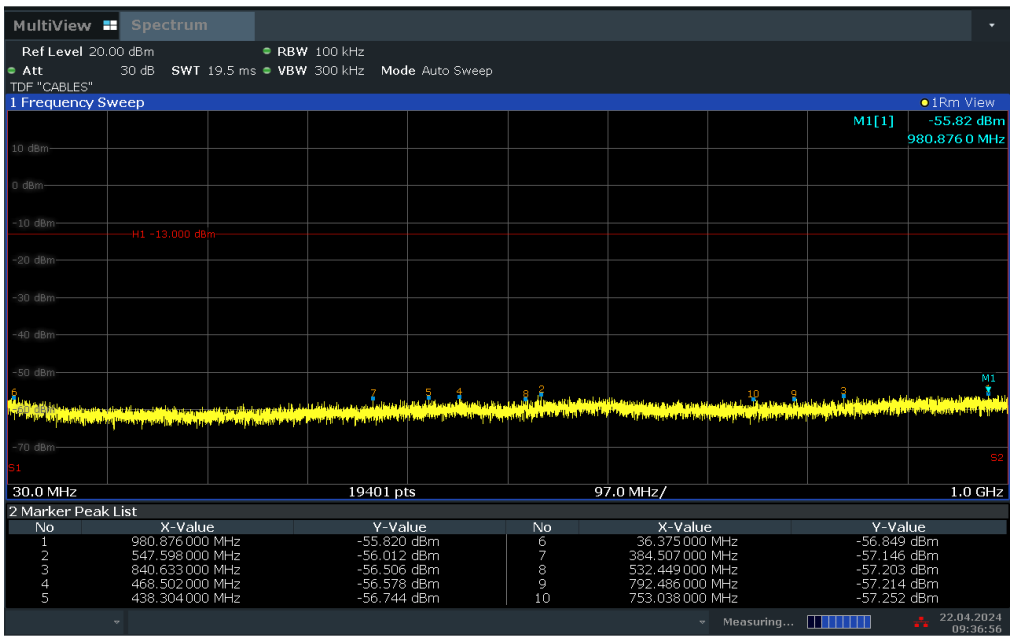
Peak



09:33:59 22.04.2024

Plot 7-31. Conducted Spurious Plot (WCDMA Ch. 9400)

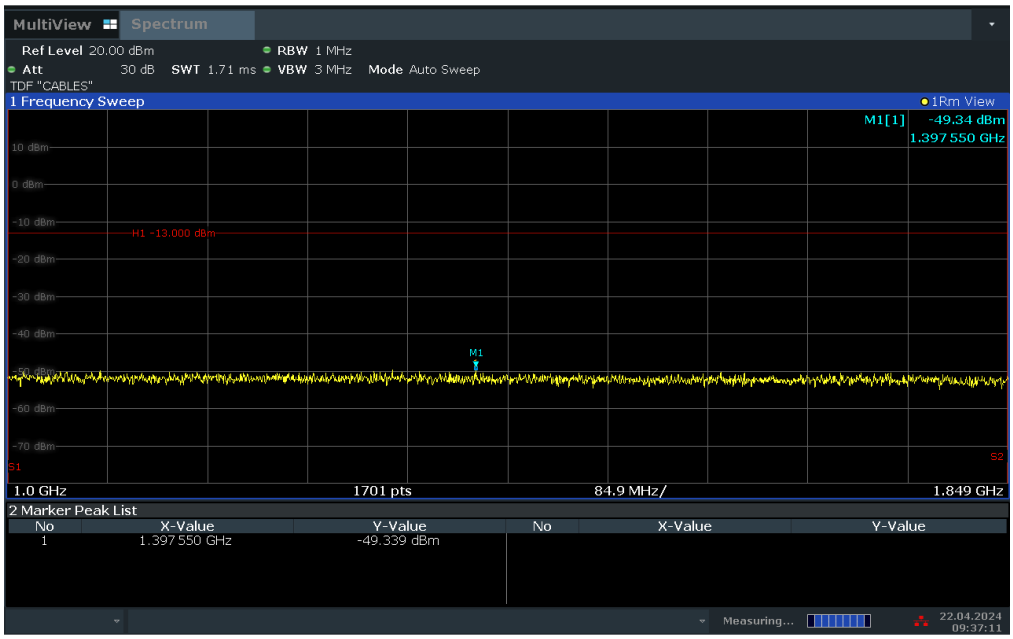
Peak



09:36:57 22.04.2024

Plot 7-32. Conducted Spurious Plot (WCDMA Ch. 9538)

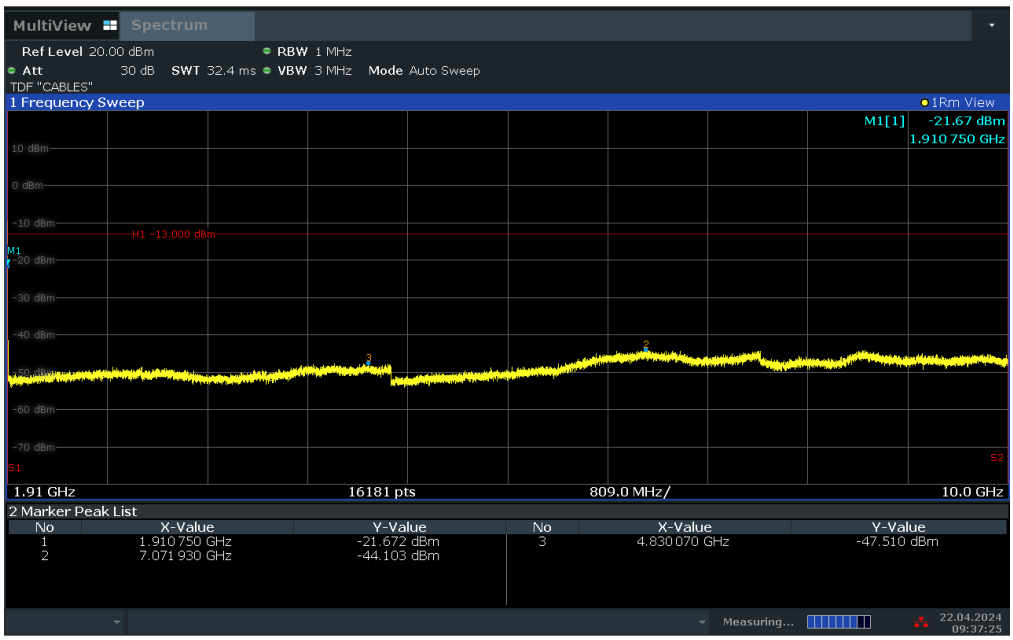
Peak



09:37:11 22.04.2024

Plot 7-33. Conducted Spurious Plot (WCDMA Ch. 9538)

Peak



09:37:26 22.04.2024

Plot 7-34. Conducted Spurious Plot (WCDMA Ch. 9538)

7.4 Band Edge Emissions at Antenna Terminal

§2.1051, §24.238(a)

Test Overview and Limit

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is 43 + 10 $log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 6.0

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW ≥ 1% of the emission bandwidth
4. VBW ≥ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

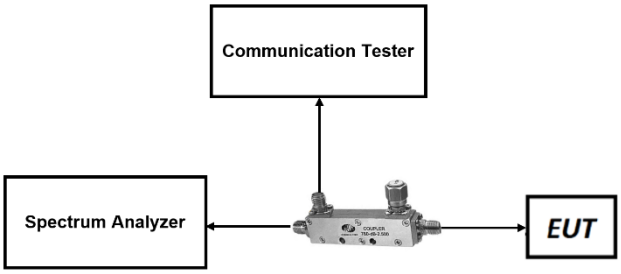
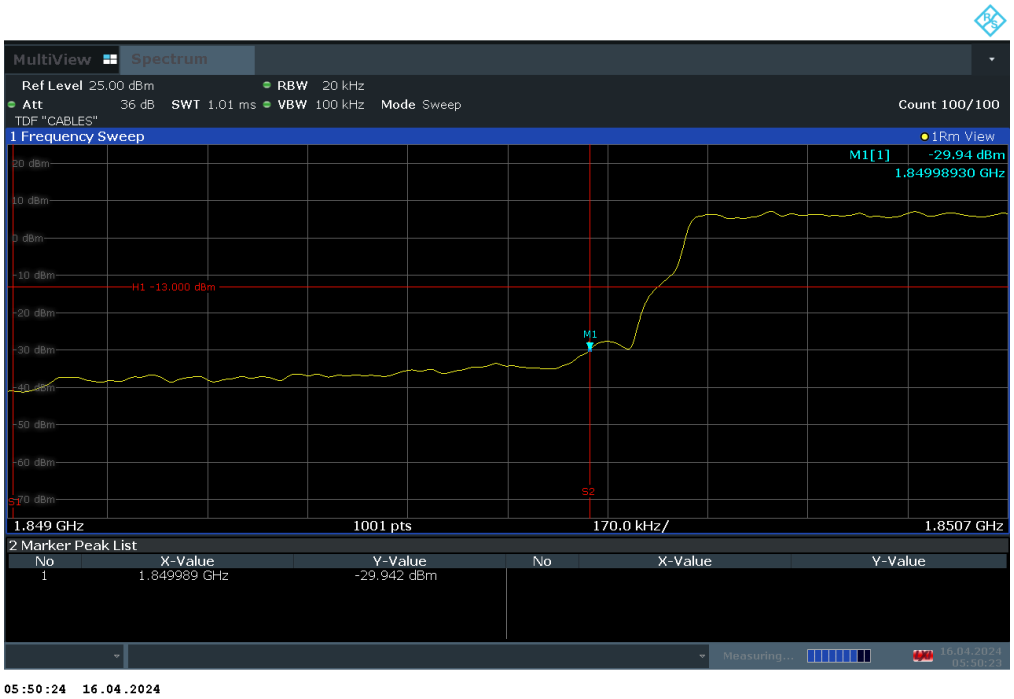


Figure 7-3. Test Instrument & Measurement Setup

Test Notes

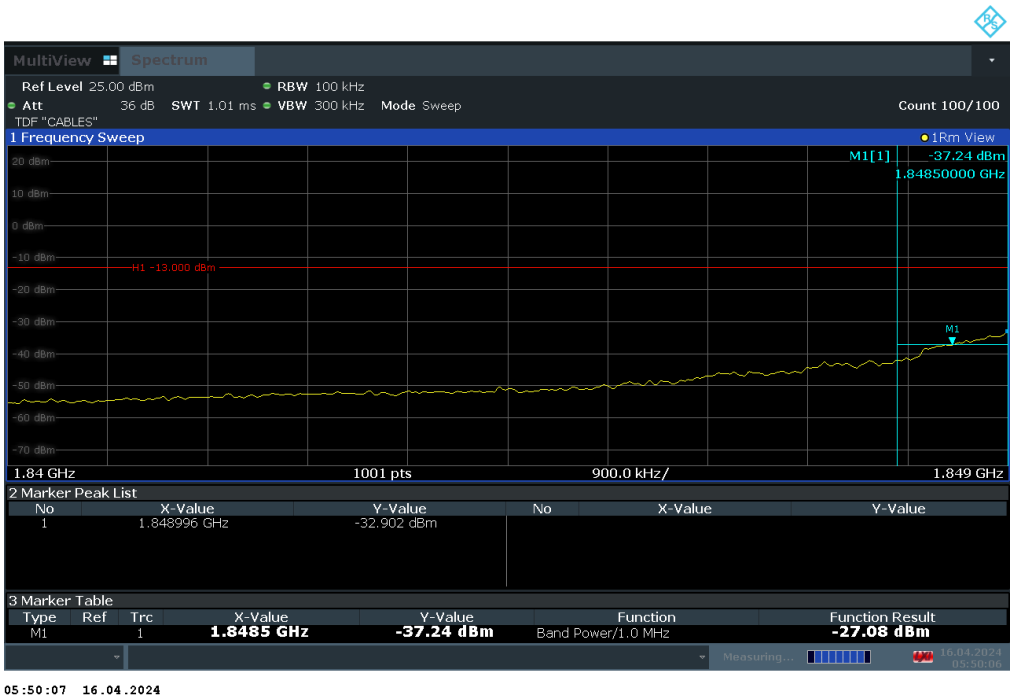
1. Per 24.238(a), in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emission are attenuated at least 26 dB below the transmitter power.

LTE Band 25



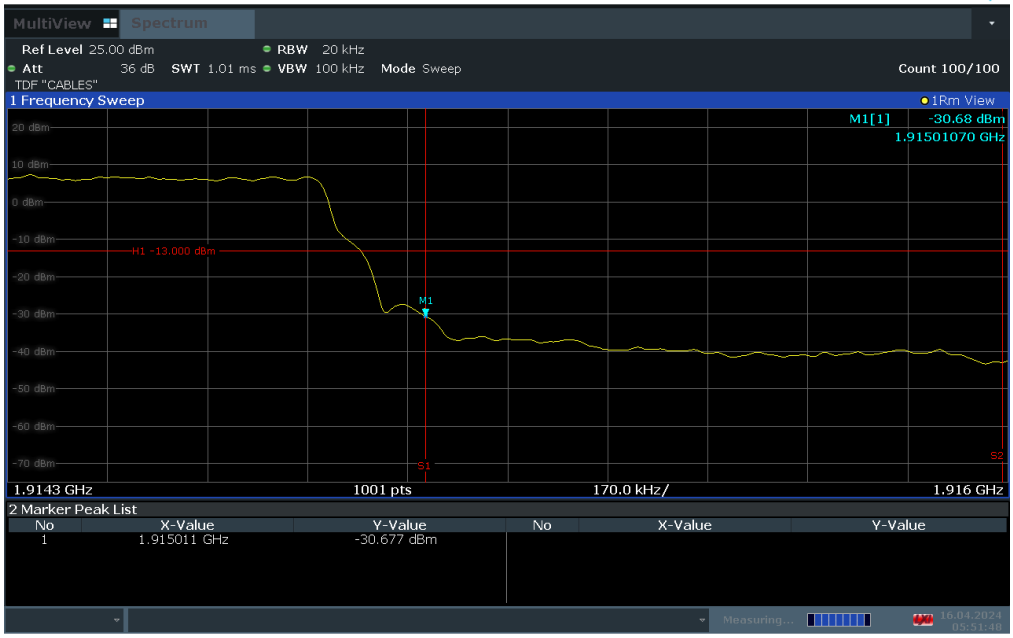
05:50:24 16.04.2024

Plot 7-35. Lower Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)



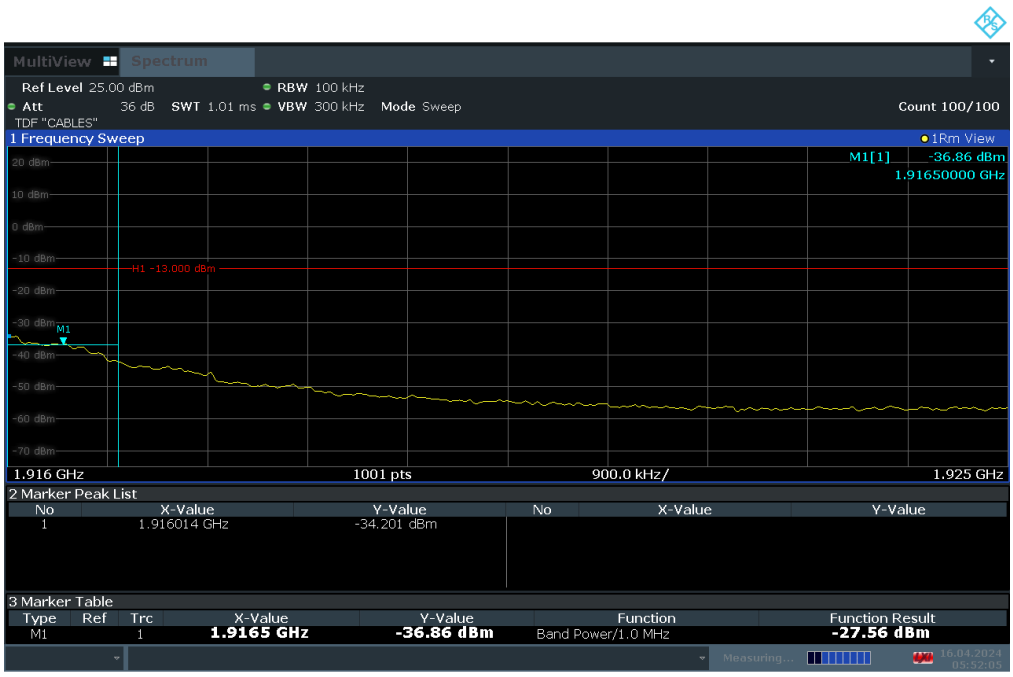
05:50:07 16.04.2024

Plot 7-36. Extended Lower Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)



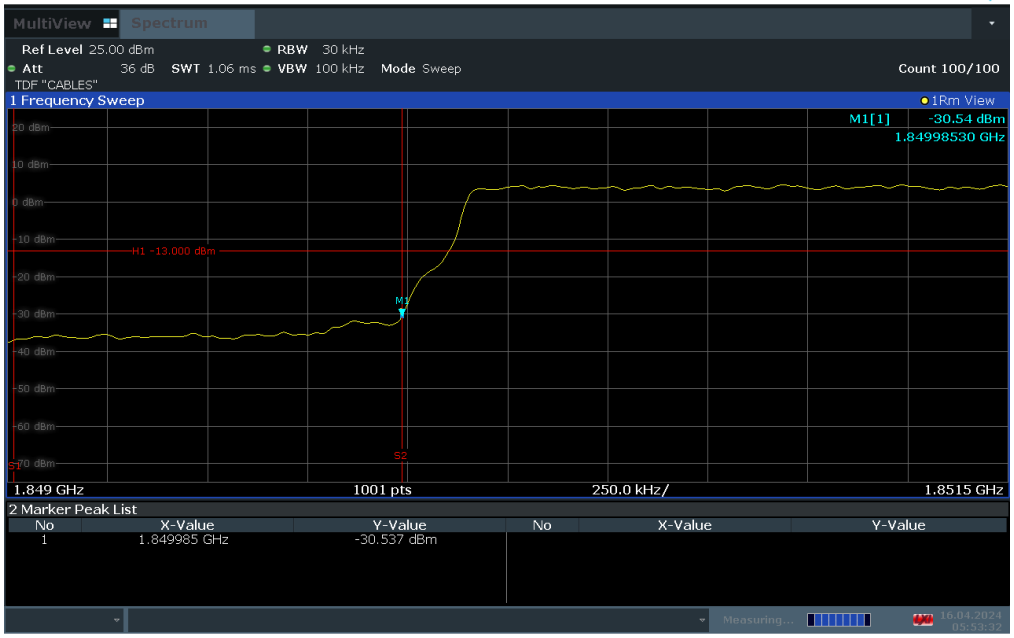
05:51:49 16.04.2024

Plot 7-37. Upper Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)



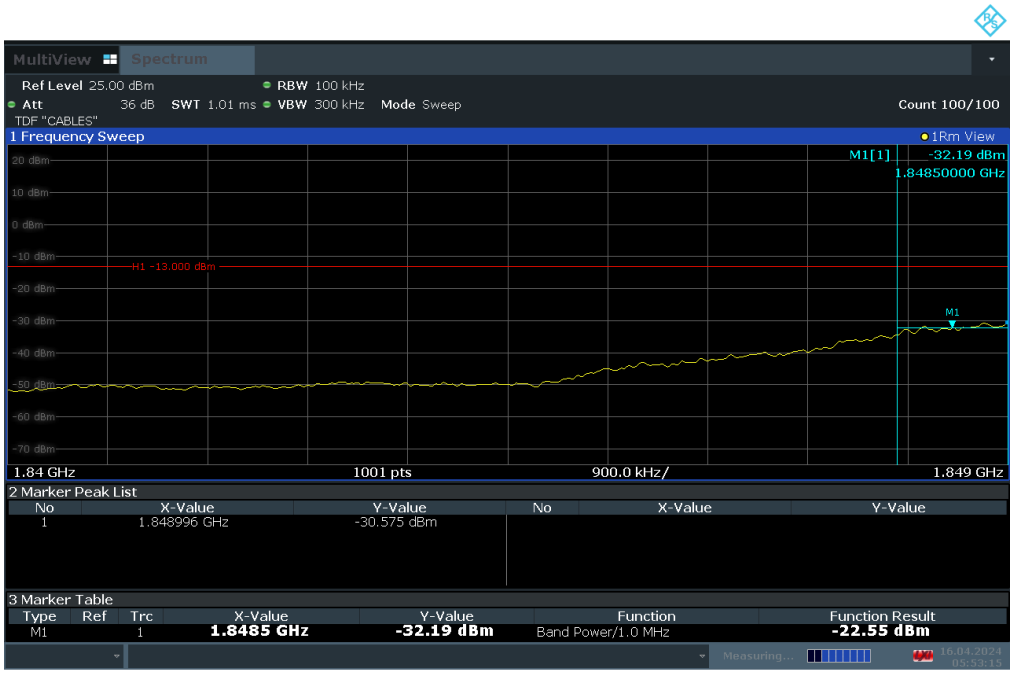
05:52:06 16.04.2024

Plot 7-38. Extended Upper Band Edge Plot (LTE Band 25 – 1.4MHz QPSK – Full RB Configuration)



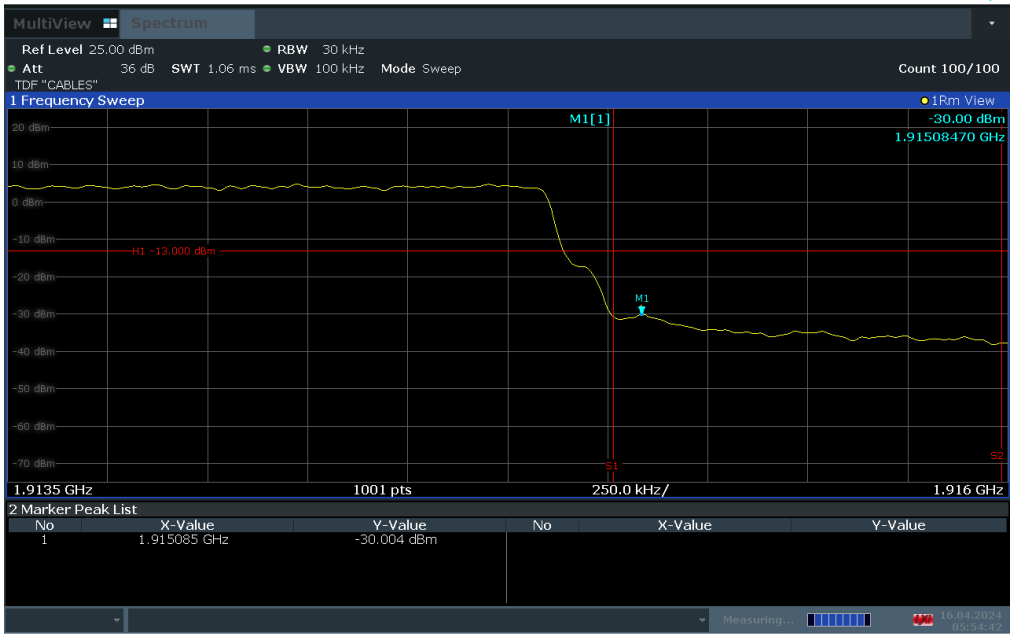
05:53:33 16.04.2024

Plot 7-39. Lower Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)



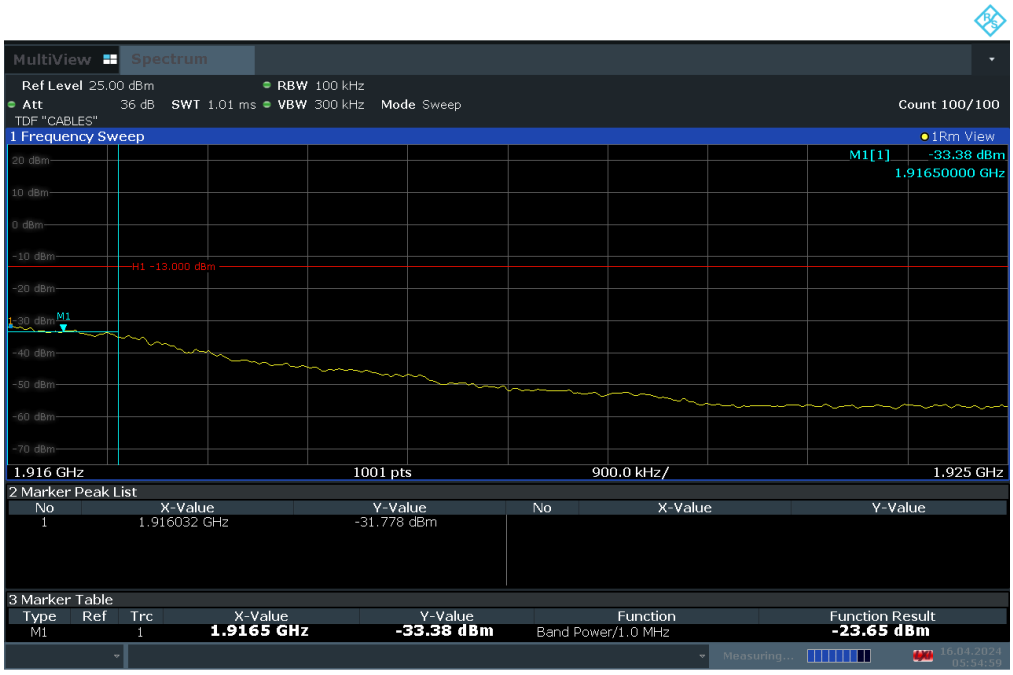
05:53:16 16.04.2024

Plot 7-40. Extended Lower Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)



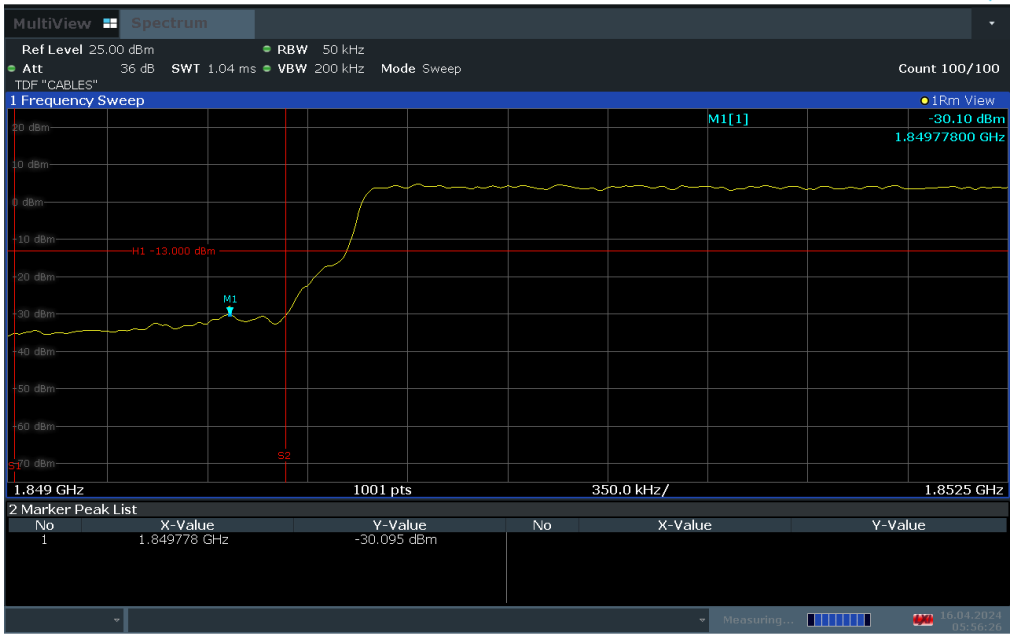
05:54:43 16.04.2024

Plot 7-41. Upper Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)



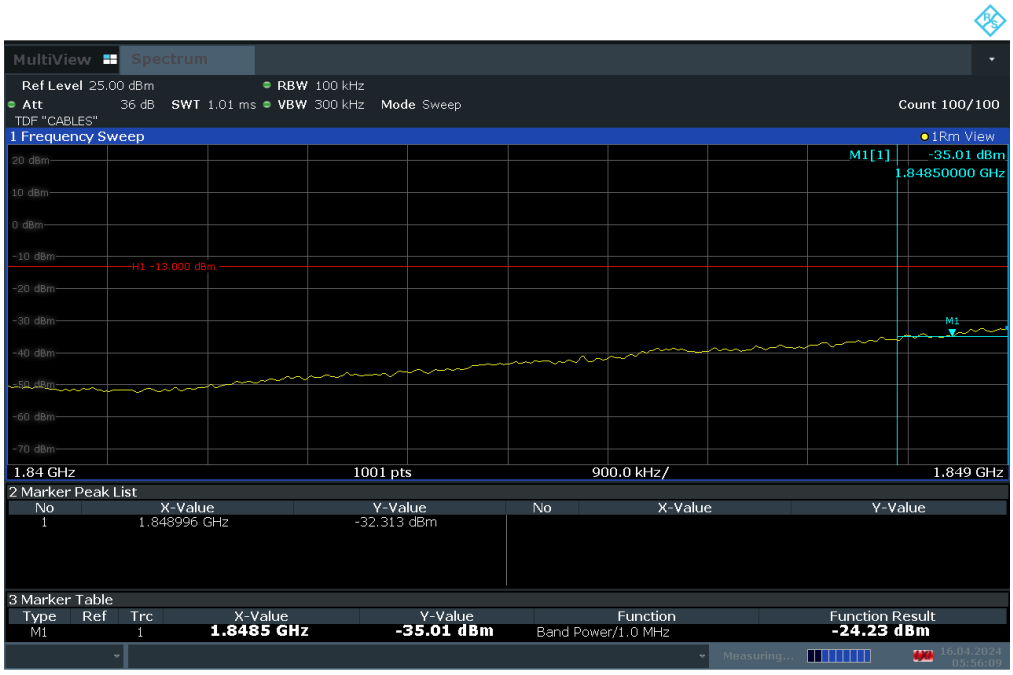
05:55:00 16.04.2024

Plot 7-42. Extended Upper Band Edge Plot (LTE Band 25 – 3MHz QPSK – Full RB Configuration)



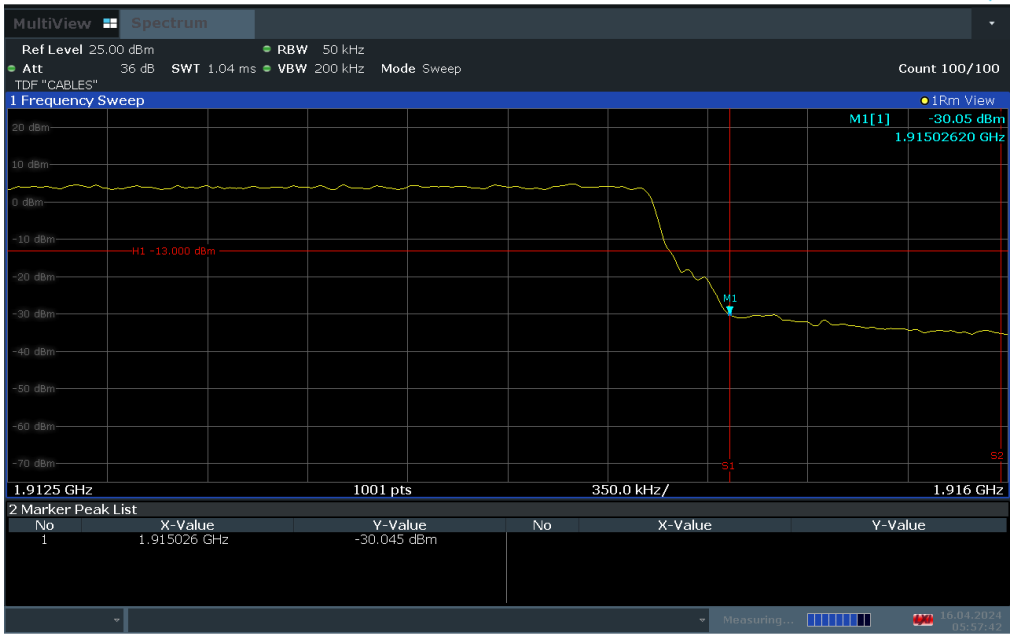
05:56:27 16.04.2024

Plot 7-43. Lower Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)

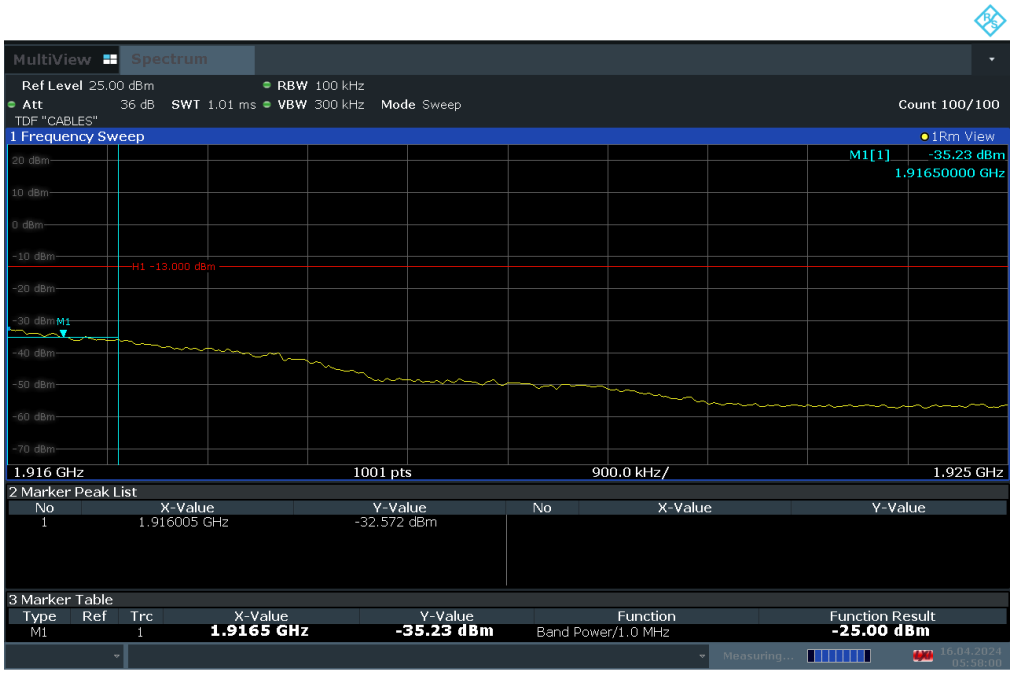


05:56:10 16.04.2024

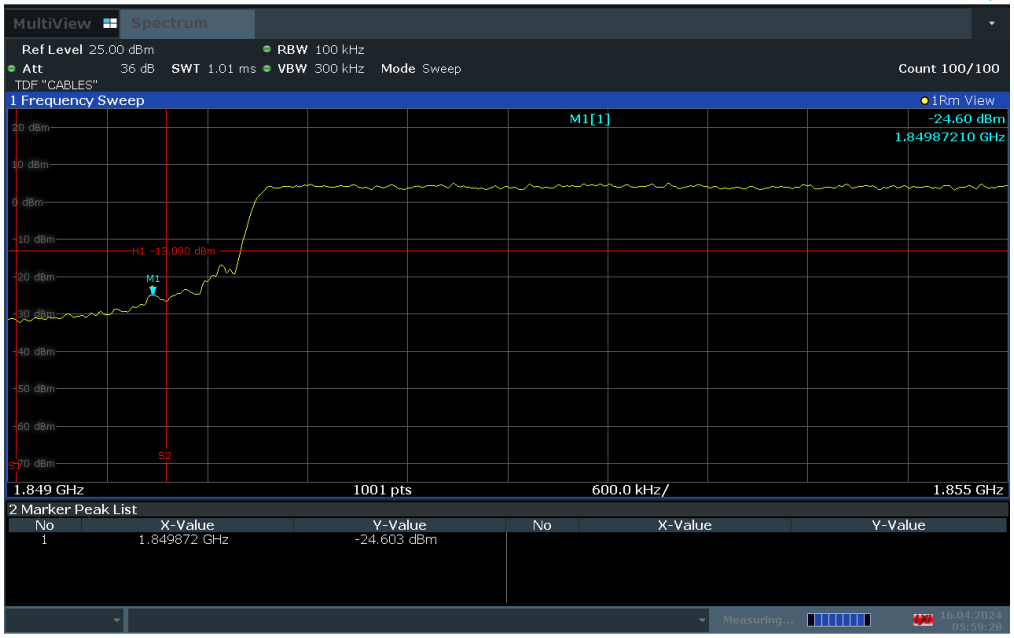
Plot 7-44. Extended Lower Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)



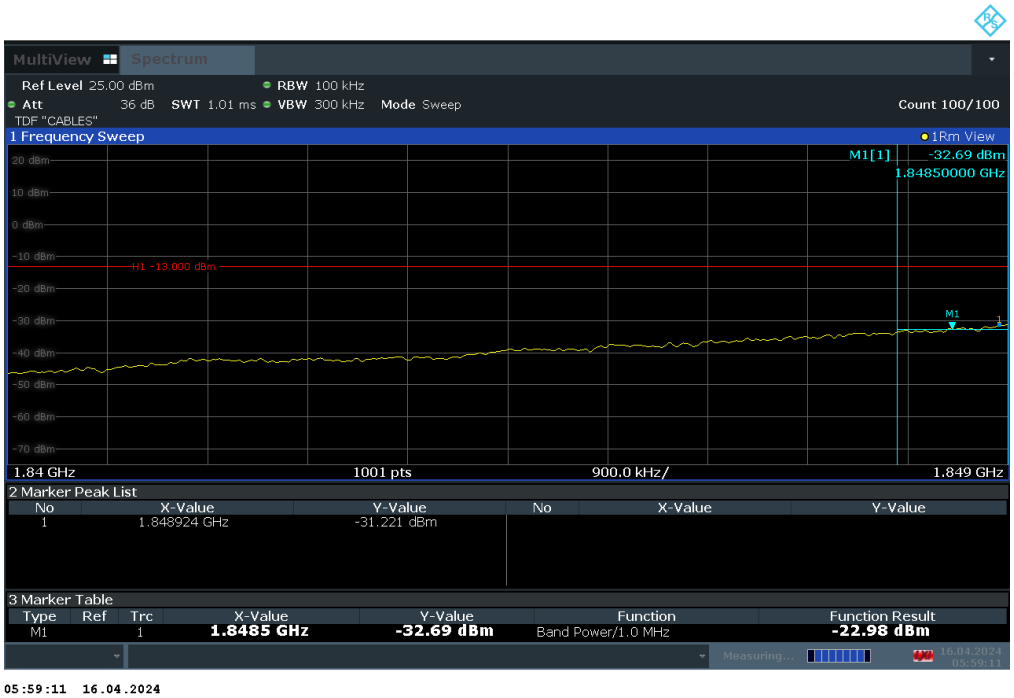
Plot 7-45. Upper Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)



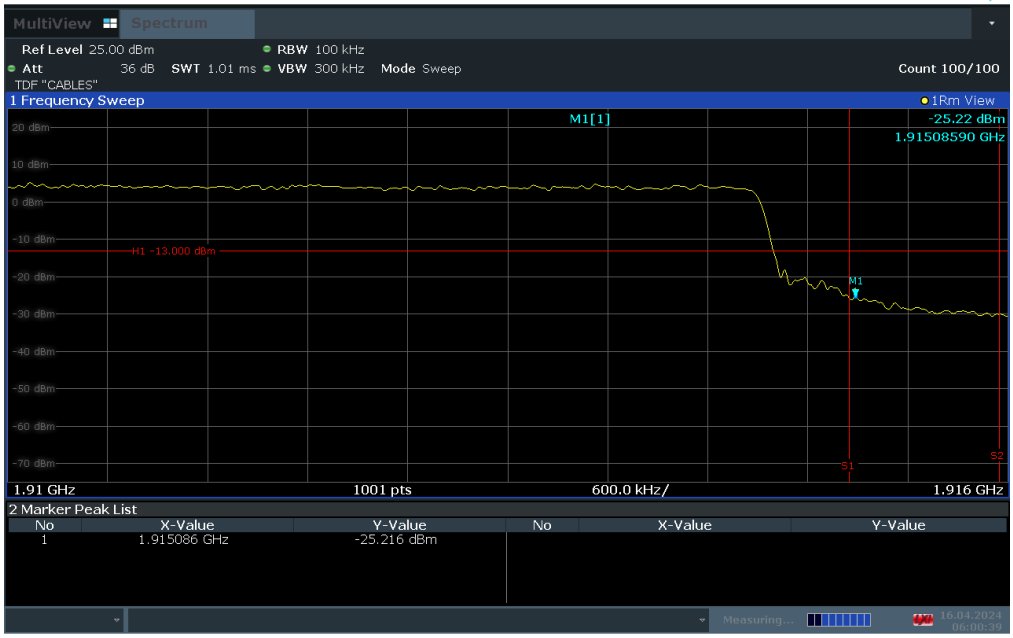
Plot 7-46. Extended Upper Band Edge Plot (LTE Band 25 – 5MHz QPSK – Full RB Configuration)



Plot 7-47. Lower Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)

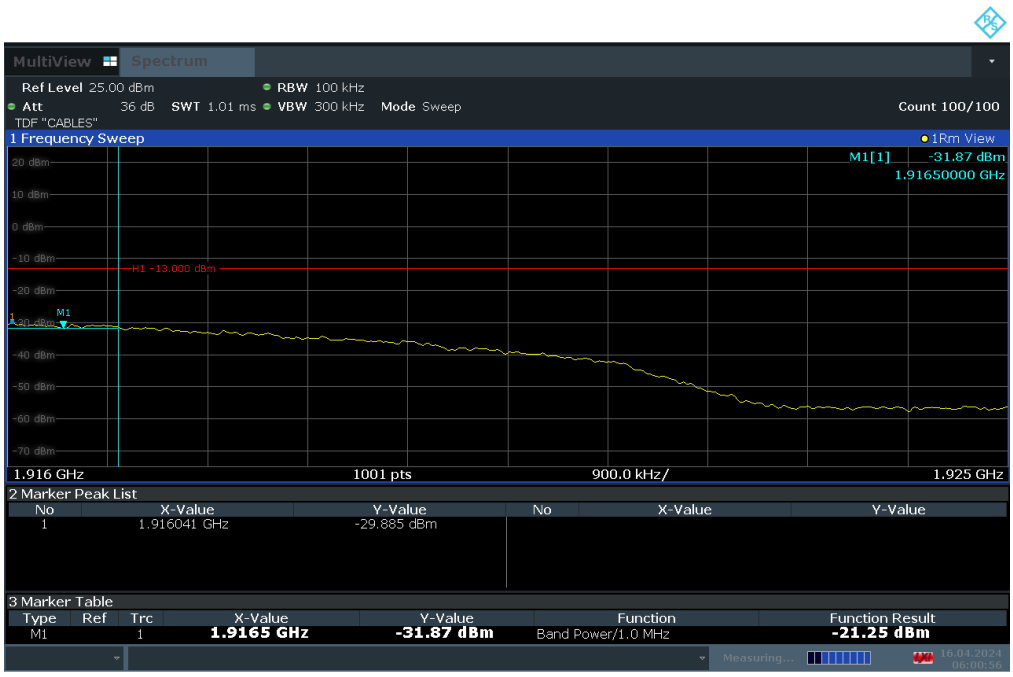


Plot 7-48. Extended Lower Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)



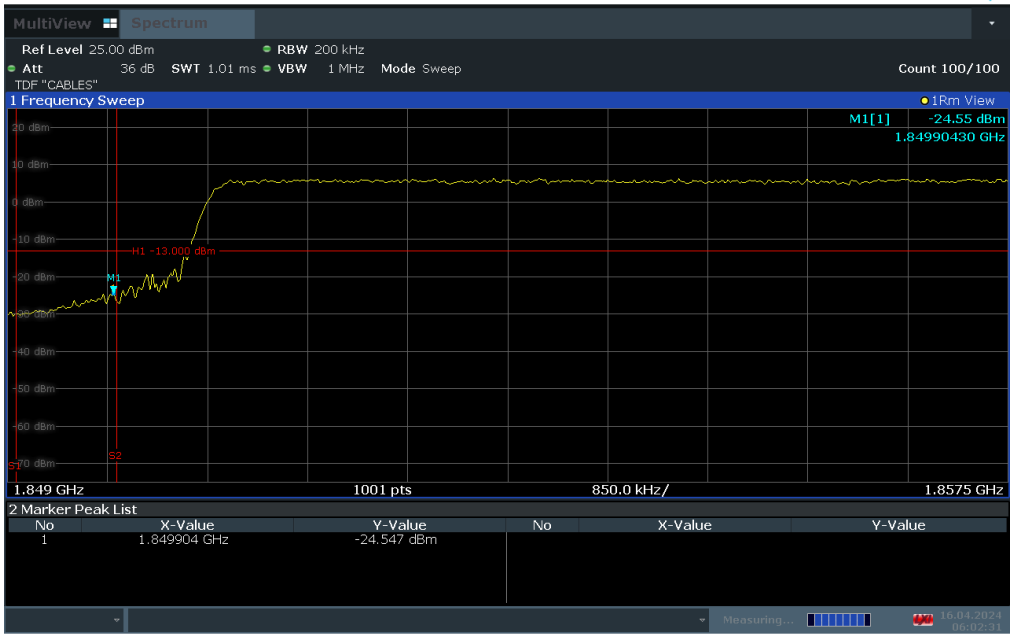
06:00:39 16.04.2024

Plot 7-49. Upper Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)



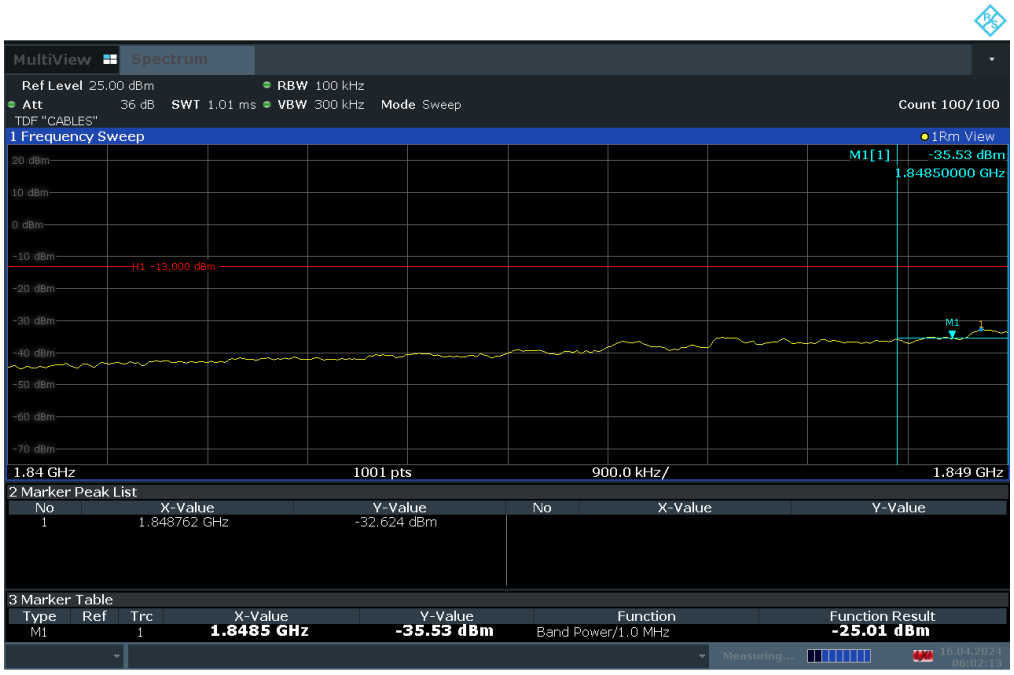
06:00:57 16.04.2024

Plot 7-50. Extended Upper Band Edge Plot (LTE Band 25 – 10MHz QPSK – Full RB Configuration)



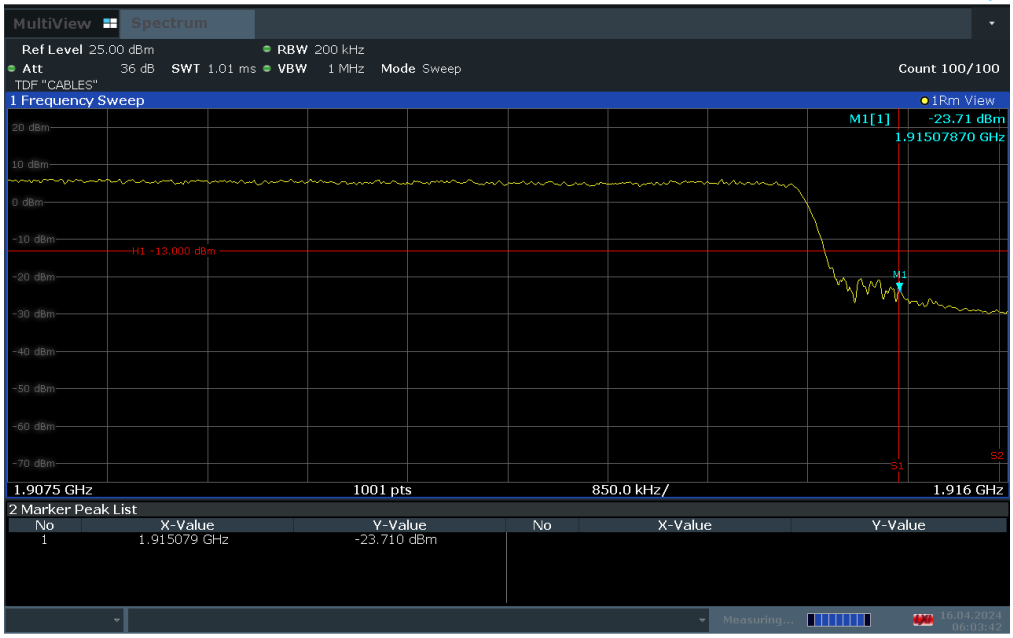
06:02:31 16.04.2024

Plot 7-51. Lower Band Edge Plot (LTE Band 25 – 15MHz QPSK – Full RB Configuration)



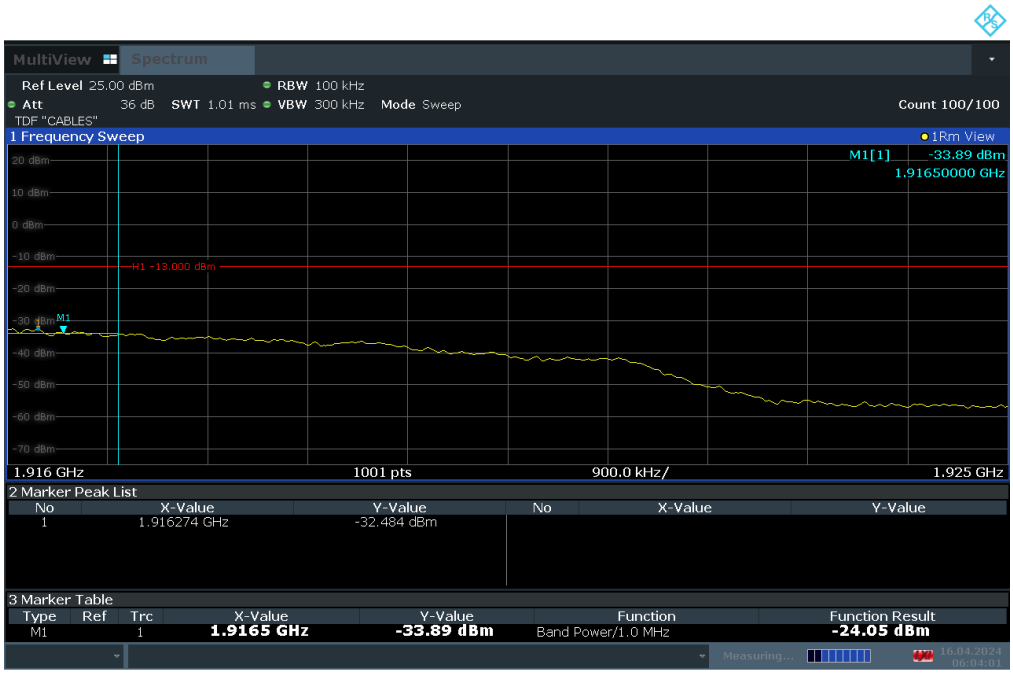
06:02:13 16.04.2024

Plot 7-52. Extended Lower Band Edge Plot (LTE Band 25 – 15MHz QPSK – Full RB Configuration)



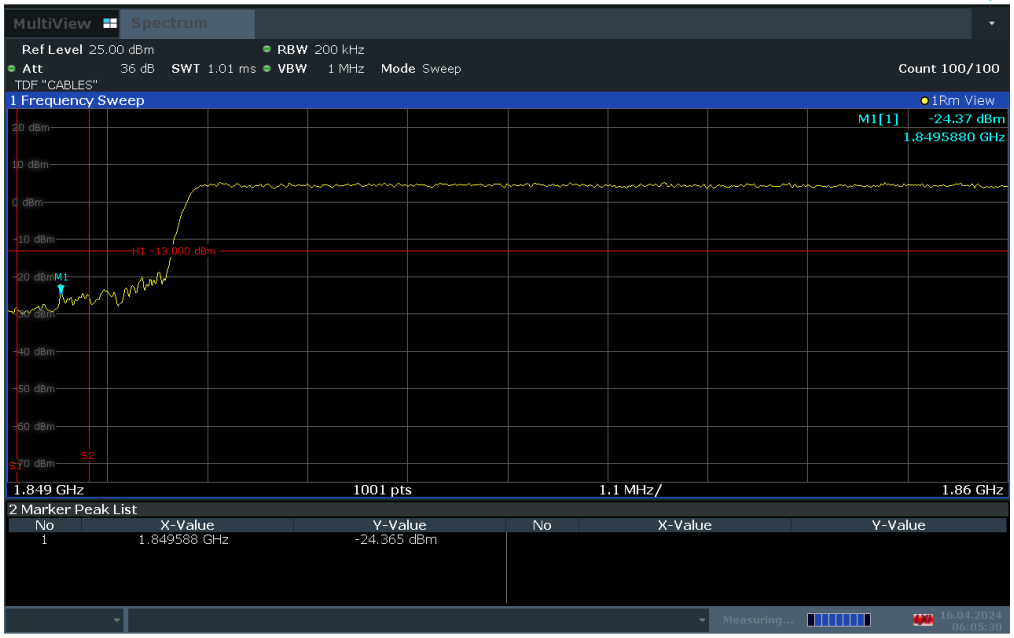
06:03:42 16.04.2024

Plot 7-53. Upper Band Edge Plot (LTE Band 25 – 15MHz QPSK – Full RB Configuration)



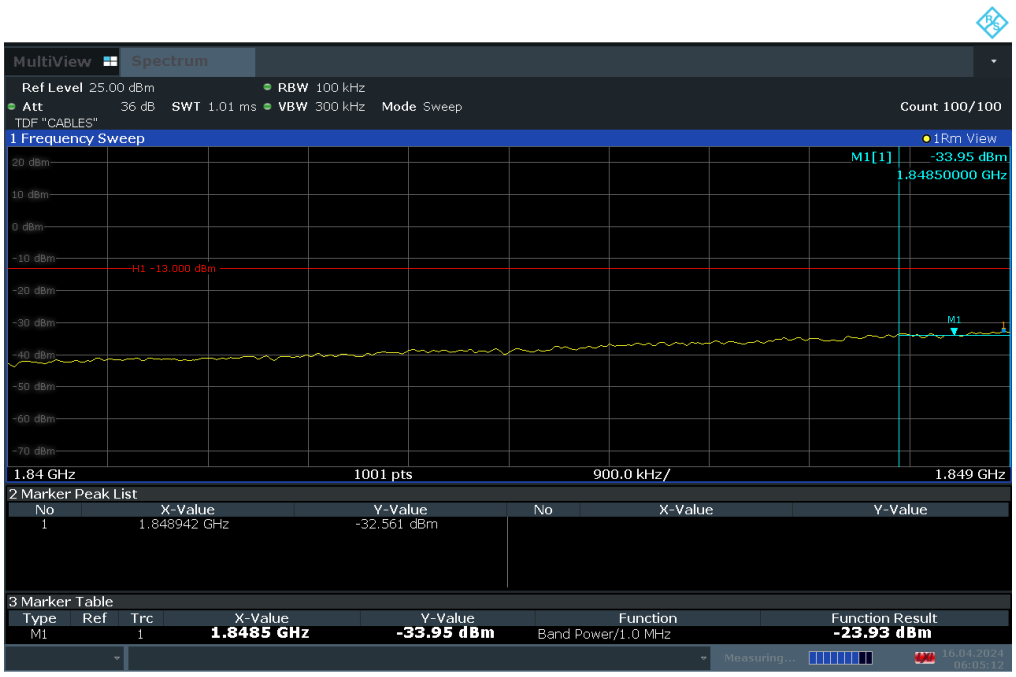
06:04:01 16.04.2024

Plot 7-54. Extended Upper Band Edge Plot (LTE Band 25 – 15MHz QPSK – Full RB Configuration)



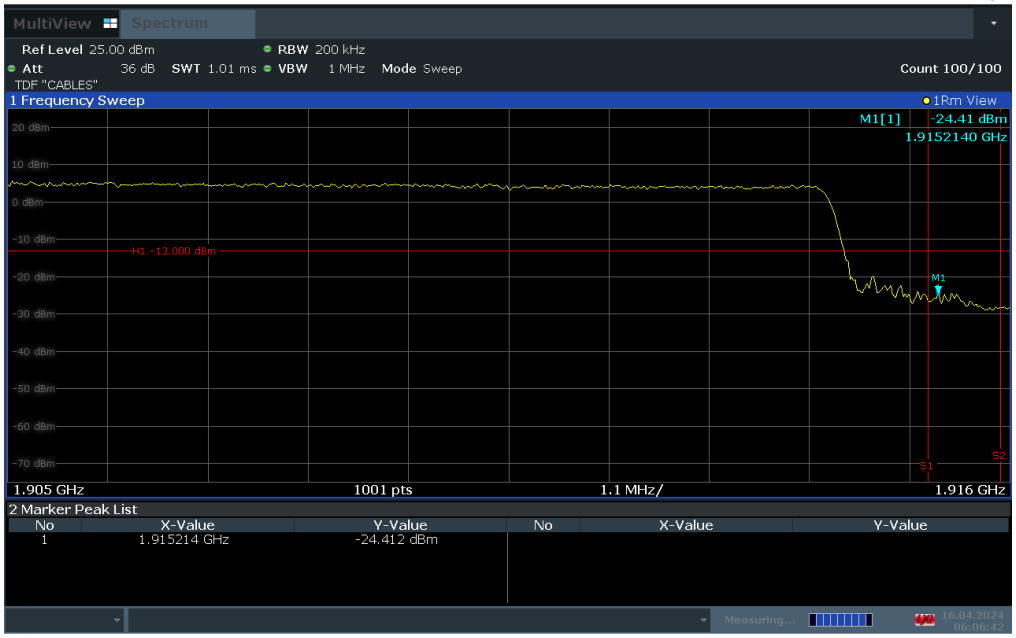
06:05:31 16.04.2024

Plot 7-55. Lower Band Edge Plot (LTE Band 25 – 20MHz QPSK – Full RB Configuration)

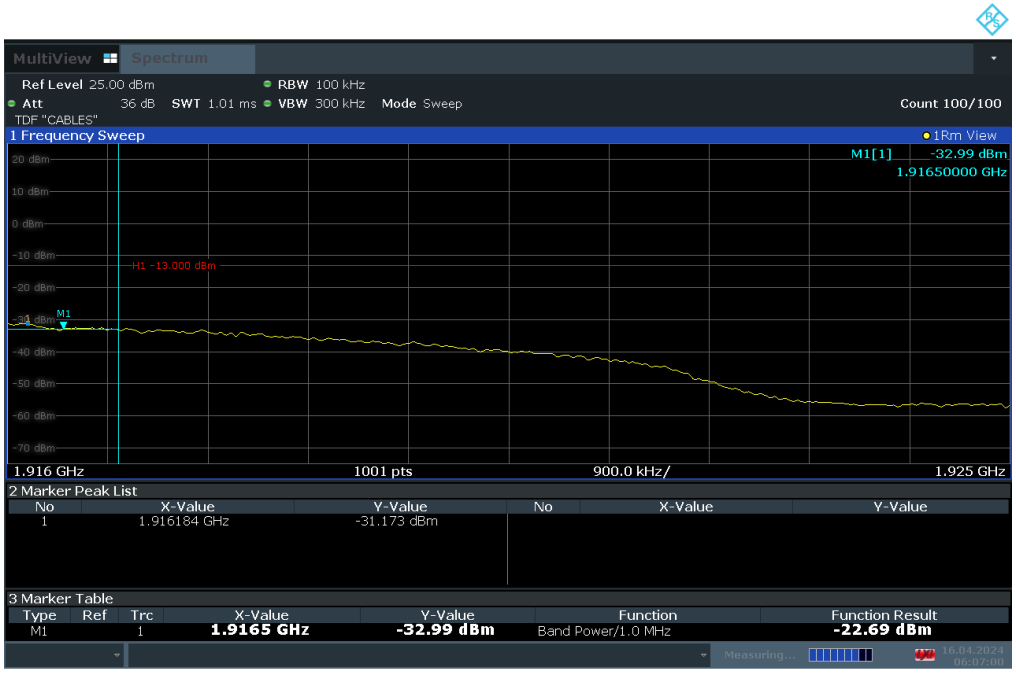


06:05:12 16.04.2024

Plot 7-56. Extended Lower Band Edge Plot (LTE Band 25 – 20MHz QPSK – Full RB Configuration)

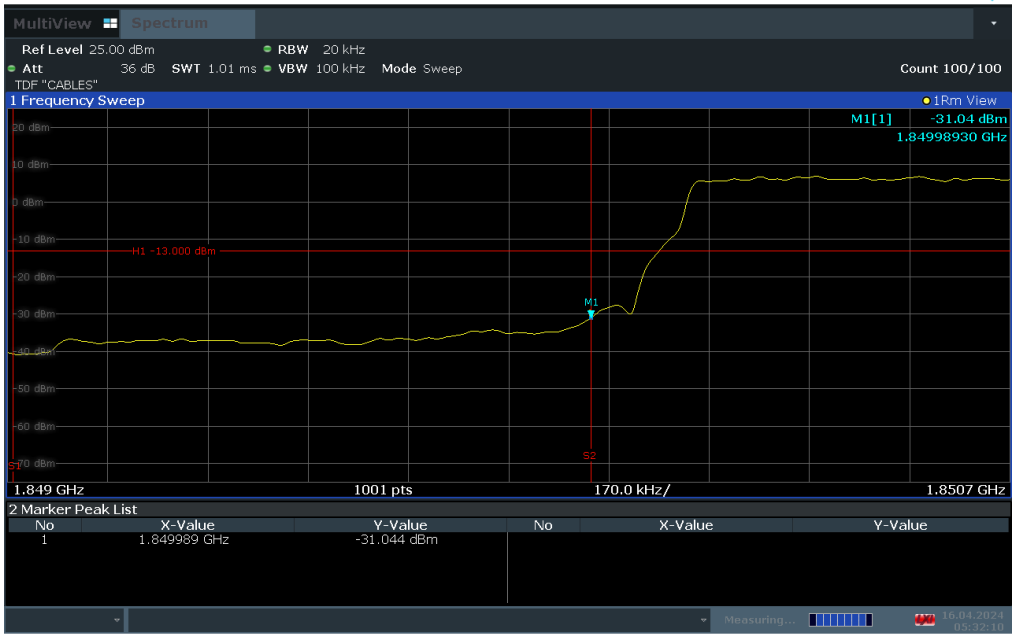


Plot 7-57. Upper Band Edge Plot (LTE Band 25 – 20MHz QPSK – Full RB Configuration)



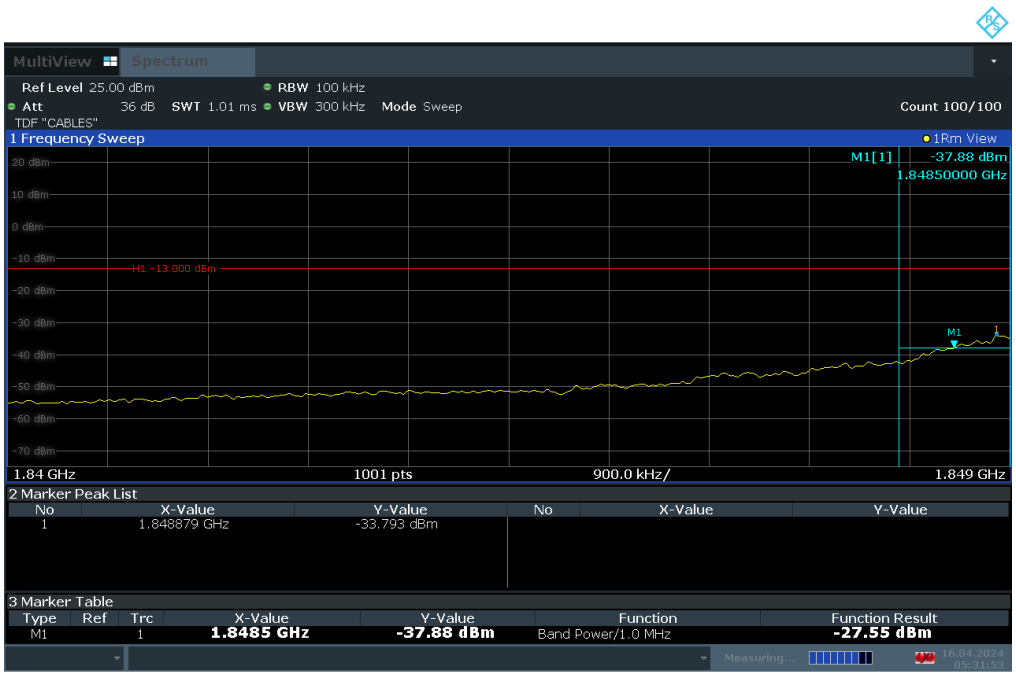
Plot 7-58. Extended Upper Band Edge Plot (LTE Band 25 – 20MHz QPSK – Full RB Configuration)

LTE Band 2



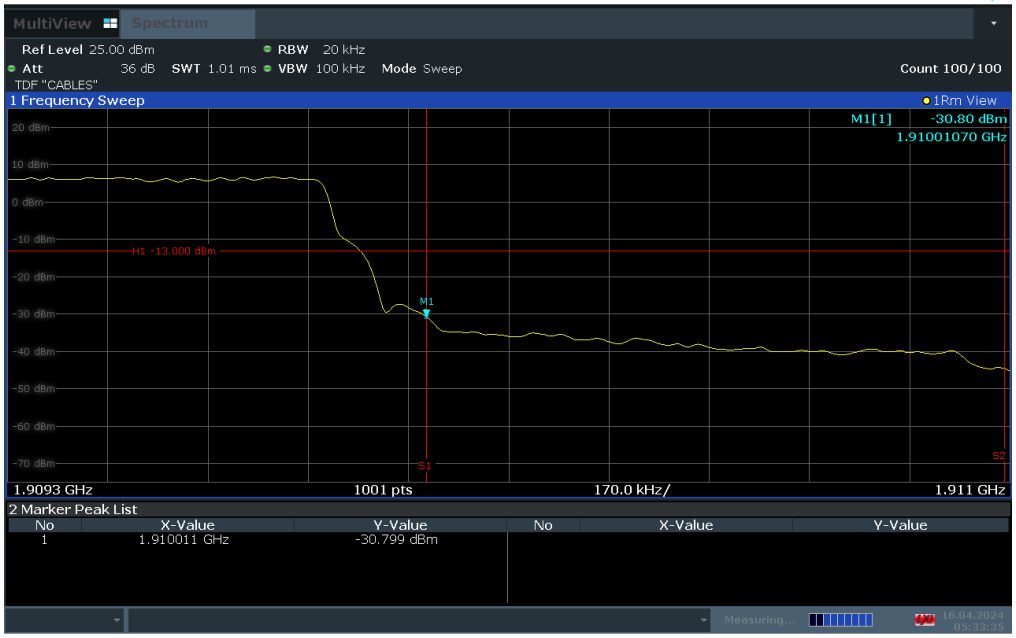
05:32:11 16.04.2024

Plot 7-59. Lower Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)



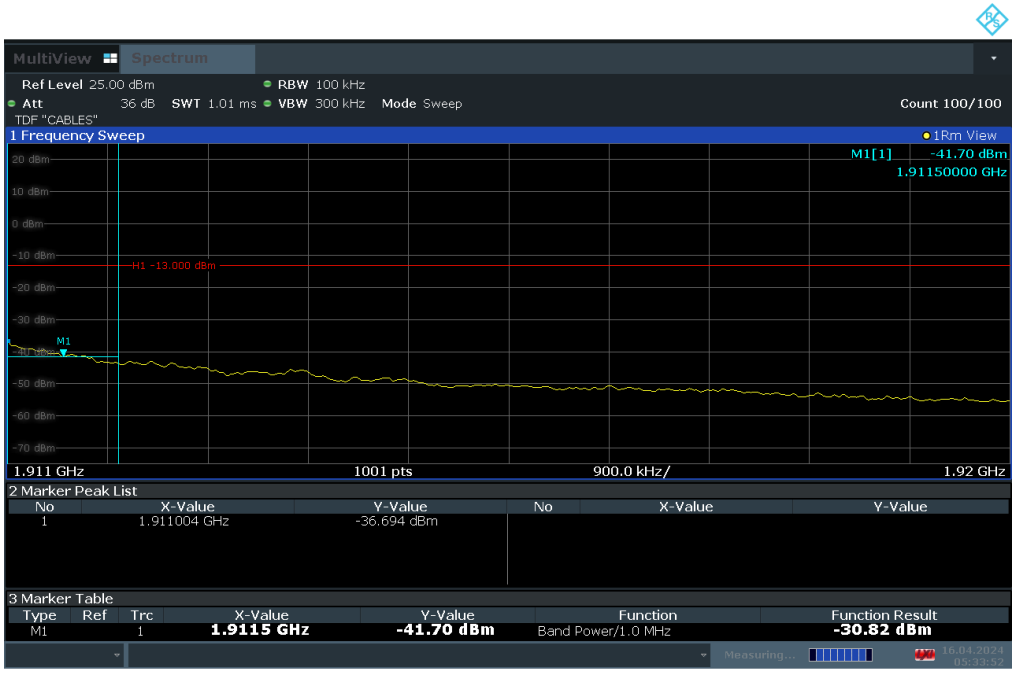
05:31:54 16.04.2024

Plot 7-60. Extended Lower Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)



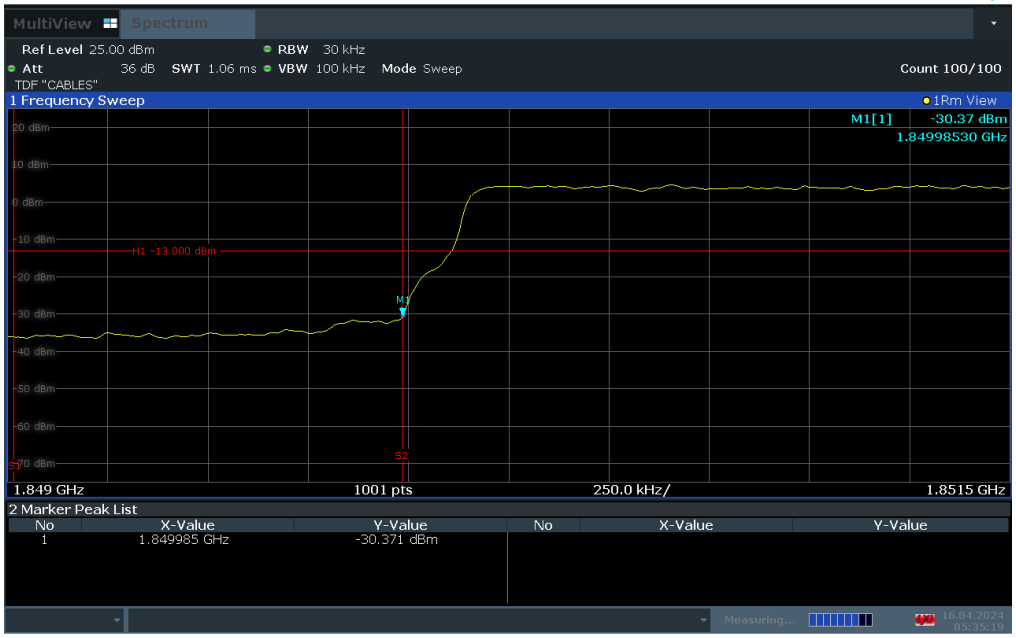
05:33:36 16.04.2024

Plot 7-61. Upper Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)



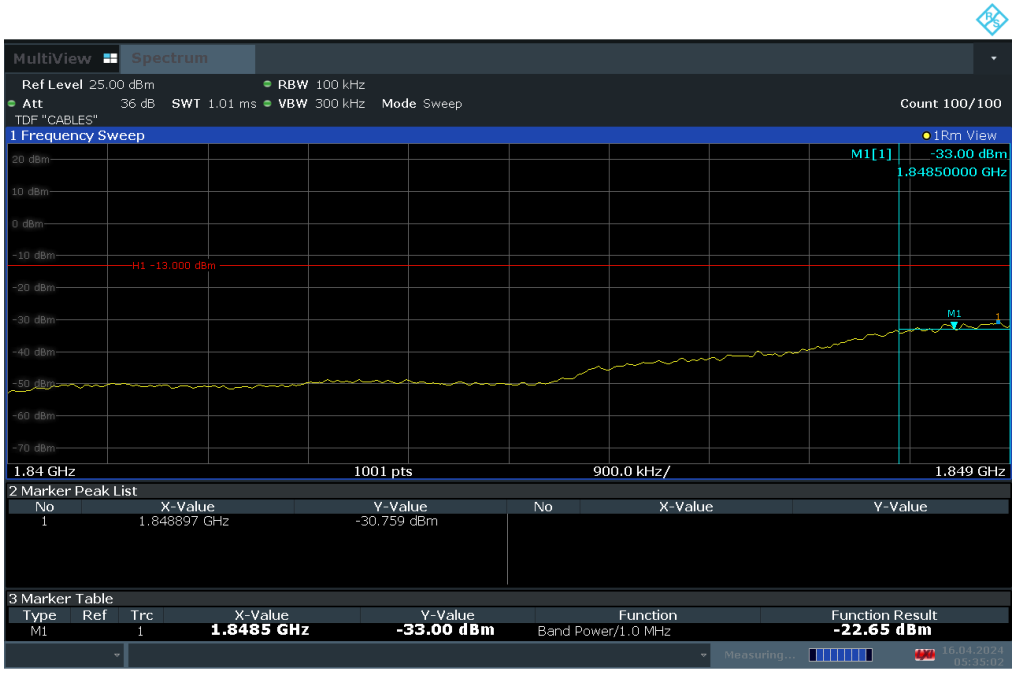
05:33:53 16.04.2024

Plot 7-62. Extended Upper Band Edge Plot (LTE Band 2 – 1.4MHz QPSK – Full RB Configuration)



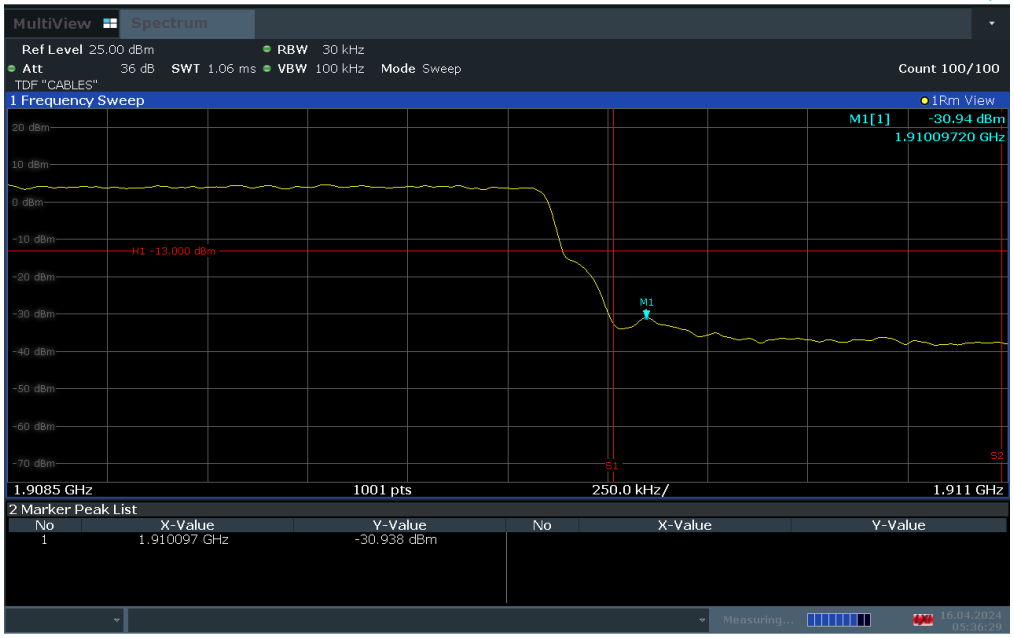
05:35:20 16.04.2024

Plot 7-63. Lower Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)



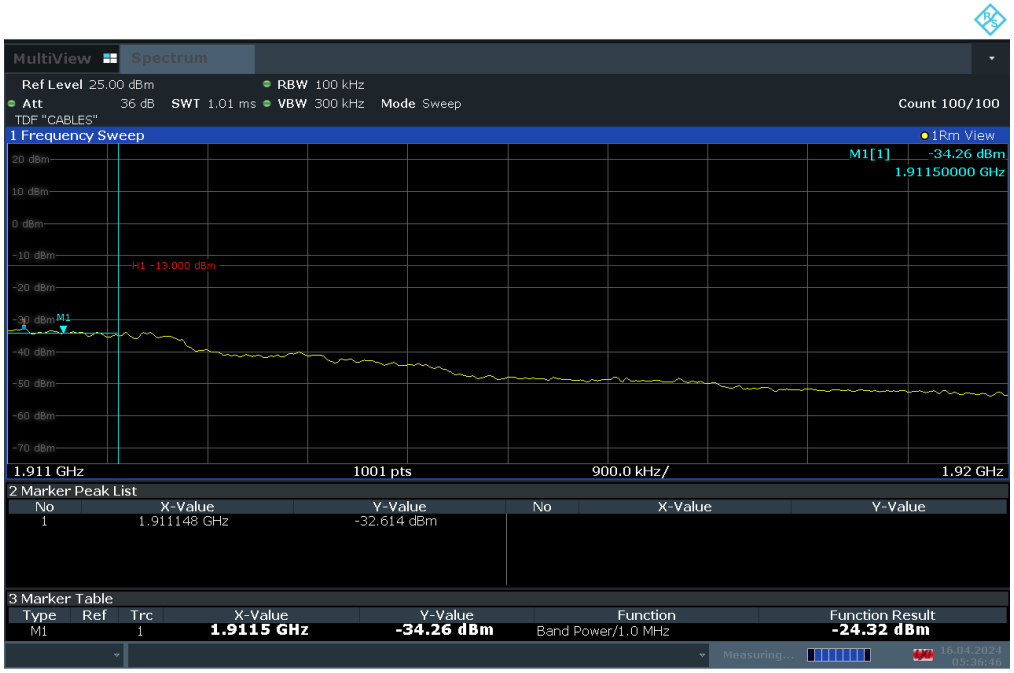
05:35:03 16.04.2024

Plot 7-64. Extended Lower Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)



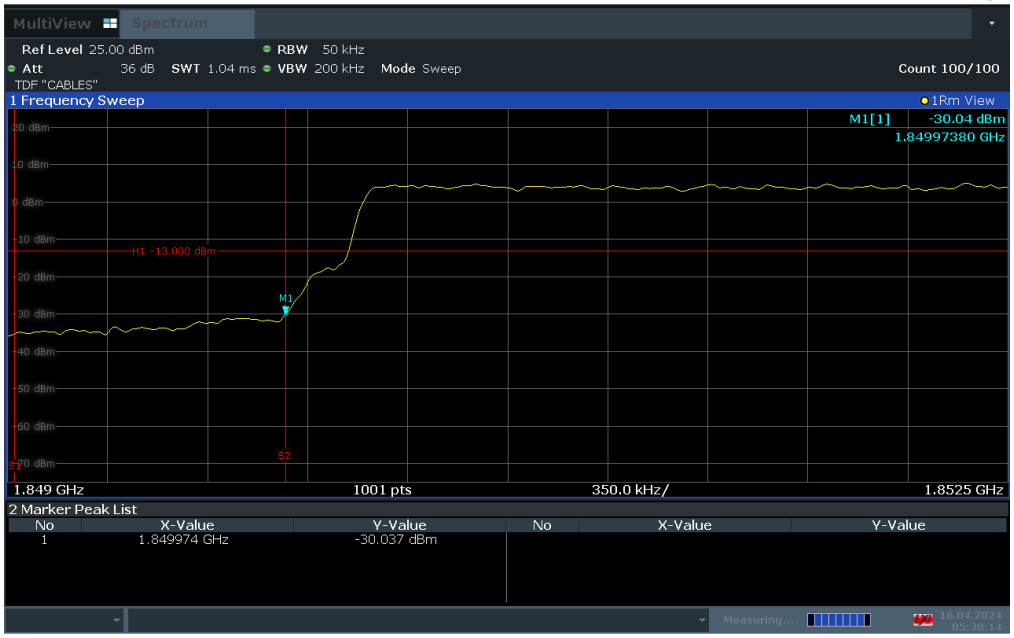
05:36:30 16.04.2024

Plot 7-65. Upper Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)

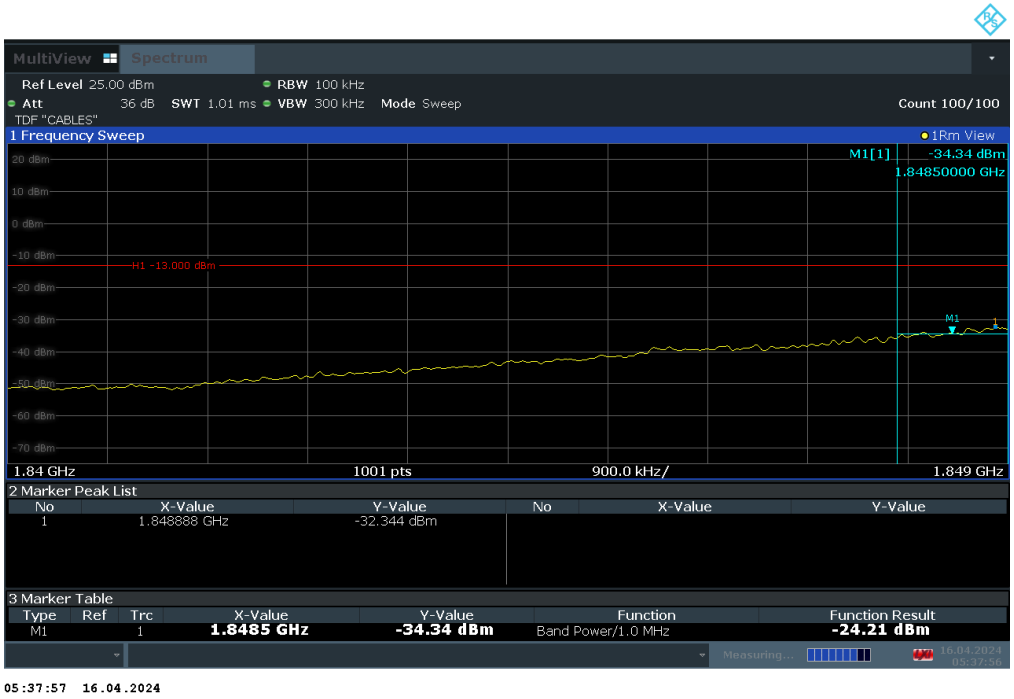


05:36:47 16.04.2024

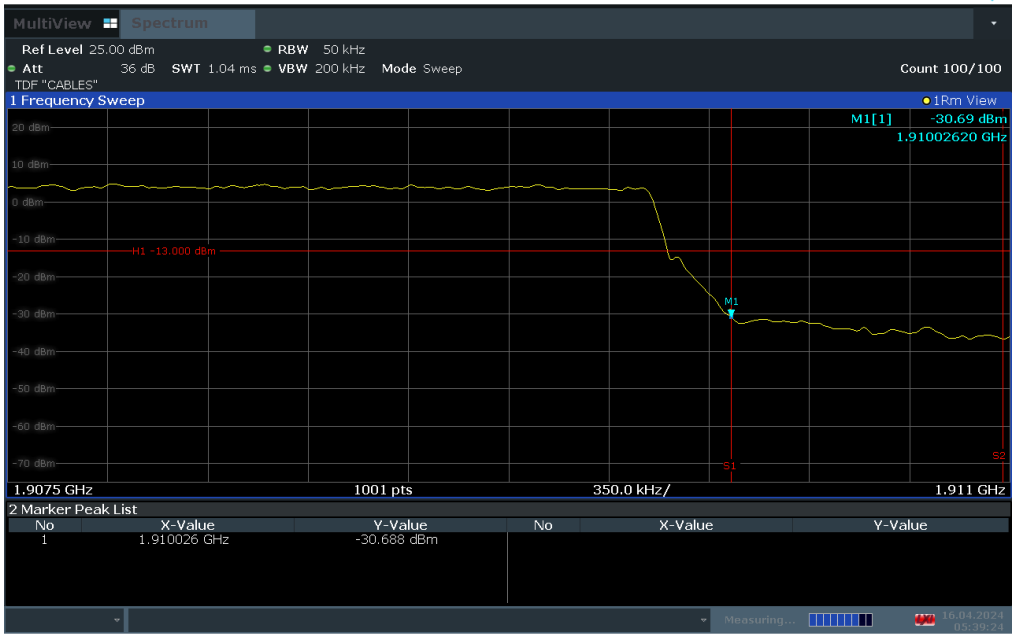
Plot 7-66. Extended Upper Band Edge Plot (LTE Band 2 – 3MHz QPSK – Full RB Configuration)



Plot 7-67. Lower Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)

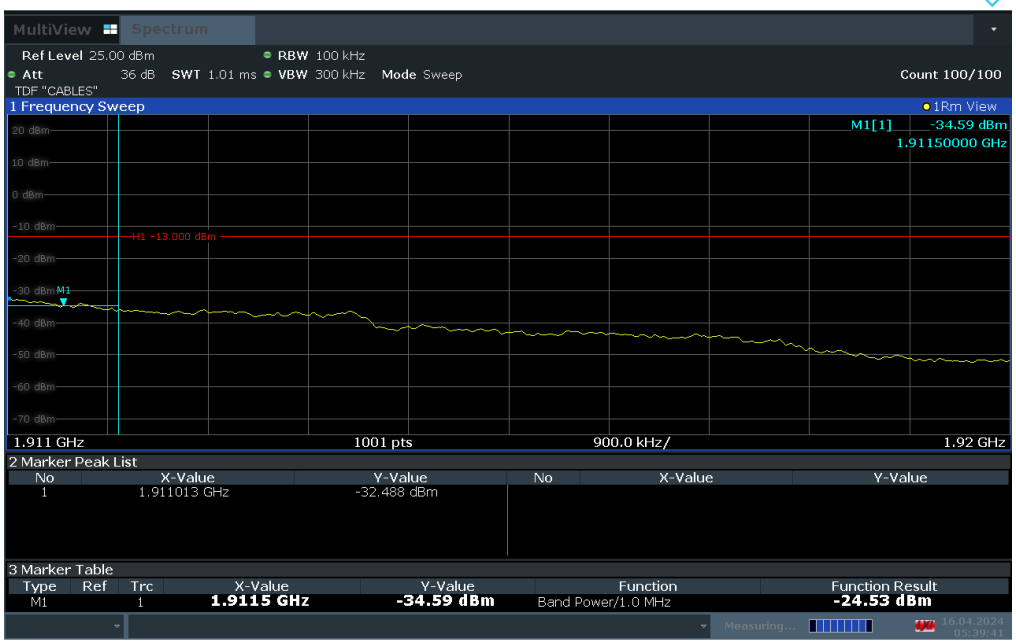


Plot 7-68. Extended Lower Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)



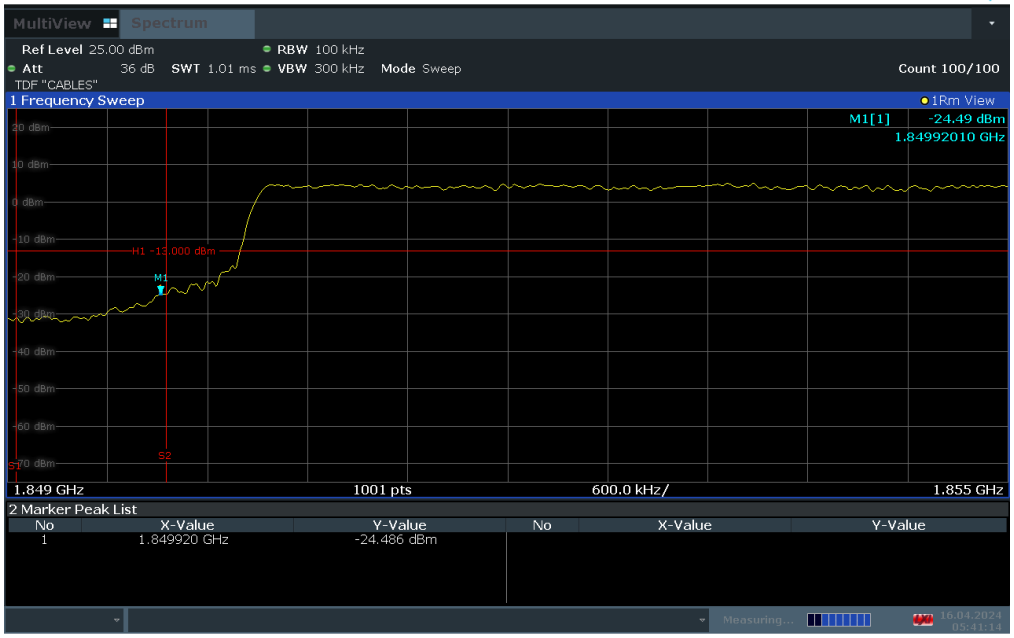
05:39:25 16.04.2024

Plot 7-69. Upper Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)



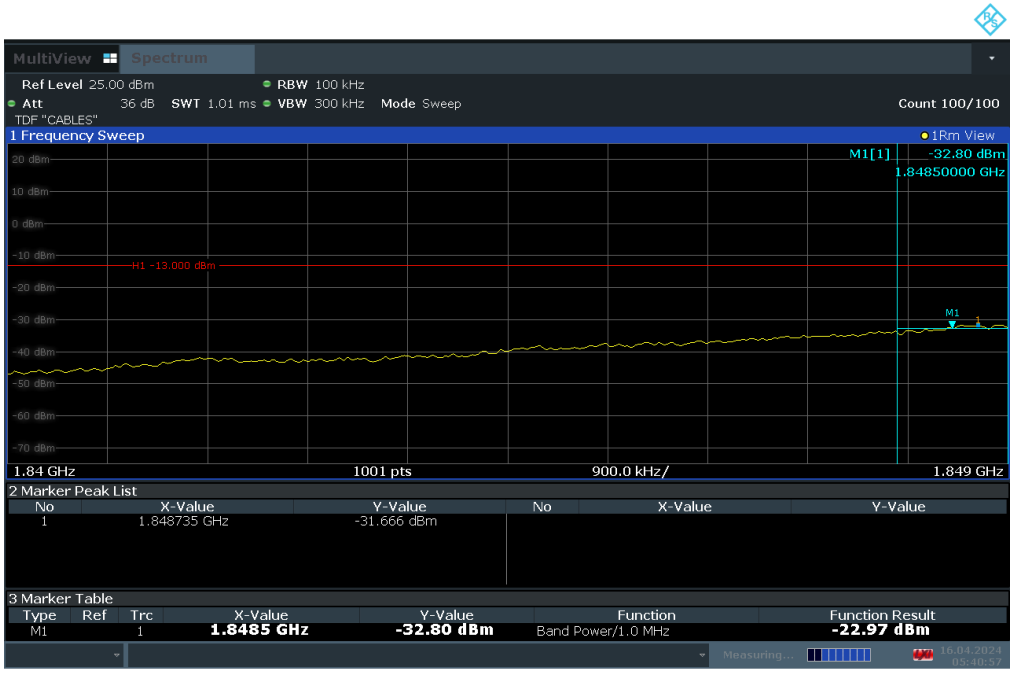
05:39:42 16.04.2024

Plot 7-70. Extended Upper Band Edge Plot (LTE Band 2 – 5MHz QPSK – Full RB Configuration)



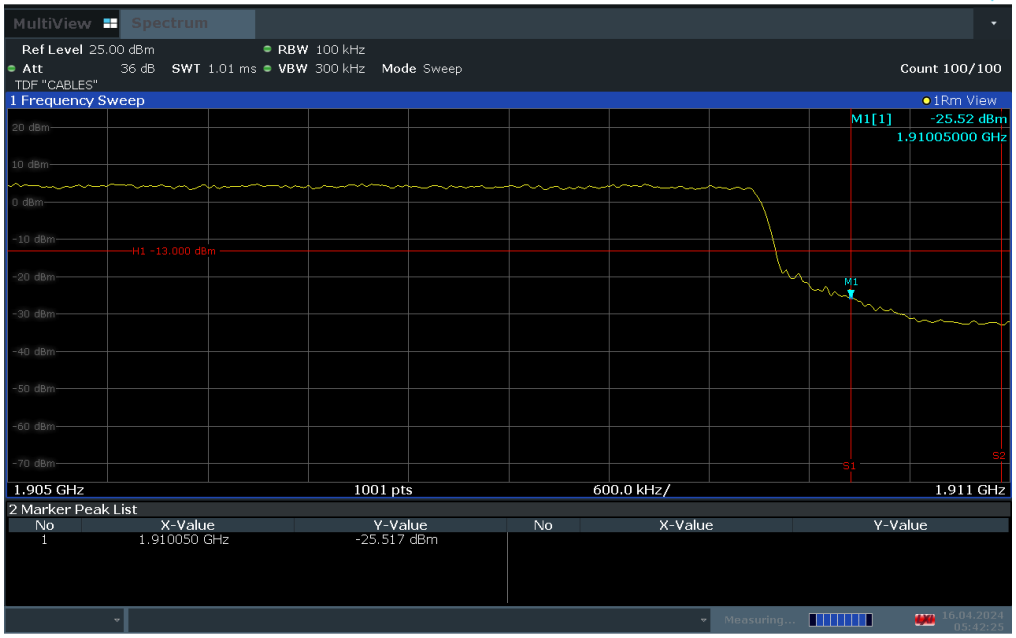
05:41:15 16.04.2024

Plot 7-71. Lower Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

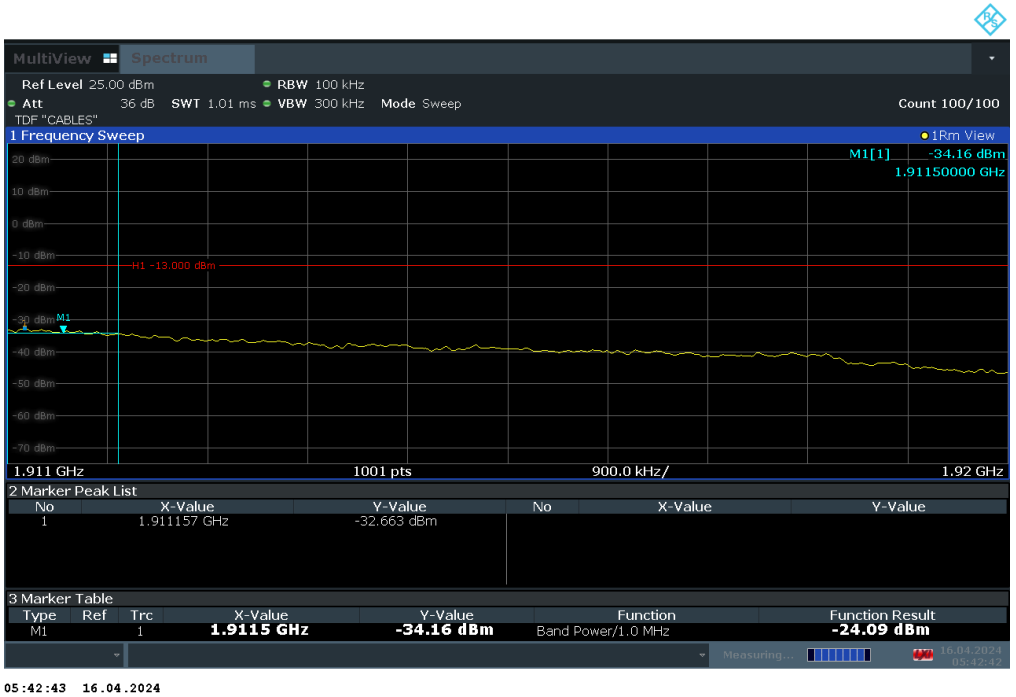


05:40:57 16.04.2024

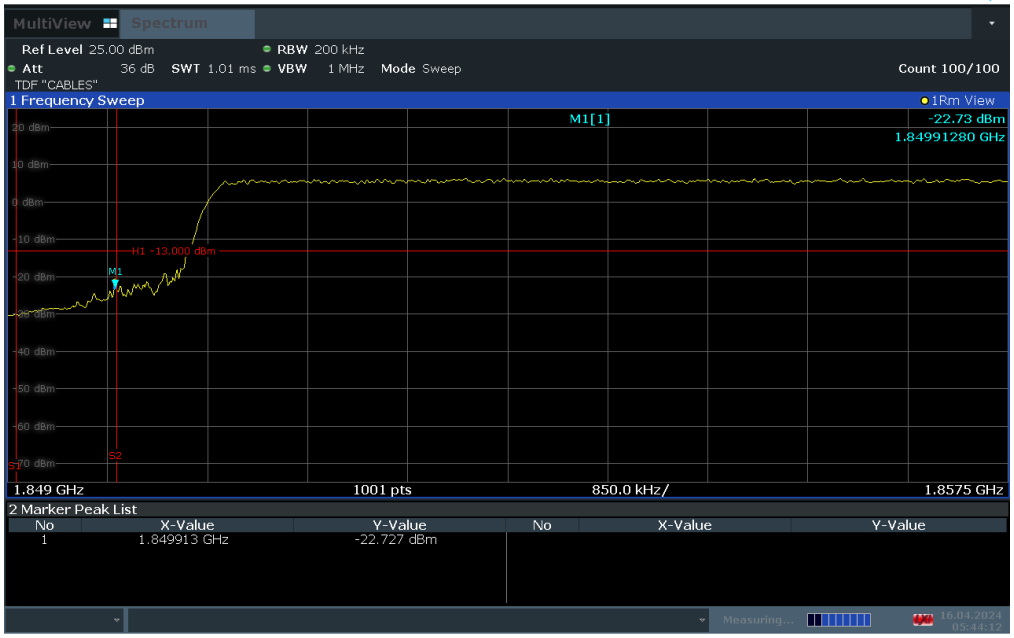
Plot 7-72. Extended Lower Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)



Plot 7-73. Upper Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)

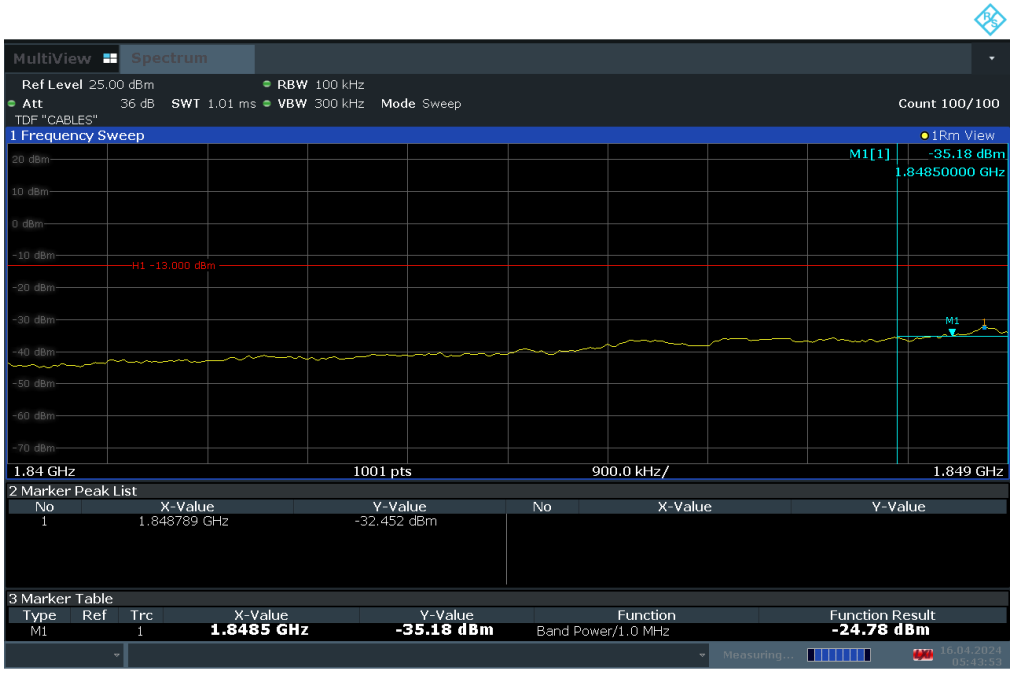


Plot 7-74. Extended Upper Band Edge Plot (LTE Band 2 – 10MHz QPSK – Full RB Configuration)



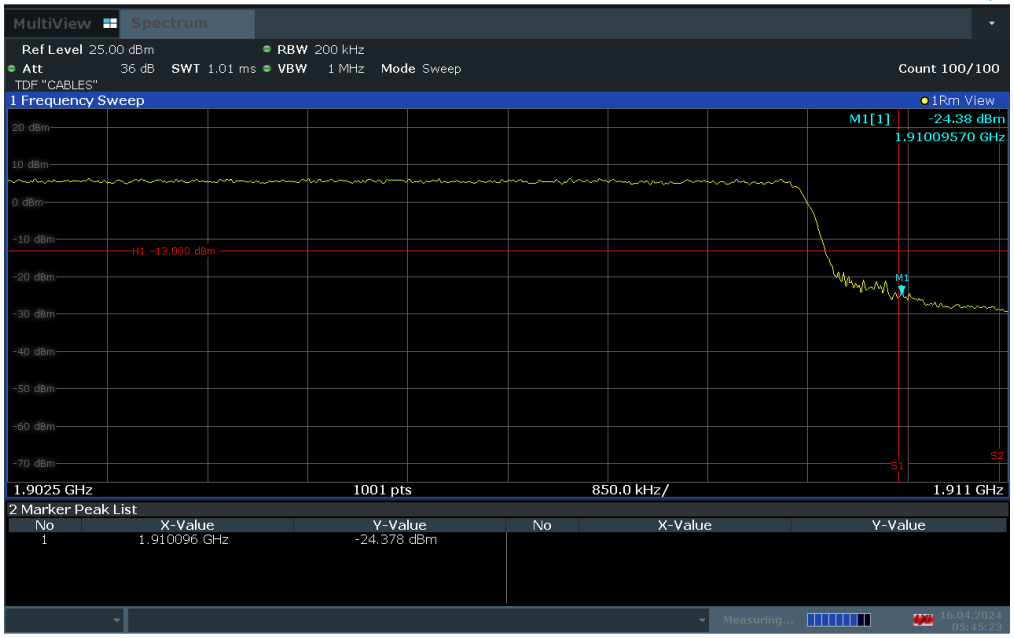
05:44:12 16.04.2024

Plot 7-75. Lower Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)

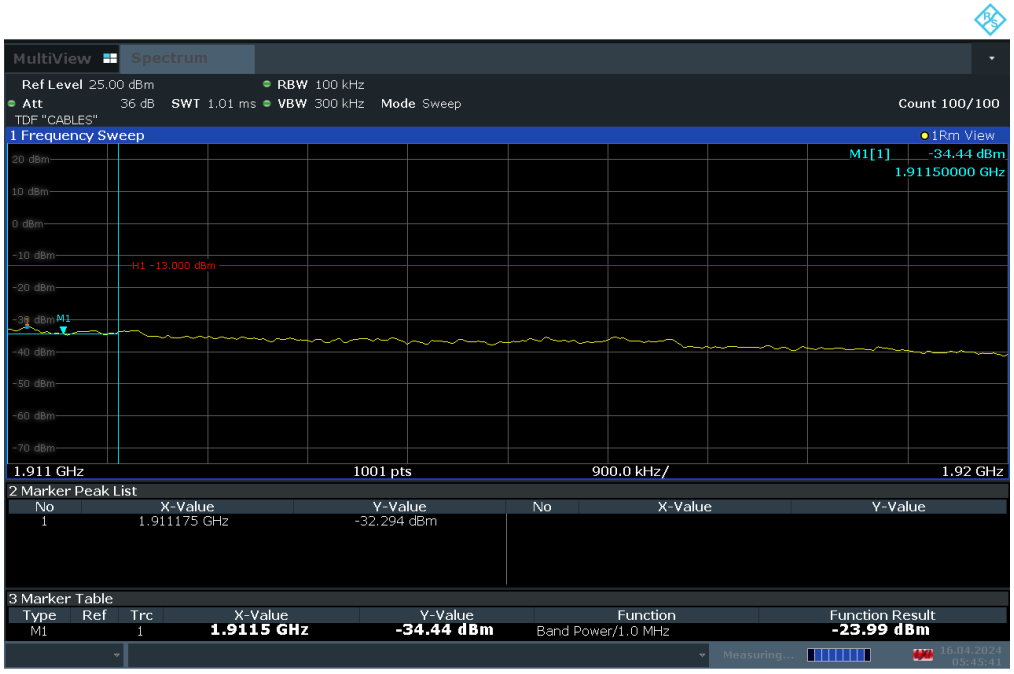


05:43:54 16.04.2024

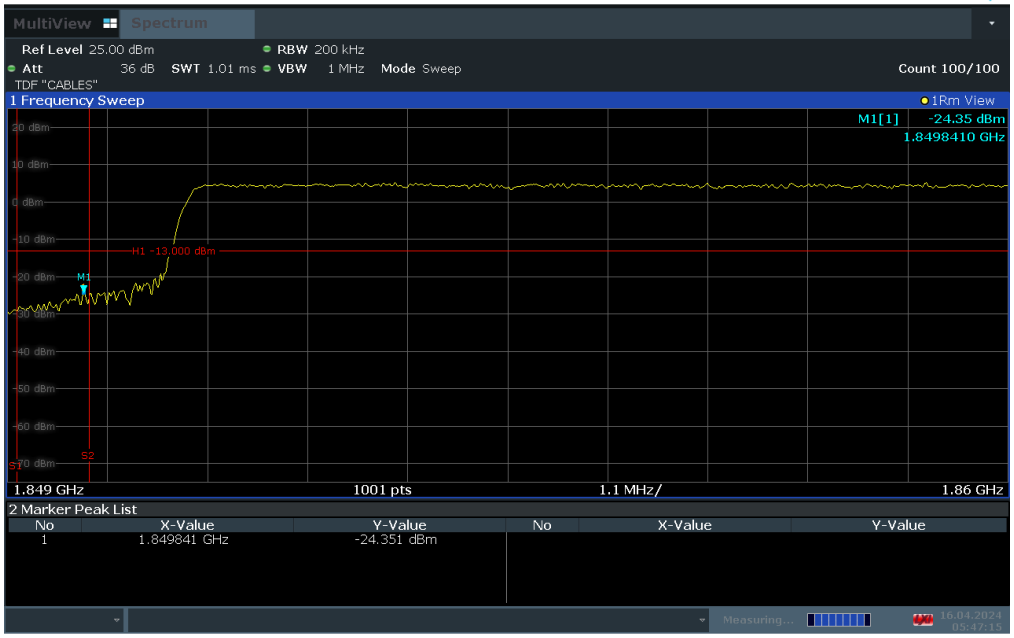
Plot 7-76. Extended Lower Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)



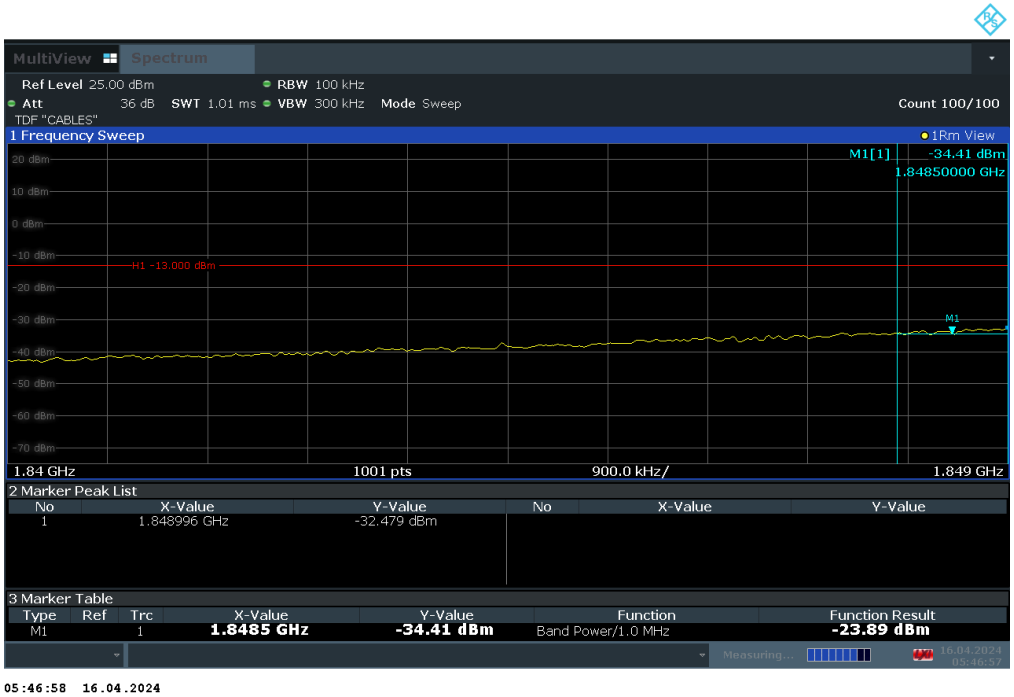
Plot 7-77. Upper Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)



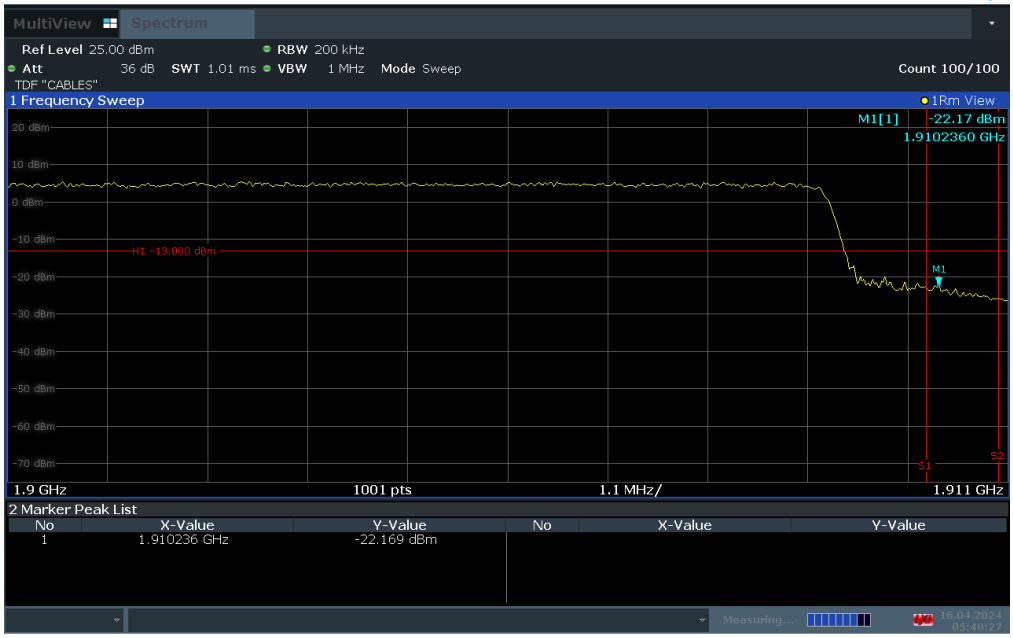
Plot 7-78. Extended Upper Band Edge Plot (LTE Band 2 – 15MHz QPSK – Full RB Configuration)



Plot 7-79. Lower Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)

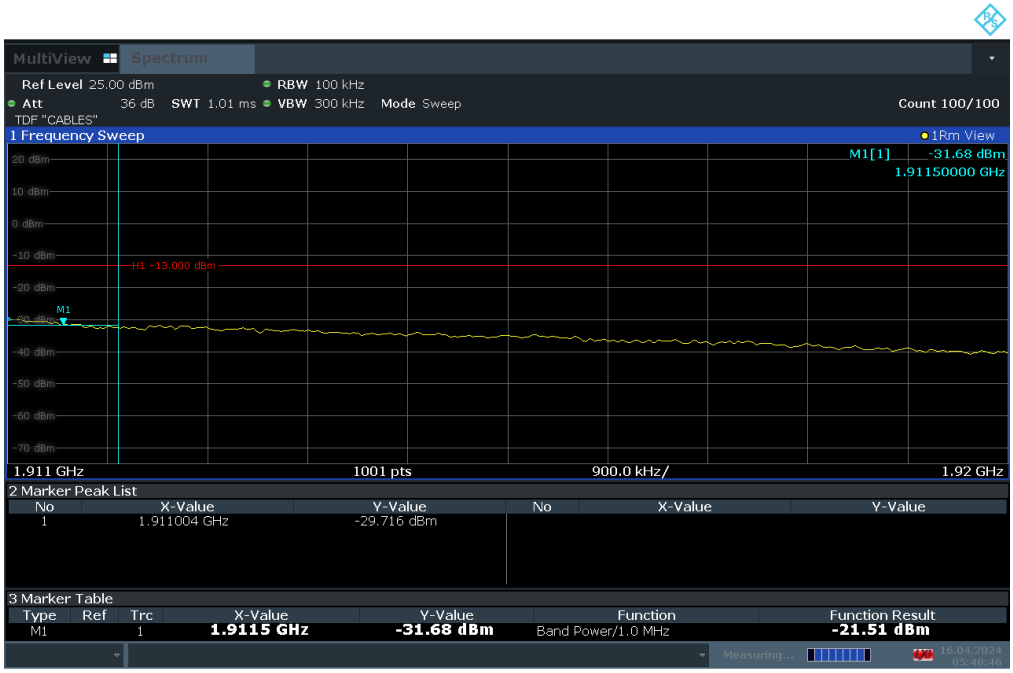


Plot 7-80. Extended Lower Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)



05:48:28 16.04.2024

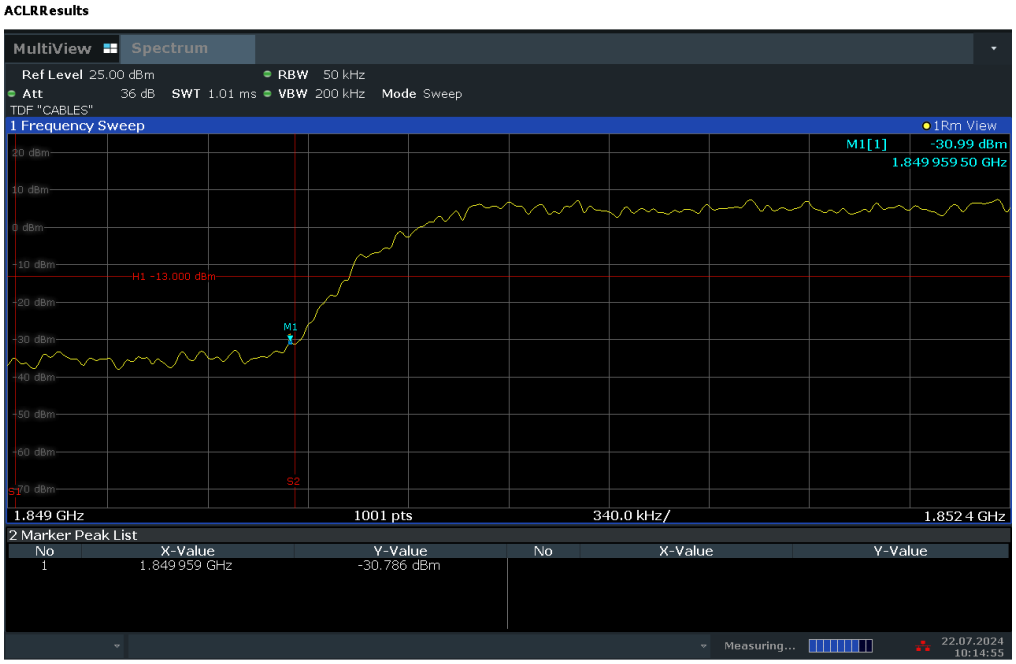
Plot 7-81. Upper Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)



05:48:47 16.04.2024

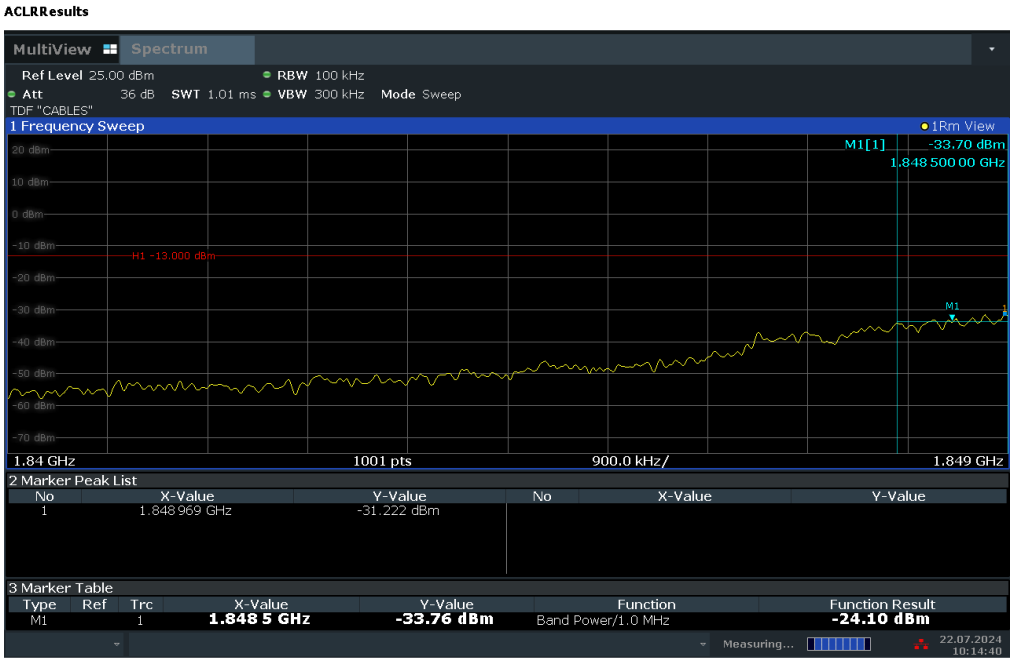
Plot 7-82. Extended Upper Band Edge Plot (LTE Band 2 – 20MHz QPSK – Full RB Configuration)

WCDMA PCS



10:14:56 22.07.2024

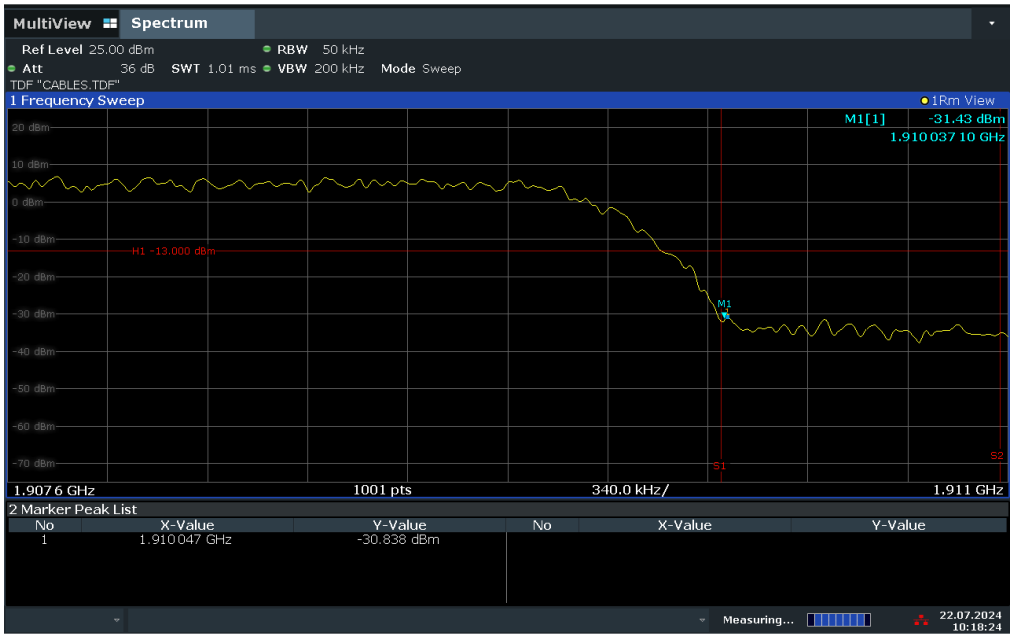
Plot 7-83. Lower Band Edge Plot (WCDMA PCS – Ch. 9262)



10:14:41 22.07.2024

Plot 7-84. Extended Lower Band Edge Plot (WCDMA PCS – Ch. 9262)

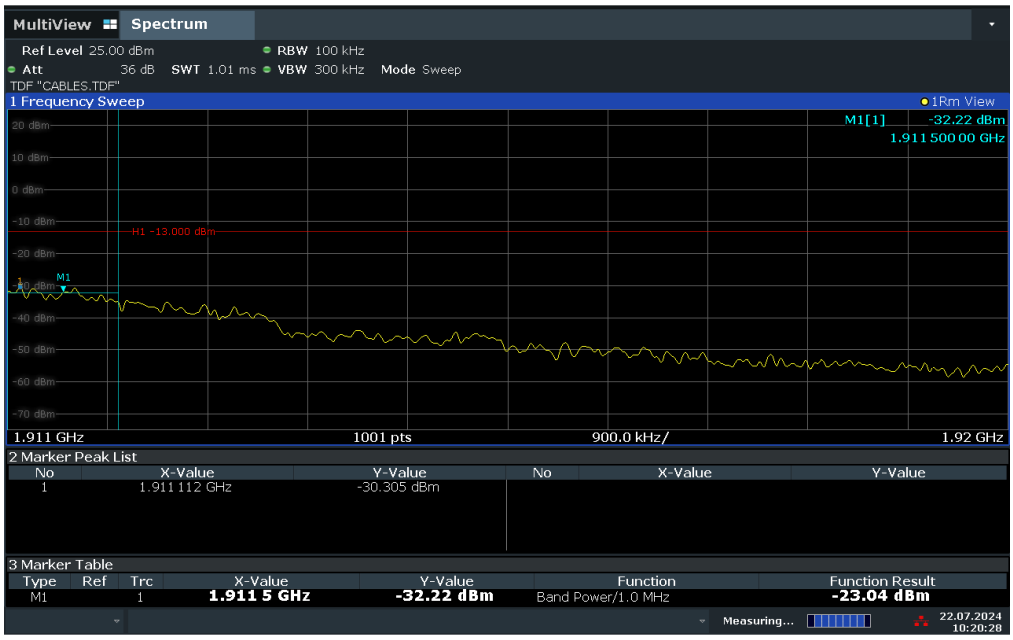
ACLRResults



10:18:25 22.07.2024

Plot 7-85. Upper Band Edge Plot (WCDMA PCS – Ch. 9538)

ACLRResults



10:20:29 22.07.2024

Plot 7-86. Extended Upper Band Edge Plot (WCDMA PCS – Ch. 9538)

7.5 Peak-Average Ratio

§24.232(d)

Test Overview and Limit

A peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

The peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 5.7.1

Test Settings

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW ≥ OBW or specified reference bandwidth
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

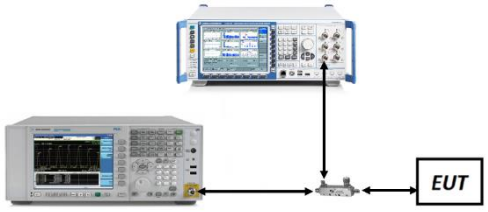


Figure 7-4. Test Instrument & Measurement Setup

Test Notes

None.

LTE Band 25

22:06:45 23.04.2024

Plot 7-87. PAR Plot (LTE Band 25 - 1.4MHz QPSK - Full RB Configuration)

22:08:17 23.04.2024

Plot 7-88. PAR Plot (LTE Band 25 - 1.4MHz 16-QAM - Full RB Configuration)

22:09:36 23.04.2024

Plot 7-89. PAR Plot (LTE Band 25 - 3MHz QPSK - Full RB Configuration)

22:10:58 23.04.2024

Plot 7-90. PAR Plot (LTE Band 25 - 3MHz 16-QAM - Full RB Configuration)

22:12:16 23.04.2024

Plot 7-91. PAR Plot (LTE Band 25 - 5MHz QPSK - Full RB Configuration)

22:13:35 23.04.2024

Plot 7-92. PAR Plot (LTE Band 25 - 5MHz 16-QAM - Full RB Configuration)

22:14:53 23.04.2024

Plot 7-93. PAR Plot (LTE Band 25 - 10MHz QPSK - Full RB Configuration)

22:16:12 23.04.2024

Plot 7-94. PAR Plot (LTE Band 25 - 10MHz 16-QAM - Full RB Configuration)

22:17:31 23.04.2024

Plot 7-95. PAR Plot (LTE Band 25 - 15MHz QPSK - Full RB Configuration)

22:18:50 23.04.2024

Plot 7-96. PAR Plot (LTE Band 25 - 15MHz 16-QAM - Full RB Configuration)

22:20:10 23.04.2024

Plot 7-97. PAR Plot (LTE Band 25 - 20MHz QPSK - Full RB Configuration)

22:21:29 23.04.2024

Plot 7-98. PAR Plot (LTE Band 25 - 20MHz 16-QAM - Full RB Configuration)

LTE Band 2

21:50:27 23.04.2024

Plot 7-99. PAR Plot (LTE Band 2 - 1.4MHz QPSK - Full RB Configuration)

21:51:59 23.04.2024

Plot 7-100. PAR Plot (LTE Band 2 - 1.4MHz 16-QAM - Full RB Configuration)

21:53:17 23.04.2024

Plot 7-101. PAR Plot (LTE Band 2 - 3MHz QPSK - Full RB Configuration)

21:54:35 23.04.2024

Plot 7-102. PAR Plot (LTE Band 2 - 3MHz 16-QAM - Full RB Configuration)

21:55:53 23.04.2024

Plot 7-103. PAR Plot (LTE Band 2 - 5MHz QPSK - Full RB Configuration)

21:57:16 23.04.2024

Plot 7-104. PAR Plot (LTE Band 2 - 5MHz 16-QAM - Full RB Configuration)

21:58:34 23.04.2024

Plot 7-105. PAR Plot (LTE Band 2 - 10MHz QPSK - Full RB Configuration)

21:59:52 23.04.2024

Plot 7-106. PAR Plot (LTE Band 2 - 10MHz 16-QAM - Full RB Configuration)

22:01:16 23.04.2024

Plot 7-107. PAR Plot (LTE Band 2 - 15MHz QPSK - Full RB Configuration)

22:02:34 23.04.2024

Plot 7-108. PAR Plot (LTE Band 2 - 15MHz 16-QAM - Full RB Configuration)

22:03:53 23.04.2024

Plot 7-109. PAR Plot (LTE Band 2 - 20MHz QPSK - Full RB Configuration)

22:05:12 23.04.2024

Plot 7-110. PAR Plot (LTE Band 2 - 20MHz 16-QAM - Full RB Configuration)

WCDMA PCS

Plot 7-111. PAR Plot (WCDMA, Ch. 9400)

7.6 Radiated Power (EIRP)

§24.232(c)

Test Overview

Equivalent Isotropic Radiated Power (EIRP) measurements are calculated by adding highest antenna gain to maximum measured conducted output power. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.2.1
ANSI C63.26-2015 – Section 5.2.5.5

Test Settings

The relevant equation for determining the EIRP from the conducted RF output power measured is:

EIRP = PMeas – LC + GT

Where:

EIRP = Equivalent Isotropic Radiated Power (expressed in the same units as PMeas, typically dBW or dBm)

PMeas = measured transmitter output power or PSD, in dBW or dBm

LC = signal attenuation in the connecting cable between the transmitter and antenna in dB

GT = gain of the transmitting antenna, in dBi (EIRP)

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

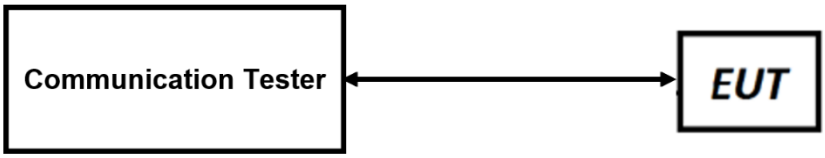


Figure 7-5. EIRP Measurement Setup

Test Notes

1. The EUT was tested in all possible test configurations. The worst case emissions are reported with the EUT modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

2. This unit was tested with its standard battery.

3. The Level (dBm) readings in the table were taken with a correction table loaded into the base station simulator. The correction table was used to account for the signal attenuation in the connecting cable between the transmitter and antenna.

4. The Ant. Gains (GT) are listed in dBi.

5. This device employs UMTS technology with WCDMA (AMR/RMC) and HSDPA capabilities. The EUT was tested under all configurations and the highest power is reported in WCDMA mode with HSDPA Inactive at 12.2 kbps RMC and TPC bits all set to “1”.

7.6.1 Antenna FCM – EIRP

LTE Band 25

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
1.4 MHz	QPSK	1850.7	-13.10	1 / 5	24.22	**11.12**	12.942	33.01	-21.89
		1882.5	-13.10	1 / 5	24.17	11.07	12.794	33.01	-21.94
		1914.3	-13.10	1 / 0	24.17	11.07	12.794	33.01	-21.94
	16-QAM	1882.5	-13.10	1 / 3	23.71	10.61	11.508	33.01	-22.40
3 MHz	QPSK	1851.5	-13.10	1 / 7	24.25	**11.15**	13.032	33.01	-21.86
		1882.5	-13.10	1 / 7	24.18	11.08	12.823	33.01	-21.93
		1913.5	-13.10	1 / 7	23.99	10.89	12.274	33.01	-22.12
	16-QAM	1851.5	-13.10	1 / 7	23.74	10.64	11.588	33.01	-22.37
5 MHz	QPSK	1852.5	-13.10	1 / 0	24.41	**11.31**	13.521	33.01	-21.70
		1882.5	-13.10	1 / 0	24.35	11.25	13.335	33.01	-21.76
		1912.5	-13.10	1 / 24	24.03	10.93	12.388	33.01	-22.08
	16-QAM	1852.5	-13.10	1 / 0	23.90	10.80	12.023	33.01	-22.21
10 MHz	QPSK	1855.0	-13.10	1 / 0	24.21	**11.11**	12.912	33.01	-21.90
		1882.5	-13.10	1 / 0	24.19	11.09	12.853	33.01	-21.92
		1910.0	-13.10	1 / 0	24.12	11.02	12.647	33.01	-21.99
	16-QAM	1882.5	-13.10	1 / 0	23.85	10.75	11.885	33.01	-22.26
15 MHz	QPSK	1857.5	-13.10	1 / 37	24.43	**11.33**	13.583	33.01	-21.68
		1882.5	-13.10	1 / 0	24.20	11.10	12.882	33.01	-21.91
		1907.5	-13.10	1 / 37	24.14	11.04	12.706	33.01	-21.97
	16-QAM	1882.5	-13.10	1 / 37	23.79	10.69	11.722	33.01	-22.32
20 MHz	QPSK	1860.0	-13.10	1 / 99	24.39	**11.29**	13.459	33.01	-21.72
		1882.5	-13.10	1 / 0	24.18	11.08	12.823	33.01	-21.93
		1905.0	-13.10	1 / 50	24.31	11.21	13.213	33.01	-21.80
	16-QAM	1905.0	-13.10	1 / 50	23.76	10.66	11.641	33.01	-22.35

Table 7-2. Antenna FCM EIRP Data (LTE Band 25)

LTE Band 2

Bandwidth	Mod.	Frequency [MHz]	Ant. Gain [dBi]	RB Size/Offset	Conducted Power [dBm]	ERP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
1.4 MHz	QPSK	1850.7	-13.10	1 / 5	24.25	**11.15**	13.032	33.01	-21.86
		1880.0	-13.10	1 / 0	24.21	11.11	12.912	33.01	-21.90
		1909.3	-13.10	1 / 0	24.23	11.13	12.972	33.01	-21.88
	16-QAM	1880.0	-13.10	1 / 3	23.79	10.69	11.722	33.01	-22.32
3 MHz	QPSK	1851.5	-13.10	1 / 7	24.26	**11.16**	13.062	33.01	-21.85
		1880.0	-13.10	1 / 7	24.20	11.10	12.882	33.01	-21.91
		1908.5	-13.10	1 / 7	24.10	11.00	12.589	33.01	-22.01
	16-QAM	1851.5	-13.10	1 / 7	23.73	10.63	11.561	33.01	-22.38
5 MHz	QPSK	1852.5	-13.10	1 / 0	24.42	**11.32**	13.552	33.01	-21.69
		1880.0	-13.10	1 / 0	24.40	11.30	13.490	33.01	-21.71
		1907.5	-13.10	1 / 0	24.20	11.10	12.882	33.01	-21.91
	16-QAM	1852.5	-13.10	1 / 24	23.82	10.72	11.803	33.01	-22.29
10 MHz	QPSK	1855.0	-13.10	1 / 0	24.21	**11.11**	12.912	33.01	-21.90
		1880.0	-13.10	1 / 0	24.21	**11.11**	12.912	33.01	-21.90
		1905.0	-13.10	1 / 25	24.11	11.01	12.618	33.01	-22.00
	16-QAM	1880.0	-13.10	1 / 0	23.80	10.70	11.749	33.01	-22.31
15 MHz	QPSK	1857.5	-13.10	1 / 0	24.44	**11.34**	13.614	33.01	-21.67
		1880.0	-13.10	1 / 0	24.25	11.15	13.032	33.01	-21.86
		1902.5	-13.10	1 / 37	24.14	11.04	12.706	33.01	-21.97
	16-QAM	1880.0	-13.10	1 / 0	23.80	10.70	11.749	33.01	-22.31
20 MHz	QPSK	1860.0	-13.10	1 / 99	24.43	**11.33**	13.583	33.01	-21.68
		1880.0	-13.10	1 / 0	24.20	11.10	12.882	33.01	-21.91
		1900.0	-13.10	1 / 99	24.26	11.16	13.062	33.01	-21.85
	16-QAM	1860.0	-13.10	1 / 0	23.80	10.70	11.749	33.01	-22.31

Table 7-3. Antenna FCM EIRP Data (LTE Band 2)

WCDMA PCS

Frequency [MHz]	Mode	Conducted Power [dBm]	Ant. Gain [dBi]	EIRP [dBm]	EIRP [mW]	EIRP Limit [dBm]	Margin [dB]
1852.40	WCDMA1900	23.53	-13.10	10.43	11.041	33.01	-22.58
1880.00	WCDMA1900	23.65	-13.10	**10.55**	**11.350**	33.01	-22.46
1907.60	WCDMA1900	23.62	-13.10	10.52	11.272	33.01	-22.49

Table 7-4. Antenna FCM EIRP Data (WCDMA PCS)

7.7 Radiated Spurious Emissions

§2.1053, 24.238(a)

Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in KDB 971168 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using horizontally and vertically polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as peak measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

Test Procedures Used

KDB 971168 D01 v03r01 – Section 5.8

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

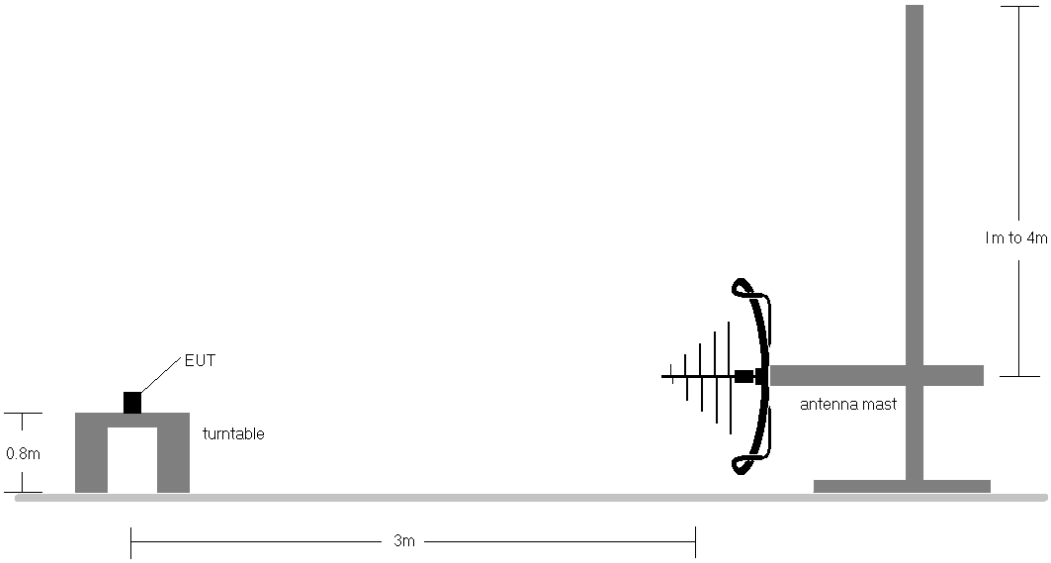


Figure 7-6. Test Instrument & Measurement Setup < 1GHz

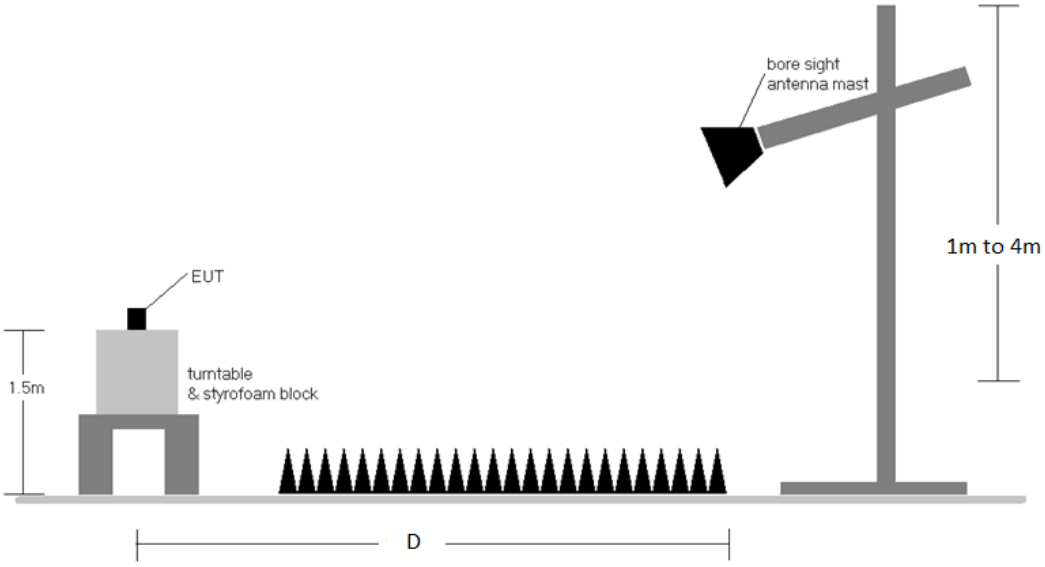


Figure 7-7. Test Instrument & Measurement Setup >1 GHz

Test Notes

1. Field strengths are calculated using the Measurement quantity conversions in KDB 971168 Section 5.8.4.
   a. E(dBµV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m)
   b. EIRP (dBm) = E(dBµV/m) + 20logD – 104.8; where D is the measurement distance in meters.

2. This device employs UMTS technology with WCDMA (AMR/RMC) and HSDPA capabilities. The EUT was tested under all configurations and the highest power is reported in WCDMA mode with HSDPA Inactive at 12.2 kbps RMC and TPC bits all set to "1".

3. The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.

4. This unit was tested with its standard battery.

5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.

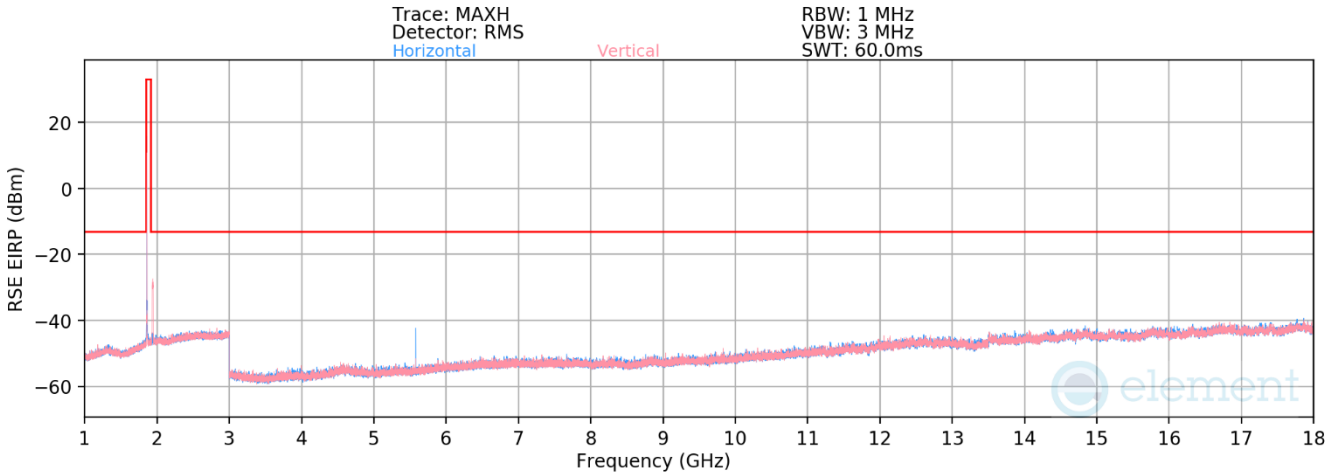
6. D is the measurement test distance and emissions 1-18GHz were measured at a 3 meters test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.

7. No significant emissions were found for below 1GHz and Above 18GHz measurement.

8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

7.7.1 Antenna FCM – Radiated Spurious Emission Measurement

LTE Band 25/2



Plot 7-112. Radiated Spurious Plot (LTE Band 25/2)

Bandwidth (MHz):	20
Frequency (MHz):	1860.0
RB / Offset:	1 / 50

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3720.0	H	-	-	-78.23	4.84	33.61	-61.64	-13.00	-48.64
5580.0	H	276	138	-68.88	8.06	46.18	-49.08	-13.00	-36.08
7440.0	H	-	-	-80.32	9.91	36.59	-58.66	-13.00	-45.66
9300.0	H	-	-	-79.82	10.93	38.11	-57.15	-13.00	-44.15
11160.0	H	-	-	-81.52	15.37	40.85	-54.41	-13.00	-41.41

Table 7-5. Antenna FCM Radiated Spurious Data (LTE Band 25/2 – Low Channel)

Bandwidth (MHz):	20
Frequency (MHz):	1882.5
RB / Offset:	1 / 50

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3765.0	H	-	-	-78.59	5.07	33.48	-61.78	-13.00	-48.78
5647.5	H	113	123	-75.98	8.18	39.20	-56.06	-13.00	-43.06
7530.0	H	-	-	-80.31	9.99	36.68	-58.58	-13.00	-45.58
9412.5	H	-	-	-79.88	11.28	38.40	-56.85	-13.00	-43.85
11295.0	H	-	-	-82.20	16.08	40.88	-54.38	-13.00	-41.38

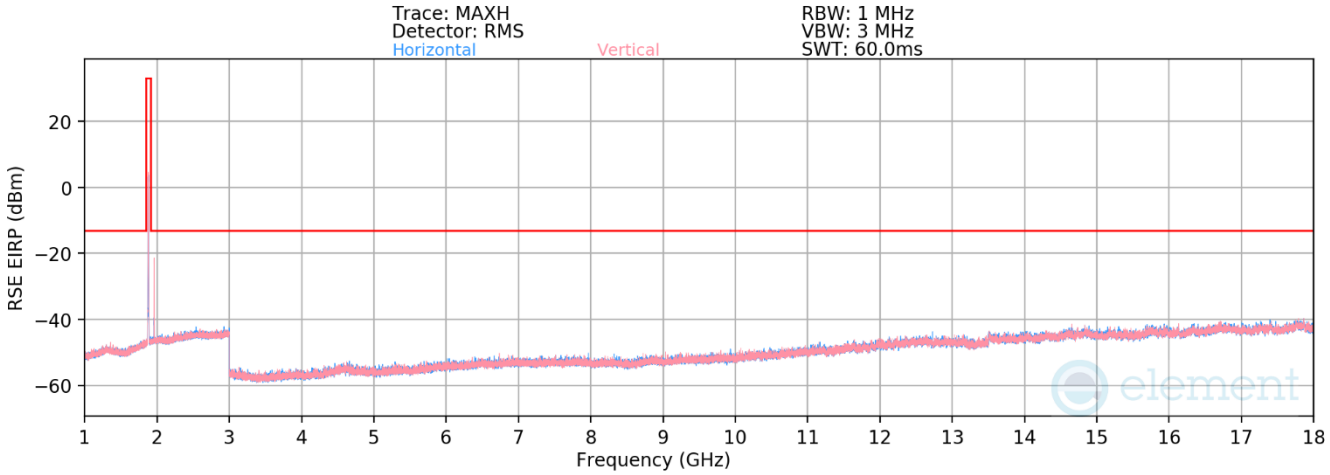
Table 7-6. Antenna FCM Radiated Spurious Data (LTE Band 25/2 – Mid Channel)

Bandwidth (MHz):	20
Frequency (MHz):	1905.0
RB / Offset:	1 / 50

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3810.00	H	-	-	-78.75	5.32	33.57	-61.68	-13.00	-48.68
5715.00	H	355	278	-78.30	8.43	37.14	-58.12	-13.00	-45.12
7620.00	H	-	-	-80.79	10.35	36.56	-58.70	-13.00	-45.70
9525.00	H	-	-	-80.52	11.44	37.92	-57.34	-13.00	-44.34
11430.00	H	-	-	-81.76	15.08	40.32	-54.94	-13.00	-41.94

Table 7-7. Antenna FCM Radiated Spurious Data (LTE Band 25/2 – High Channel)

WCDMA PCS



Plot 7-113. Radiated Spurious Plot (WCDMA PCS)

Mode:	WCDMA RMC
Channel:	9262
Frequency (MHz):	1852.4

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3704.8	V	-	-	-78.81	4.51	32.70	-62.56	-13.00	-49.56
5557.2	V	-	-	-80.63	7.89	34.26	-61.00	-13.00	-48.00
7409.6	V	-	-	-80.56	10.39	36.83	-58.43	-13.00	-45.43

Table 7-8. Antenna FCM Radiated Spurious Data (WCDMA PCS – Low Channel)

Mode:	WCDMA RMC
Channel:	9400
Frequency (MHz):	1880

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3760.0	V	-	-	-79.06	4.90	32.84	-62.42	-13.00	-49.42
5640.0	V	-	-	-80.52	8.24	34.72	-60.54	-13.00	-47.54
7520.0	V	-	-	-80.49	9.91	36.42	-58.84	-13.00	-45.84

Table 7-9. Antenna FCM Radiated Spurious Data (WCDMA PCS – Mid Channel)

Mode:	WCDMA RMC
Channel:	9538
Frequency (MHz):	1907.6

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
3815.2	V	-	-	-78.99	5.16	33.17	-62.09	-13.00	-49.09
5722.8	V	-	-	-80.51	8.55	35.04	-60.22	-13.00	-47.22
7630.4	V	-	-	-80.95	10.21	36.26	-59.00	-13.00	-46.00

Table 7-10. Antenna FCM Radiated Spurious Data (WCDMA PCS – High Channel)

7.8 Frequency Stability / Temperature Variation

§2.1055, §24.235

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015 and TIA-603-E-2016. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

For Part 24 the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test Procedure Used

ANSI C63.26-2015

TIA-603-E-2016

Test Settings

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

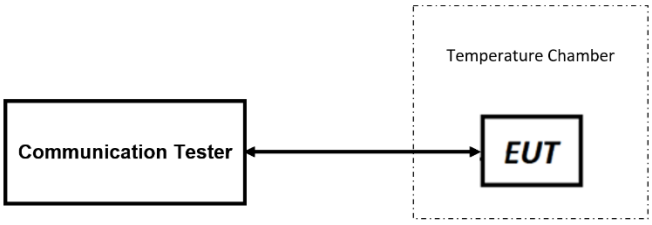


Figure 7-8. Test Instrument & Measurement Setup

Test Notes

None.

Frequency Stability / Temperature Variation

LTE B25/2	
Operating Band Lower Boundary (GHz)	1.850
Ref. Voltage (VDC):	3.80

Voltage (%)	Power (VDC)	Temp (°C)	Measured Freq. (GHz)	Freq. Delta from Operating Range (GHz)
100 %	3.80	- 30	1.8505004	-0.0005004
		- 20	1.8505386	-0.0005386
		- 10	1.8505185	-0.0005185
		0	1.8505308	-0.0005308
		+ 10	1.8505477	-0.0005477
		+ 20 (Ref)	1.8505535	-0.0005535
		+ 30	1.8505256	-0.0005256
		+ 40	1.8505133	-0.0005133
		+ 50	1.8504615	-0.0004615
Battery Endpoint	3.40	+ 20	1.8505388	-0.0005388

Table 7-11. LTE Band 25/2 Lower Boundary Frequency Stability Data

LTE B25/2	
Operating Band Upper Boundary (GHz)	1.915
Ref. Voltage (VDC):	3.80

Voltage (%)	Power (VDC)	Temp (°C)	Measured Freq. (GHz)	Freq. Delta from Operating Range (GHz)
100 %	3.80	- 30	1.9143864	-0.0006136
		- 20	1.9143855	-0.0006145
		- 10	1.9143757	-0.0006243
		0	1.9144385	-0.0005616
		+ 10	1.9144334	-0.0005666
		+ 20 (Ref)	1.9143527	-0.0006473
		+ 30	1.9143550	-0.0006450
		+ 40	1.9144360	-0.0005640
		+ 50	1.9144299	-0.0005701
Battery Endpoint	3.40	+ 20	1.9143574	-0.0006426

Table 7-12. LTE Band 25/2 Upper Boundary Frequency Stability Data

WCDMA PCS

WCDMA PCS				
	Operating Band Lower Boundary (GHz)		1.850	
	Ref. Voltage (VDC):		3.80	
Voltage (%)	**Power (VDC)**	**Temp (°C)**	**Measured Freq. (GHz)**	**Freq. Delta from Operating Range (GHz)**
100 %	3.80	- 30	1.8503507	-0.0003507
		- 20	1.8503550	-0.0003550
		- 10	1.8503502	-0.0003502
		0	1.8503449	-0.0003449
		+ 10	1.8503504	-0.0003504
		+ 20 (Ref)	1.8503438	-0.0003438
		+ 30	1.8503442	-0.0003442
		+ 40	1.8503457	-0.0003457
		+ 50	1.8503489	-0.0003489
Battery Endpoint	3.40	+ 20	1.8503480	-0.0003480

Table 7-13. WCDMA PCS Lower Boundary Frequency Stability Data

WCDMA PCS				
	Operating Band Upper Boundary (GHz)		1.910	
	Ref. Voltage (VDC):		3.80	
Voltage (%)	**Power (VDC)**	**Temp (°C)**	**Measured Freq. (GHz)**	**Freq. Delta from Operating Range (GHz)**
100 %	3.80	- 30	1.9096991	-0.0003009
		- 20	1.9096591	-0.0003409
		- 10	1.9096582	-0.0003418
		0	1.9096602	-0.0003398
		+ 10	1.9096573	-0.0003427
		+ 20 (Ref)	1.9096543	-0.0003457
		+ 30	1.9096504	-0.0003496
		+ 40	1.9096583	-0.0003417
		+ 50	1.9096604	-0.0003396
Battery Endpoint	3.40	+ 20	1.9096598	-0.0003402

Table 7-14. WCDMA PCS Upper Boundary Frequency Stability Data

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the Apple **Watch FCC ID: BCG-A3001** complies with all the requirements of Part 24 of the FCC rules.