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Report On

FCC Testing of the
Ericsson RRUS 82 B41 KRC 161 436/1 (2496 MHz - 2690 MHz)
Remote Radio Unit in accordance with FCC CFR 47 Part 27

COMMERCIAL-IN-CONFIDENCE

FCC ID: TA8AKRC161436-1

PREPARED BY

Guangdi Dong
Project Engineer

APPROVED BY

Matt Russell
Authorised Signatory

DATED

11 February 2015

Document 75929194 Report 01 Issue 1

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CONTENTS

Section	Page No
1	REPORT INFORMATION 3
1.1	Report Details 4
1.2	Brief Summary of Results 5
1.3	Configuration Description 6
1.4	Declaration of Build Status 7
1.5	Product Information 8
1.6	Test Setup 9
1.7	Test Conditions 11
1.8	Deviation From The Standard 11
1.9	Modification Record 11
1.10	Alternative Test Site 11
2	TEST DETAILS 12
2.1	Maximum RMS Output Power and Peak to Average Ratio - Conducted 13
2.2	Occupied Bandwidth 18
2.3	Spurious Emission at Band Edge 23
2.4	Radiated Spurious Emissions 33
2.5	Conducted Spurious Emissions 39
3	TEST EQUIPMENT USED 61
3.1	Test Equipment Used 62
3.2	Measurement Uncertainty 64
4	ACCREDITATION, DISCLAIMERS AND COPYRIGHT 65
4.1	Accreditation, Disclaimers and Copyright 66



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SECTION 1

REPORT INFORMATION

1.1 REPORT DETAILS

The information contained in this report is intended to show verification of the Ericsson RRUS 82 B41 KRC 161 436/1 Remote Radio Unit to the requirements of FCC CFR 47 Part 27

Manufacturer	Ericsson AB
Address	Isafjordsgatan 10 SE-164 80 Stockholm Sweden
Product Name	RRUS 82 B41
Product Number	KRC 161 436/1
Serial Number(s)	D820462482
PIS Version	CXP 9025 219/2 Rev R1D08C
Hardware Version	R1B
Number of Sample Tested	1
Test Specification/Issue/Date	FCC CFR 47 Part 27: 2013
Start of Test	27 January 2015
Finish of Test	06 February 2015
Name of Engineer(s)	Guangdi Dong
Related Document(s)	ANSI C63.4: 2009 ANSI/TIA-603-C-2004 FCC CFR 47 Part 2: 2013 KDB 971168 D01 v02 r02 KDB 662911 D01 v02 r01

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of results for each configuration, in accordance with FCC CFR 47 Part 2, Part 27 is shown below.

Section	Spec Clause		Test Description	Result
	Part 2	Part 27		
2.1	2.1046	27.50 (h) 27.50 (i)	Maximum Peak Output Power and Peak to Average Ratio – Conducted	Pass
	-	27.50 (h)	Equivalent Isotropically Radiated Power (EIRP)	N/A ¹
2.2	2.1049(h)	27.53 (m)	Occupied Bandwidth	Pass
2.3	2.1051	27.53 (m)	Spurious Emissions at Band Edge	Pass
2.4	2.1053	27.53 (m)	Radiated Spurious Emissions	Pass
2.5	2.1051	27.53 (m)	Conducted Spurious Emissions	Pass
2.6	2.1055	27.54	Frequency Stability	Pass
-	-	-	Receiver Spurious Emissions	N/A

N/A – Not Applicable

N/A¹– Not Applicable, due to no integrated antenna

1.3 CONFIGURATION DESCRIPTION

Configuration Code	Carrier(s)	Configuration Description
L-MIMO-SC	1C	LTE MIMO, Single Carrier
L-MIMO-MC 1	2C	LTE MIMO, Multi Carrier x2
L-MIMO-MC 2	3C	LTE MIMO, Multi Carrier x3

The settings below were deemed representative for all traffic scenarios when settings with different modulations, channel bandwidths, number of carriers and RF configurations has been tested to find the worst case setting. The settings below were used for all measurements if not otherwise noted:

LTE:

MIMO mode single carrier: E-TM1.1, E-TM3.2, E-TM3.1

MIMO mode multi carrier (x2): E-TM1.1

MIMO mode multi carrier (x3): E-TM1.1

The complete testing was performed with the EUT transmitting at maximum RF power unless otherwise stated.

The Maximum Output Power was tested on all TX/RX output connector RF 1 to RF 8, all other TX measurements were performed on the combined TX/RX output connector RF 4 of the EUT as the representative port.

1.4 DECLARATION OF BUILD STATUS

MAIN EUT	
MANUFACTURING DESCRIPTION	Remote Radio Unit
MANUFACTURER	Ericsson AB
PRODUCT NAME	RRUS 82 B41
PRODUCT NUMBER	KRC 161 436/1
TRANSMITTER OPERATING RANGE	TX/ RX: 2496MHz - 2690MHz
MODULATIONS	QPSK, 16QAM, 64QAM
ITU DESIGNATION OF EMISSION	20M0F9W
SUPPORTED CHANNEL BANDWIDTH CONFIGURATION	20MHz
OUTPUT POWER (RMS) (W or dBm)	MIMO: 8 x 43dBm (8 x 20W)
ANTENNA GAIN	No integrated Antenna
SUPPORTED CONFIGURATION	Single Carrier, Multi Carrier, 8x MIMO
NUMBER OF CARRIERS	Maximum 3 carriers
INSTANTANEOUS BANDWIDTH	60MHz
NUMBER OF ANTENNA PORTS	8 TX/RX ports
FCC ID	TA8AKRC161436-1
POWER SOURCE	-48V DC
TECHNICAL DESCRIPTION (a brief description of the intended use and operation)	The equipment is the Radio Part of the TDD- LTE Base Station.

Signature

Jiang Xiaoying

Date

06 February 2015

D of B S Serial No

75929194/01

No responsibility will be accepted by TÜV SÜD Product Service UK Limited as to the accuracy of the information declared in this document by the manufacturer.

1.5 PRODUCT INFORMATION

1.5.1 Technical Description

The Equipment Under Test (EUT) RRUS 82 B41, KRC 161 436/1 is an Ericsson Remote Radio Unit working in the public mobile service 2496-2690MHz band which provides communication connections to TDD-LTE network network in LTE Modes. The RRUS 82 B41 Remote Radio Unit operates from a -48V DC supply.

The EUT includes eight TX/RX ports and it can be configured to transmit in MIMO mode, and MIMO mode was used for measurements as the worst configuration.

The Equipment Under Test (EUT) is shown in the photograph below. A full technical description can be found in the Manufacturer's documentation.

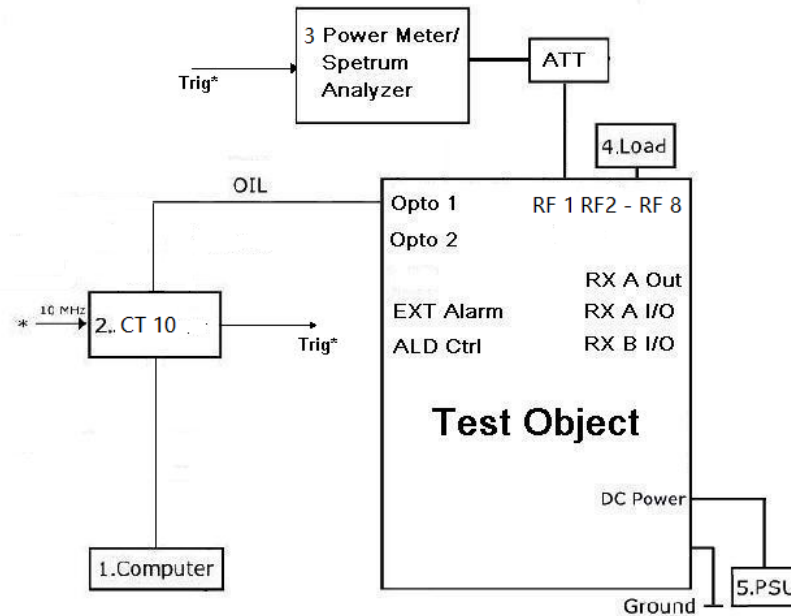


Equipment Under Test

1.6 TEST SETUP

Test Setup, Conducted Measurement:

LTE Configuration setup:

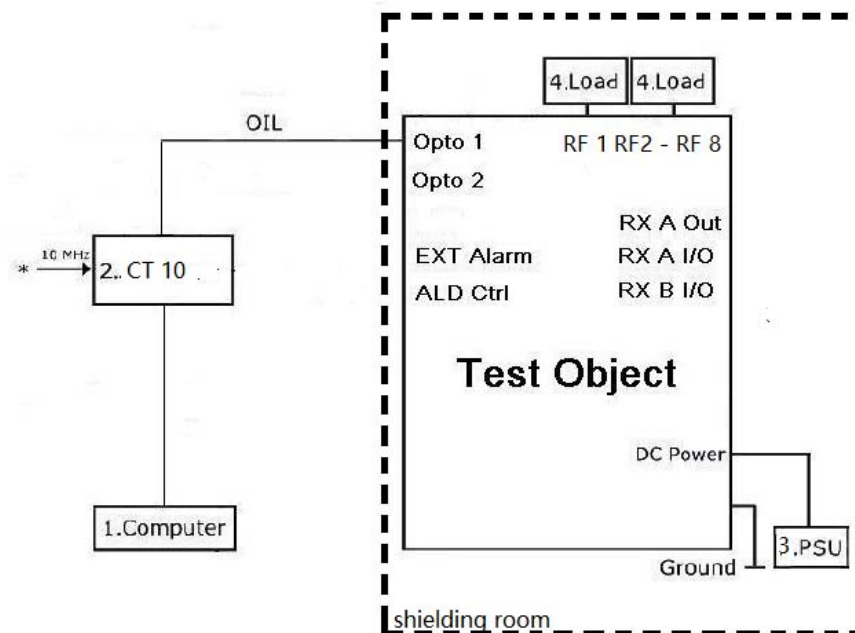


Product Name	Product Number	Version	Serial Number
RRUS 82 B41	KRC 161 436/1	R1B	D820462482

No.	Auxiliary Equipment	Part Number / Model Type	Version	Serial Number
1	Computer	Advantech-610H	--	ETD/L913
2	CT 10	LPC102487/1	R1C	T01F376487
3	Spectrum Analyzer	FSW43	--	100615
	Power Meter	NRP	--	101593
	Power Sensor	NRP-Z21	--	103607
4	Load	TSG50-3-40-11	--	1405210012
		TSG50-3-40-11	--	1405210013
		TSG50-3-40-11	--	1405210014
		TSG50-3-40-11	--	1405210015
		TSG50-3-40-11	--	1405210017
		TSG50-3-40-11	--	1405210018
		TSG50-3-40-11	--	1405210019
5	DC Power Supply	DH1716A-10	--	1000303181

Test Setup, Radiated Measurement:

LTE Configuration setup:



Product Name	Product Number	Version	Serial Number
RRUS 82 B41	KRC 161 436/1	R1B	D820462482

No.	Auxiliary Equipment	Part Number / Model Type	Version	Serial Number
1	Computer	Advantech-610H	--	ETD/L913
2	CT 10	LPC102487/1	R1C	T01F376487
3	DC Power Supply	DH1716A-10	--	1000303181
4	Load	TSG50-3-40-11	--	1405210012
		TSG50-3-40-11	--	1405210013
		TSG50-3-40-11	--	1405210014
		TSG50-3-40-11	--	1405210015
		TSG50-3-40-11	--	1405210017
		TSG50-3-40-11	--	1405210018
		TSG50-3-40-11	--	1405210019
		TSG50-3-40-11	--	1405210016

1.7 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure, test laboratories or a chamber as appropriate.

All test cases were tested with the EUT supplied with -48V DC by an external power supply.

1.8 DEVIATION FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.9 MODIFICATION RECORD

Modification State 0 - No modifications were made to the EUT during testing.

1.10 ALTERNATIVE TEST SITE

Under our group UKAS Accreditation, TÜV SÜD Product Service conducted the following tests at Ericsson in Beijing, China:

- Maximum Output Power and Peak to Average Ratio – Conducted
- Occupied Bandwidth
- Band Edge
- Conducted Spurious Emissions
- Frequency Stability

Radiated Spurious Emissions testing have been performed under the following site registrations:

FCC Accreditation 910917:

The State Radio Monitoring Centre, No.80 Beilishi Road Xicheng District Beijing, China.



Product Service

SECTION 2

TEST DETAILS

2.1 MAXIMUM OUTPUT POWER AND PEAK TO AVERAGE RATIO - CONDUCTED

2.1.1 Specification Reference

FCC CFR 47 Part 2.1046
FCC CFR 47 Part 27, Clause 27.50 (h)(1)(i)

2.1.2 Equipment Under Test

RRUS 82 B41, KRC 161 436/1, S/N: D820462482

2.1.3 Date of Test and Modification State

27 to 29 January 2015 - Modification State 0

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Environmental Conditions

Ambient Temperature	22.6 - 23.8°C
Relative Humidity	24.0 - 25.5%

2.1.6 Test Method

The test was applied in accordance with the test method requirements of FCC Part 2 and KDB 971168 D01.

Using a power meter and attenuator(s), the output power of the EUT was measured at the antenna terminal. The path loss between the EUT and the power sensor was measured and recorded for the test band. The path loss was entered as an offset into the Power Meter and Spectrum Analyzer.

The EUT was configured to transmit on maximum power on the configurations defined in the tables below. Since the EUT transmits on eight antennas simultaneously in the same frequency range for MIMO devices, i.e., TX MIMO mode, using the Measure-and-Sum approach, the output power at all antennas were tested, and the total output power were then summed mathematically in linear power units according to FCC KDB 662911 D01.

A peak to average ratio measurement is performed at the conducted ports of the EUT for single carrier for Multiple RAT mode. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) was used and 0.1% probability value recorded.

The RMS Power and Peak to Average Ratio was measured and recorded with the results being compared with the limits.

2.1.7 Test Results

Configuration L-MIMO-SC (1C)

Maximum Output Power 43.0dBm per port

Antenna	Modulation / Carrier Bandwidth (MHz)	RMS Output Power / Peak to Average Ratio (PAR)								
		Channel Position B 2506.0MHz			Channel Position M 2593.0MHz			Channel Position T 2680.0MHz		
		dBm	W	PAR (dB)	dBm	W	PAR (dB)	dBm	W	PAR (dB)
1	QPSK / 20.0 MHz	42.64	18.37	7.48	42.62	18.28	6.81	42.75	18.84	7.45
2		42.74	18.79	7.37	42.66	18.45	6.78	42.72	18.71	7.41
3		42.72	18.71	7.46	42.69	18.58	6.84	42.78	18.97	7.32
4		42.77	18.92	7.41	42.51	17.82	6.80	42.62	18.28	7.33
5		42.68	18.54	7.51	42.46	17.62	6.81	42.61	18.24	7.28
6		42.72	18.71	7.33	42.63	18.32	6.80	42.76	18.88	7.39
7		42.70	18.62	7.67	42.56	18.03	6.85	42.79	19.01	7.33
8		42.74	18.79	7.39	42.64	18.37	6.83	42.71	18.66	7.26
Total(dBW)		21.74			21.63			21.75		

Antenna	Modulation / Carrier Bandwidth (MHz)	RMS Output Power / Peak to Average Ratio (PAR)								
		Channel Position B 2506.0MHz			Channel Position M 2593.0MHz			Channel Position T 2680.0MHz		
		dBm	W	PAR (dB)	dBm	W	PAR (dB)	dBm	W	PAR (dB)
1	16QAM / 20.0 MHz	-	-	-	42.62	18.28	6.81	-	-	-
2		-	-	-	42.71	18.66	6.80	-	-	-
3		-	-	-	42.77	18.92	6.82	-	-	-
4		-	-	-	42.67	18.49	6.80	-	-	-
5		-	-	-	42.66	18.45	6.83	-	-	-
6		-	-	-	42.78	18.97	6.81	-	-	-
7		-	-	-	42.71	18.66	6.85	-	-	-
8		-	-	-	42.75	18.84	6.81	-	-	-
Total(dBW)		-			21.74			-		

Antenna	Modulation / Carrier Bandwidth (MHz)	RMS Output Power / Peak to Average Ratio (PAR)								
		Channel Position B 2506.0MHz			Channel Position M 2593.0MHz			Channel Position T 2680.0MHz		
		dBm	W	PAR (dB)	dBm	W	PAR (dB)	dBm	W	PAR (dB)
1	64QAM / 20.0 MHz	-	-	-	42.53	17.91	6.81	-	-	-
2		-	-	-	42.63	18.32	6.80	-	-	-
3		-	-	-	42.57	18.07	6.84	-	-	-
4		-	-	-	42.55	17.99	6.81	-	-	-
5		-	-	-	42.45	17.58	6.81	-	-	-
6		-	-	-	42.53	17.91	6.79	-	-	-
7		-	-	-	42.45	17.58	6.85	-	-	-
8		-	-	-	42.76	18.88	6.82	-	-	-
Total(dBW)		-			21.59			-		

Configuration L-MIMO-MC 1 (2C)

Maximum Output Power 43.0dBm per port

Antenna	Modulation / Carrier Bandwidth (MHz)	RMS Output Power / Peak to Average Ratio (PAR)								
		Channel Position B _{RFBW} 2506.0MHz + 2546.0MHz			Channel Position M _{RFBW} 2573.0MHz+ 2613.0MHz			Channel Position T _{RFBW} 2640.0MHz+ 2680.0MHz		
		dBm	W	PAR (dB)	dBm	W	PAR (dB)	dBm	W	PAR (dB)
1	QPSK / 20.0 MHz	42.41	17.42	-	42.45	17.58	-	42.31	17.02	-
2		42.47	17.66	-	42.44	17.54	-	42.35	17.18	-
3		42.38	17.30	-	42.57	18.07	-	42.42	17.46	-
4		42.45	17.58	-	42.48	17.70	-	42.31	17.02	-
5		42.62	18.28	-	42.64	18.37	-	42.53	17.91	-
6		42.54	17.95	-	42.47	17.66	-	42.41	17.42	-
7		42.33	17.10	-	42.54	17.95	-	42.41	17.42	-
8		42.54	17.95	-	42.63	18.32	-	42.43	17.50	-
Total(dBW)		21.50			21.56			21.43		

Antenna	Modulation / Carrier Bandwidth (MHz)	RMS Output Power / Peak to Average Ratio (PAR)								
		Channel Position B _{RFBW} 2506.0MHz + 2546.0MHz			Channel Position M _{RFBW} 2573.0MHz+ 2613.0MHz			Channel Position T _{RFBW} 2640.0MHz+ 2680.0MHz		
		dBm	W	PAR (dB)	dBm	W	PAR (dB)	dBm	W	PAR (dB)
1	16QAM / 20.0 MHz	-	-	-	42.49	17.74	-	-	-	-
2		-	-	-	42.43	17.50	-	-	-	-
3		-	-	-	42.42	17.46	-	-	-	-
4		-	-	-	42.33	17.10	-	-	-	-
5		-	-	-	42.48	17.70	-	-	-	-
6		-	-	-	42.39	17.34	-	-	-	-
7		-	-	-	42.43	17.50	-	-	-	-
8		-	-	-	42.47	17.66	-	-	-	-
Total(dBW)		-			21.46			-		

Antenna	Modulation / Carrier Bandwidth (MHz)	RMS Output Power / Peak to Average Ratio (PAR)								
		Channel Position B _{RFBW} 2506.0MHz + 2546.0MHz			Channel Position M _{RFBW} 2573.0MHz+ 2613.0MHz			Channel Position T _{RFBW} 2640.0MHz+ 2680.0MHz		
		dBm	W	PAR (dB)	dBm	W	PAR (dB)	dBm	W	PAR (dB)
1	64QAM / 20.0 MHz	-	-	-	42.55	17.99	-	-	-	-
2		-	-	-	42.45	17.58	-	-	-	-
3		-	-	-	42.58	18.11	-	-	-	-
4		-	-	-	42.42	17.46	-	-	-	-
5		-	-	-	42.52	17.86	-	-	-	-
6		-	-	-	42.50	17.78	-	-	-	-
7		-	-	-	42.45	17.58	-	-	-	-
8		-	-	-	42.65	18.41	-	-	-	-
Total(dBW)		-			21.55			-		

Configuration L-MIMO-MC 2 (3C)

Maximum Output Power 43.0dBm per port

Antenna	Modulation / Carrier Bandwidth (MHz)	RMS Output Power / Peak to Average Ratio (PAR)								
		Channel Position B _{RFBW} 2506.0MHz + 2526.0MHz + 2546.0MHz			Channel Position M _{RFBW} 2573.0MHz + 2593.0MHz + 2613.0MHz			Channel Position T _{RFBW} 2640.0MHz + 2660.0MHz + 2680.0MHz		
		dBm	W	PAR (dB)	dBm	W	PAR (dB)	dBm	W	PAR (dB)
1	QPSK / 20.0 MHz	42.38	17.30	-	42.46	17.62	-	42.35	17.18	-
2		42.38	17.30	-	42.35	17.18	-	42.34	17.14	-
3		42.48	17.70	-	42.46	17.62	-	42.43	17.50	-
4		42.44	17.54	-	42.44	17.54	-	42.39	17.34	-
5		42.63	18.32	-	42.62	18.28	-	42.45	17.58	-
6		42.56	18.03	-	42.51	17.82	-	42.39	17.34	-
7		42.52	17.86	-	42.48	17.70	-	42.47	17.66	-
8		42.54	17.95	-	42.65	18.41	-	42.43	17.50	-
Total(dBW)		21.52			21.53			21.44		

Antenna	Modulation / Carrier Bandwidth (MHz)	RMS Output Power / Peak to Average Ratio (PAR)								
		Channel Position B _{RFBW} 2506.0MHz + 2526.0MHz + 2546.0MHz			Channel Position M _{RFBW} 2573.0MHz + 2593.0MHz + 2613.0MHz			Channel Position T _{RFBW} 2640.0MHz + 2660.0MHz + 2680.0MHz		
		dBm	W	PAR (dB)	dBm	W	PAR (dB)	dBm	W	PAR (dB)
1	16QAM / 20.0 MHz	-	-	-	42.38	17.30	-	-	-	-
2		-	-	-	42.35	17.18	-	-	-	-
3		-	-	-	42.41	17.42	-	-	-	-
4		-	-	-	42.34	17.14	-	-	-	-
5		-	-	-	42.54	17.95	-	-	-	-
6		-	-	-	42.38	17.30	-	-	-	-
7		-	-	-	42.33	17.10	-	-	-	-
8		-	-	-	42.40	17.38	-	-	-	-
Total(dBW)		-			21.42			-		

Antenna	Modulation / Carrier Bandwidth (MHz)	RMS Output Power / Peak to Average Ratio (PAR)								
		Channel Position B _{RFBW} 2506.0MHz + 2526.0MHz + 2546.0MHz			Channel Position M _{RFBW} 2573.0MHz + 2593.0MHz + 2613.0MHz			Channel Position T _{RFBW} 2640.0MHz + 2660.0MHz + 2680.0MHz		
		dBm	W	PAR (dB)	dBm	W	PAR (dB)	dBm	W	PAR (dB)
1	64QAM / 20.0 MHz	-	-	-	42.44	17.54	-	-	-	-
2		-	-	-	42.43	17.50	-	-	-	-
3		-	-	-	42.32	17.06	-	-	-	-
4		-	-	-	42.36	17.22	-	-	-	-
5		-	-	-	42.40	17.38	-	-	-	-
6		-	-	-	42.48	17.70	-	-	-	-
7		-	-	-	42.42	17.46	-	-	-	-
8		-	-	-	42.62	18.28	-	-	-	-
Total(dBW)		-			21.47			-		

Limit	
33 dBW+10log(X/Y) dBW	Where X is the actual channel width and Y is 6MHz. X=18.58, Limit=37.91dBW
Peak to Average Ratio	13 dB

This unit is tested without antenna. ERP/EIRP compliance is addressed at the time of licensing, as required by the responsible FCC/IC Bureau(s). Licensees are required to take into account maximum allowed antenna gain used in combination with above power settings to prevent the radiated output power to exceed the limits.

2.2 OCCUPIED BANDWIDTH

2.2.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1049
FCC CFR 47 Part 27, Clause 27.53 (m)

2.2.2 Equipment Under Test

RRUS 82 B41, KRC 161 436/1, S/N: D820462482

2.2.3 Date of Test and Modification State

28 January and 06 February 2015 - Modification State 0

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Environmental Conditions

Ambient Temperature	23.6 - 24.5°C
Relative Humidity	25.9 - 28.5%

2.2.6 Test Method

The test was applied in accordance with the test method requirements of FCC Part 2 and KDB 971168 D01.

The EUT was set to transmit at maximum power and testing was carried out on Bottom, Middle and Top Channels. Using the Occupied Bandwidth measurement function in the Spectrum Analyser, the Occupied Bandwidth is defined as the width of the signal between two points, one below the carrier centre frequency and one above the carrier centre frequency.

For FCC requirement, outside of which all emissions are attenuated by at least X dB below the transmitter power, where the value of X is typically specified as 26. The -26dBc Bandwidth was measured in accordance with FCC KDB 971168 D01 Clause 4.2.

The results are shown in the plots below.

2.2.7 Test Results

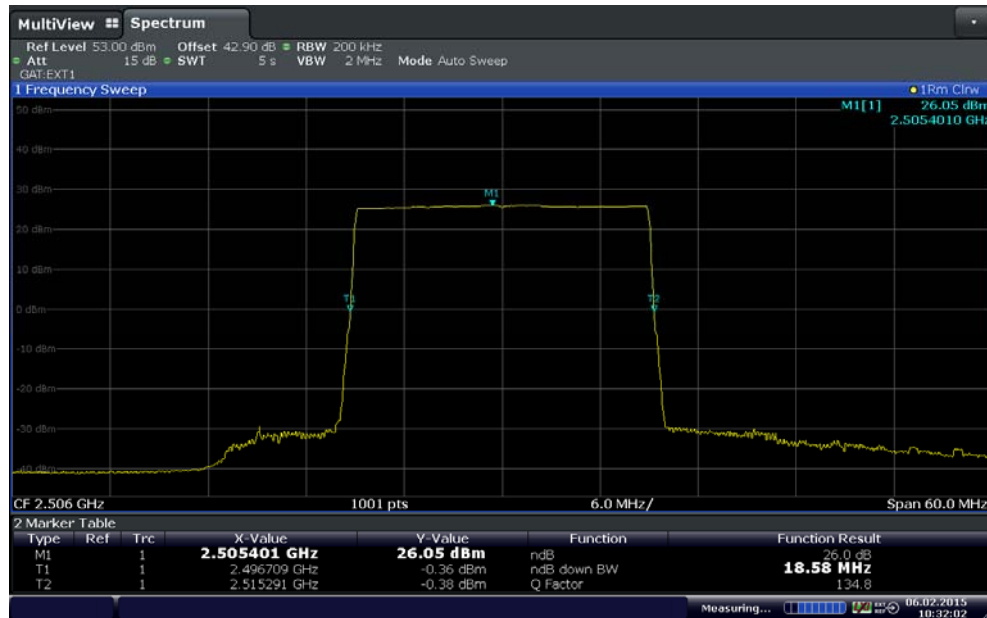
Configuration L-MIMO-SC (1C)

Maximum Output Power 43.0dBm per port

-26dBc Occupied Bandwidth for FCC requirement

Modulation / Bandwidth	Occupied Bandwidth (MHz)		
	Channel Position B 2506.0MHz	Channel Position M 2593.0MHz	Channel Position T 2680.0MHz
QPSK / 20.0 MHz	18.58	18.58	18.58
16QAM / 20.0 MHz	-	18.58	-
64QAM / 20.0 MHz	-	18.58	-

Channel Position B - QPSK / Bandwidth 20.0 MHz



Date: 6.FEB.2015 10:32:03

Channel Position M - QPSK / Bandwidth 20.0 MHz



Date: 28.JAN.2015 10:08:37

Channel Position M – 16QAM / Bandwidth 20.0 MHz



Date: 28. JAN.2015 10:12:16

Channel Position M – 64QAM / Bandwidth 20.0 MHz



Date: 28. JAN.2015 10:16:22

Channel Position T - QPSK / Bandwidth 20.0 MHz



Date: 28. JAN. 2015 10:02:03

2.3 SPURIOUS EMISSION AT BAND EDGE

2.3.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051
FCC CFR 47 Part 27, Clause 27.53 (m)

2.3.2 Equipment Under Test

RRUS 82 B41, KRC 161 436/1, S/N: D820462482

2.3.3 Date of Test and Modification State

02 February 2015 - Modification State 0

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Environmental Conditions

Ambient Temperature	25.5°C
Relative Humidity	28.6%

2.3.6 Test Method

In accordance with FCC CFR 47 Part 27, Clause 27.53 (m) and Part 2, Clause 2.1051, any emissions outside of the block edges shall be attenuated by at least $43 + 10 \log (P)$. In the 1MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 1% of the emission bandwidth should be used.

For measurements of emissions $> 1\text{MHz}$ away from the band edges, an RBW of 1MHz or greater should be used. A resolution bandwidth of 50kHz was used between 1MHz to 6MHz from the band edge. to compensate for the reduced measurement bandwidth, the limit was adjusted with
-13dB to -26dBm.

For MIMO mode configurations, the limit was adjusted with a correction of -9dB $[10\log(8)]$ by using the Measure and Add $10\log(N)$ dB technique according to FCC KDB662911 D01 accounting for simultaneous transmission from antennas port RF 1 to RF 8.

The path loss was measured and entered as a reference level offset. The EUT was set to transmit at its maximum rated output power in the configurations described in the tables below. Measurements were made at the Top and Bottom of the band.

The results are shown in the plots below.

2.3.7 Test Results

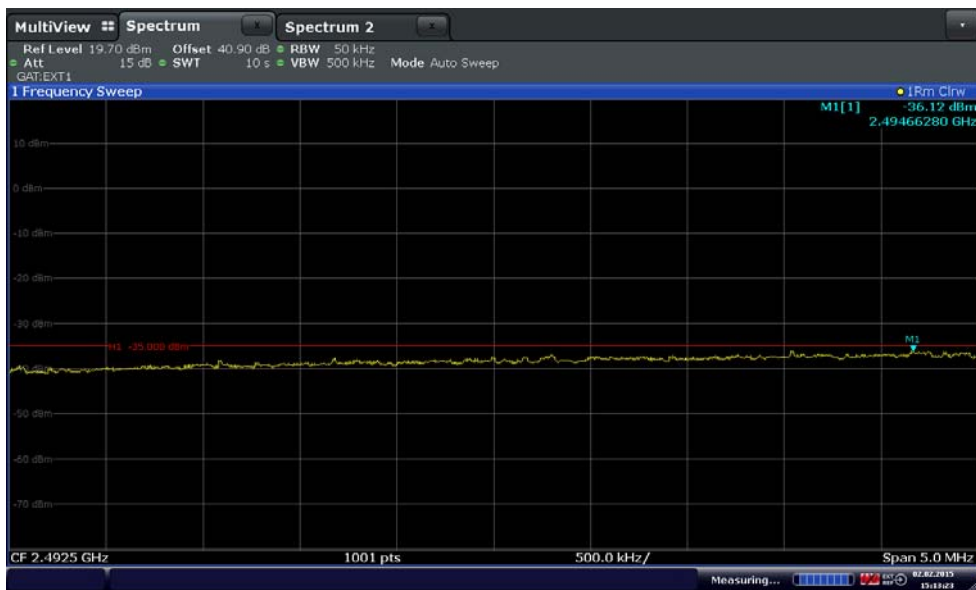
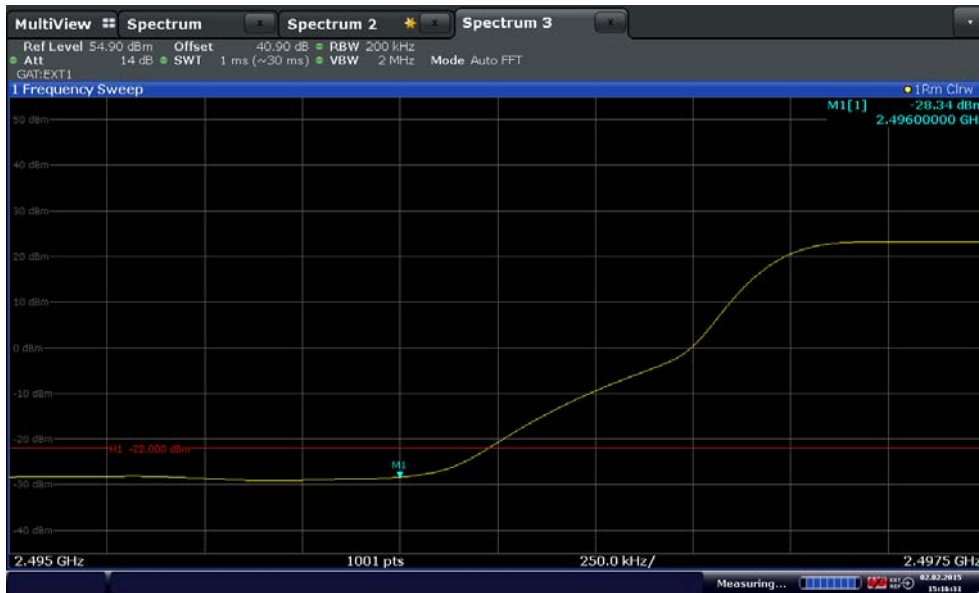
Configuration L-MIMO-SC (1C)

Maximum Output Power 43.0dBm per port

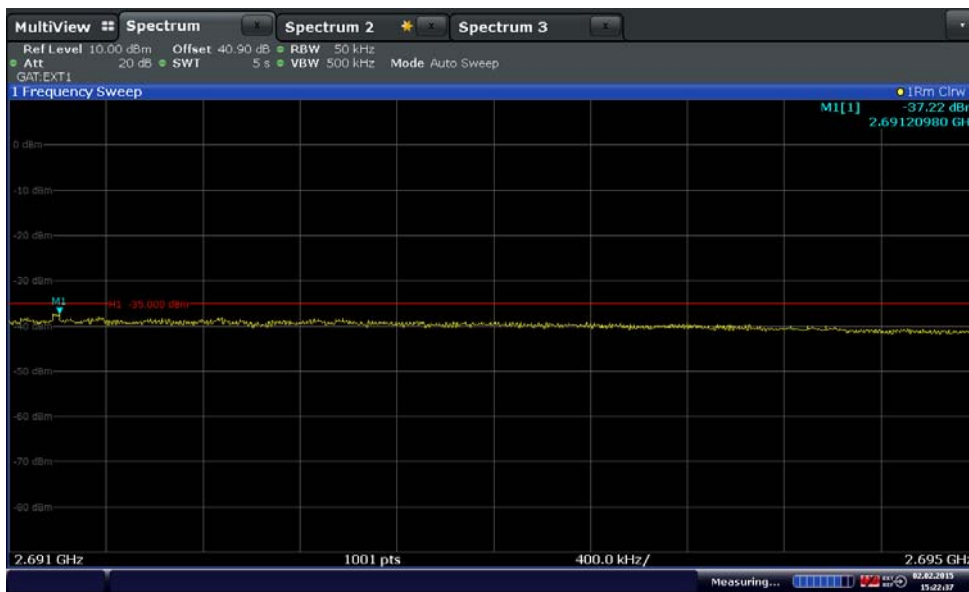
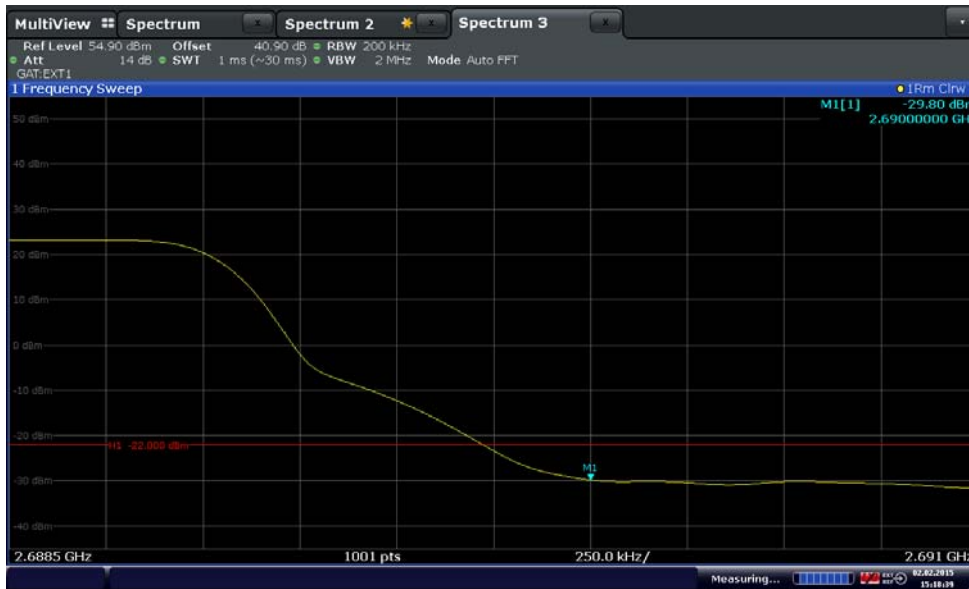
Band Edge Frequency	Channel Bandwidth	Edge Test with modulation QPSK Channel Frequencies
Channel Position B 2496.0 MHz	20.0 MHz	2506.0 MHz
Channel Position T 2690.0 MHz	20.0 MHz	2680.0 MHz

Note: The channels shown in the table above are the minimum and maximum channels that can be used in the authorised frequency ranges to maintain compliance. Channels outside of the ranges shown in the above tables shall not be made available to the end user.

Channel Position B - QPSK / Bandwidth 20.0 MHz



Channel Position T - QPSK / Bandwidth 20.0 MHz



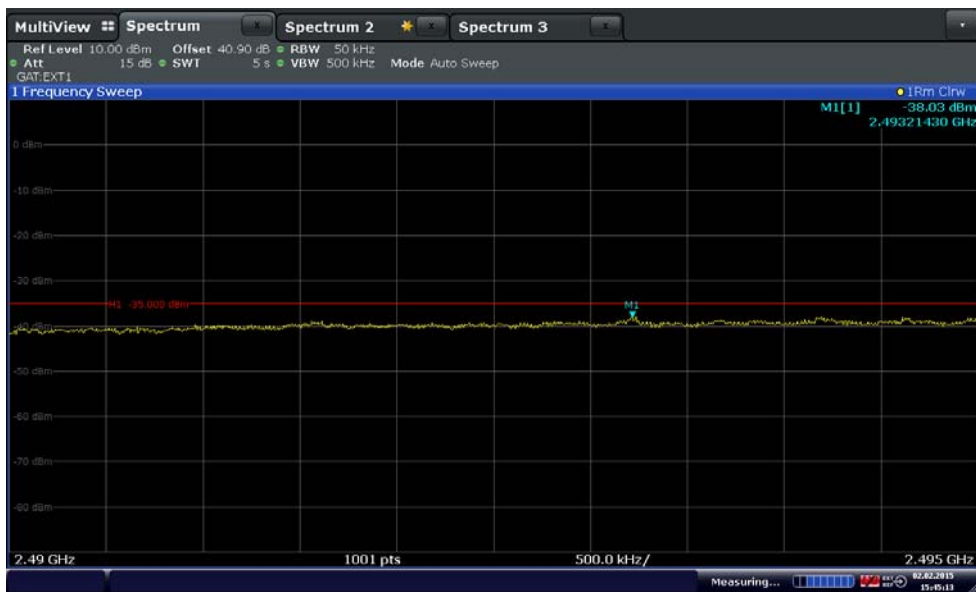
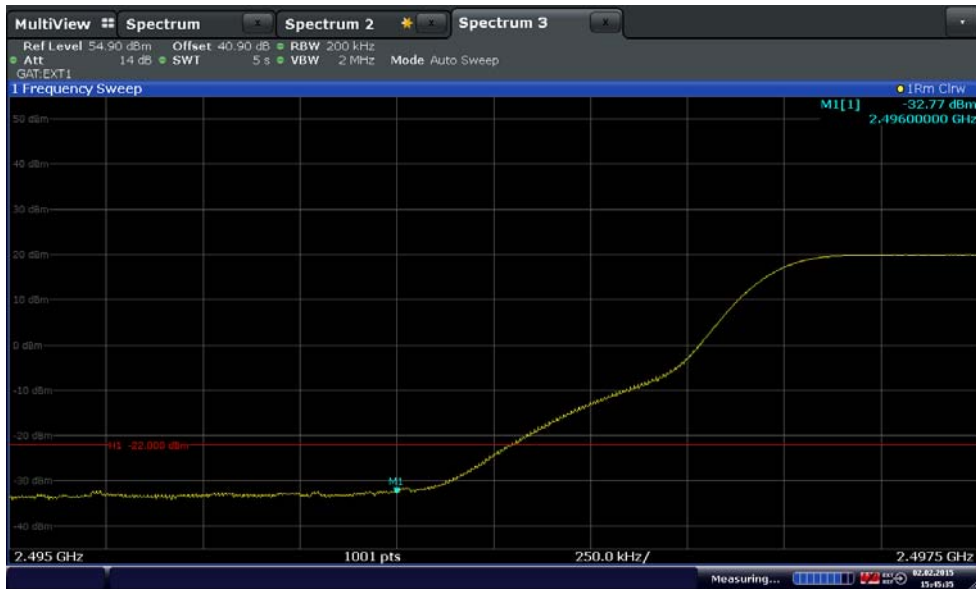
Configuration L-MIMO-MC 1 (2C)

Maximum Output Power 43.0dBm per port

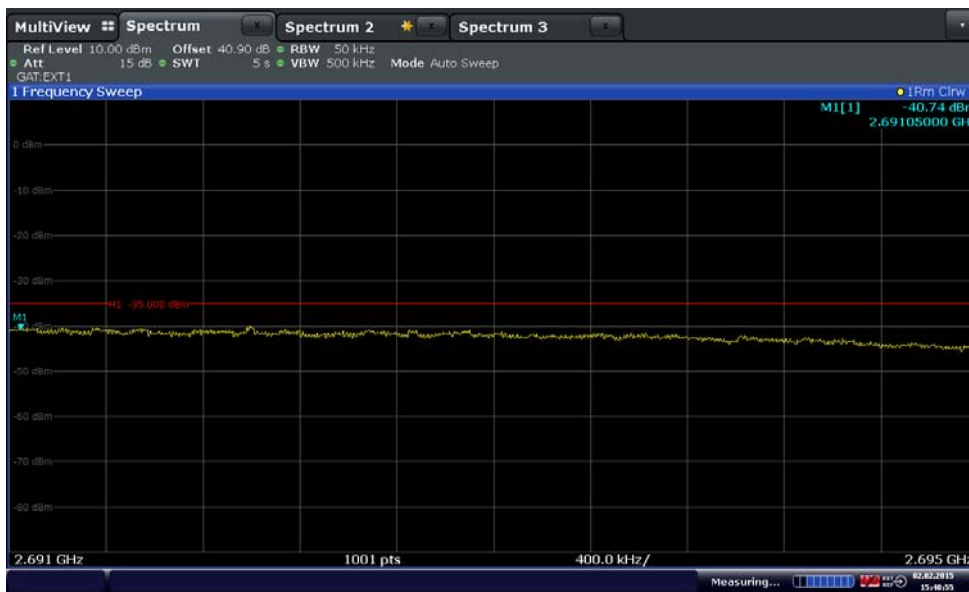
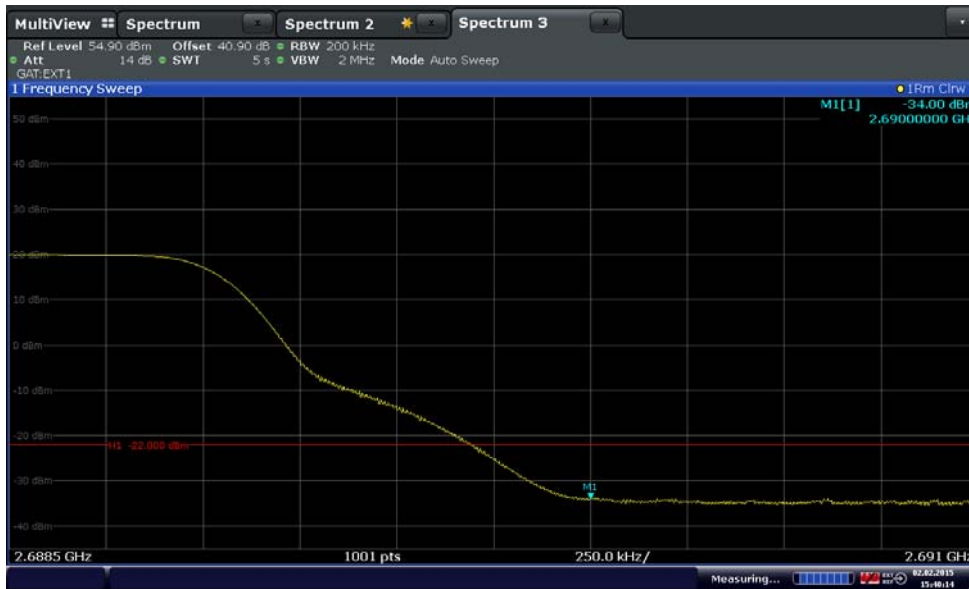
Band Edge Frequency	Channel Bandwidth	Edge Test with modulation QPSK Channel Frequencies
Channel Position B_{RFBW} 2496.0 MHz	20.0 MHz	2506.0 MHz + 2526.0 MHz
Channel Position T_{RFBW} 2690.0 MHz	20.0 MHz	2660.0 MHz + 2680.0 MHz

Note: The channels shown in the table above are the minimum and maximum channels that can be used in the authorised frequency ranges to maintain compliance. Channels outside of the ranges shown in the above tables shall not be made available to the end user.

Channel Position B_{RFBW} - QPSK / Bandwidth 20.0 MHz



Channel Position T_{RFBW} - QPSK / Bandwidth 20.0 MHz



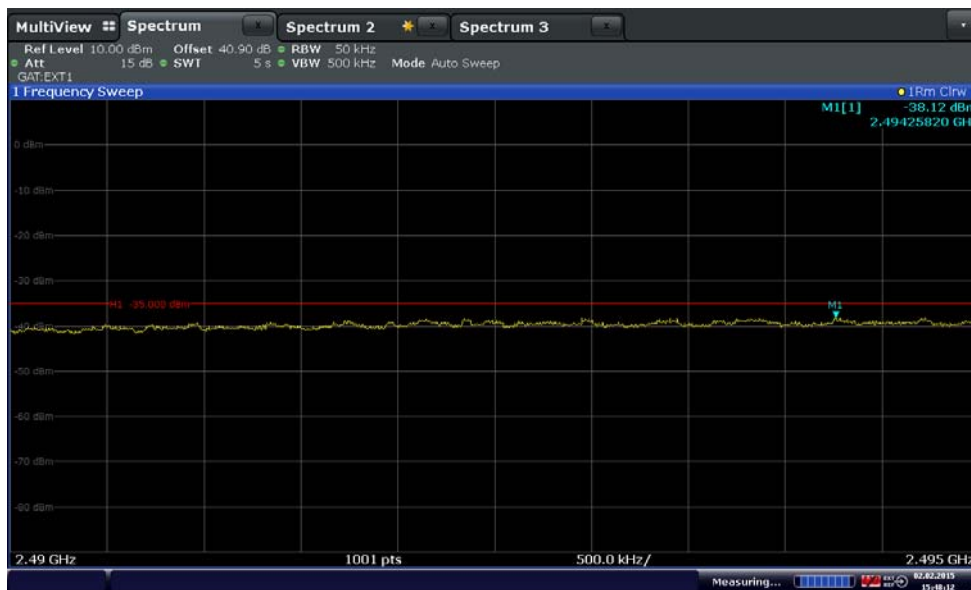
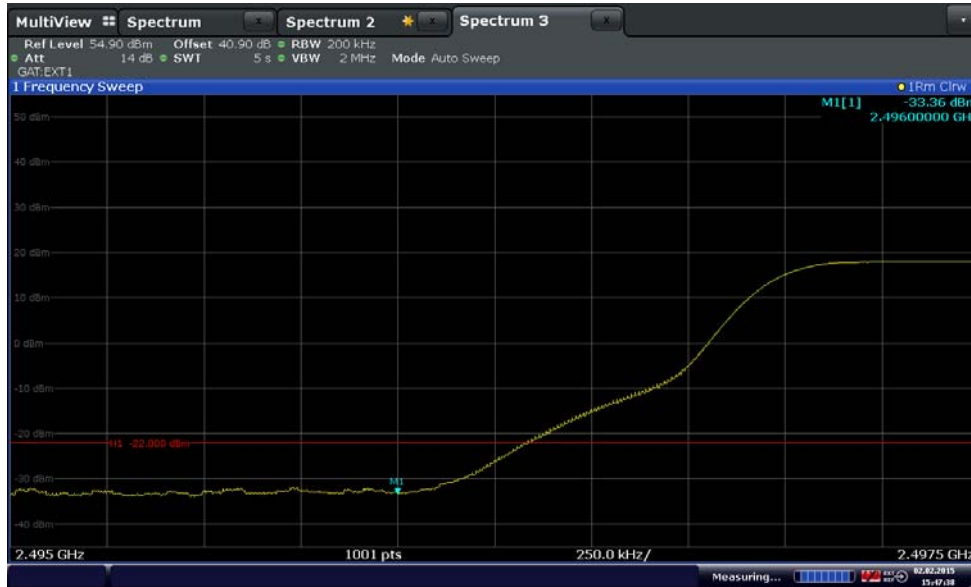
Configuration L-MIMO-MC 2 (3C)

Maximum Output Power 43.0dBm per port

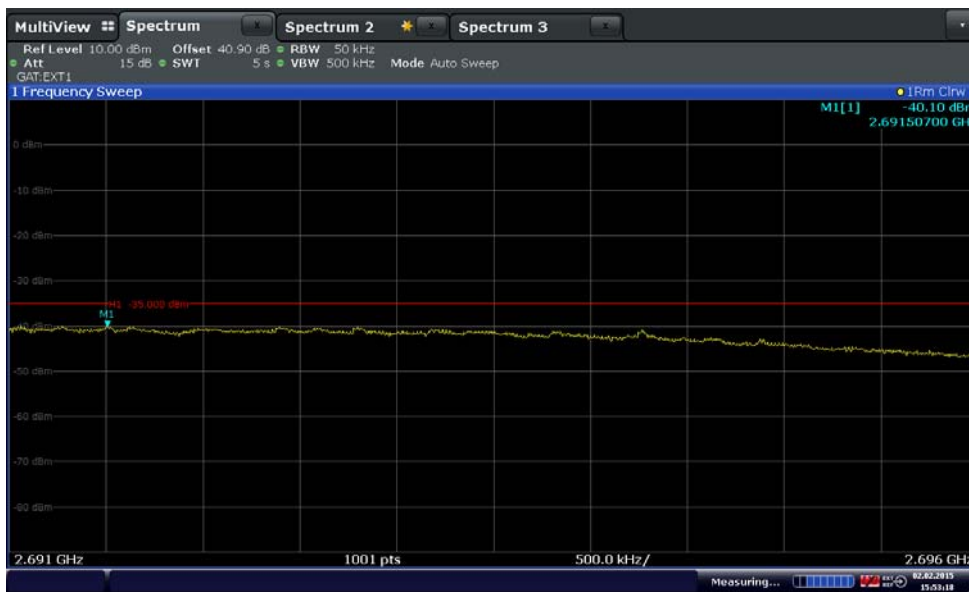
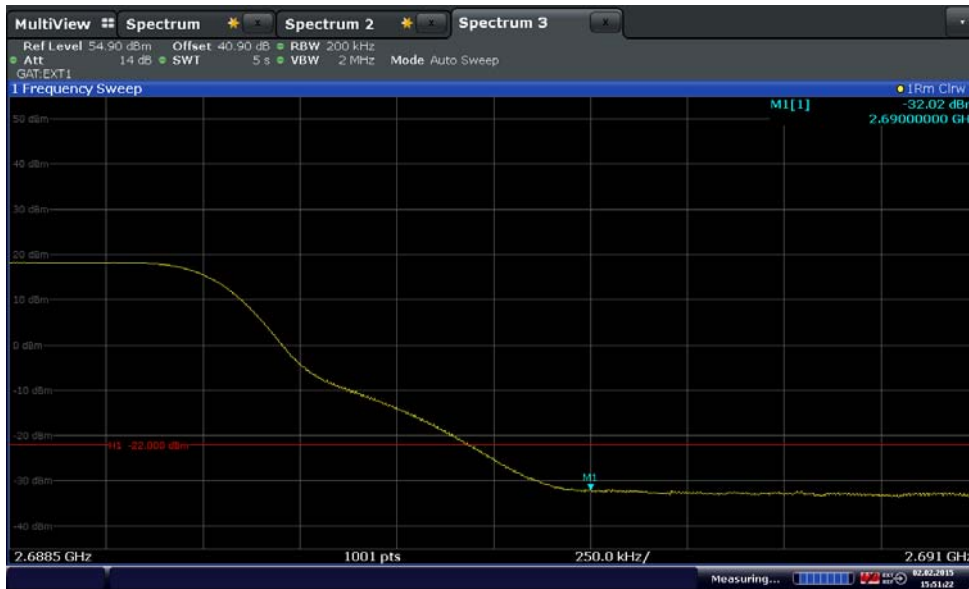
Band Edge Frequency	Channel Bandwidth	Edge Test with modulation QPSK Channel Frequencies
Channel Position B_{RFBW} 2496.0 MHz	20.0 MHz	2506.0 MHz + 2526.0 MHz + 2546.0 MHz
Channel Position T_{RFBW} 2690.0 MHz	20.0 MHz	2640.0 MHz + 2660.0 MHz + 2680.0 MHz

Note: The channels shown in the table above are the minimum and maximum channels that can be used in the authorised frequency ranges to maintain compliance. Channels outside of the ranges shown in the above tables shall not be made available to the end user.

Channel Position B_{RFBW} - LTE QPSK: Bandwidth 20.0MHz



Channel Position T_{RFBW} - LTE QPSK: Bandwidth 20.0MHz



Limit

The power of any emission outside the frequency band shall be attenuated below the transmitter power (P) by at least $43 + 10\log P$ dB.

2.4 RADIATED SPURIOUS EMISSIONS

2.4.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1053
FCC CFR 47 Part 27, Clause 27.53 (m)

2.4.2 Equipment Under Test

RRUS 82 B41, KRC 161 436/1, S/N: D820462482

2.4.3 Date of Test and Modification State

30 January 2015 - Modification State 0

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.5 Environmental Conditions

Ambient Temperature	23.5°C
Relative Humidity	32.5%

2.4.6 Test Method

The test was applied in accordance with test method requirements of ANSI/TIA-603-C-2004.

A preliminary profile of the Spurious Radiated Emissions was obtained by operating the EUT on a remotely controlled turntable within the chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations.

Emissions identified within the range 30MHz – 27GHz were then formally measured using a Peak detector as the worst case.

In the frequency Range 30MHz – 27GHz, the measurement was performed with a resolution bandwidth of 1MHz.

The measurements were performed at a 3m distance unless otherwise stated.

The limits for Spurious Emissions have been calculated, as shown below using the following formula:

Field Strength of Carrier - $(43 + 10\log(P))$ dB

Where:

Field Strength is measured in dB μ V/m

P is measured Transmitter Power in Watts

Determination of Spurious Emission Limit

As the EUT does not have an integral antenna, the field strength of the carrier has been calculated assuming that the power is to be fed to a half-wave tuned dipole as per 2.1053 (a).

$$E_{(v/m)} = (30 \times G_i \times P_o)^{0.5} / d$$

Where G_i is the antenna gain of an ideal half-wave dipole,
 P_o is the power out of the transceiver in W,
 d is the measurement distance in meter.

Therefore at 3m measurement distance the field strength using the lowest transceiver output power would be:

$$E_{(v/m)} = (30 \times 1.64 \times 17.02)^{0.5} / 3 = 9.65V/m = 139.71dB\mu V/m$$

As per 24.238(a) the spurious emission must be attenuated by $43 + 10\log(P_o)$ dB this gives:

$$43 + 10\log(17.02) = 55.31dB$$

Therefore the limit at 3m measurement distance is:

$$139.71 - 55.31 = 84.4 \text{ dB}\mu V/m$$

This limit has been used to determine Pass or Fail for the harmonics measured and detailed in the following results.

The results are shown in the plots below.

2.4.7 Test Results

Note: Only the worst case results plots have been included as all of the emissions are greater than 20dB below the limit. A set of plots have been included to show the measurement system noise floor.

Configuration L-MIMO-SC (1C)

Maximum Output Power 43.0dBm per port, LTE Bandwidth 20.0MHz

Channel Position	Channel Frequencies
Channel Position B	2506.0MHz
Channel Position M	2593.0MHz
Channel Position T	2680.0MHz

Channel Position B – 16QAM

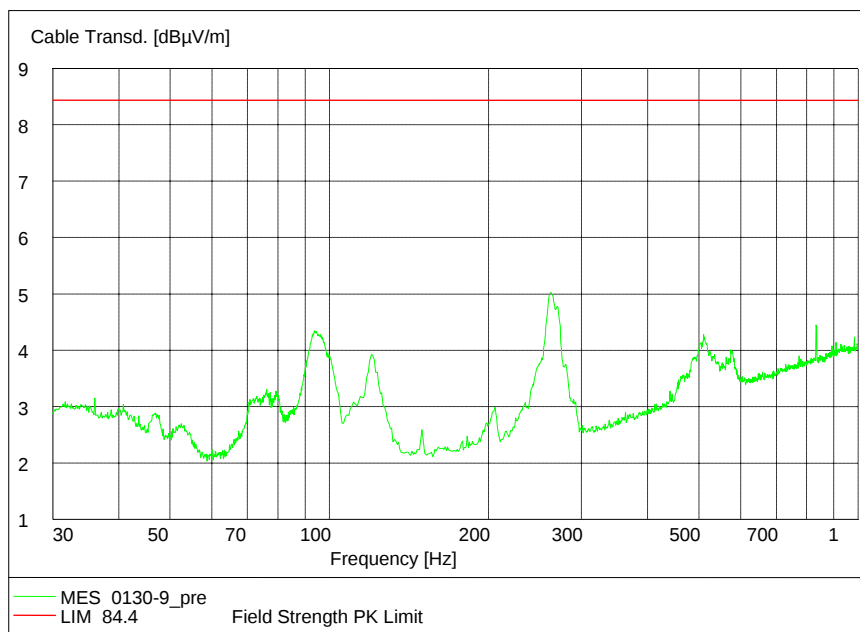
No emissions were detected within 20dB of the limit.

Channel Position M – 16QAM

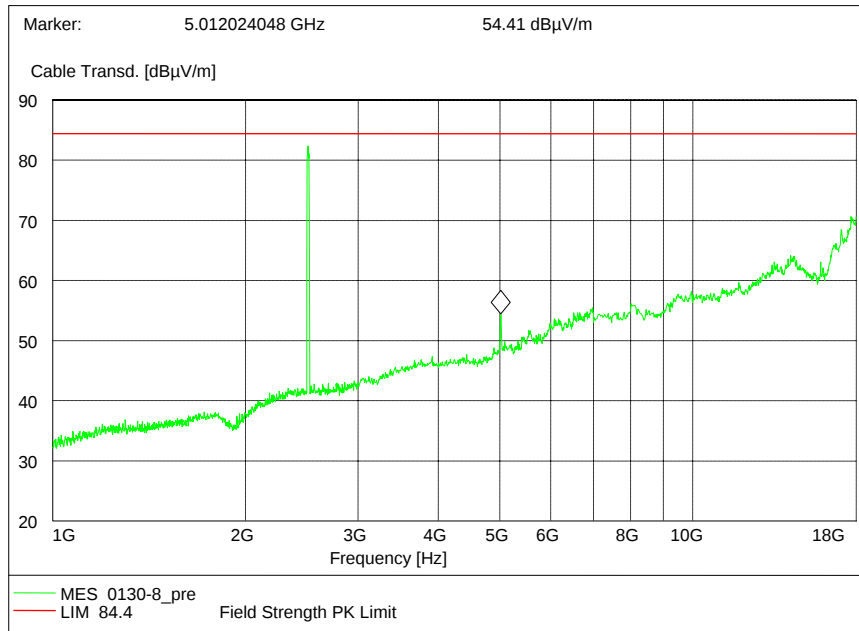
No emissions were detected within 20dB of the limit.

Channel Position T – 16QAM

Channel Position T – 16QAM / Bandwidth 20.0MHz – 30MHz – 1GHz

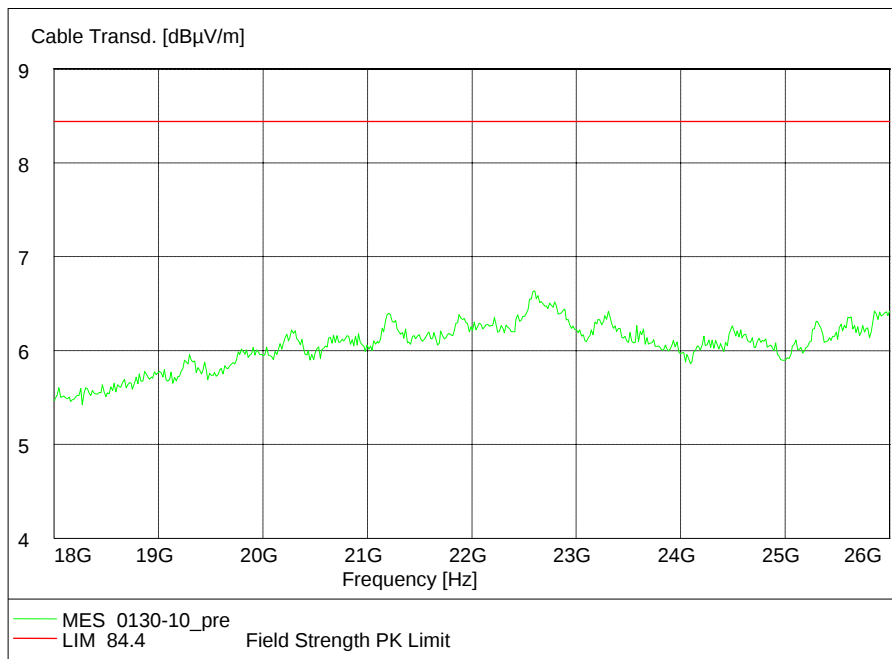


Channel Position T – 16QAM / Bandwidth 20.0MHz - 1GHz – 18GHz

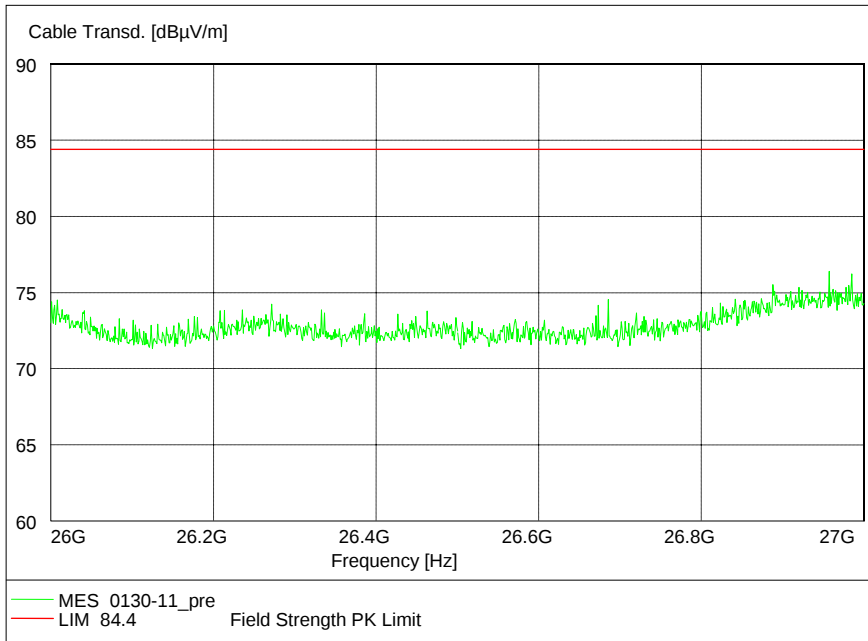


Note: The frequency marked is the harmonic.

Channel Position T – 16QAM / Bandwidth 20.0MHz - 18GHz – 26GHz



Channel Position T – 16QAM / Bandwidth 20.0MHz - 26GHz – 27GHz



Configuration L-MIMO-SC (1C)

Maximum Output Power 43.0dBm per port, LTE Bandwidth 20.0MHz

Channel Position	Channel Frequencies
Channel Position M	2593.0MHz

Channel Position M – QPSK

No emissions were detected within 20dB of the limit.

Channel Position M – 64QAM

No emissions were detected within 20dB of the limit.

Configuration L-MIMO-MC 1 (2C)

Maximum Output Power 43.0dBm per port, LTE Bandwidth 20.0MHz

Channel Position	Channel Frequencies
Channel Position T _{RFBW}	2660.0MHz + 2680.0MHz

Channel Position T_{RFBW} – QPSK

No emissions were detected within 20dB of the limit.

Configuration L-MIMO-MC 2 (3C)

Maximum Output Power 43.0dBm per port, LTE Bandwidth 20.0MHz

Channel Position	Channel Frequencies
Channel Position T_{RFBW}	2640.0MHz + 2660.0MHz + 2680.0MHz

Channel Position T_{RFBW} – QPSK

No emissions were detected within 20dB of the limit.

Remarks

Limit	-13dBm / 84.4dB μ V/m
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The EUT does not exceed -13dBm / 84.4dB μ V/m at the measured frequencies.

2.5 CONDUCTED SPURIOUS EMISSIONS

2.5.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051
FCC CFR 47 Part 27, Clause 27.53 (m)

2.5.2 Equipment Under Test

RRUS 82 B41, KRC 161 436/1, S/N: D820462482

2.5.3 Date of Test and Modification State

02 and 06 February 2015 - Modification State 0

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.5 Environmental Conditions

Ambient Temperature	24.7 - 25.5 °C
Relative Humidity	26.8 - 28.6 %

2.5.6 Test Method

The test was applied in accordance with test method requirements of FCC Part 2 and KDB 971168 D01.

In accordance with FCC CFR 47 Part 2, Clause 2.1051, the spurious emissions from the antenna terminal were measured. In accordance with FCC CFR 47 Part 27, Clause 27.53 (m), any emissions outside of the block edges shall be attenuated by at least $43 + 10 \log (P)$.

The EUT was set to transmit at its maximum rated output power. The path loss between the Spectrum Analyser and the EUT was measured with the worst case level being entered as a Reference Level Offset. In accordance with 27.53 (m), the RBW was set to 1MHz and a Peak detector with the trace set to Max Hold was used. The frequency spectrum was then investigated between 9 kHz and 27GHz. Testing was carried out on the Bottom, Middle and Top channels.

For MIMO mode configurations, the limit was adjusted with a correction of -9dB $[10\log(8)]$ by using the Measure and Add $10\log(N)$ dB technique according to FCC KDB662911 D01 accounting for simultaneous transmission from antenna ports RF 1 to RF 8.

The measurements were performed on the output connector RF 4. Limited complementary measurement were done at other output connectors to verify identical performance for all transmitter chains in MIMO mode.

The results are shown in the plots below.

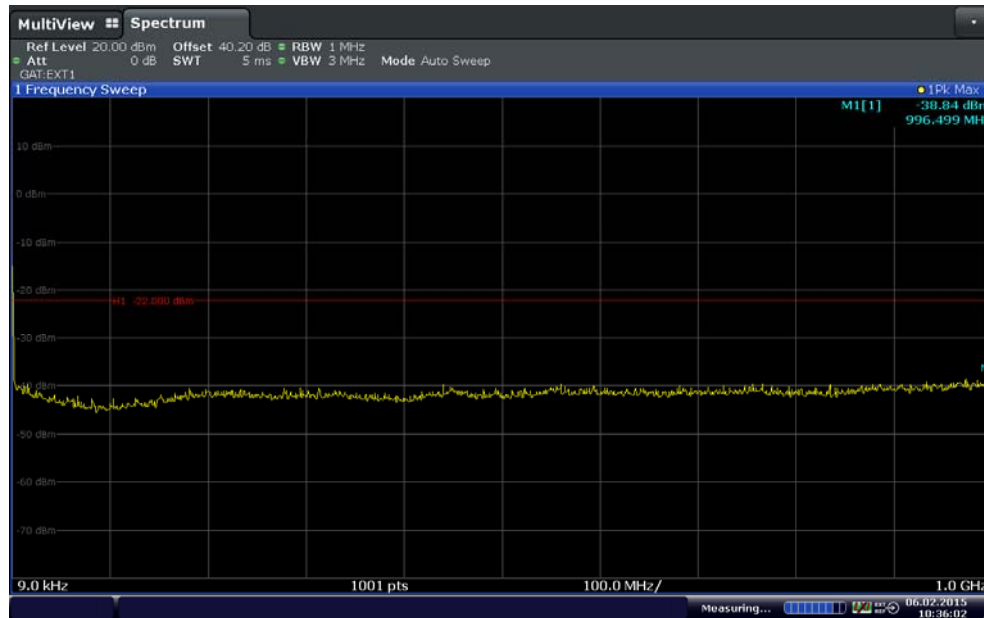
2.5.7 Test Results

Configuration L-MIMO-SC (1C)

Maximum Output Power 43.0dBm per port

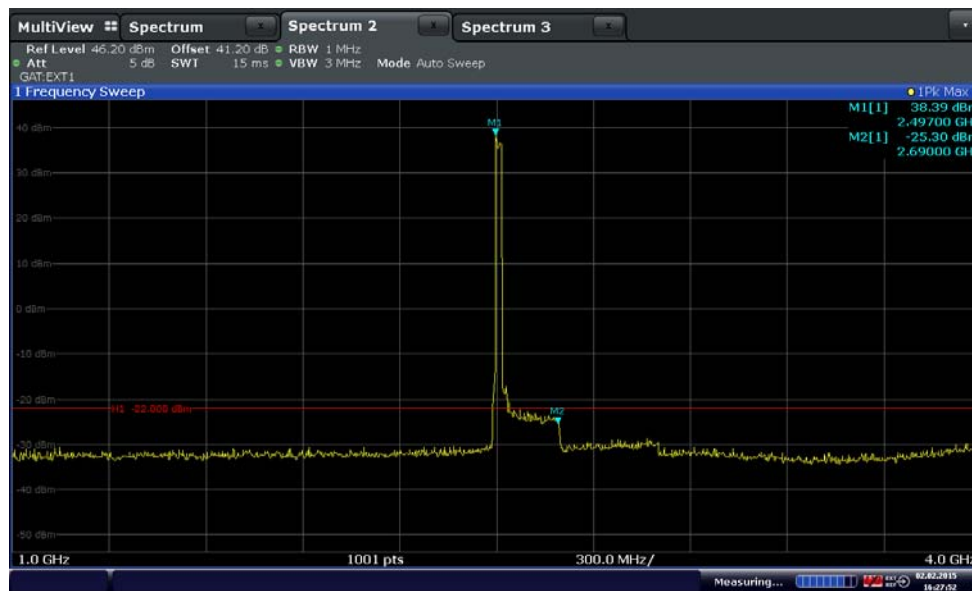
Channel Position	Bandwidth	Channel Frequency
Channel Position B	20.0MHz	2506.0MHz
Channel Position M	20.0MHz	2593.0MHz
Channel Position T	20.0MHz	2680.0MHz

Channel Position B - QPSK / Bandwidth 20.0MHz - 9kHz – 1GHz



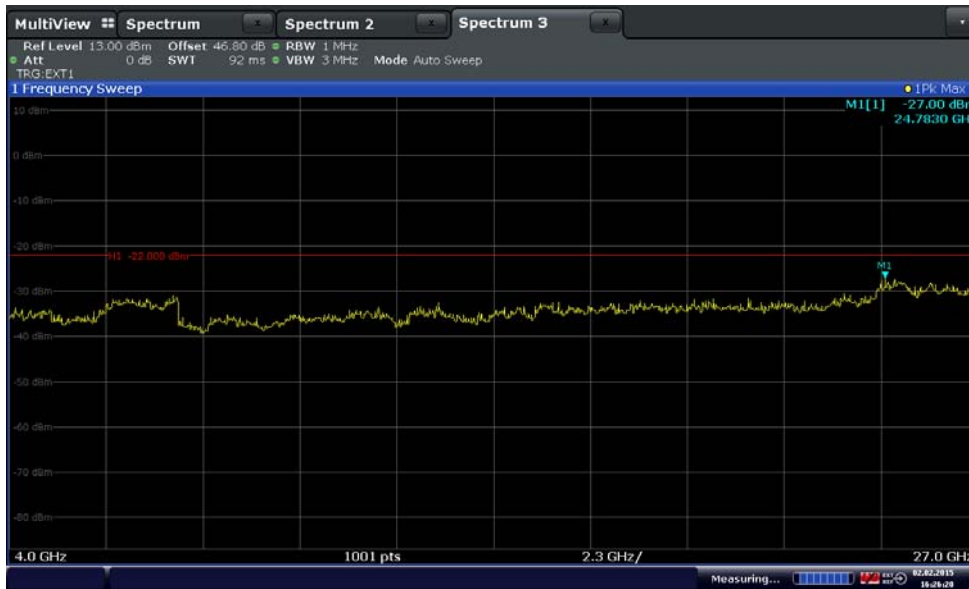
Date: 6.FEB.2015 10:36:02

Channel Position B - QPSK / Bandwidth 20.0MHz - 1GHz – 4GHz

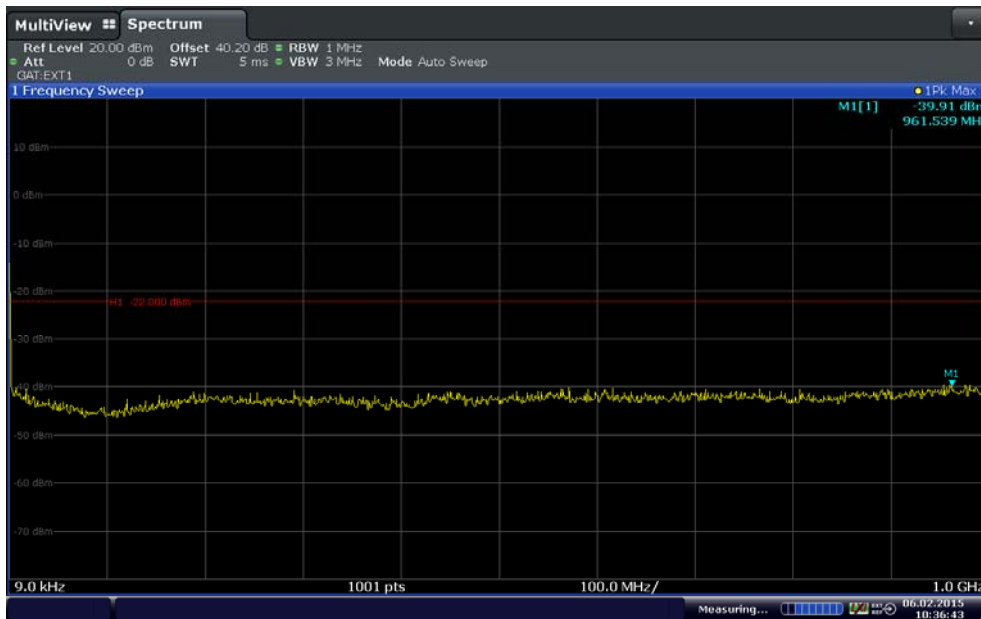


Note: The emission beyond the limit is within the operating frequency

Channel Position B - QPSK / Bandwidth 20.0MHz - 4GHz – 27GHz

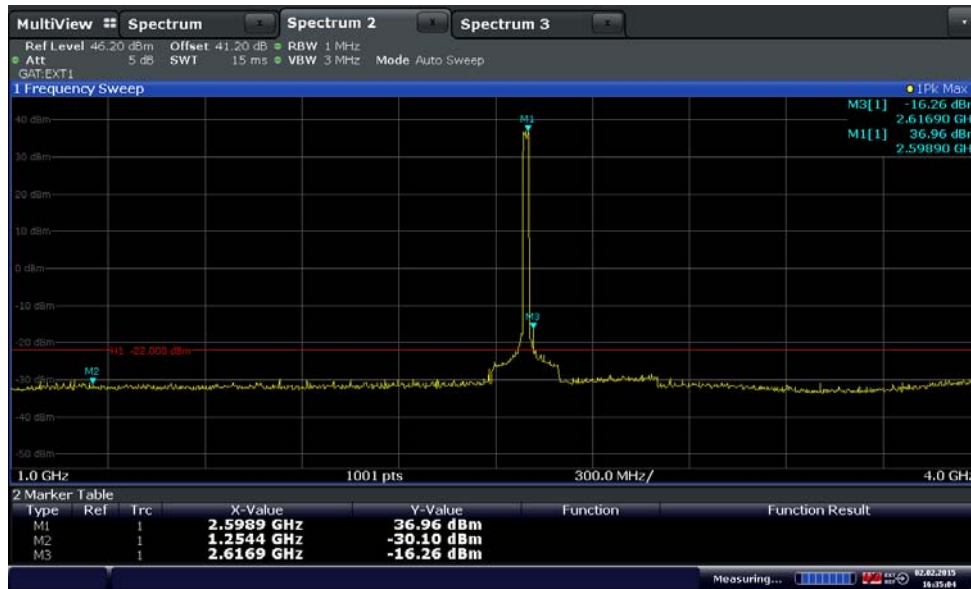


Channel Position M - QPSK / Bandwidth 20.0MHz - 9kHz – 1GHz



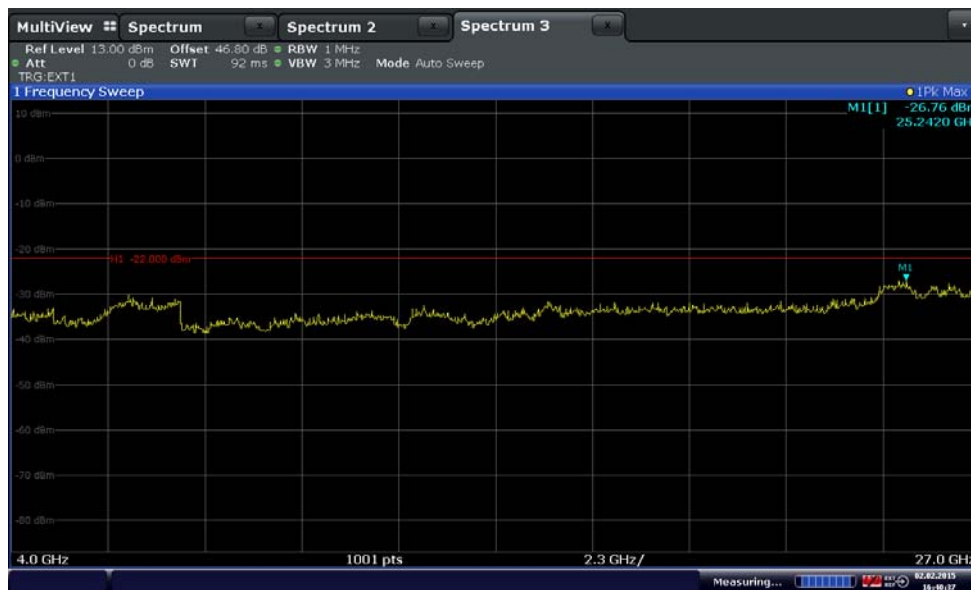
Date: 6.FEB.2015 10:36:43

Channel Position M - QPSK / Bandwidth 20.0MHz - 1GHz – 4GHz

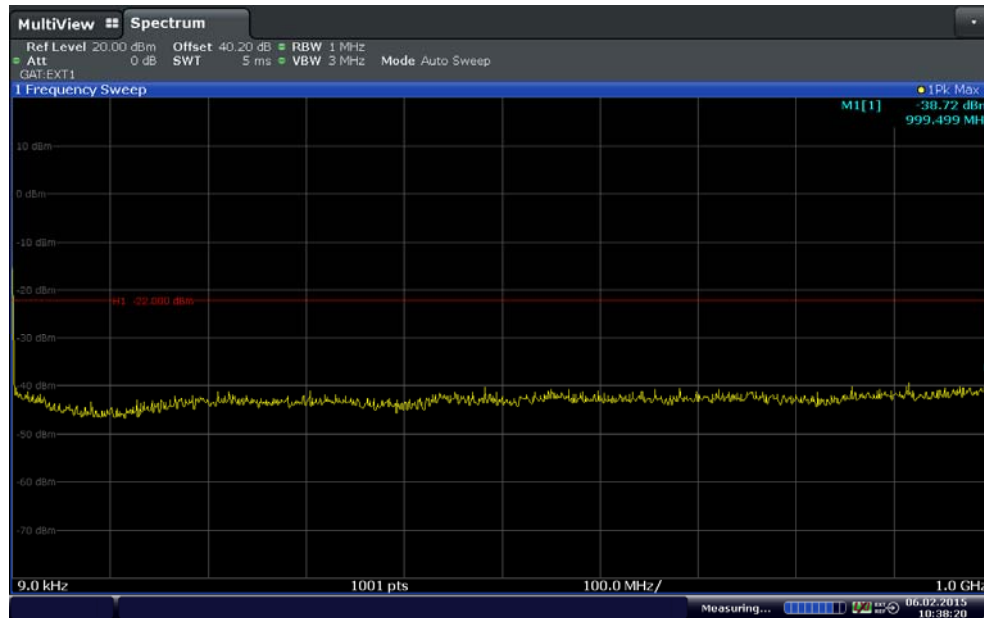


Note: The emission beyond the limit is within the operating frequency

Channel Position M - QPSK / Bandwidth 20.0MHz - 4GHz – 27GHz

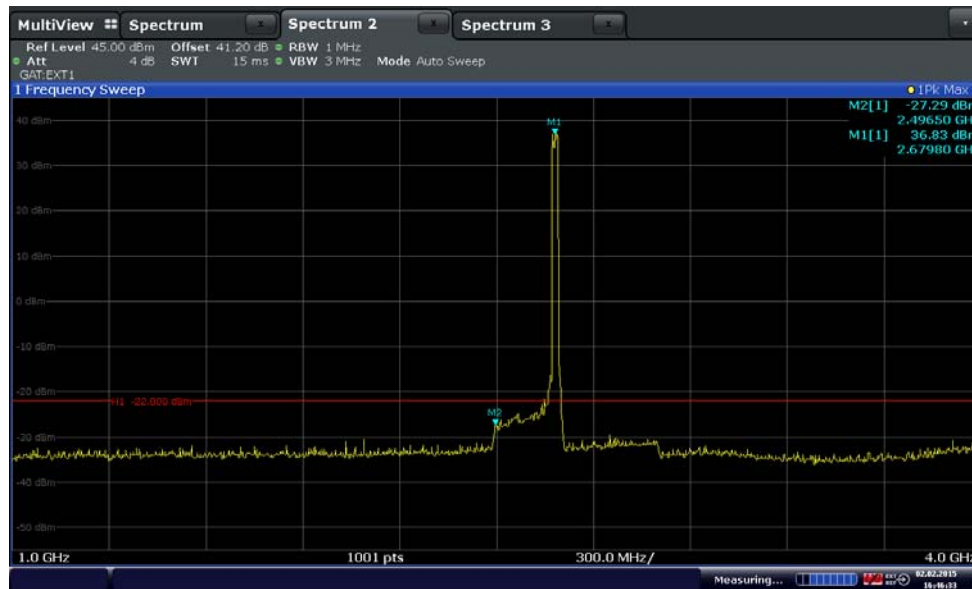


Channel Position T - QPSK / Bandwidth 20.0MHz - 9kHz – 1GHz



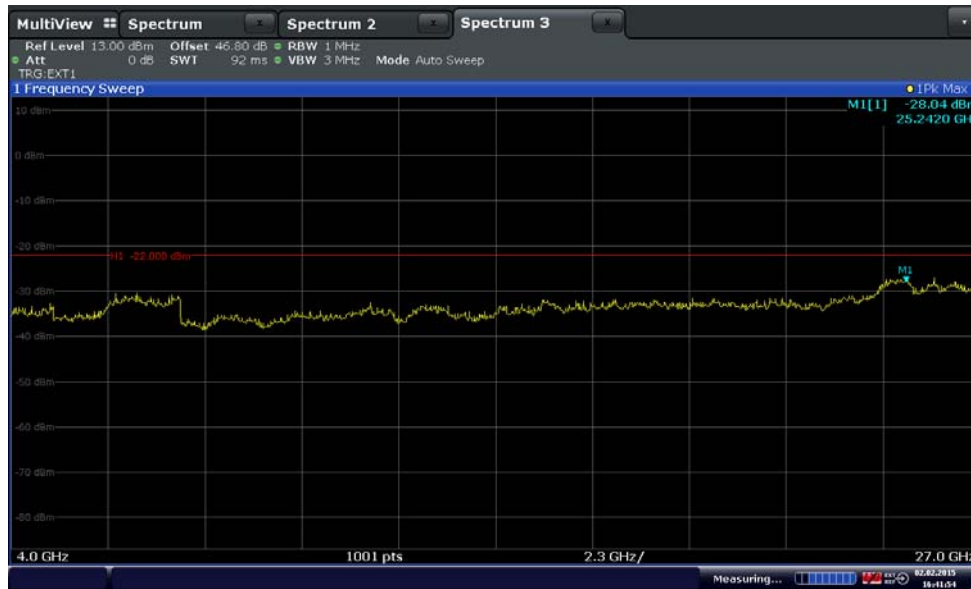
Date: 6.FEB.2015 10:38:19

Channel Position T - QPSK / Bandwidth 20.0MHz - 1GHz – 4GHz



Note: The emission beyond the limit is within the operating frequency

Channel Position T - QPSK / Bandwidth 20.0MHz - 4GHz – 27GHz

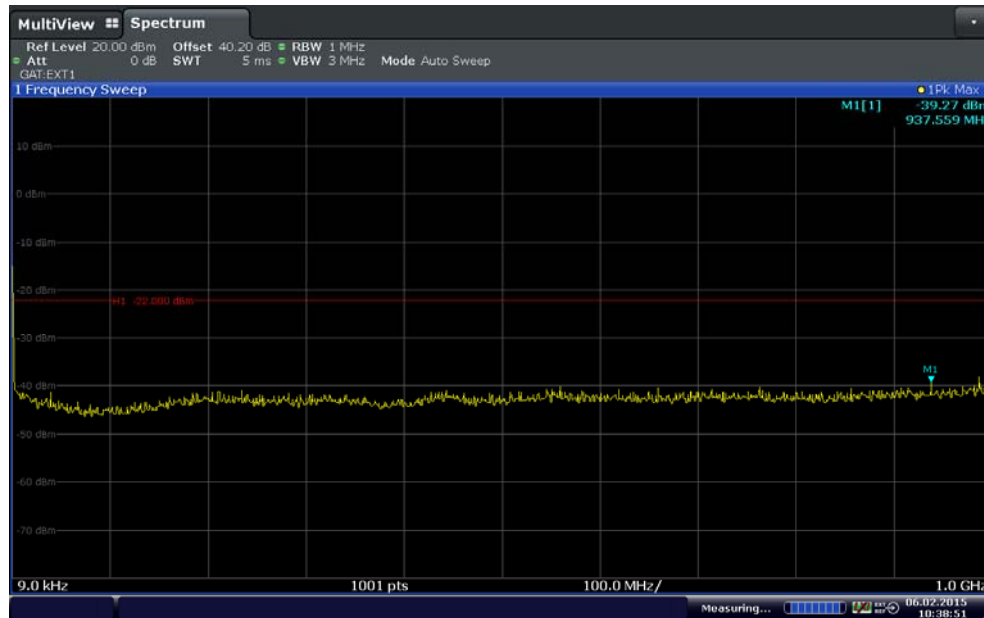


Configuration L-MIMO-MC 1 (2C)

Maximum Output Power 43.0dBm per port

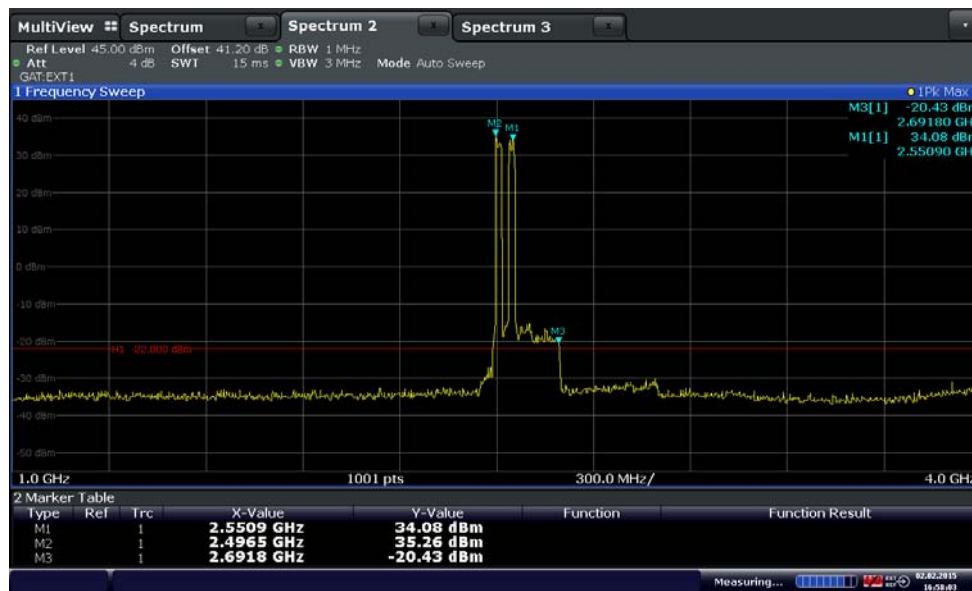
Channel Position	Bandwidth	Channel Frequency
Channel Position B _{RFBW}	20.0MHz	2506.0MHz + 2546.0MHz
Channel Position M _{RFBW}	20.0MHz	2573.0MHz + 2613.0MHz
Channel Position T _{RFBW}	20.0MHz	2640.0MHz + 2680.0MHz

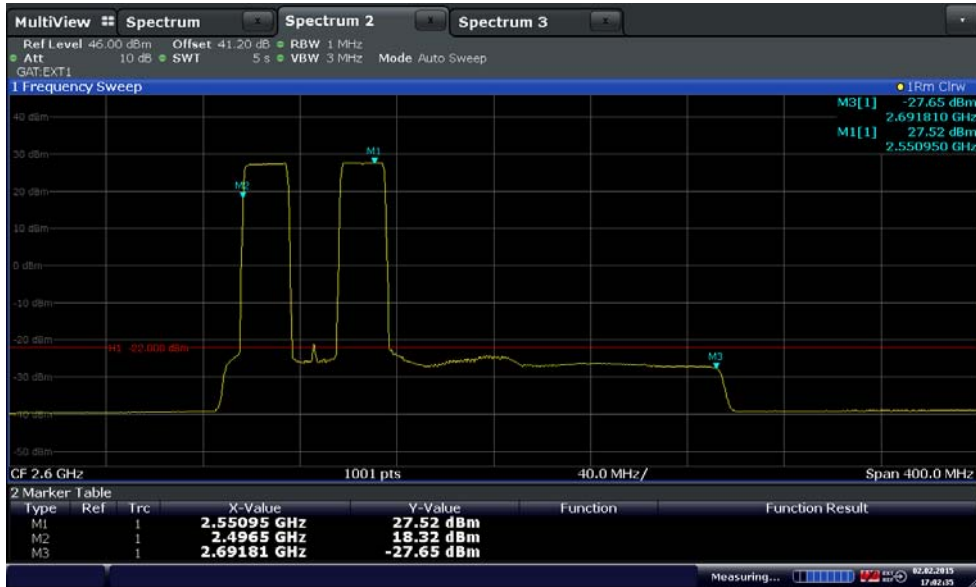
Channel Position B_{RFBW} - QPSK / Bandwidth 20.0MHz - 9kHz – 1GHz



Date: 6.FEB.2015 10:38:52

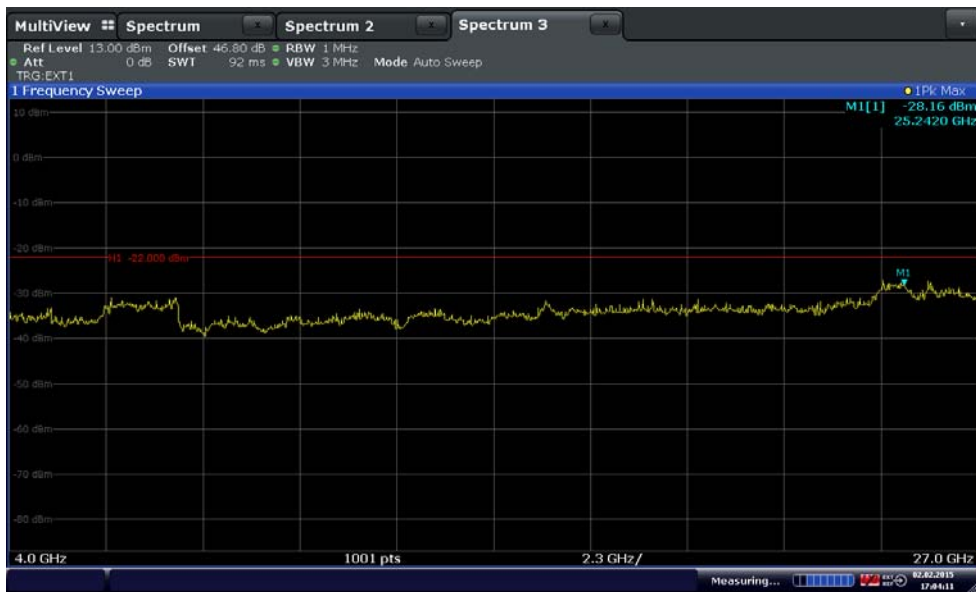
Channel Position B_{RFBW} - QPSK / Bandwidth 20.0MHz - 1GHz – 4GHz



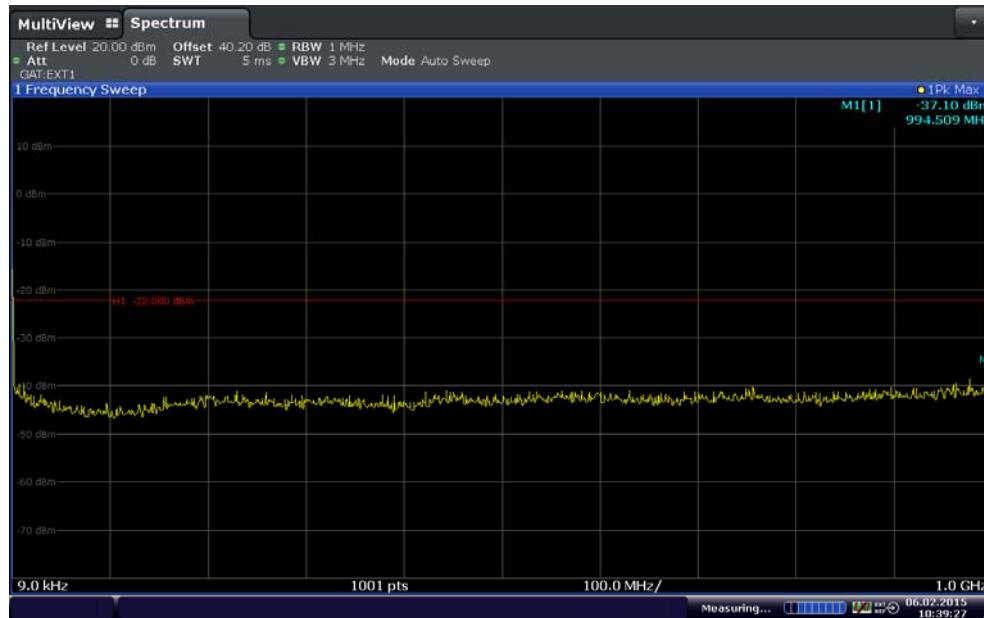


Note: The emission beyond the limit is within the operating frequency

Channel Position B_{RFBW} - QPSK / Bandwidth 20.0MHz - 4GHz – 27GHz

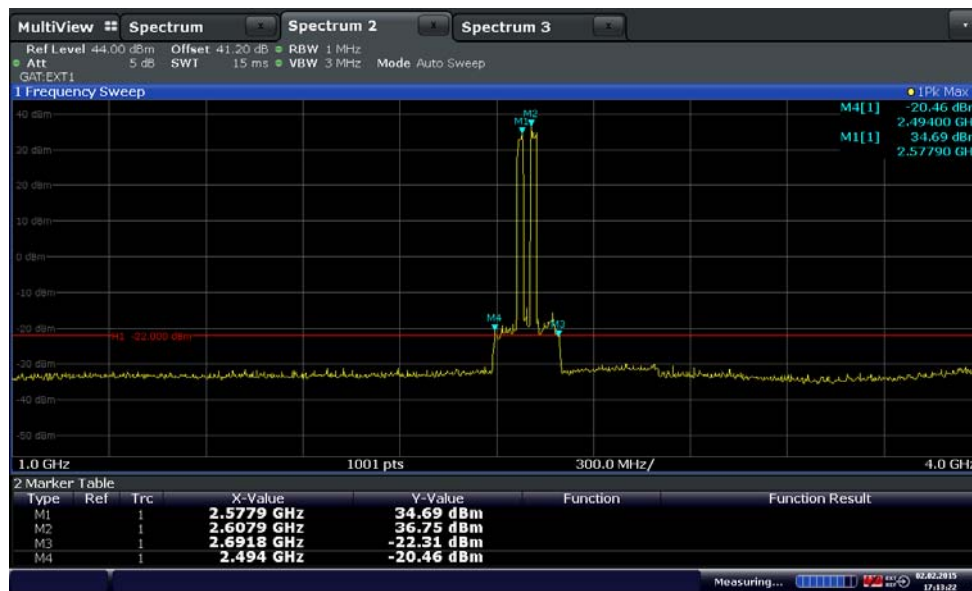


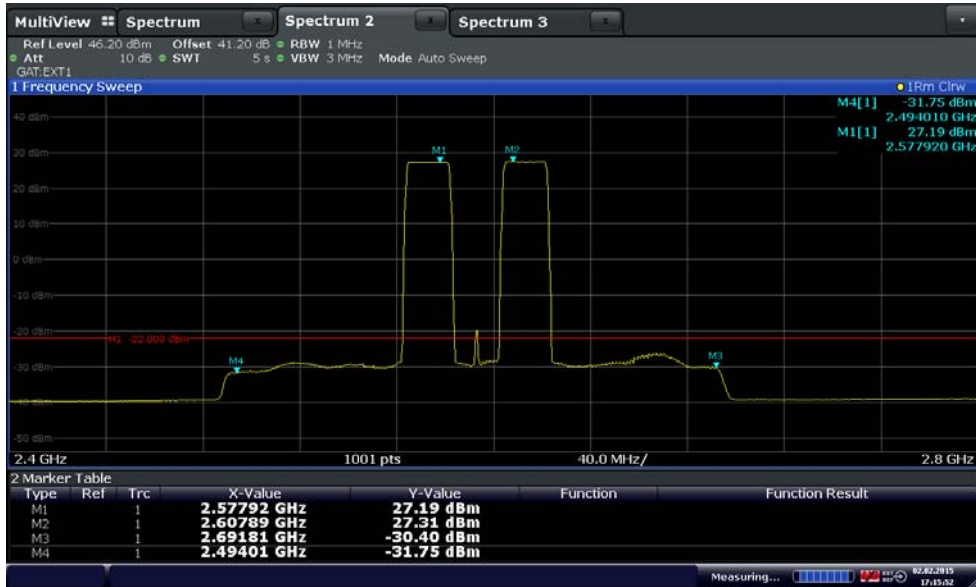
Channel Position M_{RFBW} - QPSK / Bandwidth 20.0MHz - 9kHz – 1GHz



Date: 6.FEB.2015 10:39:27

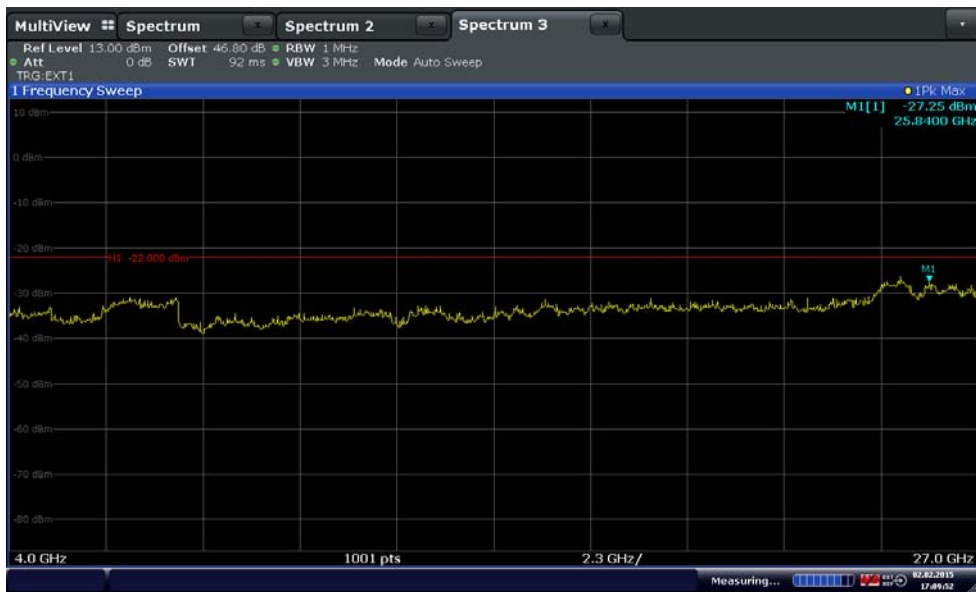
Channel Position M_{RFBW} - QPSK / Bandwidth 20.0MHz - 1GHz – 4GHz



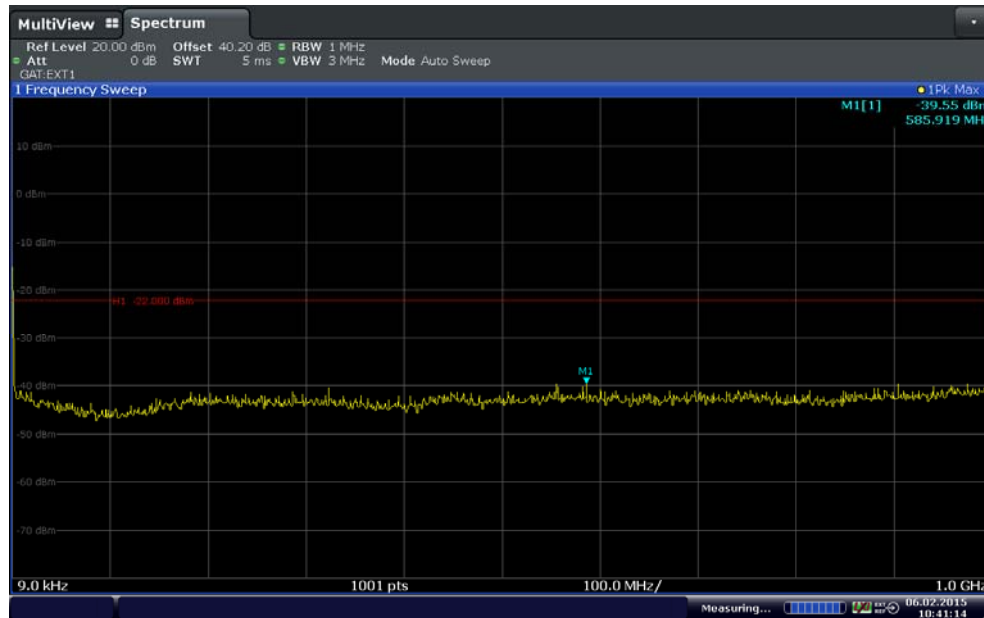


Note: The emission beyond the limit is within the operating frequency

Channel Position M_{RFBW} - QPSK / Bandwidth 20.0MHz - 4GHz – 27GHz

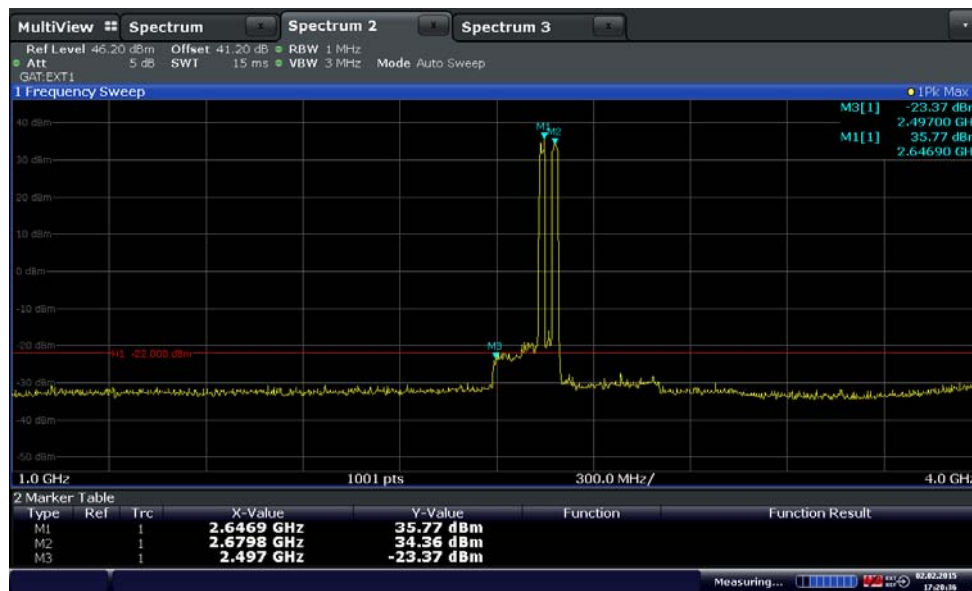


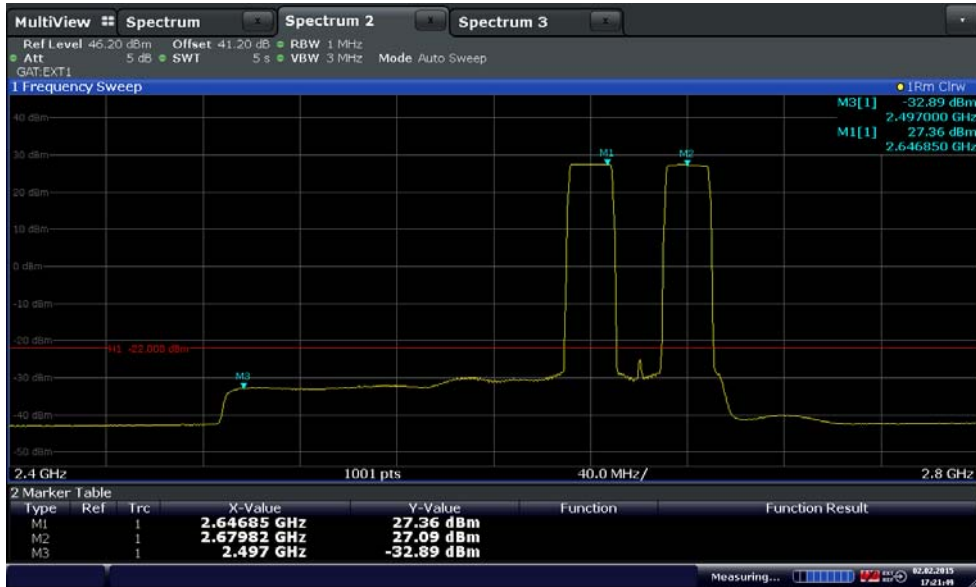
Channel Position T_{RFBW} - QPSK / Bandwidth 20.0MHz - 9kHz – 1GHz



Date: 6.FEB.2015 10:41:14

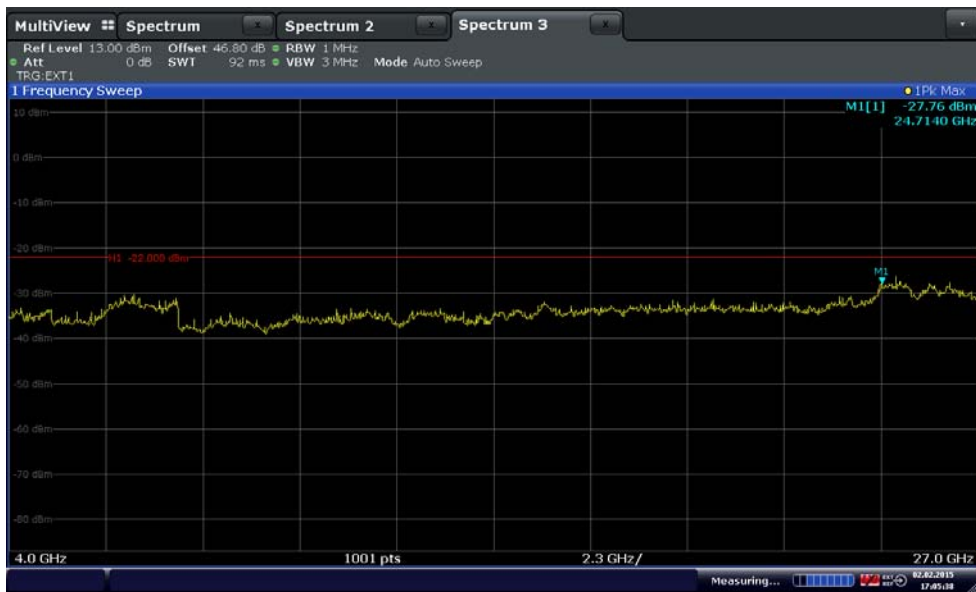
Channel Position T_{RFBW} - QPSK / Bandwidth 20.0MHz - 1GHz – 4GHz





Note: The emission beyond the limit is within the operating frequency

Channel Position T_{RFBW} - QPSK / Bandwidth 20.0MHz - 4GHz – 27GHz

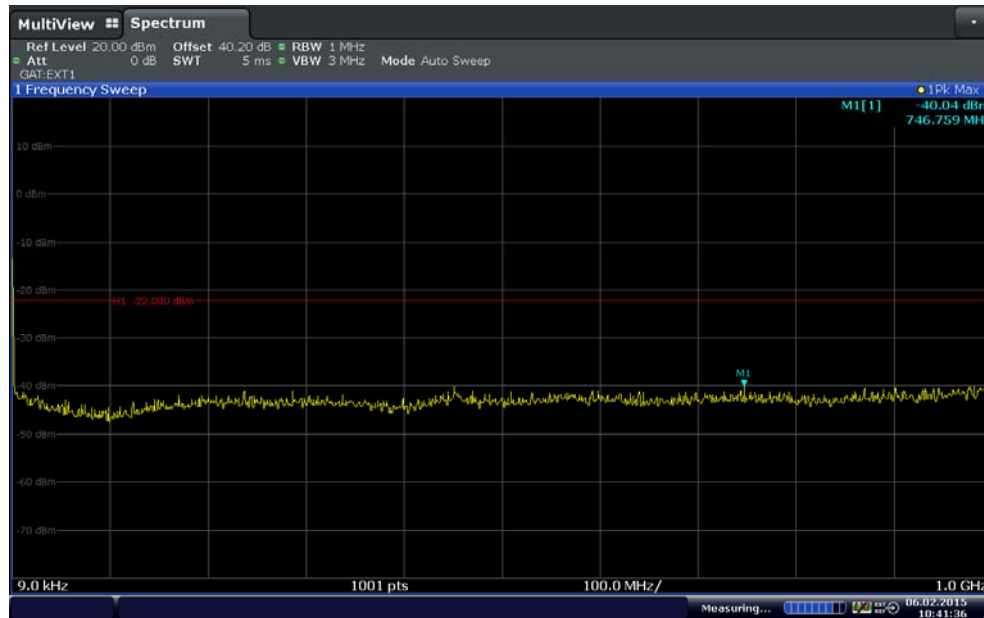


Configuration L-MIMO-MC 2 (3C)

Maximum Output Power 43.0dBm per port

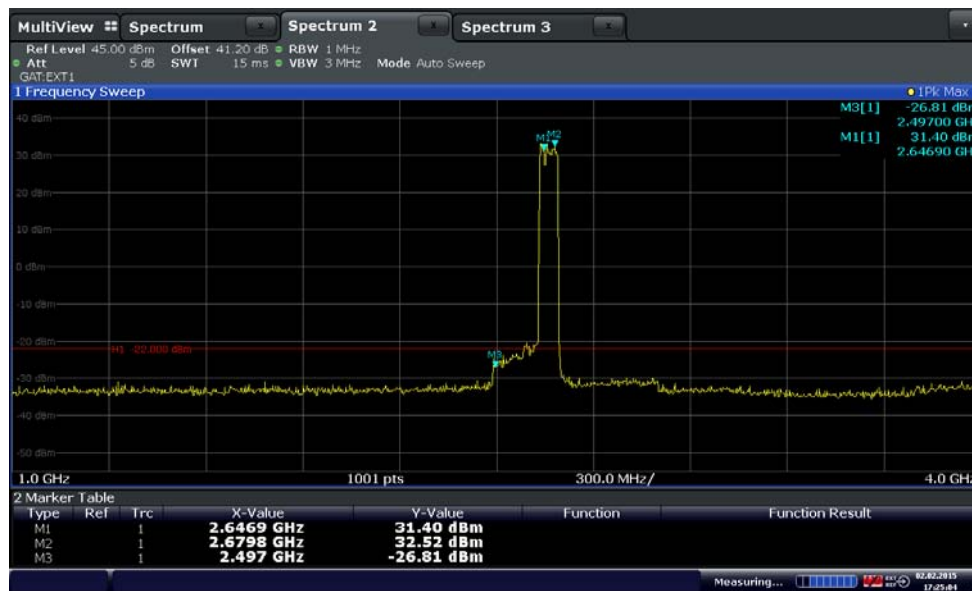
Channel Position	Bandwidth	Channel Frequency
Channel Position B_{RFBW}	20.0MHz	2506.0MHz + 2526.0MHz + 2546.0MHz
Channel Position M_{RFBW}	20.0MHz	2573.0MHz + 2593.0MHz + 2613.0MHz
Channel Position T_{RFBW}	20.0MHz	2640.0MHz + 2660.0MHz + 2680.0MHz

Channel Position B_{RFBW} - QPSK / Bandwidth 20.0MHz - 9kHz – 1GHz



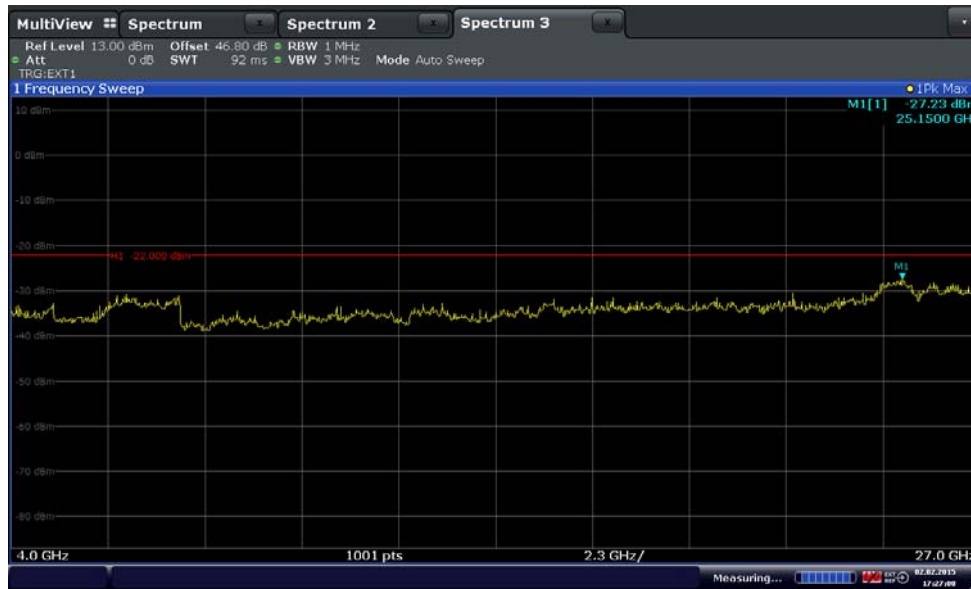
Date: 6.FEB.2015 10:41:37

Channel Position B_{RFBW} - QPSK / Bandwidth 20.0MHz - 1GHz – 4GHz

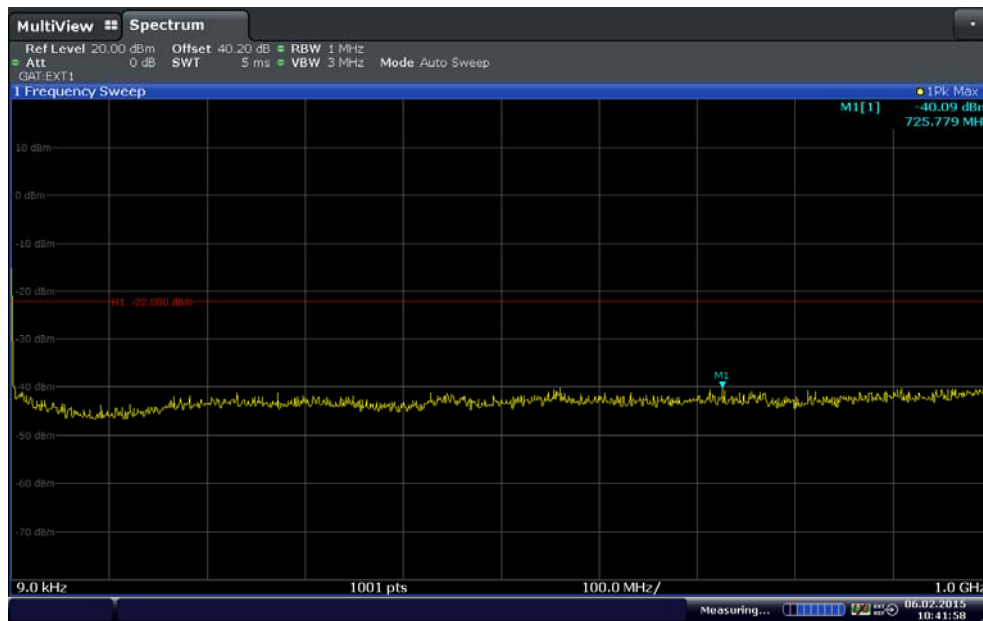


Note: The emission beyond the limit is within the operating frequency

Channel Position B_{RFBW} - QPSK / Bandwidth 20.0MHz - 4GHz – 27GHz

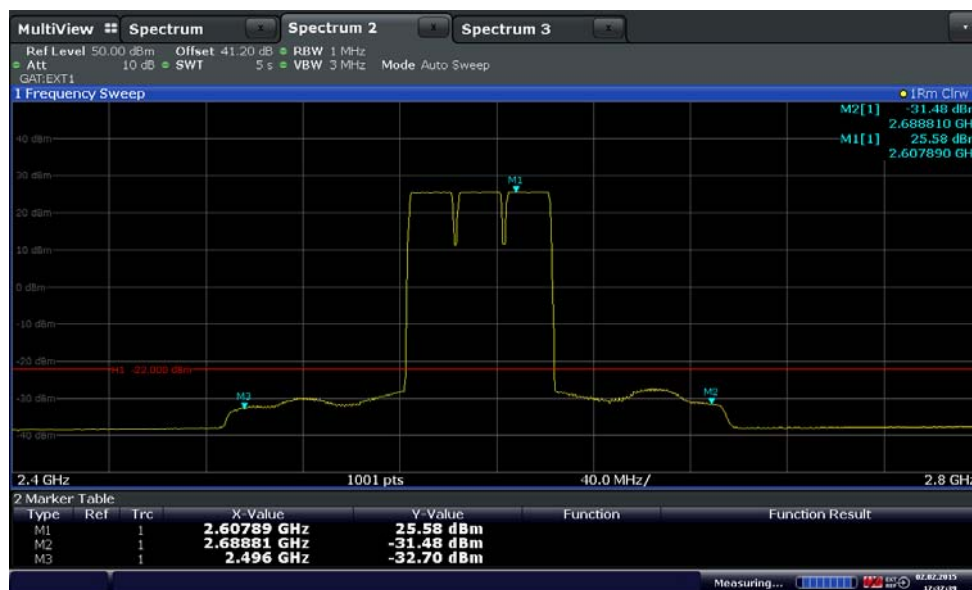
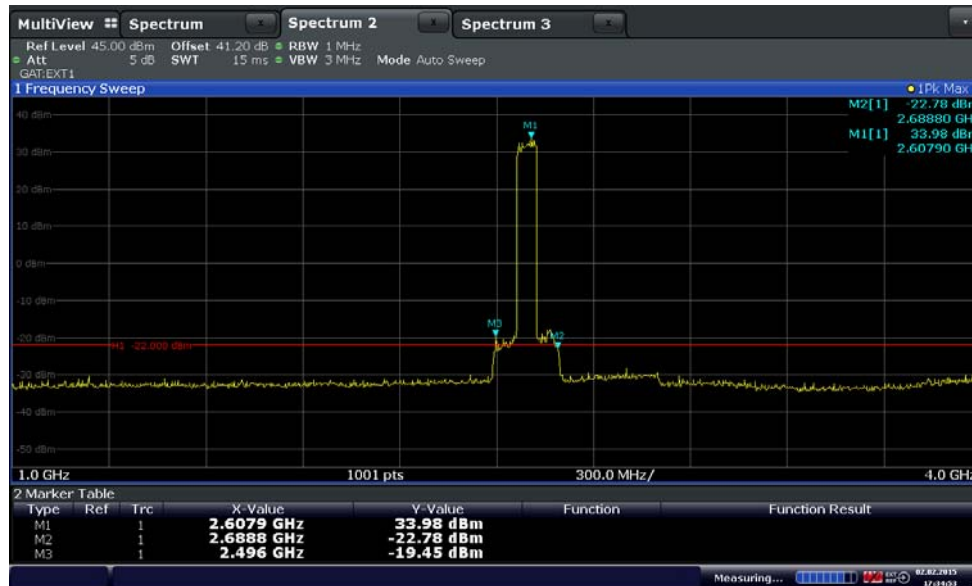


Channel Position M_{RFBW} - QPSK / Bandwidth 20.0MHz - 9kHz – 1GHz



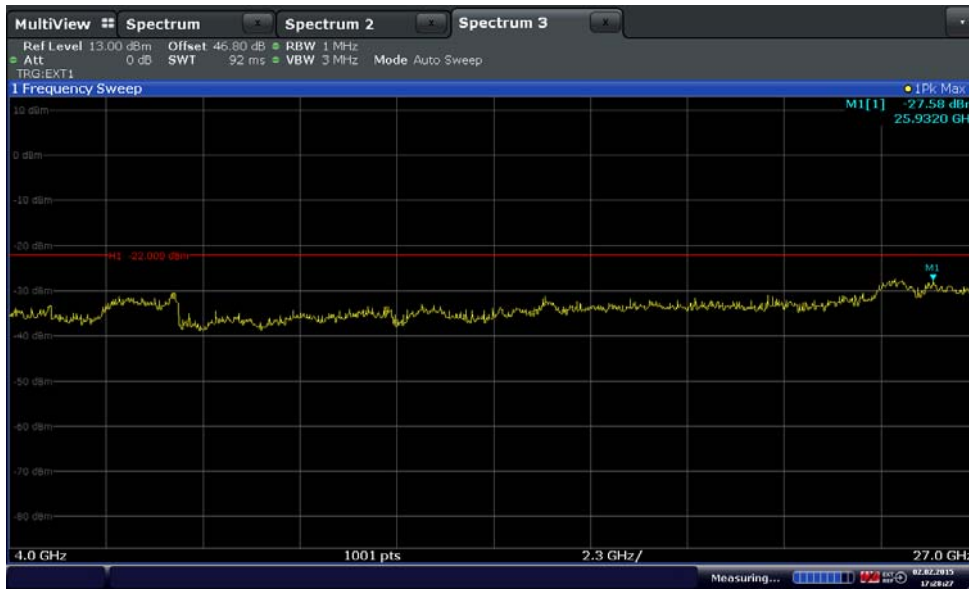
Date: 6.FEB.2015 10:41:58

Channel Position M_{RFBW} - QPSK / Bandwidth 20.0MHz - 1GHz – 4GHz

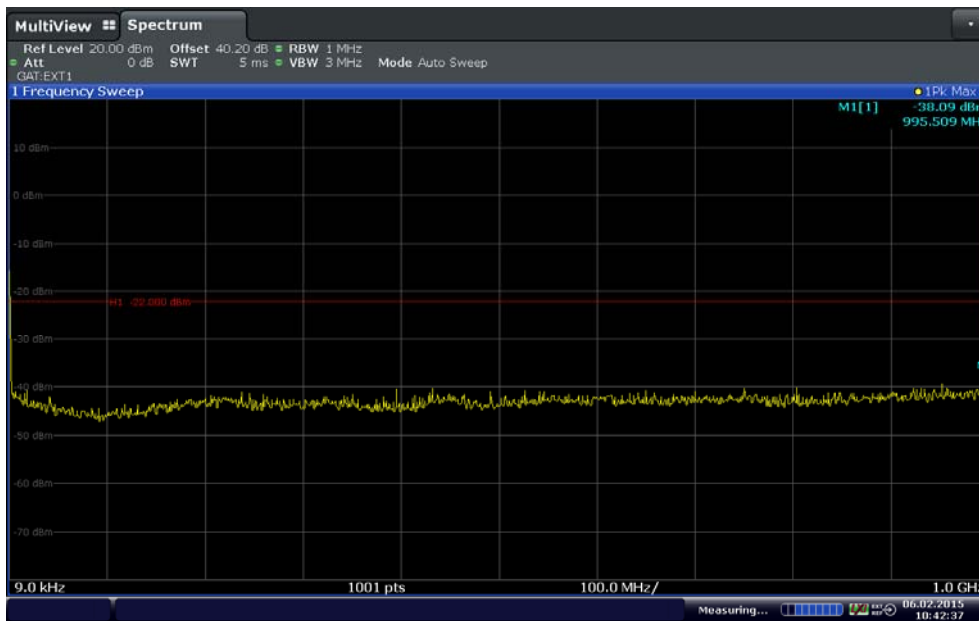


Note: The emission beyond the limit is within the operating frequency

Channel Position M_{RFBW} - QPSK / Bandwidth 20.0MHz - 4GHz – 27GHz

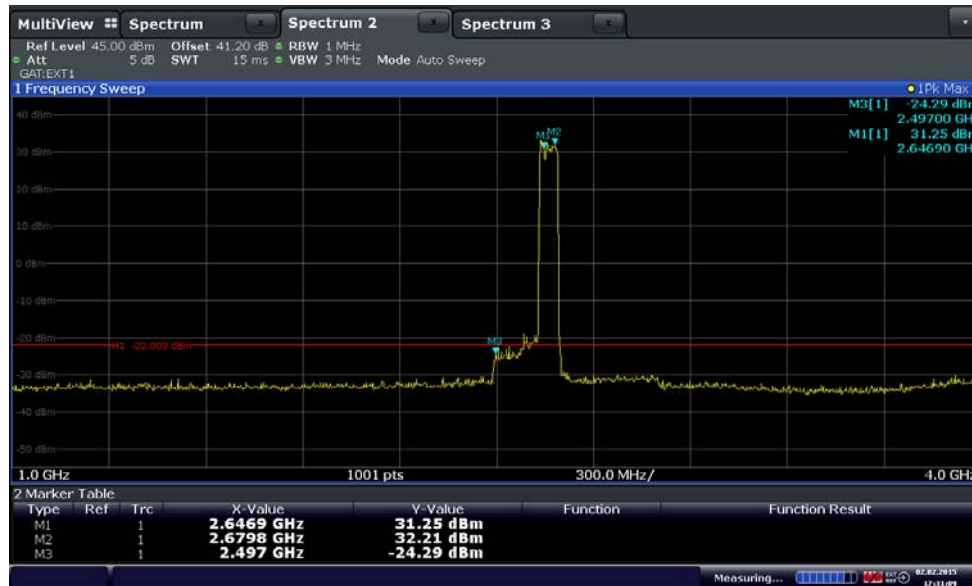


Channel Position T_{RFBW} - QPSK / Bandwidth 20.0MHz - 9kHz – 1GHz



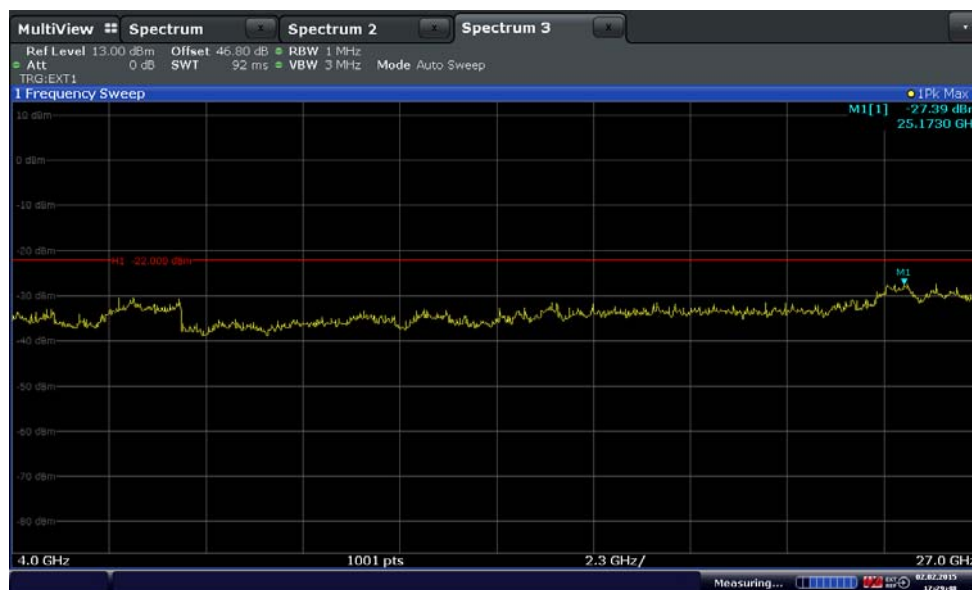
Date: 6.FEB.2015 10:42:38

Channel Position T_{RFBW} - QPSK / Bandwidth 20.0MHz - 1GHz – 4GHz



Note: The emission beyond the limit is within the operating frequency

Channel Position T_{RFBW} - QPSK / Bandwidth 20.0MHz - 4GHz – 27GHz



Limit	-22dBm
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Remarks

The EUT does not exceed -22dBm (-13dBm – 10log8) at the frequency range of 9kHz to 27GHz.

2.6 FREQUENCY STABILITY

2.6.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1055
FCC CFR 47 Part 27, Clause 27.54

2.6.2 Equipment Under Test

RRUS 82 B41, KRC 161 436/1, S/N: D820462482

2.6.3 Date of Test and Modification State

03 and 04 January 2015 - Modification State 0

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Environmental Conditions

Ambient Temperature	25.3 - 25.8°C
Relative Humidity	25.8 - 23.7%

2.6.6 Test Method

Frequency Error – Temperature Variation

The EUT was tested over the temperature range -30°C to +50°C in 10°C steps with -48 VDC Power Supply. At each temperature step, the RRUS was configured to transmit an [RAT]* at maximum power on the middle channel of the operating band. After achieving thermal balance, the averages of 200 transmission bursts were measured and the result recorded.

Frequency Error – Voltage Variation

The EUT was tested at the supplied voltages varied from 85 to 115 percent of the nominal values of both -48 VDC power supplies. At +20°C, the RRUS was configured to transmit an [RAT]* at maximum power on the middle channel of the operating band. The average of 200 transmission bursts was measured and the result recorded.

[RAT]* LTE (20.0 MHz OBW) – Single Carrier with QPSK modulation

Test Results

Configuration L-MIMO-SC (1C)

Maximum Output Power 43.0dBm per port

Supply Voltage DC (V)	Temperature	Frequency Stability (Hz)
		Channel Position M (2593.0MHz)
-48.0	-30°C	-6.90
	-20°C	-6.25
	-10°C	-7.34
	0°C	-8.30
	+10°C	-7.24
	+20°C	-4.22
	+30°C	-3.72
	+40°C	-2.14
	+50°C	-5.39

Supply Voltage DC (V)	Temperature	Frequency Stability (Hz)
		Channel Position M (2593.0MHz)
-40.8 V	+20°C	-4.56
-48.0 V		-4.22
-55.2 V		-5.21

Remarks

Limit	The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.
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Product Service

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Maximum Average Output Power and Peak to Average Ratio - Conducted					
Network Analyzer	Agilent	8720D	US36140166	12	17-Nov-2015
Power Meter	Rohde & Schwarz	NRP	101593	12	10-Aug-2015
Power Sensor	Rohde & Schwarz	NRP-Z21	103607	12	15-Apr-2015
Spectrum Analyser	Rohde & Schwarz	FSW43	100615	12	10-Aug-2015
40dB Attenuator	Aeroflex / Weinschel	48-40-43-LIM	BR5020	-	O/P MON
DC Power Supply	Dahua	DH1716A-10	1000303181	-	O/P MON
Digital Multimeter	FLUKE	179	91820401	12	14-Dec-2015
Thermo-hygrometer	AZ Instruments	8705	9151665	12	10-Dec-2015
Occupied Bandwidth					
Network Analyzer	Agilent	8720D	US36140166	12	17-Nov-2015
Spectrum Analyser	Rohde & Schwarz	FSW43	100615	12	10-Aug-2015
40dB Attenuator	Aeroflex / Weinschel	48-40-43-LIM	BR5020	-	O/P MON
DC Power Supply	Dahua	DH1716A-10	1000303181	-	O/P MON
Digital Multimeter	FLUKE	179	91820401	12	14-Dec-2015
Thermo-hygrometer	AZ Instruments	8705	9151665	12	10-Dec-2015
Band Edge					
Network Analyzer	Agilent	8720D	US36140166	12	17-Nov-2015
Spectrum Analyser	Rohde & Schwarz	FSW43	100615	12	10-Aug-2015
40dB Attenuator	Aeroflex / Weinschel	48-40-43-LIM	BR5020	-	O/P MON
DC Power Supply	Dahua	DH1716A-10	1000303181	-	O/P MON
Digital Multimeter	FLUKE	179	91820401	12	14-Dec-2015
Thermo-hygrometer	AZ Instruments	8705	9151665	12	10-Dec-2015
Conducted Spurious Emission					
Network Analyzer	Agilent	8720D	US36140166	12	17-Nov-2015
Spectrum Analyser	Rohde & Schwarz	FSW43	100615	12	10-Aug-2015
40dB Attenuator	Aeroflex / Weinschel	48-40-43-LIM	BR5020	-	O/P MON
Pass Filter	K & L	ULK 904 240/n	23	-	O/P MON
DC Power Supply	Dahua	DH1716A-10	1000303181	-	O/P MON
Digital Multimeter	FLUKE	179	91820401	12	14-Dec-2015
Thermo-hygrometer	AZ Instruments	8705	9151665	12	10-Dec-2015

Radiated Spurious Emissions					
EMI Receiver	Rohde & Schwarz	ESIB26	100301	12	20-Aug-2015
Ultra log test antenna	Rohde & Schwarz	HL562	100167	12	20-Aug-2015
Double-Ridged Wave-guide Horn Antenna	Rohde & Schwarz	HF 906	100029	12	20-Aug-2015
Pyramidal Horn Antenna	EMCO	3160-09	760840	12	20-Aug-2015
Pyramidal Horn Antenna	EMCO	3160-10	808234	12	20-Aug-2015
Semi Anechoic Chamber	ETS-Lindgren	9.6m×6.72m×5.98m	-	12	20-Mar-2015
30MHz~3GHz Pre-amplifier	Rohde & Schwarz	SCU03	10005	-	O/P MON
3GHz~18GHz Pre-amplifier	Rohde & Schwarz	AFS42-00101800-25-S-42	1078388		O/P MON
Filters Array	Rohde & Schwarz	TS-Filt	-	-	O/P MON
Switches Array	Rohde & Schwarz	TS-RSP	100241	-	O/P MON
Multi-Device Controller	ETS-Lindgren	2090	00049393	-	O/P MON
Viedo monitoring system	ETS-Lindgren	Y21953A	2501103	-	O/P MON
DC Power Supply	Dahua	DH1716-5D	2007060032	-	O/P MON
Digital Multimeter	FLUKE	179	91820401	12	14-Dec-2015
Thermo-hygrometer	AZ Instruments	8705	9151665	12	10-Dec-2015

N/A – Not Applicable

OP MON – Output Monitored with Calibrated Equipment

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	Frequency / Parameter	MU
Conducted Maximum Peak Output Power	30MHz to 10GHz Amplitude	0.5dB*
Conducted Emissions	30MHz to 40GHz Amplitude	3.0dB*
Frequency stability	30MHz to 2GHz	$<\pm 1 \times 10^{-7}$
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.1dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Worst case error for both Time and Frequency measurement 12 parts in 10^6		

* In accordance with CISPR 16-4



Product Service

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

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