DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29507456

ISED CABid: ES1909
Lab. Company Number: 4621A

Test Report No:
77535RRF.001A1

Test Report
USA FCC Part 22
CANADA RSS-132

(*) Identification of item tested	nRF91
(*) Trademark	nRF91
(*) Model and/or type reference	nRF9151
Other identification of the product	FCC ID: 2ANPO00nRF9151 IC: 24529-NRF9151
(*) Features	LTE Cat-M1, LTE NB1&NB2 HW version: nRF9151 LACA AA SW version: mfw_nrf91x1_2.0.0
Applicant	NORDIC SEMICONDUCTOR ASA Otto Nielsens Veg 12, 7052 Trondheim, Norway
Test method requested, standard	USA FCC Part 22 (10-1-22 Edition). CANADA RSS-132 Issue 4, Jan. 2023. ANSI C63.26-2015. KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	José Manuel Gómez Galván EMC Consumer & RF Lab. Manager Firmado digitalmente por 53680346W JOSE MANUEL GOMEZ (C:A29507456)
Date of issue	2024-04-04
Report template No	FDT08_24 (*) "Data provided by the client"

Index

Competences and guarantees

DEKRA Testing and Certification is a testing laboratory accredited by the National Accreditation Body (ENAC - Entidad Nacional de Acreditación) to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory, CABid: ES1909, Company Number: 4621A, with the appropriate scope of accreditation that covers the performed tests in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

DEKRA Testing and Certification is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample model nRF9151 DK is a Development Kit that has nRF9151 IOT Module and GPS. The nRF9151 is capable of LTE Cat-M1, Cat-NB1&NB2 and GPS. The Development kit contains antennas for cellular and GPS.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: The client.

Id	Control Number	Description	Model	HW Version	Serial Nº	Date of Reception	Application
S/01	77535C/025_.1	nRF91	nRF9151	nRF9151 LACA CB0	1051231716	2024-01-08	Element Under Test
S/01	77535C/022_.1	SMA Cable	-	-	-	2024-01-08	Auxiliary Element
S/01	77535C/013_.1	USB Cable	-	-	-	2024-01-08	Auxiliary Element
S/02	77535C/026_.1	nRF91	nRF9151	nRF9151 LACA CB0	1051261483	2024-01-08	Element Under Test
S/02	77535C/012_.1	USB Cable	-	-	-	2023-12-15	Auxiliary Element
S/03	77535C/027_.1	nRF91	nRF9151	nRF9151 LACA CB0	1051275581	2024-01-08	Element Under Test
S/03	77535C/023_.1	SMA Cable	-	-	-	2024-01-08	Auxiliary Element
S/03	77535C/015_.1	USB Cable	-	-	-	2024-01-08	Auxiliary Element

Notes referenced to samples during the project:

Id	Type
S/01	Conducted tests.
S/03	Conducted tests: but the RF Output Power tests.
S/02	Radiated tests.

Test sample description

Ports……:	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)		
	LTE RF	2	☒	☒	☐		
	GPS	2	☐	☐	☐		
Supplementary information to the ports……:	-						
Rated power supply ..... :	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 3.0-5.5V, nominal 3.8V					
	☐	DC:					
Rated Power..... :	1W						
Clock frequencies..... :	32kHz, 32MHz						

Other parameters ..... :	Temperature range: -40C..+85C		
Software version..... :	mfw_nrf91x1_2.0.0		
Hardware version ..... :	nRF9151 LACA AA		
Dimensions in cm (W x H x D) ... :	155x64x9mm		
Mounting position ..... :	☒ Table top equipment		
	☐ Wall/Ceiling mounted equipment		
	☐ Floor standing equipment		
	☐ Hand-held equipment		
	☐ Other:		
Modules/parts..... :	Module/parts of test item	Type	Manufacturer
	-	-	-
Accessories (not part of the test item) ..... :	Description	Type	Manufacturer
	-	-	-
Documents as provided by the applicant ..... :	Description	File name	Issue date
	-	-	-

(3) Only for Medical Equipment

Identification of the client

NORDIC SEMICONDUCTOR ASA

Otto Nielsens Veg 12, 7052 Trondheim, Norway

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2024-01-08
Date (finish)	2024-02-22

Document history

Report number	Date	Description
77535RRF.001	2024-03-21	First release.
77535RRF.001A1	2024-04-04	Second release. Typos corrected about NB1 and NB2 references. This report replaces and cancels 77535RRF.001.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

In the semi-anechoic chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Ireneo Bibang, Pablo Redondo, Carmen Vázquez, Valentín Andarias, Rafael Fernández.

Used instrumentation:

Control No.	Equipment	Model	Manufacturer	Next Calibration
7760	Digital Multimeter	175	FLUKE	2024-11
6157	Signal and Spectrum Analyzer 10 Hz - 40 GHz	FSV40	ROHDE AND SCHWARZ	2025-01
9227	Wideband Radio Communication Tester	CMW500	ROHDE AND SCHWARZ	2024-07
6254	Attenuator 6 dB 2W DC-26.5 GHz	TWSMAG2	TECHNIWAVE	2024-03
2215	Power Divider DC-25 GHz	5333-104	PICOSECOND PULSE LABS	2024-07
6794	Shielded Room	S101	ETS LINDGREN	N/A
6791	SEMIANECHOIC ABSORBER LINED	FACT 3 200 STP	ETS LINDGREN	N/A
6792	SHIELDED ROOM	S101	ETS LINDGREN	N/A
6666	EMI TEST RECEIVER 2Hz-44GHz	ESW44	ROHDE AND SCHWARZ	2024-03
3541	Hybrid Bilog Antenna 30MHz-6GHz	JB6	SUNOL SCIENCES CORPORATION	2024-11
6021	Attenuator 3 dB, 2W, DC-6GHz	50HN-03	JFW	2025-02
3783	PRE-AMPLIFIER G>30dB 1GHz-18GHz	BLMA 0118-3A	BONN ELEKTRONIK	2025-02
6496	HORN ANTENNA 1-18GHz	BBHA 9120 D	SCHWARZBECK	2026-12
6143	Biconical/Log Antenna 30 MHz - 6 GHz	3142E	ETS LINDGREN	2027-01
4848	SOFTWARE FOR EMC/RF TESTING	EMC32	ROHDE AND SCHWARZ	N/A

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

Appendix A: LTE Cat-M1 Bands 5, 26.

FCC PART 22 / RSS-132 PARAGRAPH		
Requirement – Test case	**Verdict**	**Remark**
FCC 22.913 / RSS-132 5.4: RF Output Power	P	
FCC 2.1047 / RSS-132 5.2: Modulation Characteristics	P	
FCC 22.355 / RSS-132 5.3: Frequency Stability	P	
FCC 2.1049: Occupied Bandwidth	P	
FCC 22.917 / RSS-132 5.5: Spurious Emissions at Antenna Terminals	P	
FCC 22.917 / RSS-132 5.5: Spurious Emissions at Antenna Terminals at Block Edges	P	
FCC 22.917 / RSS-132 5.5: Radiated Emissions	P	
Supplementary information and remarks: None.		

Appendix B: LTE Cat NB2 Bands 5, 26.

FCC PART 22 / RSS-132 PARAGRAPH		
Requirement – Test case	**Verdict**	**Remark**
FCC 22.913 / RSS-132 5.4: RF Output Power	P	
FCC 2.1047 / RSS-132 5.2: Modulation Characteristics	P	
FCC 22.355 / RSS-132 5.3: Frequency Stability	P	
FCC 2.1049: Occupied Bandwidth	P	
FCC 22.917 / RSS-132 5.5: Spurious Emissions at Antenna Terminals	P	
FCC 22.917 / RSS-132 5.5: Spurious Emissions at Antenna Terminals at Block Edges	P	
FCC 22.917 / RSS-132 5.5: Radiated Emissions	P	
Supplementary information and remarks: None.		

Appendix A: Test results for FCC 22 / RSS-132: LTE Cat-M1 Bands 5, 26

INDEX

TEST CONDITIONS

(*): Declared by the Applicant.

POWER SUPPLY (*):

Vnormal: 3.8 Vdc.
Vminimum: 3 Vdc
Vmaximum: 5.5 Vdc

Type of Power Supply: Internal DC.

ANTENNA (*):

Bands	Gain (dBi)	Type of Antenna
LTE Cat-M1 5	+2.7	SMD
LTE Cat-M1 26	+2.7	SMD

TEST FREQUENCIES:

LTE Cat-M1 Band 5. QPSK and 16QAM:

Channel (Frequency MHz)			
BW=1.4 MHz	BW=3 MHz	BW=5 MHz	BW=10 MHz
20407 (824.70)	20415 (825.50)	20425 (826.50)	20450 (829.00)
20525 (836.50)	20525 (836.50)	20525 (836.50)	20525 (836.50)
20643 (848.30)	20635 (847.50)	20625 (846.50)	20600 (844.00)

NOTE: The 824-849 MHz band of the LTE Cat-M1 Band 5 is completely included in the LTE Cat-M1 Band 26, so the LTE Cat-M1 Band 26 channels were tested to give conformity to the assigned block.

LTE Cat-M1 Band 26 sub-band 824-849 MHz. QPSK and 16QAM:

	Channel (Frequency MHz)				
	BW=1.4 MHz	BW=3 MHz	BW=5 MHz	BW=10 MHz	BW=15 MHz
Low	26797 (824.70)	26805 (825.50)	26815 (826.50)	26840 (829.00)	26865 (831.50)
Middle	26915 (836.50)	26915 (836.50)	26915 (836.50)	26915 (836.50)	26915 (836.50)
High	27033 (848.30)	27025 (847.50)	27015 (846.50)	26990 (844.00)	26965 (841.50)

RF Output Power

Limits

* FCC §2.1046 and FCC §22.913. The Effective Radiated Power (E.R.P) of mobile transmitter and auxiliary test transmitter must not exceed 7 Watts (38.45 dBm E.R.P.).

* RSS-132 Issue 4. Clause 5.4. The transmitter output power shall be measured in terms of average power. The equivalent radiated power (e.r.p.) shall not exceed 7 watts for mobile equipment and 3 watts for portable equipment.

The effective isotropic radiated power (e.i.r.p.) shall not exceed the limits specified in SRSP-503 for base station equipment.

In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

Method

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester R&S CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

The peak-to-average power ratio (PAPR) is measured using an attenuator, power splitter and spectrum analyser with a Complementary Cumulative Distribution Function implemented.

The maximum equivalent isotropically radiated power (e.i.r.p.) is calculated by adding the declared maximum antenna gain (dBi).

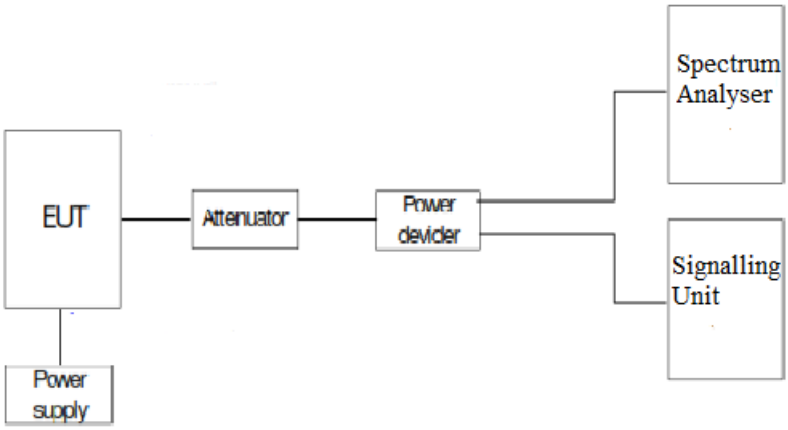
The maximum effective radiated power e.r.p. is calculated from the maximum equivalent isotropically radiated power (e.i.r.p.) by subtracting 2.15 dB:

E.R.P. = E.I.R.P. - 2.15 dB

Test Setup

1. CONDUCTED AVERAGE POWER:

2. PEAK-TO-AVERAGE POWER RATIO (PAPR) and Conducted Average power:


Spectrum Analyser
EUT
Attenuator
Power devicler
Signalling Unit
Power supply

Results

1. CONDUCTED AVERAGE POWER:

LTE Cat-M1 Band 26:

Preliminary measurements determined the worst case of RF Power is BW=3 MHz, Middle Channel, QPSK, RB Size=1, RB Offset=0, Narrowband=0.

BANDWIDTH (MHz)	CHANNEL	FREQUENCY (MHz)	MODULATION	RB SIZE	RB OFFSET	AVERAGE POWER (dBm)
3	Low 26805	825.5	QPSK	1	0	22.07
				1	2	22.08
				1	5	22.07
				3	0	21.36
				3	1	21.36
				3	3	21.36
				6	0	20.29
			16QAM	1	0	21.1
				1	2	21.14
				1	5	21.13
				3	0	20.25
				3	1	20.27
				3	3	20.3
				5	0	20.09
	Middle 26865	831.5	QPSK	1	0	22.52
				1	2	22.44
				1	5	22.46
				3	0	21.5
				3	1	21.5
				3	3	21.51
				6	0	20.46
			16QAM	1	0	21.52
				1	2	21.53
				1	5	21.52
				3	0	20.69
				3	1	20.69
				3	3	20.71
				5	0	20.45
	High 27025	847.5	QPSK	1	0	22.22
				1	2	22.29
				1	5	22.29
				3	0	21.29
				3	1	21.3
				3	3	21.27
				6	0	20.24
			16QAM	1	0	21.43
				1	2	21.37
				1	5	21.35
				3	0	20.5
				3	1	20.5
				3	3	20.51
				5	0	20.28

BW=3 MHz. QPSK:

MAX POWER	QPSK COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
LOW	22.08	2.7	24.78	22.63
MIDDLE	22.52	2.7	25.22	23.07
HIGH	22.29	2.7	24.99	22.84
MAX:	22.52		25.22	23.07

BW=3 MHz. 16QAM:

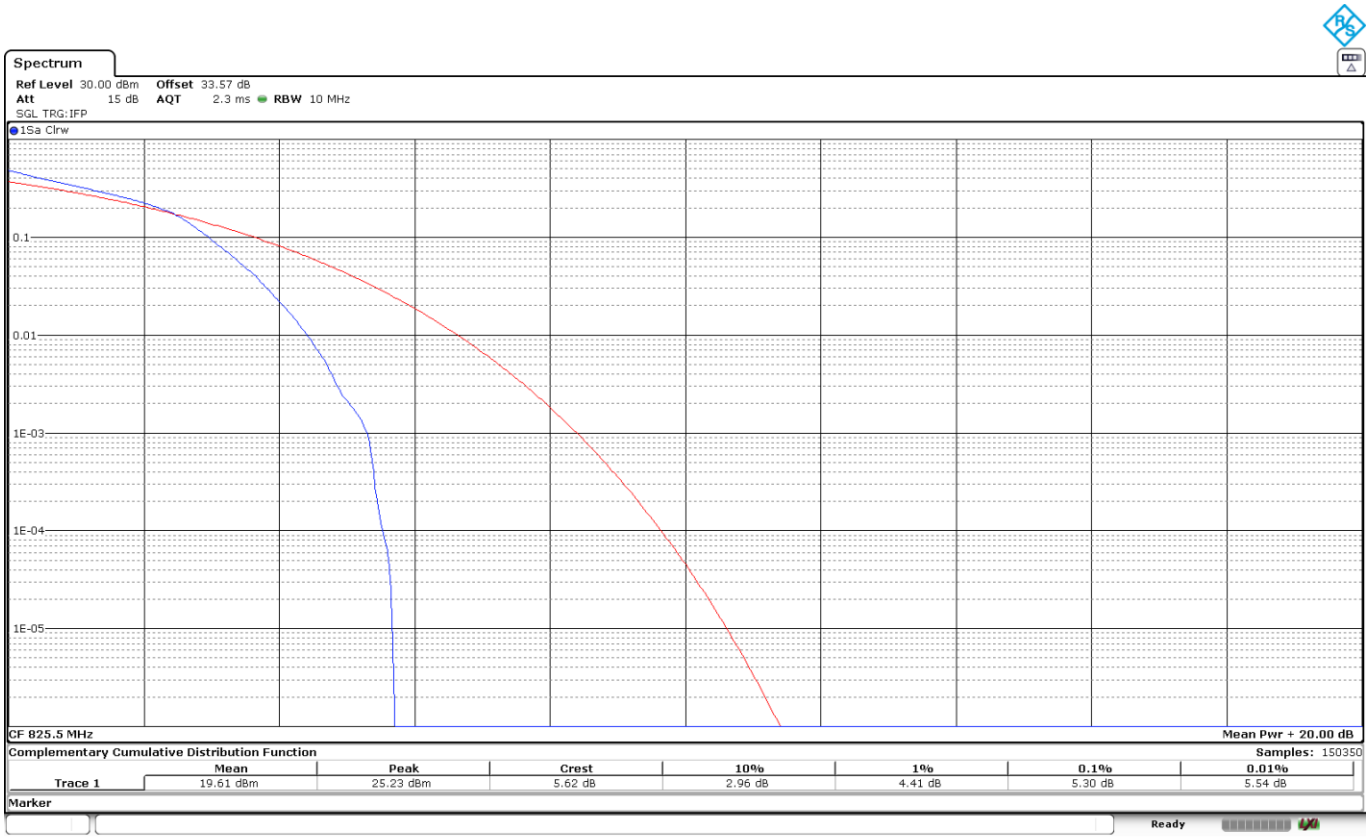
MAX POWER	16QAM COND. POWER AVG (dBm)	ANTENNA GAIN (dBi)	RAD. POWER AVG EIRP (dBm)	RAD. POWER AVG ERP (dBm)
LOW	21.14	2.7	23.84	21.69
MIDDLE	21.53	2.7	24.23	22.08
HIGH	21.43	2.7	24.13	21.98
MAX:	21.53		24.23	22.08

2. PEAK-TO-AVERAGE POWER RATIO (PAPR)

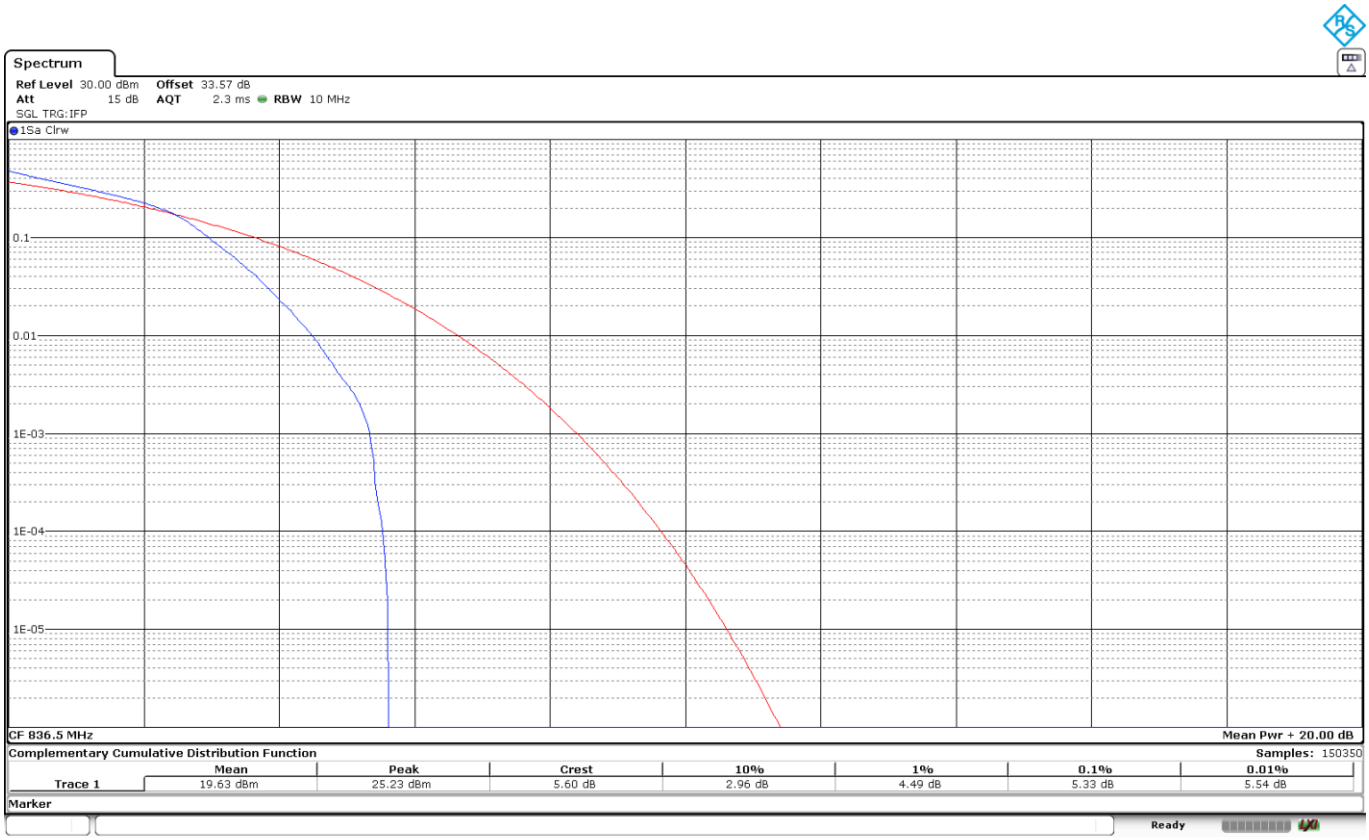
LTE Cat-M1 Band 26:

Preliminary measurements determined the worst-case of PAPR is BW=3 MHz, Middle Channel, 16QAM, RB Size=5, RB Offset=0, Narrowband=0.

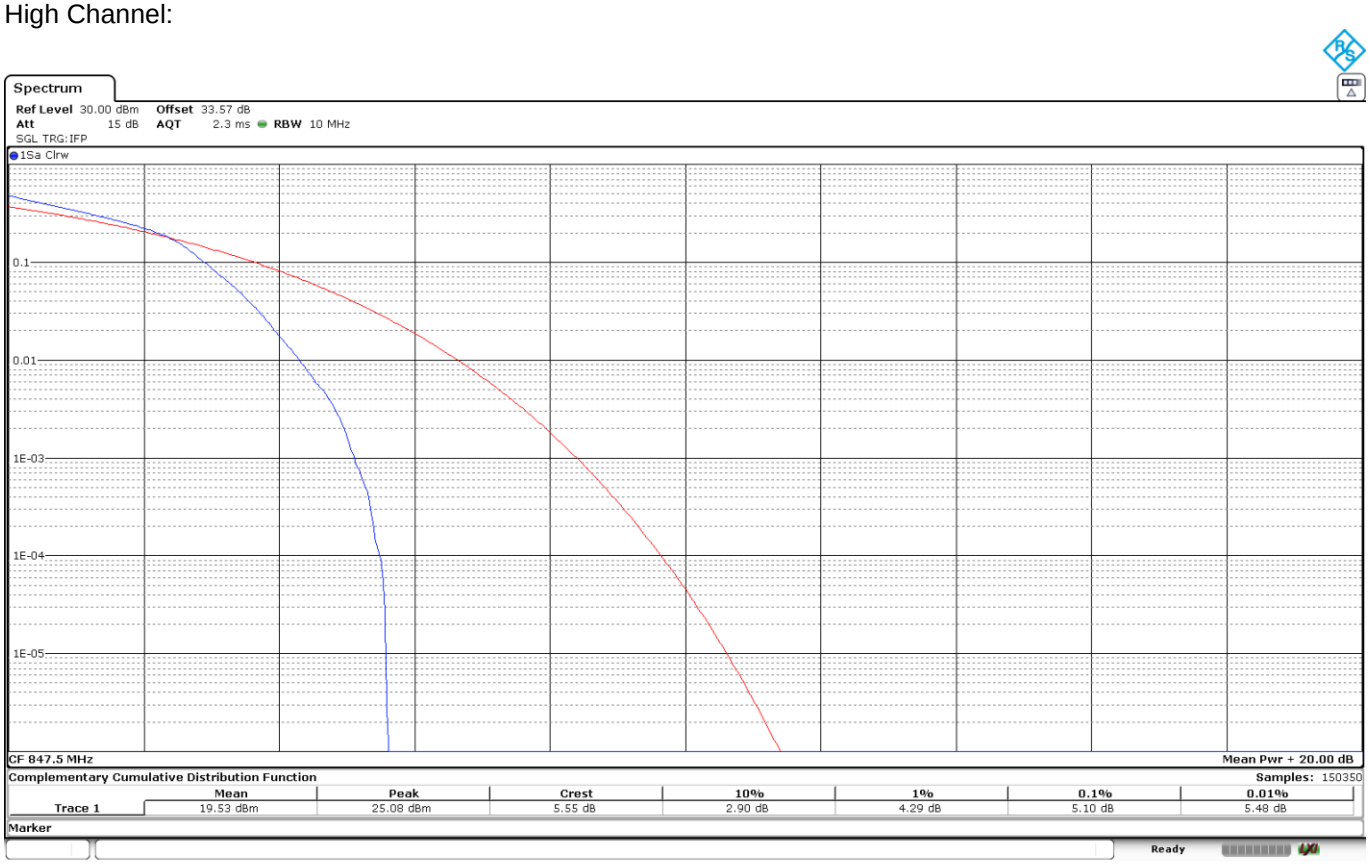
Low Channel:



Middle Channel:



High Channel:



16QAM	Low	Middle	High
PAPR (dB)	5.3	5.33	5.1

Measurement uncertainty (dB) <±1.11

Verdict

Pass

Frequency Stability

Limits

* FCC §2.1055 and §22.355. ±2.5 ppm for mobile stations operating in the range 821 to 896 MHz.

* RSS-132 Issue 4. Clause 5.3. The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within each of the sub-bands when tested at the temperature and supply voltage variations specified in RSS-Gen.

Method

The frequency tolerance measurements over temperature variations were made over the temperature range of -40ºC to +85ºC. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10ºC steps from -40ºC up to +85ºC.
The supply voltage was varied between 85% and 115% of nominal voltage.

Temperature and voltage range of testing has been extended to the maximum and minimum values declared by customer.

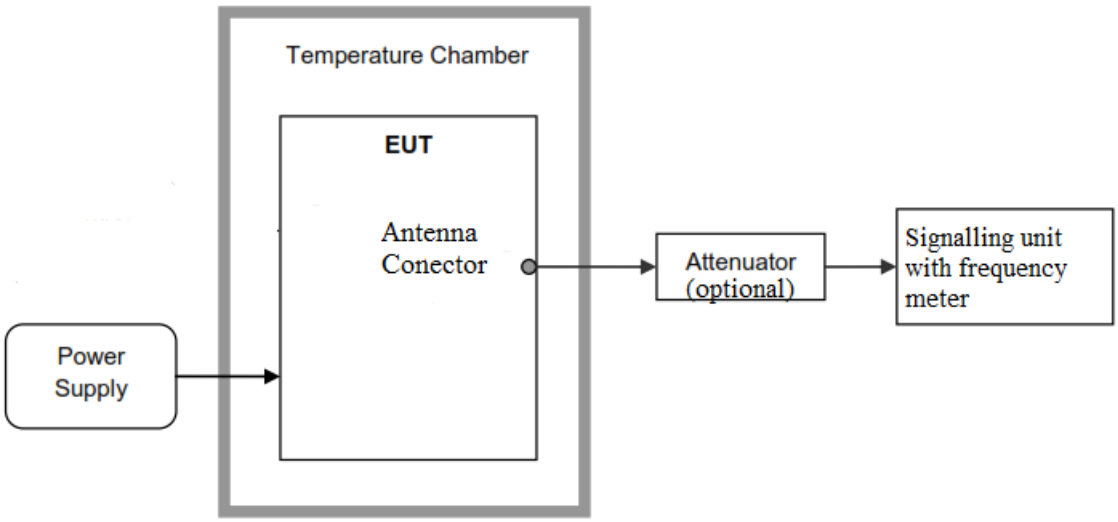
The EUT was set in “Radio Resource Control (RRC) mode” on the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.
The worst-case LTE mode for conducted power was used for the test.

In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the LOW and HIGH channels of operation are identified as fL and fH respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of fL and fH to check that the resulting frequencies remain within the band.

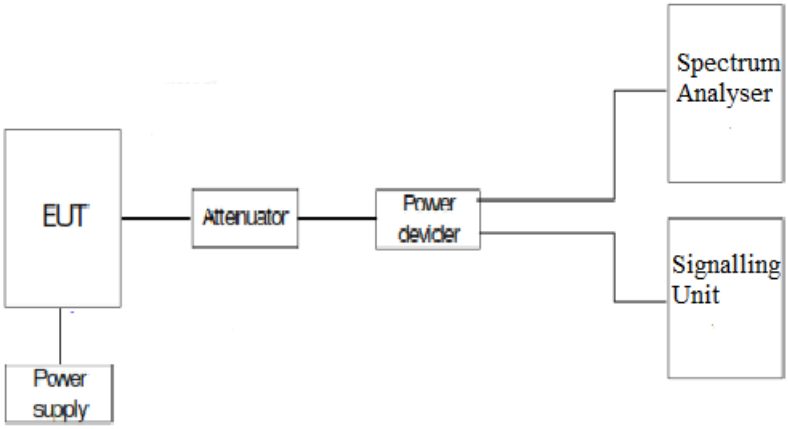
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

Test Setup

Frequency tolerance:



Reference points *f*L and *f*H:



Results

LTE Cat-M1 Band 26:

The worst case modulation in terms of Frequency Stability is BW=1.4 MHz, QPSK.

1. Frequency Tolerance:

- **Frequency Stability over Temperature Variations:**

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
+85	3.55	0.004243873
+80	1.96	0.002343096
+70	-5.91	-0.007065152
+60	-2.35	-0.002809325
+50	-2.06	-0.002462642
+40	0.23	0.000274955
+30	1.47	0.001757322
+20	-0.82	-0.000980275
+10	1.36	0.001625822
0	0.63	0.000753138
-10	2.65	0.003167962
-20	-4.45	-0.005319785
-30	-7.83	-0.00936043
-40	0.67	0.000800956

- **Frequency Stability over Voltage Variations.**

Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	5.5	-2.1	-0.00251046
Vmin	3	6.28	0.007507472

2. Reference Frequency Points fL and fH:

The worst-case frequency offsets added or subtracted per band and bandwidth:

*f*L (MHz)	824.0086
*f*H (MHz)	848.4632

The reference frequency points fL and fH stay within the authorized blocks for the band above.

Measurement uncertainty (Hz) <± 249.55

Verdict
Pass

Modulation Characteristics

Limits

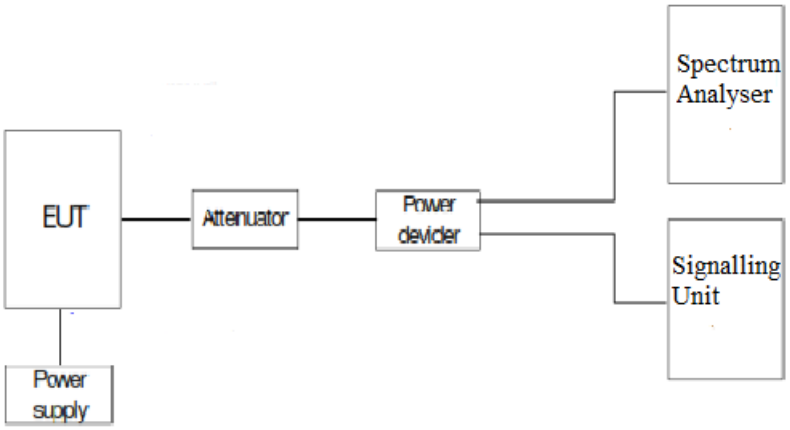
FCC §2.1047.

RSS-132. Clause 5.2: Equipment certified under this standard shall use digital modulation.

Method

For LTE the EUT operates with QPSK and 16QAM modes in which the information is digitized and coded into a bit stream. The RF transmission is multiplexed using *Orthogonal Frequency Division Multiplexing (OFDM)* using different possible arrangement of subcarriers (Resource Blocks RB).

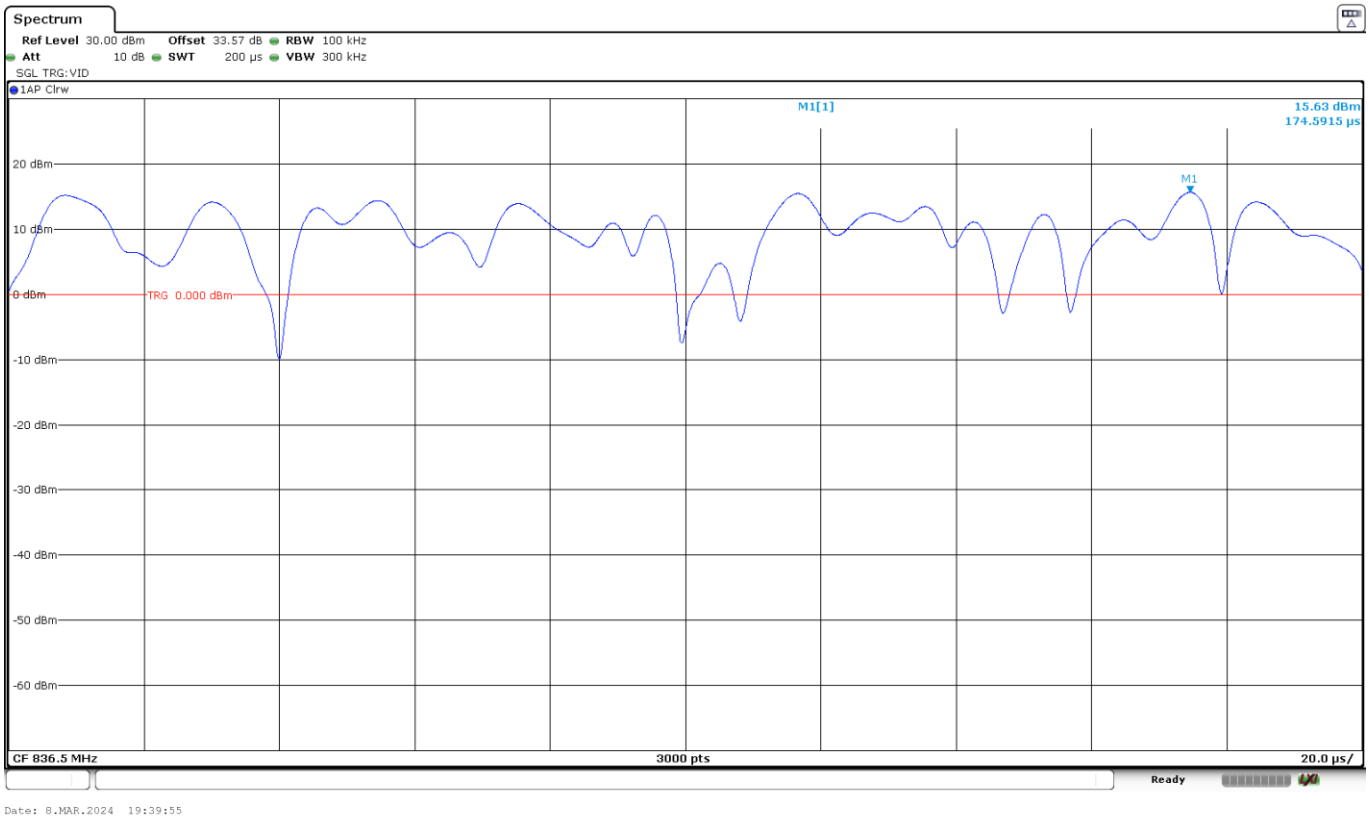
Test Setup



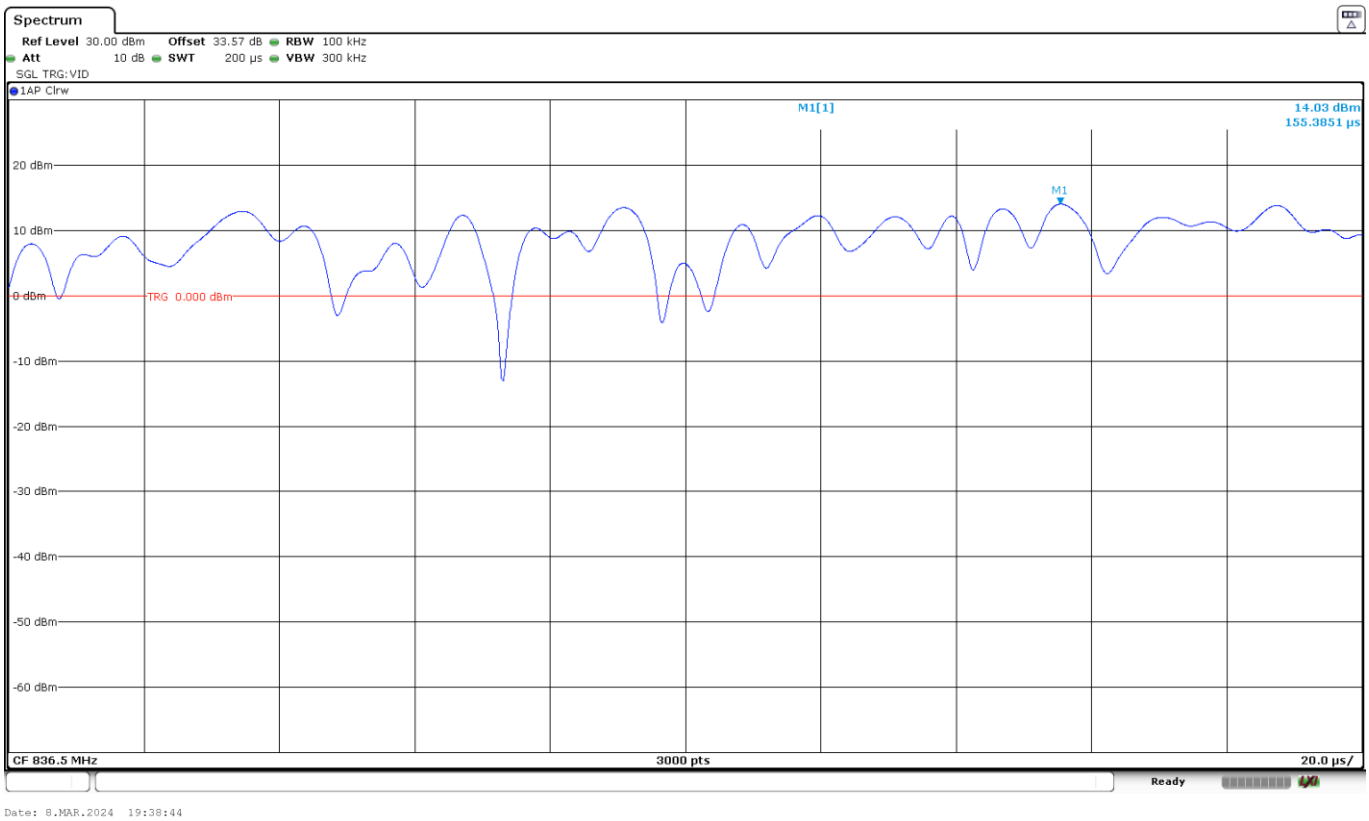
Results

The following plots show the modulation schemes in the EUT.

LTE Cat-M1 Band 26: BW = 1.4 MHz. QPSK. RB Size=1. RB Offset=0.



LTE Cat-M1 Band 26: BW = 1.4 MHz. 16QAM. RB Size=1. RB Offset=0.



Occupied Bandwidth

Limits

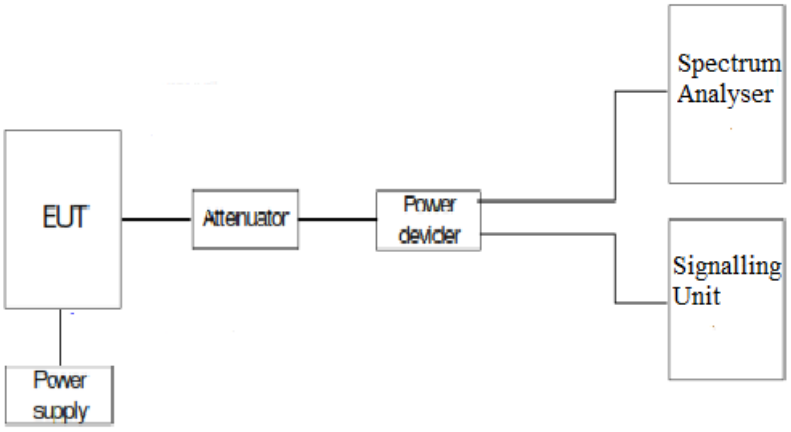
FCC §2.1049. Measurements required: Occupied bandwidth.

RSS-Gen, Clause 6.7.

Method

The occupied bandwidth measurement was performed at the output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

Test Setup



Results

The worst case of occupied bandwidth corresponds to all Resource Blocks (RB) offset 0 regardless either the Narrowband position or the nominal bandwidth selected.

<u>LTE Cat-M1 Band 26</u>:

LTE Cat-M1 Band 26. BW=1.4 MHz. QPSK. RB Size=6. RB Offset=0. Narrowband=0.

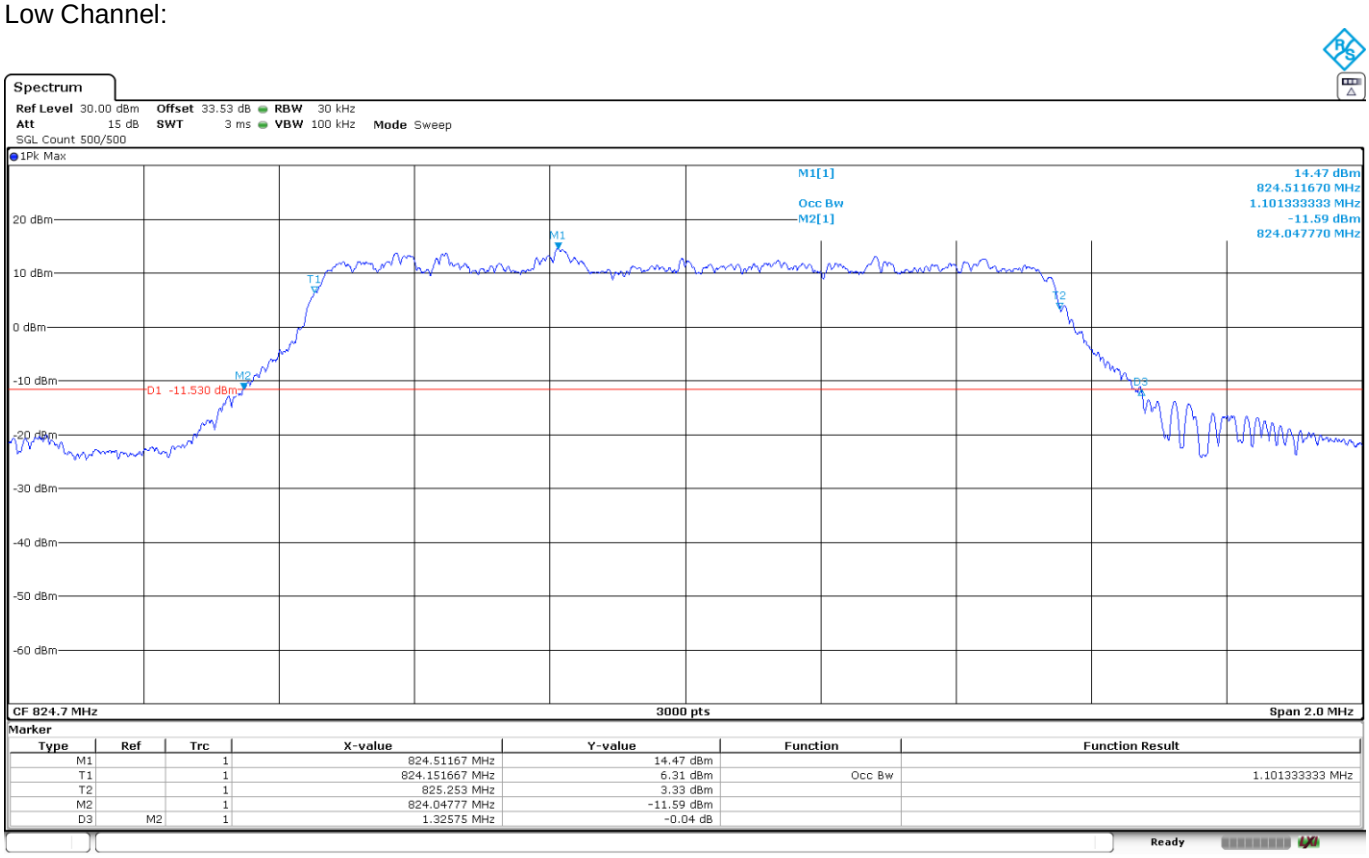
	Low Channel	Middle Channel	High Channel
99% Occupied Bandwidth (MHz)	1.10133	1.10200	1.10333
-26 dBc Bandwidth (MHz)	1.32575	1.32340	1.38540
Measurement uncertainty (kHz)	<±3.75		

LTE Cat-M1 Band 26. BW=1.4 MHz. 16QAM. RB Size=5. RB Offset=0. Narrowband=0.

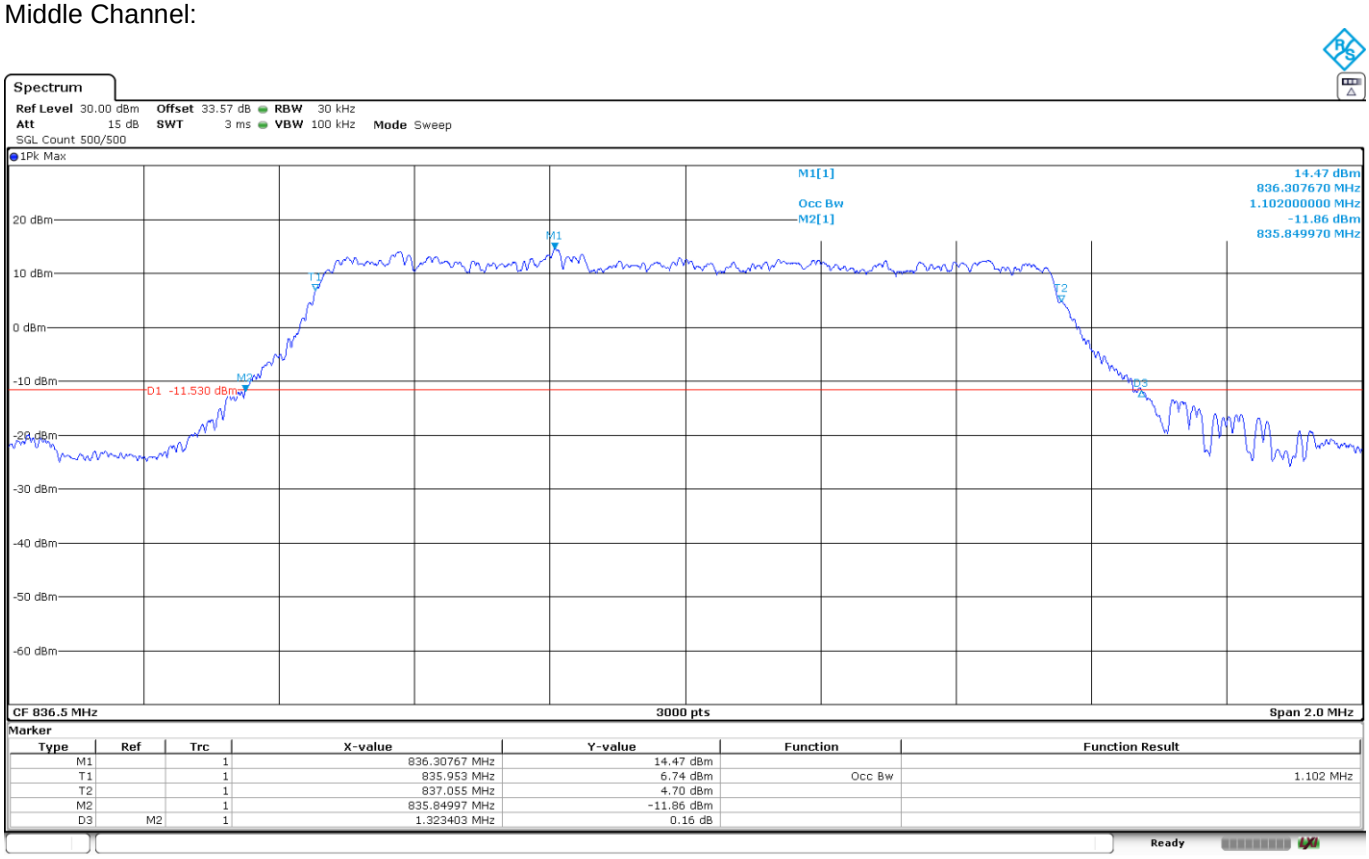
	Low Channel	Middle Channel	High Channel
99% Occupied Bandwidth (MHz)	0.95000	0.93867	0.94600
-26 dBc Bandwidth (MHz)	1.28118	1.28925	1.28848
Measurement uncertainty (kHz)	<±3.75		

LTE Cat-M1 Band 26. BW=1.4 MHz. QPSK. RB Size 6. Offset 0. Narrowband 0.

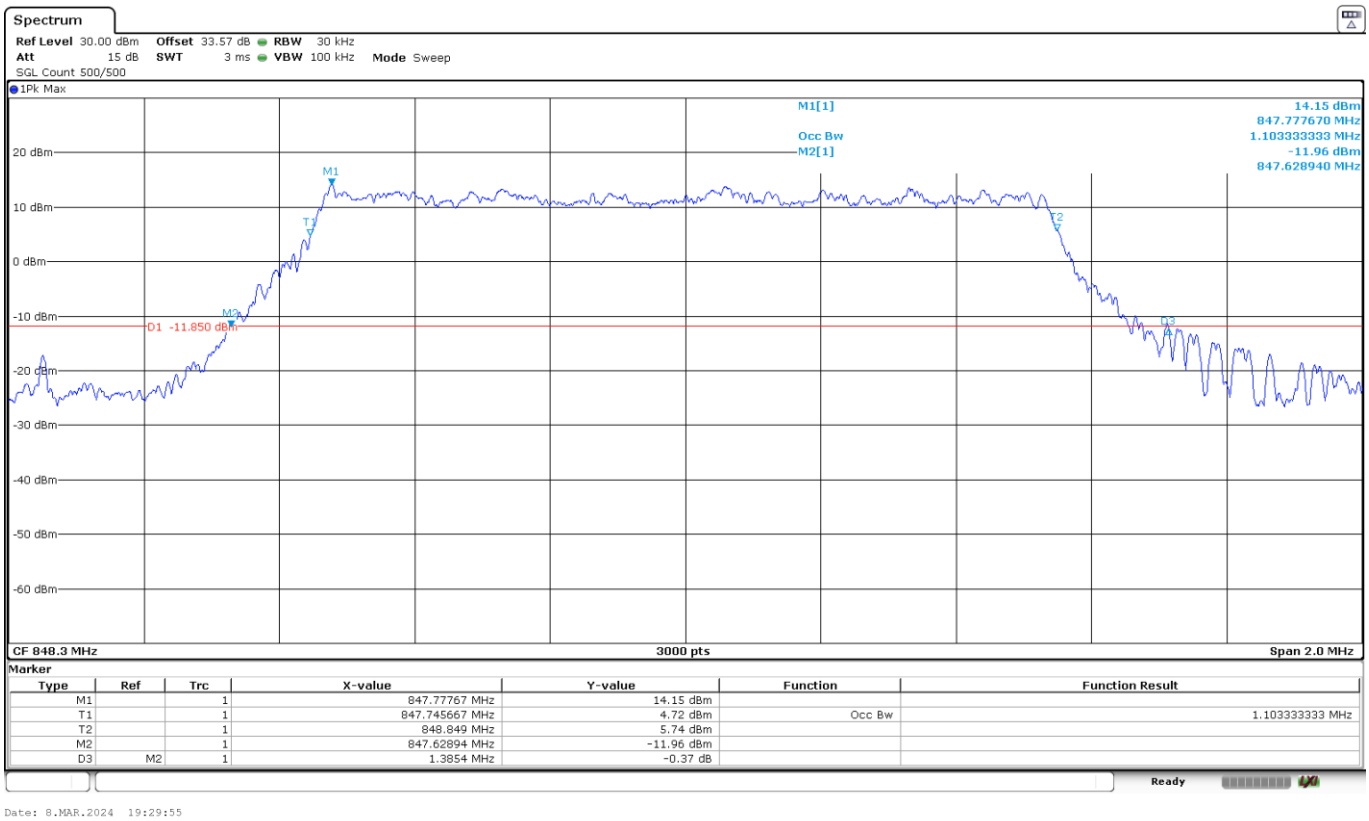
Low Channel:



Middle Channel:

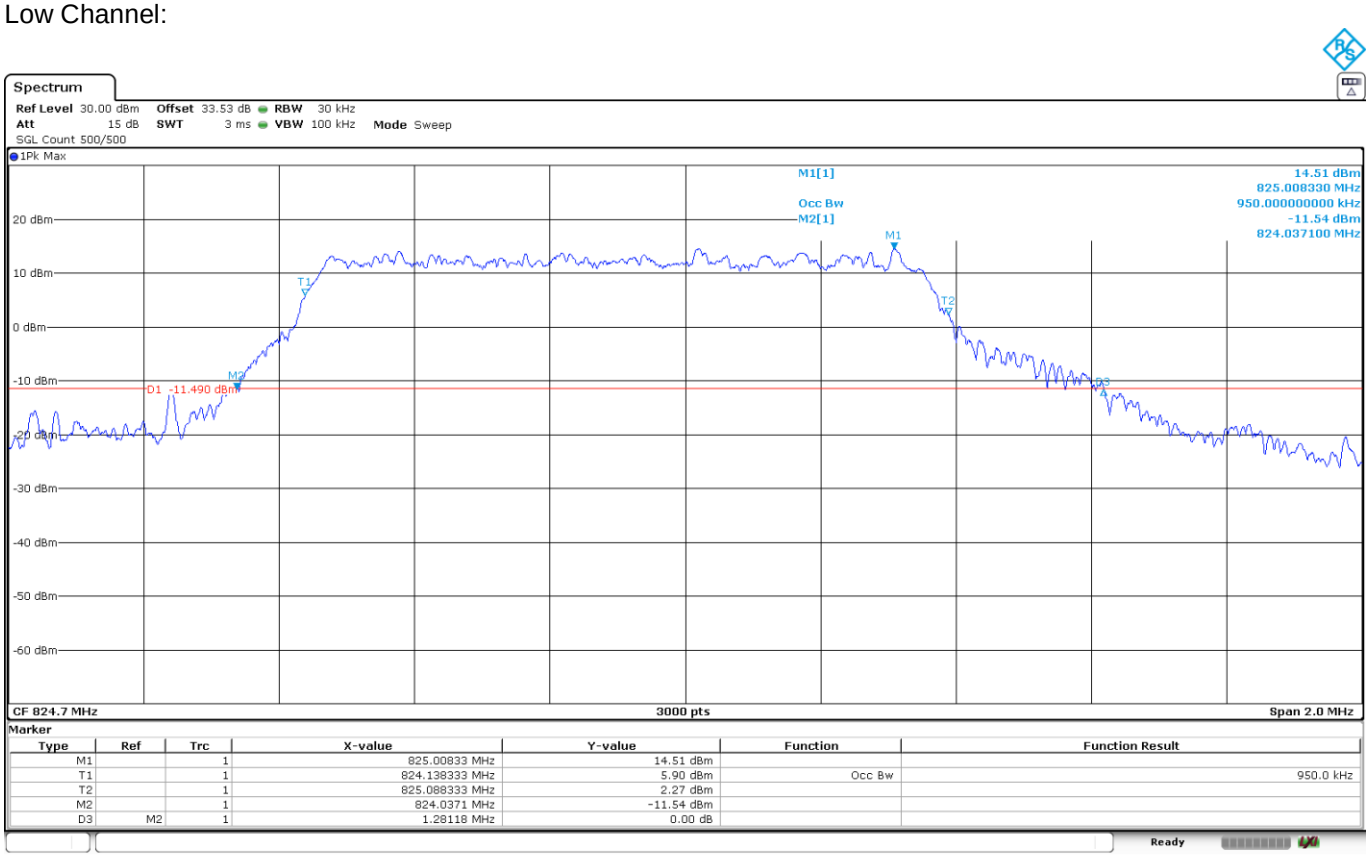


High Channel:

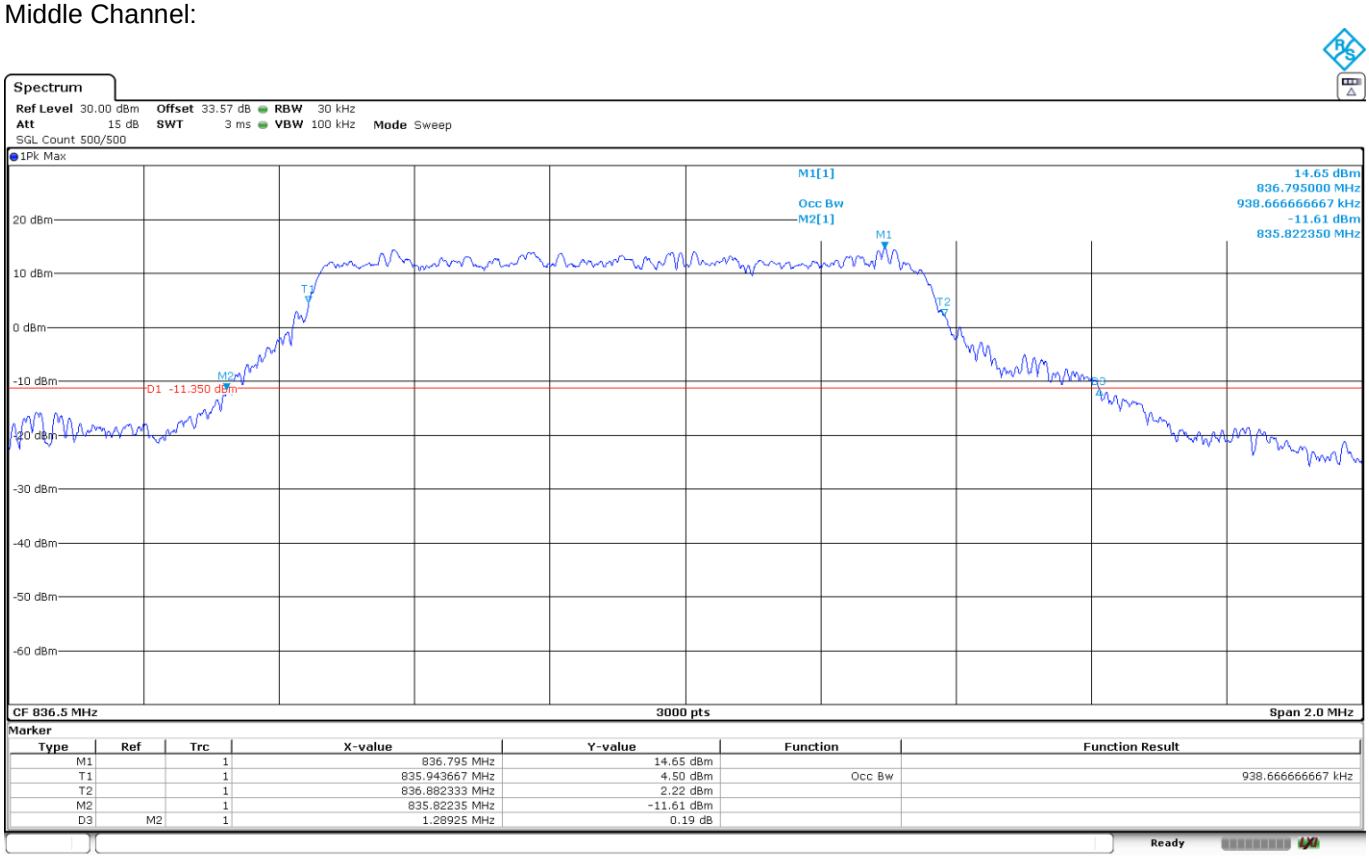


LTE Cat-M1 Band 26. BW=1.4 MHz. 16QAM. RB Size 5. Offset 0. Narrowband 0.

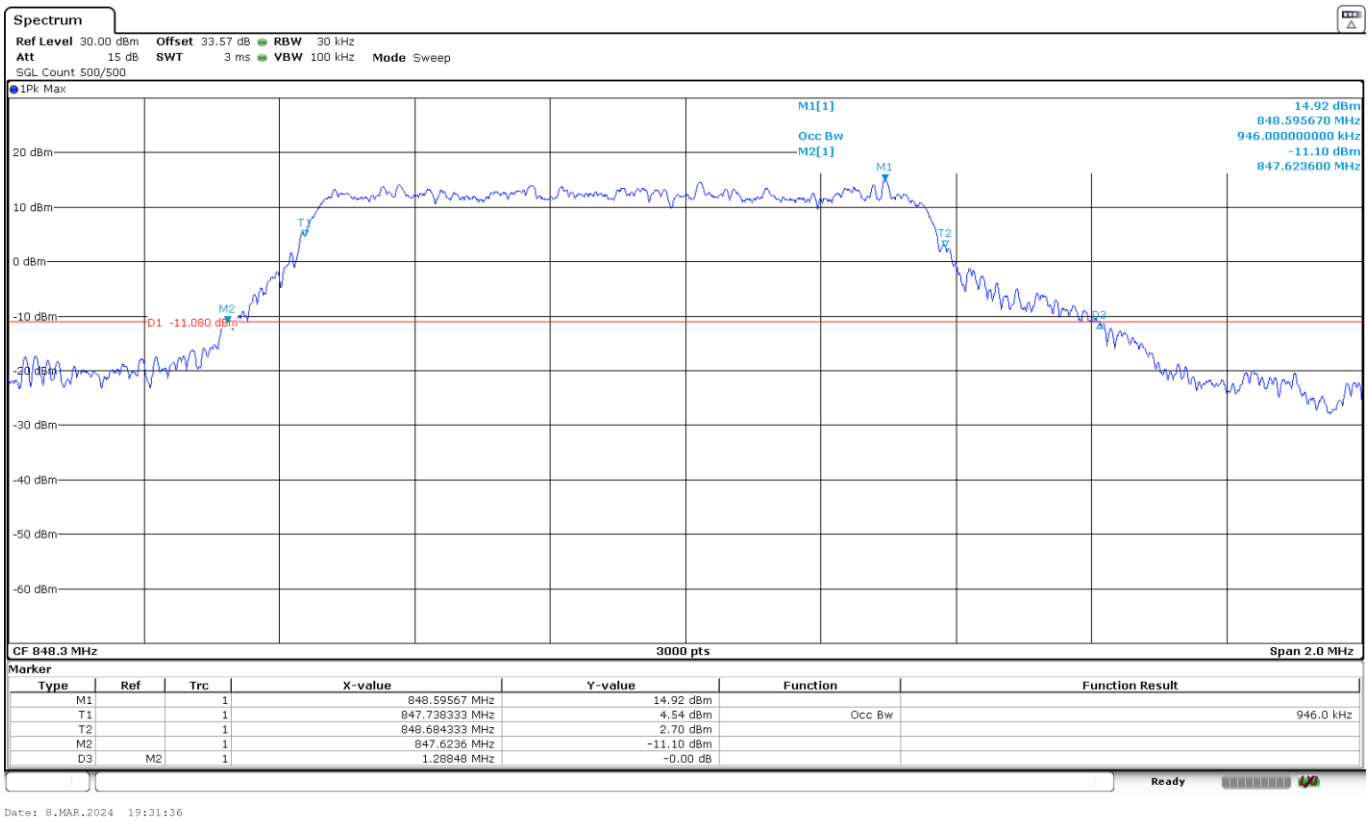
Low Channel:



Middle Channel:



High Channel:



Date: 8.MAR.2024 19:31:36

Spurious Emissions at Antenna Terminals

Limits

FCC §2.1051 and §22.917. RSS-132 Clause 5.5.

> The power of emissions shall be attenuated below the transmitter power (P) by a factor of at least 43 + 10 log (P) dB. P in watts.
>
> In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.

At Po transmitting power, the specified minimum attenuation becomes 43+10 log (Po), and the level in dBm relative to Po becomes:

Po (dBm) – [43 + 10 log (Po in mW) - 30] = -13 dBm

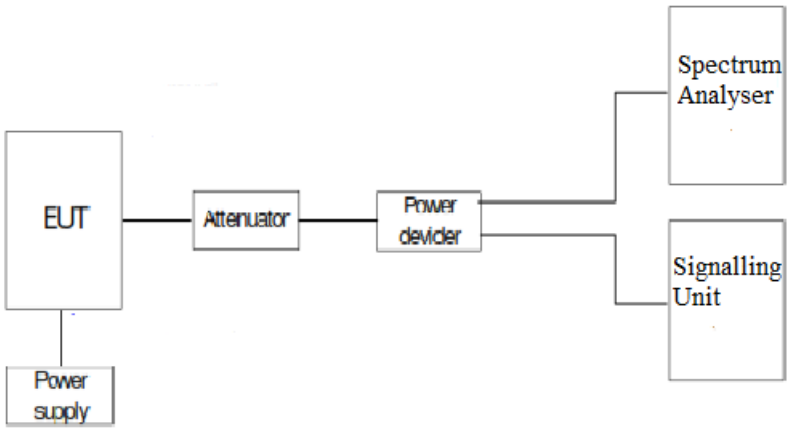
Method

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50-Ohm attenuator and a power divider.

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

The configuration of Resource Blocks and modulation which is the worst case for conducted power was used.

Test Setup



Results

LTE Cat-M1 Band 26:

A preliminary scan determined the worst-case:

BW=3 MHz. QPSK. RB Size=1. RB Offset=0. Narrowband=0.

The next results are for this worst-case configuration.

Frequency range 9 KHz - 10 GHz:

- Low Channel: No spurious frequencies at less than 20 dB below the limit.
- Middle Channel: No spurious frequencies at less than 20 dB below the limit.
- High Channel: Spurious frequencies at less than 20 dB below the limit:

Frequency (MHz)	Emission limitations conducted (dBm)
1692.4375	-34.9

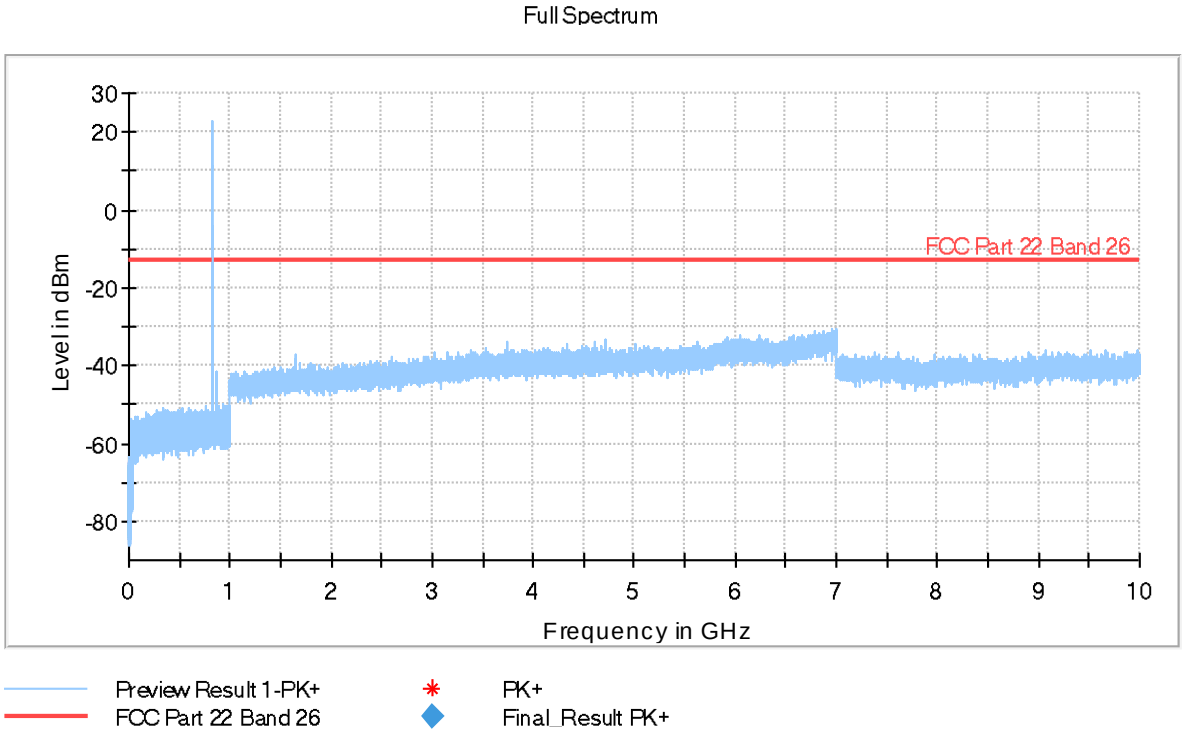
Measurement uncertainty (dB): <±2.76

Verdict: PASS

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [FSV 40]					
9 kHz - 150 kHz	14,1 Hz	PK+	300 Hz	Coupled	0 dB
150 kHz - 30 MHz	932,812 Hz	PK+	10 kHz	Coupled	0 dB
30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	Coupled	0 dB
1 GHz - 10 GHz	281,25 kHz	PK+	1 MHz	Coupled	0 dB

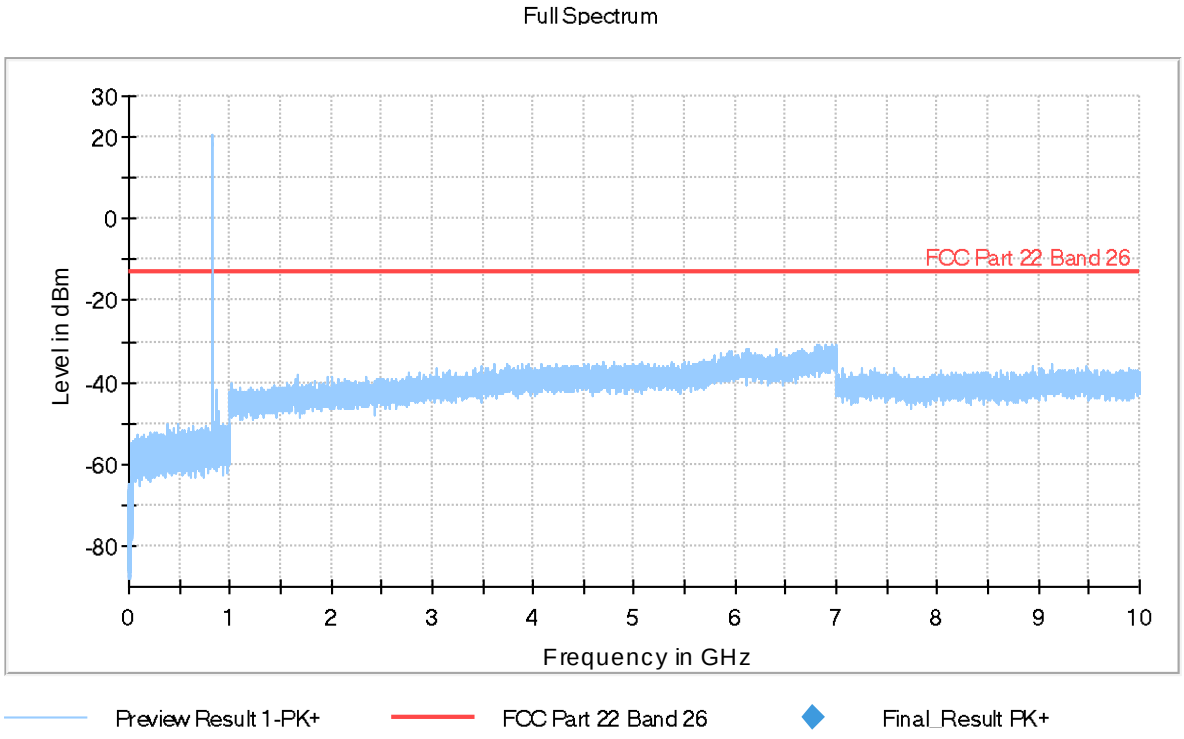
LTE Cat-M1 Band 26: BW=3 MHz. QPSK. RB Size=1. RB Offset=0. Narrowband=0.

Low Channel:



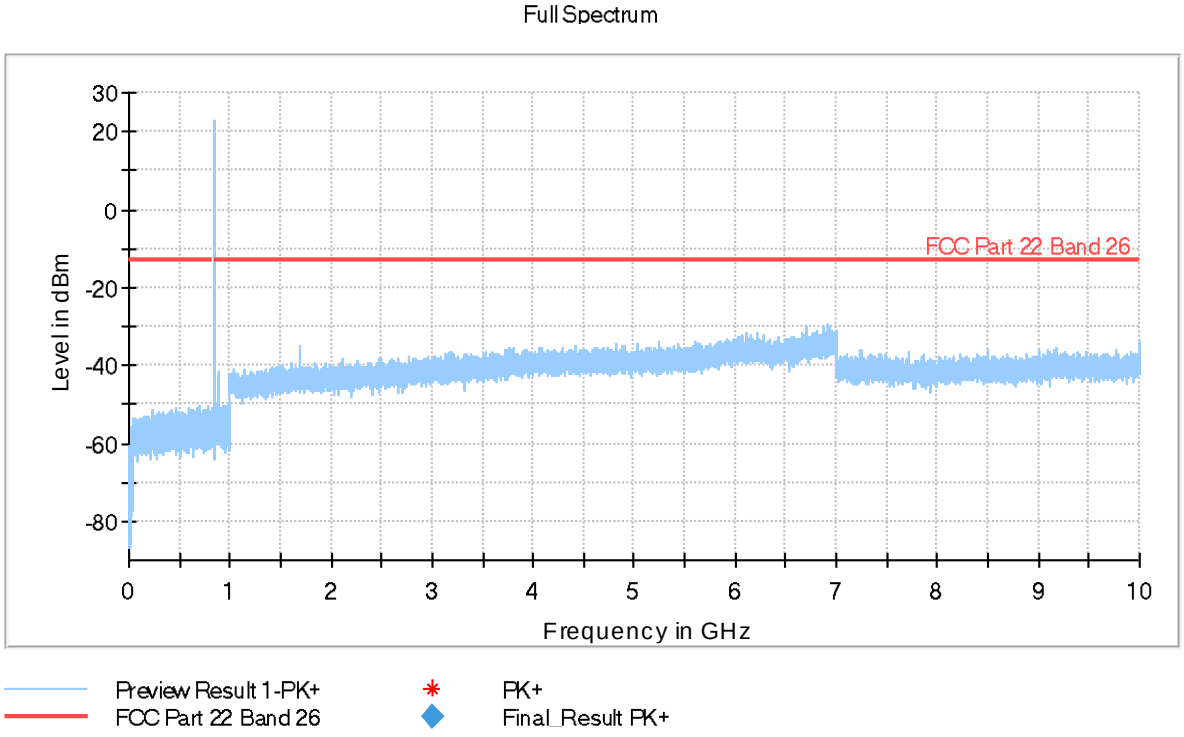
The peak above the limit is the carrier frequency.

Middle Channel:



The peak above the limit is the carrier frequency.

High Channel:



The peak above the limit is the carrier frequency.

Spurious Emissions at Antenna Terminals at Block Edges

Limits

FCC § 2.1051 and § 22.917:

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.

Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. 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.

RSS-132. Clause 5.5:

Mobile and base station equipment shall comply with the limits below.

In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log 10 p (watts).

Method

The EUT RF output connector was connected to a spectrum analyzer and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50-Ohm attenuator and a power splitter.

The reading of the spectrum analyser is corrected with the path loss of the connection between the output terminal of the EUT and the input of the spectrum analyzer.

The configuration of modulation which is the worst case for conducted power was used.

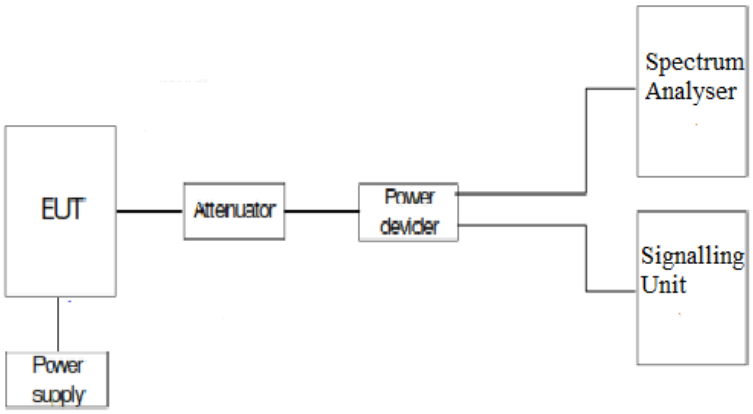
As stated in FCC part 22.917 / RSS-132 Clause 5.5, in the 1 MHz bands immediately outside and adjacent to the frequency block or band a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

Measurement Limit:

At Po transmitting power, the specified minimum attenuation 43 + 10 log10 p (watts) becomes:

$$Po\ (dBm) - [43 + 10 \log (Po\ in\ mwatts) - 30] = -13\ dBm$$

Test Setup



Results

LTE Cat-M1 Band 26:

Preliminary measurements determined QPSK, BW=1.4 MHz as the worst-case modulation in terms of band edge results. The next results are for this worst-case configuration.

LTE Cat-M1 Band 26. QPSK.	Narrowband=0 RB=1. Offset=0. BW=1.4 MHz	Narrowband=0 RB=1. Offset =0. BW = 3 MHz	Narrowband=0 RB=1. Offset =0. BW=5 MHz	Narrowband=0 RB=1. Offset =0. BW=10 MHz	Narrowband=0 RB=1. Offset =0. BW=15 MHz
Maximum measured level at Low Block Edge at antenna port (dBm)	-14.17	-20.79	-19.53	-29.44	-33.56

LTE Cat-M1 Band 26. QPSK.	Narrowband=0 RB=6. Offset=0. BW=1.4 MHz	Narrowband=0 RB=6. Offset=0. BW = 3 MHz	Narrowband=0 RB=6. Offset=0. BW=5 MHz	Narrowband=0 RB=6. Offset=0. BW=10 MHz	Narrowband=0 RB=6. Offset=0. BW=15 MHz
Maximum measured level at Low Block Edge at antenna port (dBm)	-15.14	-17.84	-14.67	-19.39	-21.51

LTE Cat-M1 Band 26. QPSK.	Narrowband=0 RB=1. Offset=Max. BW=1.4 MHz	Narrowband=1 RB=1. Offset =Max. BW = 3 MHz	Narrowband=3 RB=1. Offset =Max. BW=5 MHz	Narrowband=7 RB=1. Offset =Max. BW=10 MHz	Narrowband=11 RB=1. Offset =Max. BW=15 MHz
Maximum measured level at High Block Edge at antenna port (dBm)	-14.75	-21.42	-17.78	-19.95	-25.09

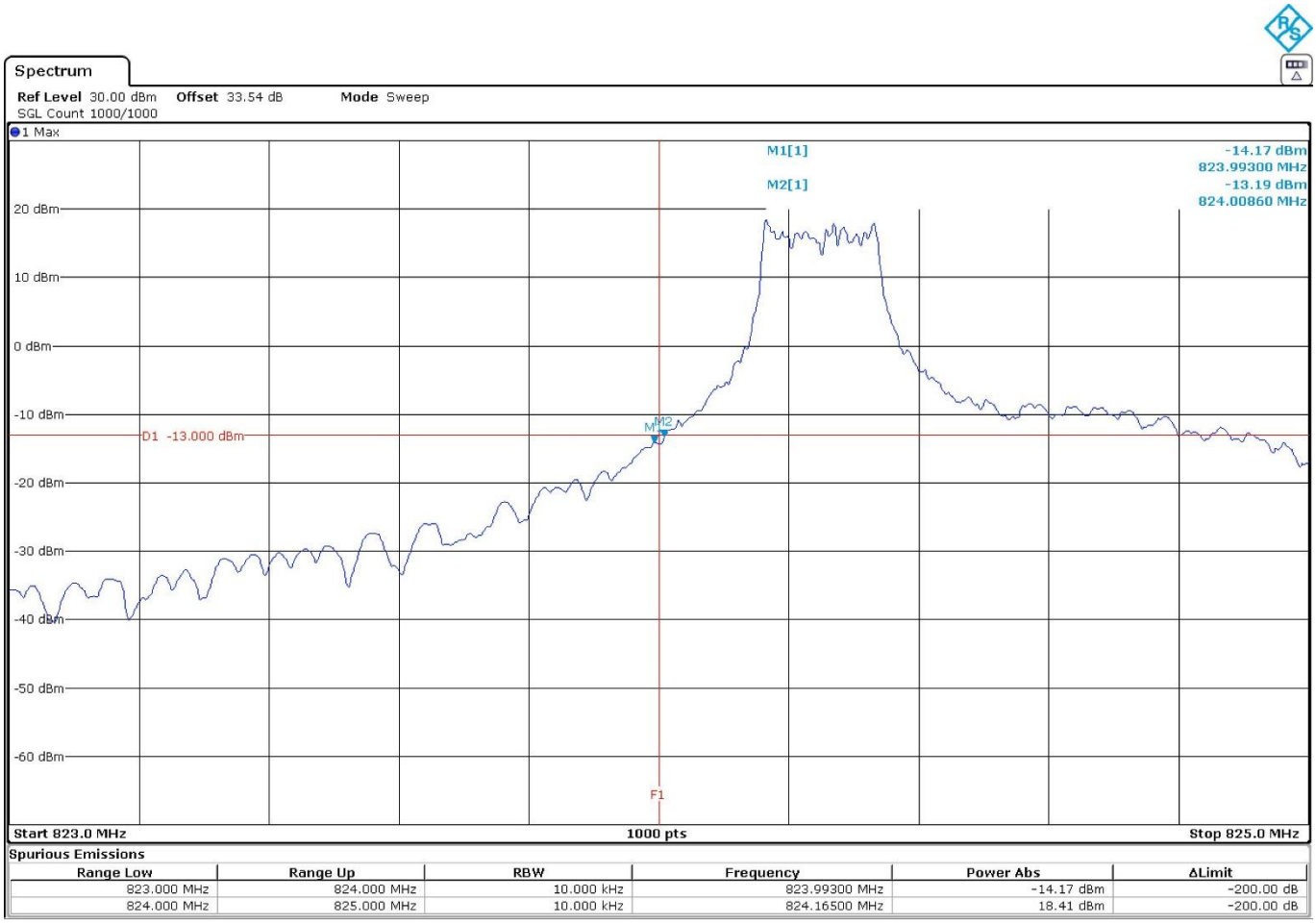
LTE Cat-M1 Band 26. QPSK.	Narrowband=0 RB=6. Offset=1. BW=1.4 MHz	Narrowband=1 RB=6. Offset=1. BW = 3 MHz	Narrowband=3 RB=6. Offset=1. BW=5 MHz	Narrowband=7 RB=6. Offset=1. BW=10 MHz	Narrowband=11 RB=6. Offset=1. BW=15 MHz
Maximum measured level at High Block Edge at antenna port (dBm)	-14.27	-16.89	-14.31	-20.97	-19.68

Measurement uncertainty (dB): <±2.76

Verdict

Pass

LTE Cat-M1 Band 26. BW=1.4 MHz. QPSK. RB Size=1. RB Offset=0. Low Block Edge:

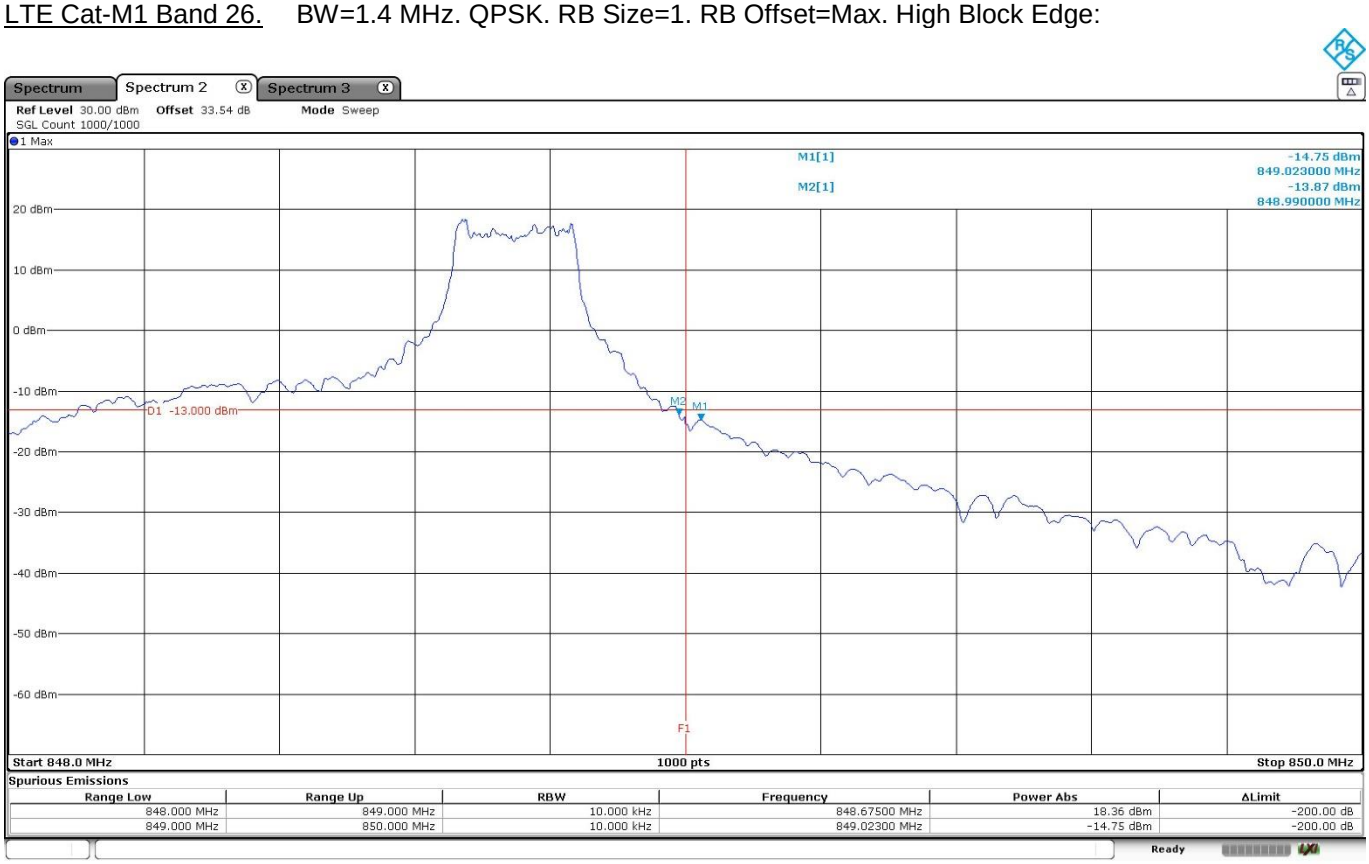


Spurious Emissions

Range Low	Range Up	RBW	Frequency	Power Abs	ΔLimit
823.000 MHz	824.000 MHz	10.000 kHz	823.99300 MHz	-14.17 dBm	-200.00 dB
824.000 MHz	825.000 MHz	10.000 kHz	824.16500 MHz	18.41 dBm	-200.00 dB

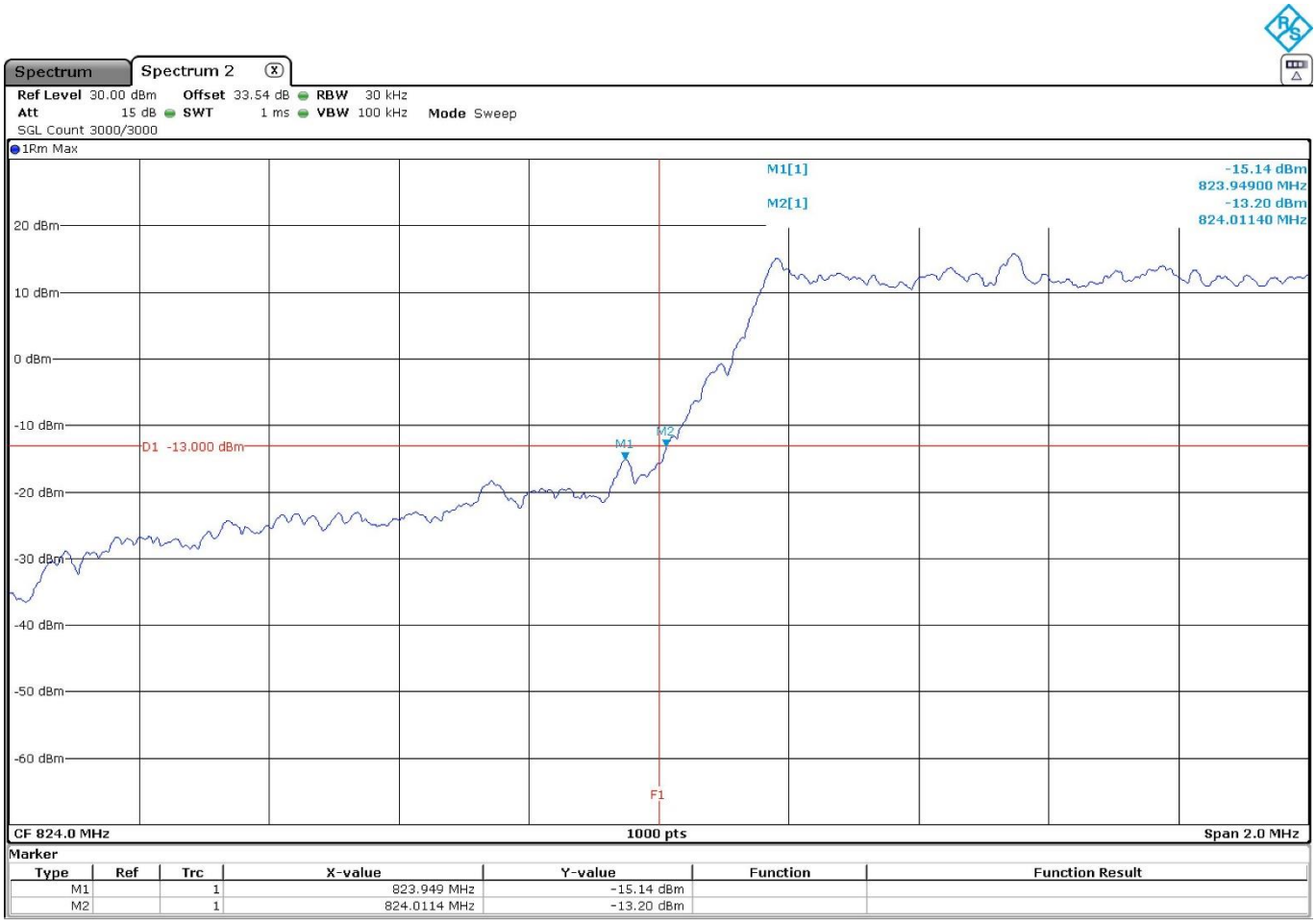
The equipment transmits at the maximum output power.

LTE Cat-M1 Band 26. BW=1.4 MHz. QPSK. RB Size=1. RB Offset=Max. High Block Edge:



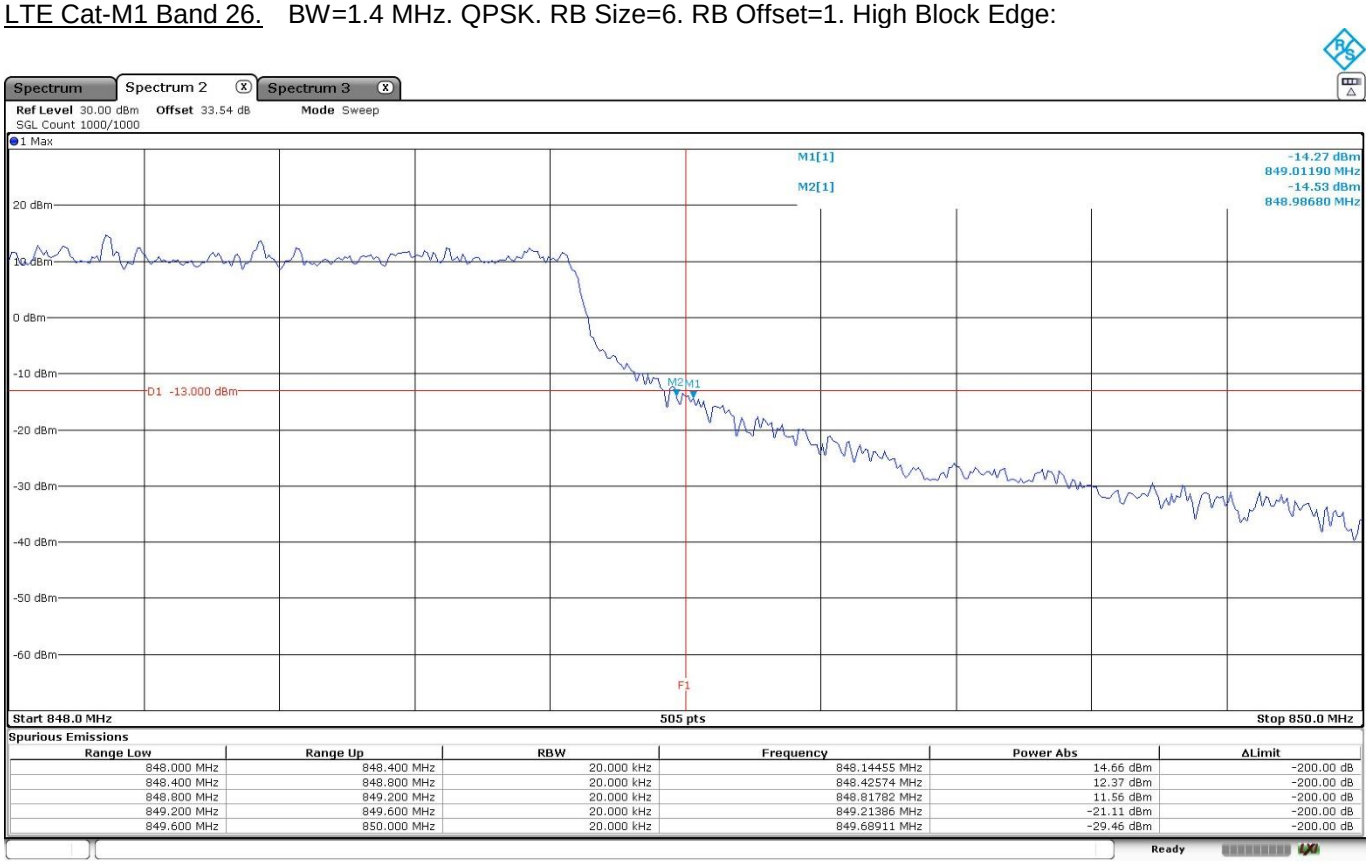
The equipment transmits at the maximum output power.

LTE Cat-M1 Band 26. BW=1.4 MHz. QPSK. RB Size=6. RB Offset=0. Low Block Edge:



The equipment transmits at the maximum output power.

LTE Cat-M1 Band 26. BW=1.4 MHz. QPSK. RB Size=6. RB Offset=1. High Block Edge:



The equipment transmits at the maximum output power.

Verdict: PASS

Radiated Emissions

Limits

* FCC §2.1051 and §22.917: 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.

* RSS-132. 5.5: Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 P (watts).

ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 P (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

Method

The measurement was performed with the EUT inside an anechoic chamber. The spectrum was scanned from 30 MHz to at least the 10th harmonic of the HIGH frequency generated within the equipment.

The EUT was placed on a 1 meter high non-conductive stand at a 3 meter distance from the measuring antenna. Detected emissions were maximized at each frequency by rotating the EUT and adjusting the height and polarization of the measuring antenna. The maximum meter reading was recorded.

Measurement Limit:

According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least 43 + 10 log (P) dB, P in watts.
At Po transmitting power, the specified minimum attenuation becomes 43+10log (Po), and the level in dBm relative Po becomes:

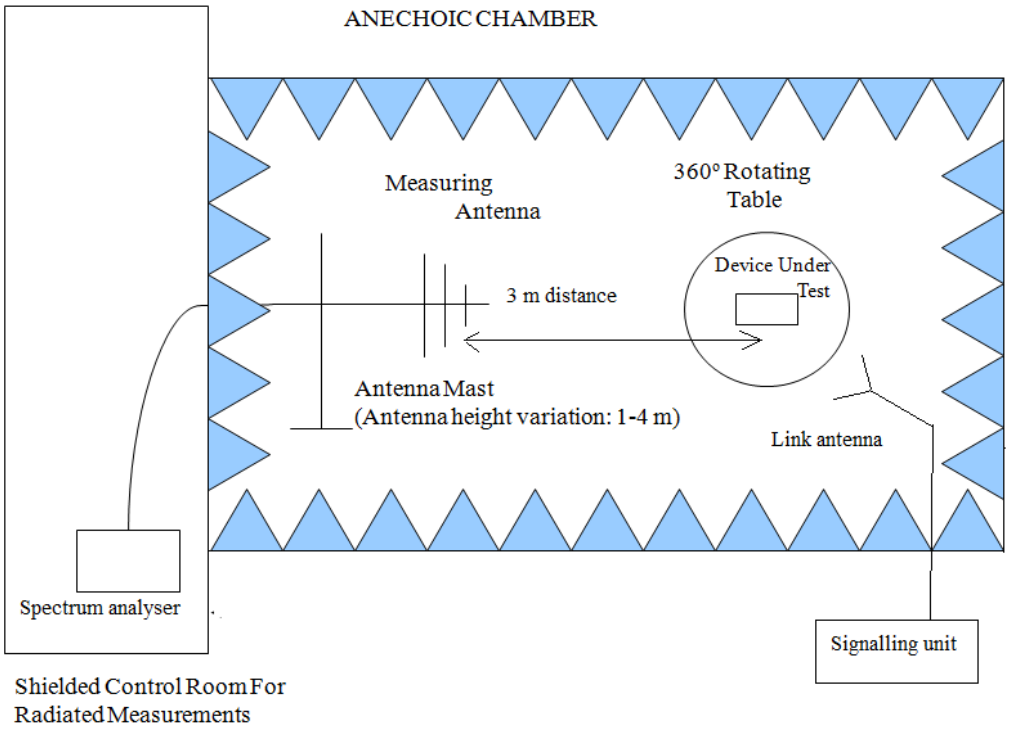
$$Po\ (dBm) – [43 + 10 \log (Po\ in\ mwatts) - 30] = - 13\ dBm$$

The maximum field strength (dBµV/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

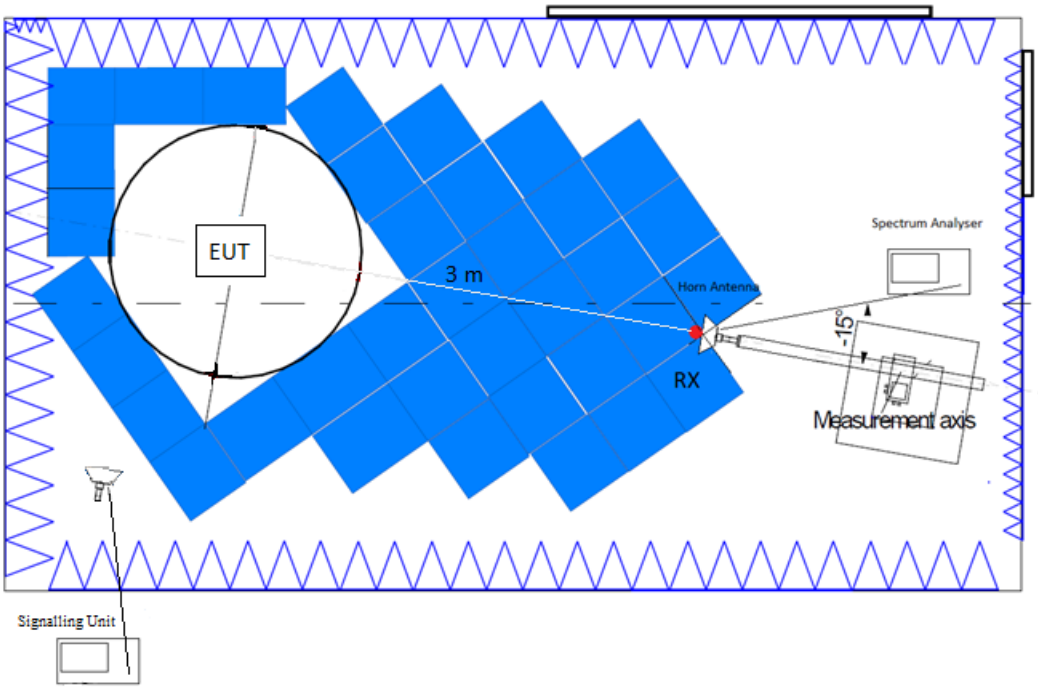
EIRP (dBm) = E (dBµV/m) + 20 log(D) - 104.8; where D is the measurement distance (in the far field region) in m. D = 3 m

Test Setup

Radiated measurements below 1 GHz:



Radiated measurements above 1 GHz:



Results

LTE Cat-M1 Band 26:

A preliminary scan determined the BW=3 MHz, QPSK, RB Size=1, RB Offset=0, Narrowband=0 as the worst case. The following results are for this worst-case configuration.

- LOW CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 8.5 GHz:

No spurious frequencies at less than 20 dB below the limit.

- MIDDLE CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 8.5 GHz:

No spurious frequencies at less than 20 dB below the limit.

- HIGH CHANNEL:

Frequency range 30 MHz - 1 GHz:

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 8.5 GHz:

No spurious frequencies at less than 20 dB below the limit.

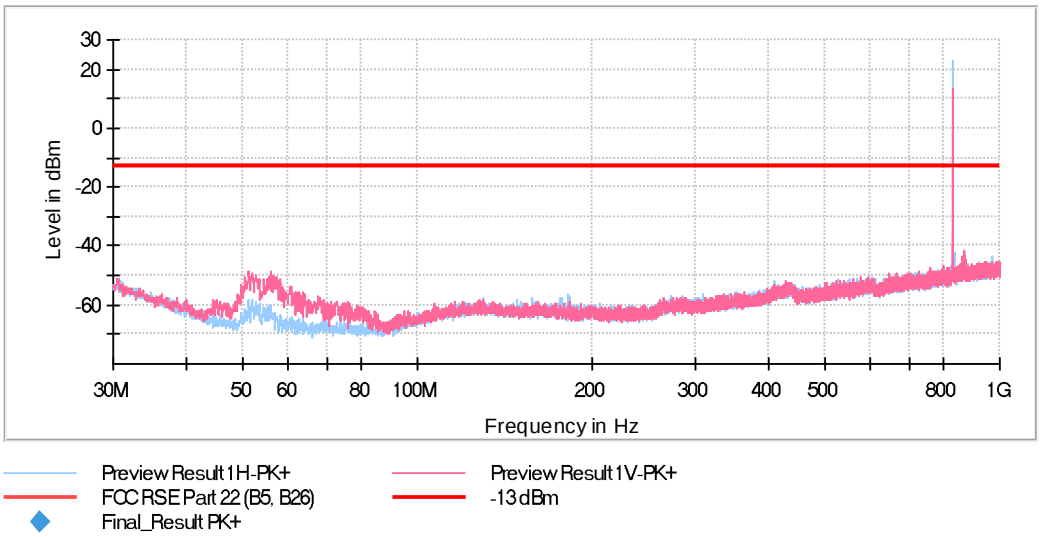
Measurement uncertainty (dB): <± 5.03 for f ≥ 30 MHz up to 1 GHz
<± 4.32 for f ≥ 1 GHz up to 8.5 GHz

Verdict: PASS

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	30.312 kHz	PK+	100 kHz	Coupled	0 dB
1 GHz - 8.5 GHz	234.375 kHz	PK+	100 kHz	1 s	0 dB

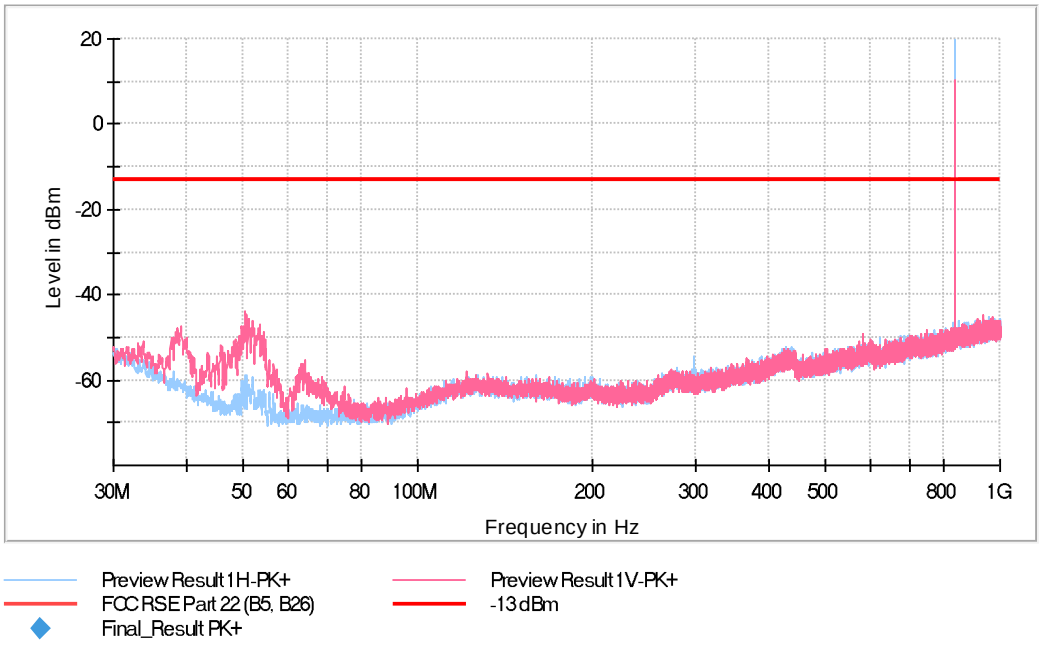
FREQUENCY RANGE 30 MHz - 1 GHz:

- LOW CHANNEL:



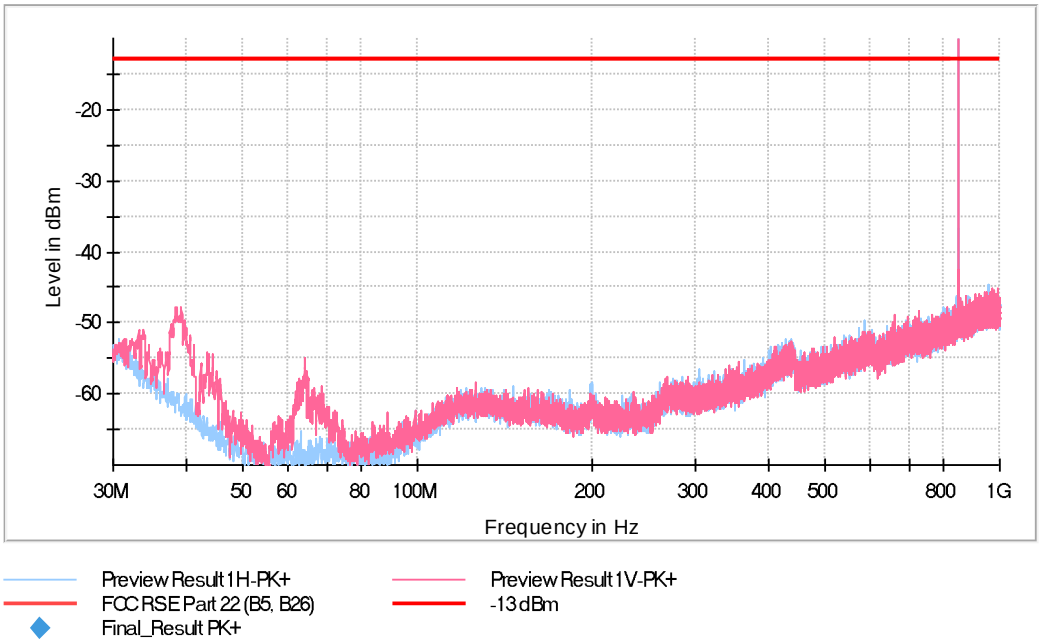
The peak above the limit is the carrier frequency.

- MIDDLE CHANNEL:



The peak above the limit is the carrier frequency.

- HIGH CHANNEL:



The peak above the limit is the carrier frequency.

FREQUENCY RANGE 1 - 8.5 GHz:

- LOW CHANNEL: