Nokia Siemens Networks

TEST REPORT NO: D488575393

FCC ID: VBNFZHA-01

Date:	Oulu 08. Apr 2013
Pages:	104
Appendices:	-

Equipment Under Test:	Flexi Multiradio 10 BTS RF module 2.6GHz Radio Access technology: E-UTRA (TDD)
Type:	FZHA
Manufacturer:	Nokia Siemens Networks Oy
Address:	P.O. Box 319, Kaapelitie 4, FI-90620, Oulu, Finland
Task:	Conformance test according to the specificarions mentioned below
Test Specification(s):	FCC 47 CFR part 2 (10-1-02 edition) and part 27 (10-1-05 edition)
Result:	The EUT complies with the requirements of the specification

The results relate only to the items tested as described in this test report.

Approved by:	**Date**	**Signature**
Jaakko Sirviö R&D Line Manager NSN	08. Apr 2013	

CONTENTS

1. SUMMARY

The following tests were performed according to the FCC rules in order to verify the compliance of the EUT with the FCC requirements:

Test No.	Measurement	FCC Rule	Page Number of this Report	Result
1	RF Power Output	§ 2.1046, § 27.50	8	compliant
2	Modulation Characteristics	§ 2.1047, § 2.201	11	compliant
3	Occupied Bandwidth	§ 2.1049	12	compliant
4	Spurious Emissions at Antenna Terminals	§ 2.1051, § 2.1057, § 27.53	14	compliant
5	Field Strength of Spurious Radiation	§ 2.1053, § 2.1057, § 27.53, § 27.55	21	compliant
6	Frequency Stability	§ 2.1055, § 27.54	23	compliant

Table 1 Results – Summary

In accordance with the FCC Rule §15.3 (z) the equipment was tested with the limits that are valid for an *unintentional radiator*.

1.1 Test Laboratory

Nokia Siemens Networks Oy

P.O. Box 319,

Kaapelitie 4,

FI-90620, Oulu, Finland

Jaakko Sirvio

FCC Reg. No: 411251

1.2 Time Schedule

Test No.	1, 2, 3, 4	5	6
Start of Test:	27 Feb 2013	21 Jan 2013	14 Mar 2013
End of Test:	13 Mar 2013	23 Jan 2013	15 Mar 2013

1.3 Participants

Name	Function	Signature
Rami Salomäki (NSN)	Testing, Setup of EUT	
Jari Veijola (NSN)	Testing, Setup of EUT	

2. EQUIPMENT UNDER TEST

The EUT is a LTE Base transceiver station RF module 2.6GHz with 8 power amplifiers.

The BTS performs the full RAN function of LTE system (evolved UTRA). This is sometimes refered to as collapsed RAN, where equivalent functions of former 3G BTS and 3G RNC are all integrated into BTS. BTS is connected directly to the core network via S1 interface, and to mobile stations via Air interface (Uu). In addition BTSs are optionally connected directly to each others via X2 interface for handover purposes.

The tested equipment is representative for serial production.

2.1 Configuration of EUT

The used different EUT configurations are shown by the following table.

Module Type	**Flexi Multiradio BTS RF module 2.6GHz**	
Radio Access Technology	E-UTRA	
Duplex mode	Time Division Duplex (TDD)	
Channel Bandwidth	10MHz (Config. A), 20MHz (Config. B)	
Supply Voltage	48 V DC	
Frequency Bands		
Channel Bandwidth 10MHz	Lowest tunable freq.	2580MHz
	Middle freq.	2595MHz
	Highest tunable freq.	2610MHz
Channel Bandwidth 20MHz	Lowest tunable freq.	2585MHz
	Middle freq.	2595MHz
	Highest tunable freq.	2605MHz
Single carrier		
Rated Output Power (Prat)	10W (40dBm) conducted	
Downlink/Uplink ratio	1/3 to 8/1	
	RX	**TX**
Number of Antenna Ports	8 (ANT1 to ANT8)	8 (ANT1 to ANT8)
MiMo	Yes	Yes

Table 2 Overview of EUT configuration

The tests were performed with one EUT at the antenna ports ANT1 and/or ANT2.

The used different EUT configurations are shown by the following table.

Module Name	Serial-No.	Module Type	Config.
FZHA	L9122902205	RF module	A, B
Other Modules	**Module Type**		**Config.**
FSMF	System module		A, B
FTIF	Transmission module		A, B

Table 3 Configuration of EUT

For a functional description of the modules, please refer to the appropriate related parts and exhibit sections of this certification application.

2.2 Operating Conditions

The EUT supports QPSK, 16QAM and 64QAM modulation. If not stated otherwise, the following standard setup procedure for the EUT was used:

The transmitter was set up according to 3GPP TS 36.141 E-UTRA Test Models (E-TM) for all tests:

- E-TM 1.1: All QPSK modulation testing
- E-TM 3.1: All 64QAM modulation testing
- E-TM 3.2: All 16QAM modulation testing

During the measurements, one carrier channel was tested at a time. The carrier was set to the maximum power level to ensure the maximum emission amplitudes during all measurements.

During the tests, the Flexi Multiradio BTS is transmitting a pseudo random bit pattern on the data channels. This ensures that the measurements of the emission characteristics of the transmitter are pursuant to § 2.1049.

Test models E-TM1.1, E-TM3.1 and E-TM3.2 have uplink/downlink ratio 3:6.

3. TEST CONFIGURATION

If not stated otherwise, the following measurement configuration was used to perform all measurements (see figure below).

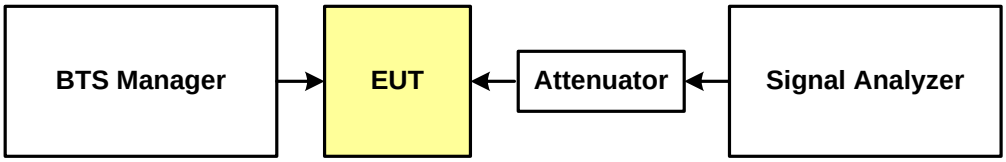


Figure 1 Test Configuration (single output)

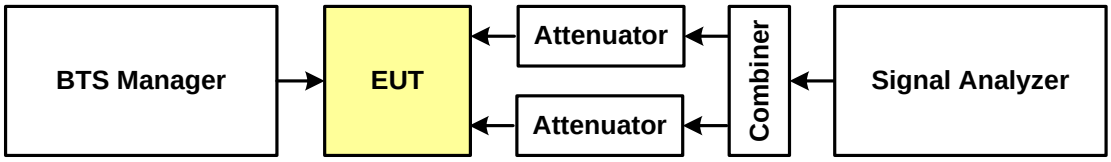


Figure 2 Test Configuration (combined output)

The RF output of the transceiver (cell) under test is connected to a signal analyzer via a high power attenuator to protect the input of the signal analyzer from high RF power levels. A description of the analyzer settings is given in each of the sections describing the measurements. The other transceivers are terminated.

A complete list of the measurement equipment is included on page 29 of this measurement report.

3.1 Calibration of the Test Equipment

All relevant test equipment has a valid calibration from an external calibration laboratory. Additionally the signal analyzer has a built-in self-calibration procedure. This calibration procedure was activated prior to the measurements so that the analyzer is deemed accurate. High quality cables were used to connect the measurement equipment to the EUT. The actual loss of the attenuator and the cables was measured with a high precision network analyzer and taken into account for all measurements.

4. TEST RESULTS

4.1 Test No. 1: RF Power Output (§ 2.1046, § 27.50)

4.1.1. Limits

Para. No. 27.50 (h).(1) Main, booster and base stations. (i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

Sample calculation: 33dBW + 10log(10MHz/5.5MHz) dBW = 34.26 dBW = ~2667W

4.1.2. Test Procedure and Results

Detachable Antenna: The maximum output power at the antenna terminals was measured using a signal analyzer.

The RF power was measured with a frequency sweep across the carrier (see screenshots). The carrier power was calculated from the signal analyzer by integration over the result. The base station maximum output power is the sum of the measured carrier power and the external attenuation (cable loss of the test set up).

The following table shows the measured output powers at the antenna connector. Screenshots of the measurements are included on pages 30 of this report.

Config A:

Carrier Frequency [MHz]	RF Power Output		Result
	[dBm]	[W]	
QPSK-Modulation ANT1			
2580	39.43	8.77	compliant
2595	39.63	9.18	compliant
2610	39.62	9.16	compliant
QPSK-Modulation ANT2			
2580	39.37	8.65	compliant
2595	39.69	9.31	compliant
2610	39.6	9.12	compliant
QPSK-Modulation ANT1+ANT2 Calculated Total			
2580	42.41	17.42	compliant
2595	42.67	18.49	compliant
2610	42.62	18.28	compliant
16QAM-Modulation ANT1			
2580	39.48	8.87	compliant
2595	39.77	9.48	compliant
2610	39.69	9.31	compliant
16QAM-Modulation ANT2			
2580	39.71	9.35	compliant
2595	39.61	9.14	compliant
2610	39.67	9.27	compliant
16QAM-Modulation ANT1+ANT2 Calculated Total			
2580	42.61	18.23	compliant
2595	42.70	18.63	compliant
2610	42.69	18.58	compliant
64QAM-Modulation ANT1			
2580	39.66	9.25	compliant
2595	39.79	9.53	compliant
2610	39.63	9.18	compliant
64QAM-Modulation ANT2			
2580	39.62	9.16	compliant
2595	39.58	9.08	compliant
2610	39.67	9.27	compliant
64QAM-Modulation ANT1+ANT2 Calculated Total			
2580	42.65	18.41	compliant
2595	42.70	18.61	compliant
2610	42.66	18.45	compliant
Measurement Uncertainty:		±0.4dB	

Table 4 RF Power Output (10 MHz Channel BW)

Config B:

Carrier Frequency [MHz]	RF Power Output		Result
	[dBm]	[W]	
QPSK-Modulation ANT1			
2580	39.43	8.77	compliant
2595	39.63	9.18	compliant
2610	39.62	9.16	compliant
QPSK-Modulation ANT2			
2580	39.37	8.65	compliant
2595	39.69	9.31	compliant
2610	39.6	9.12	compliant
QPSK-Modulation ANT1+ANT2 Calculated Total			
2580	42.41	17.42	compliant
2595	42.67	18.49	compliant
2610	42.62	18.28	compliant
16QAM-Modulation ANT1			
2580	39.48	8.87	compliant
2595	39.77	9.48	compliant
2610	39.69	9.31	compliant
16QAM-Modulation ANT2			
2580	39.71	9.35	compliant
2595	39.61	9.14	compliant
2610	39.67	9.27	compliant
16QAM-Modulation ANT1+ANT2 Calculated Total			
2580	42.61	18.23	compliant
2595	42.70	18.63	compliant
2610	42.69	18.58	compliant
64QAM-Modulation ANT1			
2580	39.66	9.25	compliant
2595	39.79	9.53	compliant
2610	39.63	9.18	compliant
64QAM-Modulation ANT2			
2580	39.62	9.16	compliant
2595	39.58	9.08	compliant
2610	39.67	9.27	compliant
64QAM-Modulation ANT1+ANT2 Calculated Total			
2580	42.65	18.41	compliant
2595	42.70	18.61	compliant
2610	42.66	18.45	compliant
Measurement Uncertainty:		±0.4dB	

Table 5 RF Power Output (20 MHz Channel BW)

The base station maximum output power was found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

4.2 Test No. 2: Modulation Characteristics (§ 2.1047, § 2.201)

The occupied bandwidth was measured to be 9 MHz (Config. A) and 18 MHz (Config. B), which represents the 99% power bandwidth (see the following section and screenshots on pages 38).

Therefore, the modulation characteristic of the base stations transceiver is:

Config A: 9M00D9W (Channel bandwidth 10 MHz)

Config B: 18M0D9W (Channel bandwidth 20 MHz)

No further testing is required under this section of the FCC rules. No measurements other than the occupied bandwidth are required.

The modulation characteristics were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

4.3 Test No. 3: Occupied Bandwidth (§ 2.1049)

4.3.1. Limits

Para. No. 2.1049. The 99% occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the emitted power.

4.3.2. Test Procedure and Results

The 99% occupied bandwidth of the carrier emission is measured using a signal analyzer with Resolution Bandwidth set to 30 kHz (less than 1% of bandwidth; see screenshots on page 38 for details). The following tables summarizes the results:

Config A:

Carrier Frequency [MHz]	Occupied Bandwidth [MHz]	Result
QPSK-Modulation ANT1		
2580.0	8.9346	compliant
2595.0	8.9346	compliant
2610.0	8.9346	compliant
QPSK-Modulation ANT2		
2580.0	8.9346	compliant
2595.0	8.9346	compliant
2610.0	8.9346	compliant
16QAM-Modulation ANT1		
2580.0	8.9022	compliant
2595.0	8.9184	compliant
2610.0	8.9346	compliant
16QAM-Modulation ANT2		
2580.0	8.9346	compliant
2595.0	8.9184	compliant
2610.0	8.9022	compliant
64QAM-Modulation ANT1		
2580.0	8.9346	compliant
2595.0	8.9346	compliant
2610.0	8.9346	compliant
64QAM-Modulation ANT2		
2580.0	8.9346	compliant
2595.0	8.9346	compliant
2610.0	8.9346	compliant
Measurement Uncertainty:		±48kHz

Table 6 Occupied Bandwidth (10 MHz Channel BW)

Config B:

Carrier Frequency [MHz]	Occupied Bandwidth [MHz]	Result
QPSK-Modulation ANT1		
2585.0	17.8452	compliant
2595.0	17.8452	compliant
2605.0	17.8452	compliant
QPSK-Modulation ANT2		
2585.0	17.8452	compliant
2595.0	17.8452	compliant
2605.0	17.8452	compliant
16QAM-Modulation ANT1		
2585.0	17.8130	compliant
2595.0	17.8130	compliant
2605.0	17.8452	compliant
16QAM-Modulation ANT2		
2585.0	17.8130	compliant
2595.0	17.8452	compliant
2605.0	17.8452	compliant
64QAM-Modulation ANT1		
2585.0	17.8452	compliant
2595.0	17.8452	compliant
2605.0	17.8452	compliant
64QAM-Modulation ANT2		
2585.0	17.8452	compliant
2595.0	17.8452	compliant
2605.0	17.8452	compliant
Measurement Uncertainty:		±48kHz

Table 7 Occupied Bandwidth (20 MHz Channel BW)

The occupied bandwidth was found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

4.4 Test No. 4: Spurious Emissions at Antenna Terminals (§ 2.1051, § 2.1057, § 27.53)

4.4.1. Limits

Para. No. 27.53(l). For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts.

(l)(2) For fixed and temporary fixed digital stations, the attenuation shall be not less than 43 + 10 log (P) dB (P = transmitter power in Watts).

The compliance limit was calculated in the following way:

Maximum transmitter output power [W]:	P
Maximum transmitter output power [dBm]:	30 + 10 log10 P (conversion from W to dBm)
Attenuation required by FCC:	43 + 10 log10 P

Compliance limit = Maximum transmitter output power - Required attenuation

= 30 + 10 log10 P - (43 + 10 log10 P) = <u>-13 dBm</u>

4.4.2. Test Procedure and Results

The tests were carried out in accordance with § 27.53. For all frequency ranges except two (immediately below and above the carrier frequency block) a 1 MHz resolution bandwidth was used for the measurements.

In the 1 MHz frequency bands immediately outside and adjacent to the carrier frequency block the resolution bandwidth is lowered to 1% of the 26 dB occupied bandwidth of the transmitted carrier.

According to § 2.1057, all emissions including the fundamental frequency from the lowest radio frequency generated in the equipment, without going below 9 kHz, up to the 10th harmonic were investigated.

The following tables summarize the worst case detected emission levels (see screenshots on pages 45 for details). The external attenuation (cable loss of the set up) is already added in the results. It can be seen separately as the 'Offset' value in the screenshots.

Config A Lower band edge:

Carrier Frequency: 2580.0 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation ANT1			
	2575.0	-21.70	compliant
QPSK-Modulation ANT2			
	2575.0	-21.58	compliant
QPSK-Modulation ANT1+ANT2			
	2575.0	-18.80	compliant
16QAM-Modulation ANT1			
	2575.0	-20.93	compliant
16QAM-Modulation ANT2			
	2575.0	-21.28	compliant
16QAM-Modulation ANT1+ANT2			
	2575.0	-18.46	compliant
64QAM-Modulation ANT1			
	2575.0	-22.49	compliant
64QAM-Modulation ANT2			
	2575.0	-22.77	compliant
64QAM-Modulation ANT1+ANT2			
	2575.0	-19.75	compliant
Measurement Uncertainty:		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, 3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 8 Spurious Emissions (Lower bande edge) (10 MHz CH BW)

Config A Upper band edge:

Carrier Frequency: 2610.0 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation ANT1			
	2615.0	-22.60	compliant
QPSK-Modulation ANT2			
	2615.0	-22.74	compliant
QPSK-Modulation ANT1+ANT2			
	2615.0	-20.99	compliant
16QAM-Modulation ANT1			
	2615.0	-23.19	compliant
16QAM-Modulation ANT2			
	2615.0	-23.62	compliant
16QAM-Modulation ANT1+ANT2			
	2615.0	-21.00	compliant
64QAM-Modulation ANT1			
	2615.0	-21.59	compliant
64QAM-Modulation ANT2			
	2615.0	-21.60	compliant
64QAM-Modulation ANT1+ANT2			
	2615.0	-19.95	compliant
Measurement Uncertainty:		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, 3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 9 Spurious Emissions (Upper band edge) (10 MHz CH BW)

Config A Spurious emissions:

Carrier Frequency: 2595.0 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation ANT1			
0.009 - 26150	24517.63	-27.71	compliant
QPSK-Modulation ANT2			
0.009 - 26150	24517.63	-27.70	compliant
QPSK-Modulation ANT1+ANT2			
0.009 - 26150	24517.63	-33.83	compliant
16QAM-Modulation ANT1			
0.009 - 26150	24517.63	-27.72	compliant
16QAM-Modulation ANT2			
0.009 - 26150	24517.63	-27.61	compliant
16QAM-Modulation ANT1+ANT2			
0.009 - 26150	24517.63	-33.93	compliant
64QAM-Modulation ANT1			
0.009 - 26150	24517.63	-27.59	compliant
64QAM-Modulation ANT2			
0.009 - 26150	24517.63	-27.71	compliant
64QAM-Modulation ANT1+ANT2			
0.009 - 26150	24517.63	-33.99	compliant
Measurement Uncertainty:		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, 3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 10 Spurious Emissions (10 MHz Channel BW)

Config B Lower band edge:

Carrier Frequency: 2585.0 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation ANT1			
	2575.0	-27.06	compliant
QPSK-Modulation ANT2			
	2575.0	-27.68	compliant
QPSK-Modulation ANT1+ANT2			
	2575.0	-23.45	compliant
16QAM-Modulation ANT1			
	2575.0	-27.76	compliant
16QAM-Modulation ANT2			
	2575.0	-29.67	compliant
16QAM-Modulation ANT1+ANT2			
	2575.0	-23.32	compliant
64QAM-Modulation ANT1			
	2575.0	-27.82	compliant
64QAM-Modulation ANT2			
	2575.0	-28.49	compliant
64QAM-Modulation ANT1+ANT2			
	2575.0	-22.73	compliant
Measurement Uncertainty:		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, 3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 11 Spurious Emissions (Lower band edge) (20 MHz CH BW)

Config B Upper band edge:

Carrier Frequency: 2605.0 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation ANT1			
	2615.0	-27.79	compliant
QPSK-Modulation ANT2			
	2615.0	-28.48	compliant
QPSK-Modulation ANT1+ANT2			
	2615.0	-23.31	compliant
16QAM-Modulation ANT1			
	2615.0	-26.61	compliant
16QAM-Modulation ANT2			
	2615.0	-28.53	compliant
16QAM-Modulation ANT1+ANT2			
	2615.0	-23.29	compliant
64QAM-Modulation ANT1			
	2615.0	-27.47	compliant
64QAM-Modulation ANT2			
	2615.0	-28.10	compliant
64QAM-Modulation ANT1+ANT2			
	2615.0	-24.12	compliant
Measurement Uncertainty:		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, 3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 12 Spurious Emissions (Upper band edge) (20 MHz CH BW)

Config B Spurious emissions:

Carrier Frequency: 2595.0 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation ANT1			
0.009 - 26150	24517.63	-27.68	compliant
QPSK-Modulation ANT2			
0.009 - 26150	24517.63	-27.65	compliant
QPSK-Modulation ANT1+ANT2			
0.009 - 26150	24517.63	-33.92	compliant
16QAM-Modulation ANT1			
0.009 - 26150	24517.63	-27.66	compliant
16QAM-Modulation ANT2			
0.009 - 26150	24517.63	-27.70	compliant
16QAM-Modulation ANT1+ANT2			
0.009 - 26150	24517.63	-33.91	compliant
64QAM-Modulation ANT1			
0.009 - 26150	24517.63	-27.66	compliant
64QAM-Modulation ANT2			
0.009 - 26150	24517.63	-27.66	compliant
64QAM-Modulation ANT1+ANT2			
0.009 - 26150	24517.63	-33.97	compliant
Measurement Uncertainty:		f < 1.0GHz: ±1.1dB, 1.0GHz ≤ f <3.6GHz: ±1.2dB, 3.6GHz ≤ f <8.0GHz: ±1.6dB, 8.0GHz ≤ f: ±1.9dB	

Table 13 Spurious Emissions (20 MHz Channel BW)

The measured conducted emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

4.5 Test No. 5: Field Strength of Spurious Radiation (§ 2.1053, § 2.1057, § 27.53)

4.5.1. Limits

Para. No. 27.53(m). For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts.

(m)(2) For digital base stations, the attenuation shall be not less than 43 + 10 log (P) dB (P = transmitter power in Watts).

4.5.2. Test Configuration

The measurements were performed in an anechoic chamber. The radiated test site complies with the site attenuation requirements listed in ANSI C63.4 2003 and is listed with the FCC.

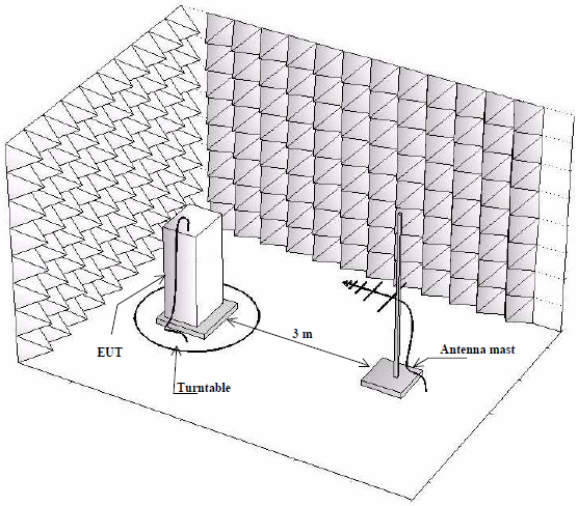


Figure 3 Test Configuration

Photographs of the EUT in the anechoic chamber are shown on page 100 of this measurement report.

4.5.3. Test Procedure and Results

TIA/EIA-603-C-2004, Section 2.2.12

The test was performed in a semi-anechoic shielded room. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable. During the test in the frequency range 30 - 26500 MHz the distance from the EUT to the measuring antenna was 3 m. In order to find the maximum levels of the disturbance radiation the angle of the turntable, the height of the measuring antenna were varied during the tests. The test was performed with the measuring antenna being both in horizontal and vertical polarizations.

Vertical and horizontal polarizations in the frequency range 30 - 26500 MHz was first measured by using the peak detector. During the peak detector scan the turntable was rotated from 0° to 360° with 30° step with the antenna heights 1.0 m and 2.5 m.

The limit of -13 dBm has been calculated to correspond 84.4 dB (µV/m). Spurious emissions closer than 20 dB to the limit was measured with average detector.

According to § 2.1057, all emissions from the lowest radio frequency generated in the equipment, without going below 9 kHz, up to the 10th harmonic were investigated.

The antenna substitution method was used to determine the equivalent radiated power at spurious frequencies. The EUT was replaced with a reference substitution antenna with a known gain referenced to an isotropic radiator $G_{Antenna[dBi]}$. This antenna was fed with a signal at the spurious frequency $P_{Gen[dBm]}$. The level of the signal was adjusted to repeat the previously measured level. The resulting

EIRP is the signal level fed to the reference antenna corrected for gain referenced to an isotropic.

The formula below was used to calculate the EIRP of the EUT.

$$P_{EIRP[dbm]} = P_{Gen[dBm]} - L_{Cable[dB]} + G_{Antenna[dBi]}$$

Worst case detected emission levels are reported in the following table (refer to spectral plots included on pages 100 for details). The antenna factor and cable loss is according to the manufacturer's specification.

Config A:

Carrier Frequency: 2585.0 MHz, 2595.0 MHz and 2605.0 MHz			
Frequency Range [MHz]	**Emission Frequency [MHz]**	**Maximum Emission Level [dBm]**	**Result**
QPSK-Modulation TX1			
30 - 26500	More than 20dB below limit -13 dBm		compliant
Measurement Uncertainty:			±5.4dB

Table 14 Field Strength of Spurious Radiation (20 MHz Channel BW)

The measured emission levels were found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

4.6 Test No. 6: Frequency Stability (§ 2.1055, § 27.54)

4.6.1. Purpose

Frequency stability measurements were performed to verify that the frequency deviation of the emission stays within the licensee's frequency block under extreme temperature

4.6.2. Limits

Para. No. 27.54. (-30 °C to +50 °C) and supply voltage conditions according to § 2.1055.

4.6.3. Test Configuration

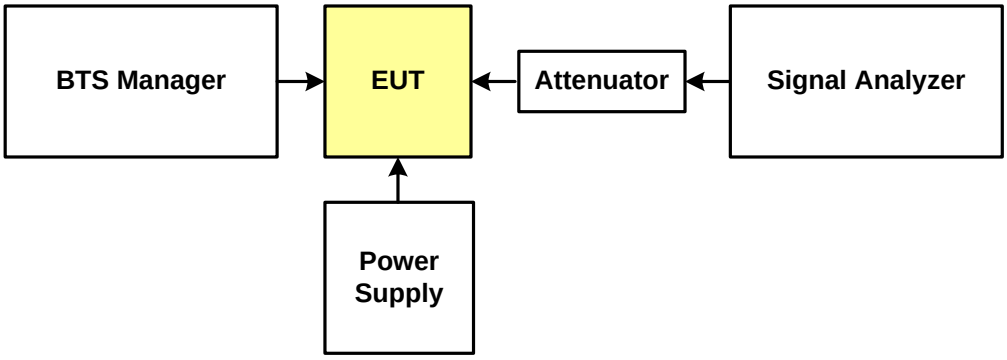


Figure 4 Test Configuration for frequency stability with voltage variation

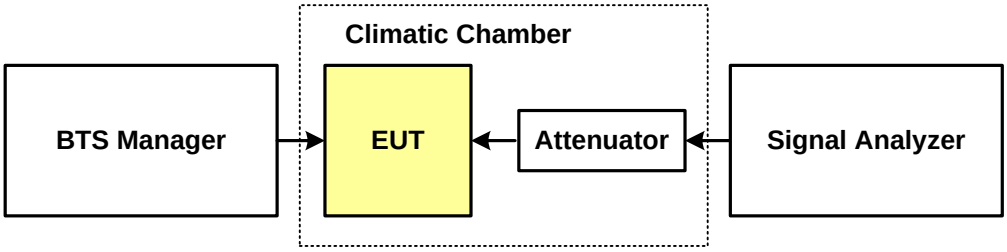


Figure 5 Test Configuration for frequency stability with temperature variation

A complete list of the measurement equipment is included on page 29 of this measurement report.

4.6.4. Test Procedure and Results

Frequency Stability with Temperature Variation:

The supply voltage of the EUT was set to the nominal value and the temperature of the environmental chamber was varied in 10 degree steps from -30 degrees celsius to +50 degrees celsius. The EUT was allowed to stabilize at each temperature and the frequency error was measured.

Config A:

Carrier Frequency: 2595.0 MHz						
Supply Voltage (DC) [V]	Ambient Temperature [°C]	Frequency Deviation		Manufacturer's Specification		Result
		[Hz]	[ppm]	[Hz]	[ppm]	
QPSK Modulation ANT1						
-48	-30	4.540	0.002	129	0.05	compliant
-48	-20	5.457	0.002	129	0.05	compliant
-48	-10	-3.785	-0.001	129	0.05	compliant
-48	0	7.011	0.003	129	0.05	compliant
-48	10	4.185	0.002	129	0.05	compliant
-48	30	9.006	0.003	129	0.05	compliant
-48	40	-4.744	-0.002	129	0.05	compliant
-48	50	-9.810	-0.004	129	0.05	compliant
QPSK Modulation ANT2						
-48	-30	9.122	0.004	129	0.05	compliant
-48	-20	7.803	0.003	129	0.05	compliant
-48	-10	4.527	0.002	129	0.05	compliant
-48	0	8.547	0.003	129	0.05	compliant
-48	10	6.669	0.003	129	0.05	compliant
-48	30	-9.517	-0.004	129	0.05	compliant
-48	40	10.516	0.004	129	0.05	compliant
-48	50	-13.441	-0.005	129	0.05	compliant
16QAM Modulation ANT1						
-48	-30	-13.740	-0.005	129	0.05	compliant
-48	-20	6.013	0.002	129	0.05	compliant
-48	-10	4.288	0.002	129	0.05	compliant
-48	0	-3.785	-0.001	129	0.05	compliant
-48	10	-2.648	-0.001	129	0.05	compliant
-48	30	-3.544	-0.001	129	0.05	compliant
-48	40	-3.305	-0.001	129	0.05	compliant
-48	50	6.959	0.003	129	0.05	compliant
16QAM Modulation ANT2						
-48	-30	-8.194	-0.003	129	0.05	compliant
-48	-20	-9.896	-0.004	129	0.05	compliant

-48	-10	-7.984	-0.003	129	0.05	compliant
-48	0	-3.863	-0.001	129	0.05	compliant
-48	10	-6.267	-0.002	129	0.05	compliant
-48	30	-7.038	-0.003	129	0.05	compliant
-48	40	3.770	0.001	129	0.05	compliant
-48	50	-6.230	-0.002	129	0.05	compliant
64QAM Modulation ANT1						
-48	-30	-7.698	-0.003	129	0.05	compliant
-48	-20	-7.338	-0.003	129	0.05	compliant
-48	-10	3.537	0.001	129	0.05	compliant
-48	0	-7.307	-0.003	129	0.05	compliant
-48	10	3.649	0.001	129	0.05	compliant
-48	30	2.576	0.001	129	0.05	compliant
-48	40	-8.972	-0.003	129	0.05	compliant
-48	50	-9.108	-0.004	129	0.05	compliant
64QAM Modulation ANT2						
-48	-30	7.870	0.003	129	0.05	compliant
-48	-20	19.912	0.008	129	0.05	compliant
-48	-10	8.215	0.003	129	0.05	compliant
-48	0	6.736	0.003	129	0.05	compliant
-48	10	2.688	0.001	129	0.05	compliant
-48	30	7.929	0.003	129	0.05	compliant
-48	40	-8.401	-0.003	129	0.05	compliant
-48	50	-9.413	-0.004	129	0.05	compliant
Measurement Uncertainty:					±1.0 Hz	

Table 15 Frequency stability with temp. var. (10 MHz Channel BW)

Config B :

Carrier Frequency: 2595.0 MHz						
Supply Voltage (DC) [V]	**Ambient Temperature [°C]**	**Frequency Deviation**		**Manufacturer's Specification**		**Result**
		[Hz]	**[ppm]**	**[Hz]**	**[ppm]**	
QPSK Modulation ANT1						
-48	-30	-9.923	-0.004	129	0.05	compliant
-48	-20	-16.649	-0.006	129	0.05	compliant
-48	-10	6.681	0.003	129	0.05	compliant
-48	0	-5.575	-0.002	129	0.05	compliant
-48	10	-13.356	-0.005	129	0.05	compliant
-48	30	9.169	0.004	129	0.05	compliant
-48	40	-6.772	-0.003	129	0.05	compliant
-48	50	7.971	0.003	129	0.05	compliant

QPSK Modulation ANT2						
-48	-30	-12.988	-0.005	129	0.05	compliant
-48	-20	7.787	0.003	129	0.05	compliant
-48	-10	-4.268	-0.002	129	0.05	compliant
-48	0	-5.179	-0.002	129	0.05	compliant
-48	10	-7.329	-0.003	129	0.05	compliant
-48	30	8.411	0.003	129	0.05	compliant
-48	40	-10.066	-0.004	129	0.05	compliant
-48	50	-7.316	-0.003	129	0.05	compliant
16QAM Modulation ANT1						
-48	-30	-9.846	-0.004	129	0.05	compliant
-48	-20	-12.645	-0.005	129	0.05	compliant
-48	-10	-5.183	-0.002	129	0.05	compliant
-48	0	6.700	0.003	129	0.05	compliant
-48	10	-14.346	-0.006	129	0.05	compliant
-48	30	-7.636	-0.003	129	0.05	compliant
-48	40	-9.349	-0.004	129	0.05	compliant
-48	50	-5.708	-0.002	129	0.05	compliant
16QAM Modulation ANT2						
-48	-30	-9.355	-0.004	129	0.05	compliant
-48	-20	-9.681	-0.004	129	0.05	compliant
-48	-10	-11.767	-0.005	129	0.05	compliant
-48	0	-5.686	-0.002	129	0.05	compliant
-48	10	-7.319	-0.003	129	0.05	compliant
-48	30	12.237	0.005	129	0.05	compliant
-48	40	-4.981	-0.002	129	0.05	compliant
-48	50	-5.759	-0.002	129	0.05	compliant
64QAM Modulation ANT1						
-48	-30	-12.022	-0.005	129	0.05	compliant
-48	-20	-11.829	-0.005	129	0.05	compliant
-48	-10	-12.321	-0.005	129	0.05	compliant
-48	0	6.340	0.002	129	0.05	compliant
-48	10	6.702	0.003	129	0.05	compliant
-48	30	-3.771	-0.001	129	0.05	compliant
-48	40	-5.086	-0.002	129	0.05	compliant
-48	50	-4.416	-0.002	129	0.05	compliant
64QAM Modulation ANT2						
-48	-30	-9.995	-0.004	129	0.05	compliant
-48	-20	-9.274	-0.004	129	0.05	compliant
-48	-10	-4.325	-0.002	129	0.05	compliant
-48	0	-13.356	-0.005	129	0.05	compliant
-48	10	-8.556	-0.003	129	0.05	compliant

-48	30	-4.449	-0.002	129	0.05	compliant
-48	40	-3.094	-0.001	129	0.05	compliant
-48	50	7.123	0.003	129	0.05	compliant
Measurement Uncertainty:					±1.0 Hz	

Table 16 Frequency stability with temp. var. (20 MHz Channel BW)

Frequency Stability with Voltage Variation:

The EUT was placed in a climatic chamber and allowed to stabilize at +20 degrees celsius for at least 30 minutes. With the supply voltage of the EUT set to 85% of the nominal value, the frequency error was measure. This procedure was repeated at 100% and 115% of the nominal supply voltage value.

Config A:

Carrier Frequency: 2595.0 MHz						
Supply Voltage (DC) [V]	**Ambient Temperature [°C]**	**Frequency Deviation**		**Manufacturer's Specification**		**Result**
		[Hz]	**[ppm]**	**[Hz]**	**[ppm]**	
QPSK Modulation ANT1						
-40.8	20	6.682	0.003	129	0.05	compliant
-48	20	-3.014	-0.001	129	0.05	compliant
-55.2	20	-7.401	-0.003	129	0.05	compliant
QPSK Modulation ANT2						
-40.8	20	10.899	0.004	129	0.05	compliant
-48	20	-3.782	-0.001	129	0.05	compliant
-55.2	20	4.999	0.002	129	0.05	compliant
16QAM Modulation ANT1						
-40.8	20	-5.792	-0.002	129	0.05	compliant
-48	20	-4.554	-0.002	129	0.05	compliant
-55.2	20	-8.800	-0.003	129	0.05	compliant
16QAM Modulation ANT2						
-40.8	20	-8.144	-0.003	129	0.05	compliant
-48	20	-6.252	-0.002	129	0.05	compliant
-55.2	20	-7.524	-0.003	129	0.05	compliant
64QAM Modulation ANT1						
-40.8	20	7.700	0.003	129	0.05	compliant
-48	20	6.727	0.003	129	0.05	compliant
-55.2	20	-3.982	-0.002	129	0.05	compliant

64QAM Modulation ANT2						
-40.8	20	-5.833	-0.002	129	0.05	compliant
-48	20	-6.342	-0.002	129	0.05	compliant
-55.2	20	5.404	0.002	129	0.05	compliant
Measurement Uncertainty:					±1.0 Hz	

Table 17 Frequency stability with voltage var. (10 MHz Channel BW)

Config B:

Carrier Frequency: 2595.0 MHz						
Supply Voltage (DC) [V]	**Ambient Temperature [°C]**	**Frequency Deviation**		**Manufacturer's Specification**		**Result**
		[Hz]	**[ppm]**	**[Hz]**	**[ppm]**	
QPSK Modulation ANT1						
-40.8	20	-3.012	-0.001	129	0.05	compliant
-48	20	-11.204	-0.004	129	0.05	compliant
-55.2	20	-8.376	-0.003	129	0.05	compliant
QPSK Modulation ANT2						
-40.8	20	4.992	0.002	129	0.05	compliant
-48	20	-13.286	-0.005	129	0.05	compliant
-55.2	20	-6.546	-0.003	129	0.05	compliant
16QAM Modulation ANT1						
-40.8	20	8.156	0.003	129	0.05	compliant
-48	20	-9.463	-0.004	129	0.05	compliant
-55.2	20	-4.089	-0.002	129	0.05	compliant
16QAM Modulation ANT2						
-40.8	20	7.072	0.003	129	0.05	compliant
-48	20	-13.406	-0.005	129	0.05	compliant
-55.2	20	-7.847	-0.003	129	0.05	compliant
64QAM Modulation ANT1						
-40.8	20	9.039	0.003	129	0.05	compliant
-48	20	-4.958	-0.002	129	0.05	compliant
-55.2	20	-7.304	-0.003	129	0.05	compliant
64QAM Modulation ANT2						
-40.8	20	-7.542	-0.003	129	0.05	compliant
-48	20	-4.535	-0.002	129	0.05	compliant
-55.2	20	5.432	0.002	129	0.05	compliant
Measurement Uncertainty:					±1.0 Hz	

Table 18 Frequency stability with voltage var. (20 MHz Channel BW)

The measured frequency stability was found to be compliant with the manufacturer's specifications and with all requirements of the FCC rules.

5. TEST DATA AND SCREENSHOTS

5.1 Part List of the RF Measurement Test Equipment

No.	Test Equipment	Manufacturer & Type	Serial Number	Calibration date	Calibration due	Test No.
1	Signal Analyzer	Rohde & Schwarz: FSQ 26	100403	07/2012	07/2013	1, 2, 3, 4, 6
2	Vector Signal Generator	Rohde & Schwarz: SMU200A	100162	01/2013	01/2015	1, 2, 3, 4, 6
3	Signal Generator	Rohde & Schwarz: SMP04	845401/001	07/2011	07/2013	1, 2, 3, 4, 6
4	Network Analyzer	Hewlett-Packard: HP8753E	US38431868	07/2012	07/2013	1, 2, 3, 4, 6
5	Network Analyzer	Hewlett-Packard: HP8753ES	US39172107	07/2012	07/2013	1, 2, 3, 4, 6
6	Calibration kit	Hewlett-Packard: HP85032B	2919A04843	07/2012	07/2013	1, 2, 3, 4, 6
7	Power Meter	Rohde & Schwarz: NRP-Z21	100393	01/2013	01/2015	1, 2, 3, 4, 6
8	Frequency Standard	Datum 8040	41005473	01/2013	01/2014	1, 2, 3, 4, 6
9	Multimeter	Fluke 83	65870302	12/2012	12/2013	1, 2, 3, 4, 6
10	Humidity and Temperature Indicator	Vaisala: HMI 31	P3730008	12/2013	12/2014	1, 2, 3, 4, 6
11	DC Power Supply	Sorensen: SGI 80/188	0525A00547	cnn	-	1, 2, 3, 4, 6
12	Interface Unit	Orbis: TX SSU Platform 700-2700A	SSU-0720-1364	cnn	-	1, 2, 3, 4, 6
13	Dummy load 200W	Spinner: 01BN537792	01343039	cnn	-	1, 2, 3, 4, 6
14	Combiner	Weinschel: 1870A	6275	cnn	-	4
15	Attenuator	MCE/Weinschel: 66-20-34	BM6886	cnn	-	4
16	Attenuator	Aeroflex/Weinschel: 66-20-33	BV3346	cnn	-	4
17	EMI Test Receiver	R&S ESU40	100262	02/2012	02/2013	5
18	Horn Antenna	Emco 3115	00075697	06/2012	06/2013	5
19	Bilog Antenna	Chase CBL6112B	2694	07/2012	07/2013	5
20	Log Periodic Antenna	R&S 1-26.5GHz	356749/012	07/2012	07/2013	5
21	Amplifier	Miteq AFSX4	902638	cnn	-	5
22	Antenna Mast	Deisel HD240	2401323194	cnn	-	5
23	Mast Controller	Deisel HD100	1001331	cnn	-	5

Table 19 Part List of the RF Measurement Test Equipment

5.2 Spectral Plots

5.2.1. Test No. 1: RF Power Output

The value 'Power' is the carrier power (RF Power Output) measured by the signal analyzer. 'Offset' is the external attenuation (cable loss of the test set up). The sum of both values is the base station maximum RF output power given on page 9. The external attenuation is frequency dependant. Thus the various 'Offset' values in the screenshots may differ.

Config A ANT1:

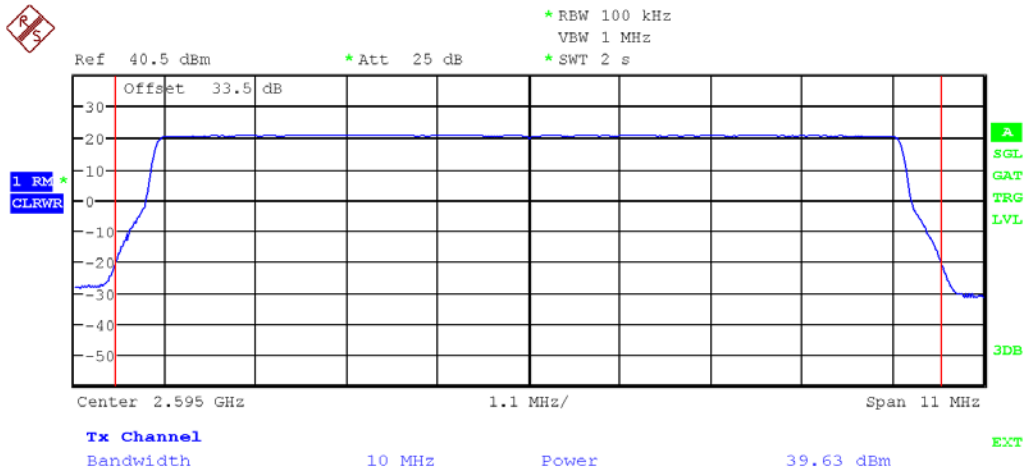


Figure 6 RF Power Output – QPSK (2595.0 MHz) (10MHz Channel BW)

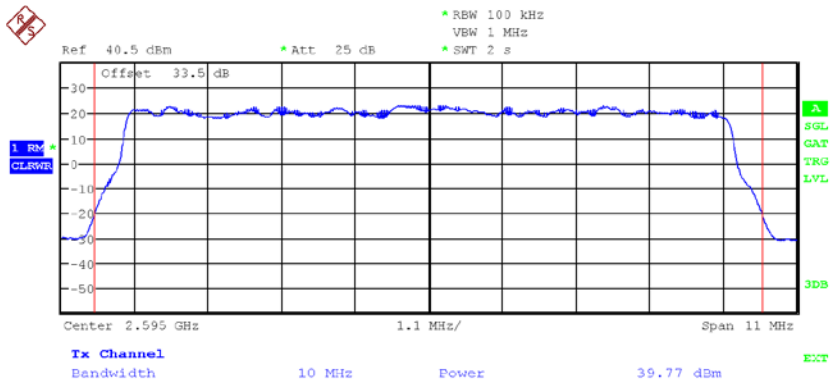


Figure 7 RF Power Output – 16QAM (2595.0 MHz) (10MHz Channel BW)

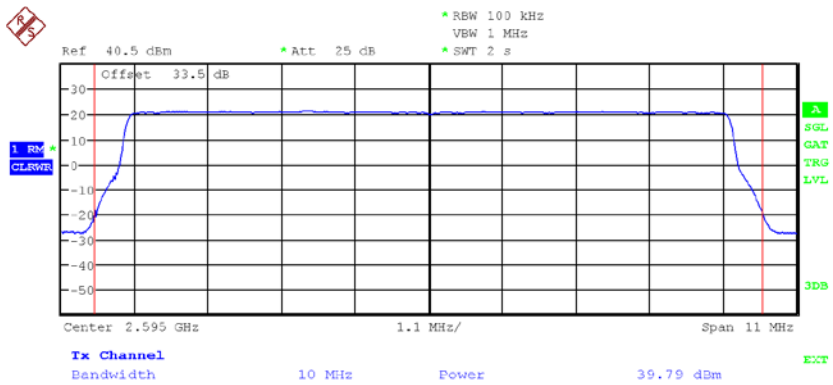


Figure 8 RF Power Output – 64QAM (2595.0 MHz) (10MHz Channel BW)

Config A ANT2:

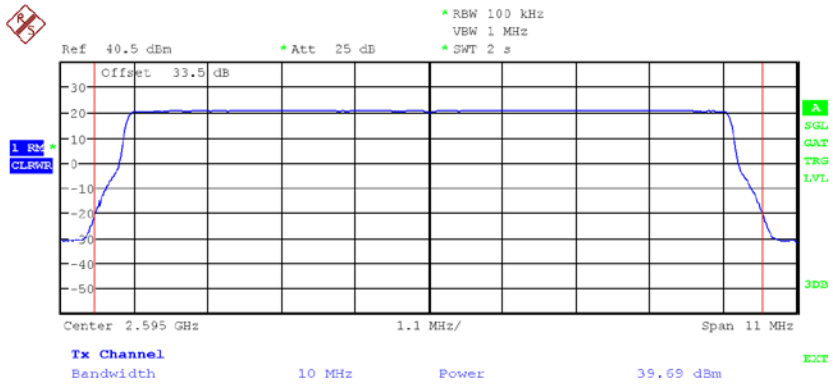


Figure 9 RF Power Output – QPSK (2595.0 MHz) (10MHz Channel BW)

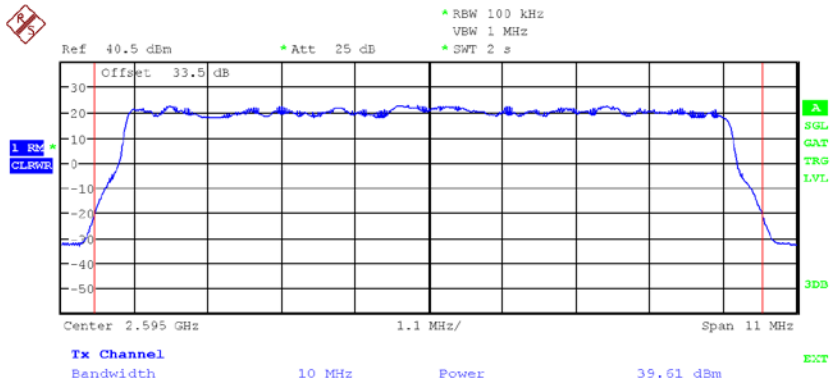


Figure 10 RF Power Output – 16QAM (2595.0 MHz) (10MHz Channel BW)

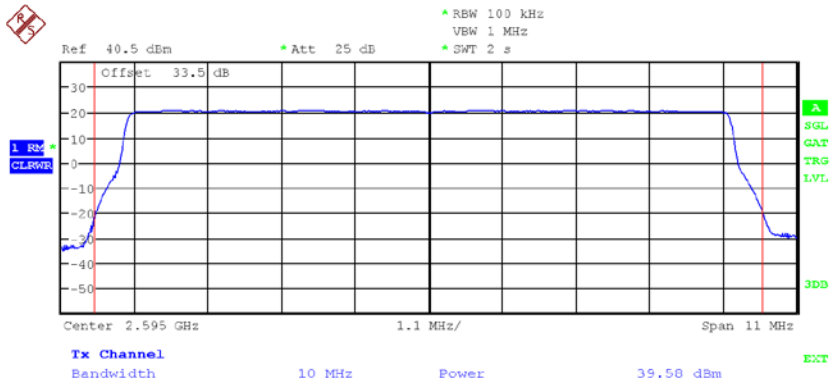


Figure 11 RF Power Output – 64QAM (2595.0 MHz) (10MHz Channel BW)

Config B ANT1:

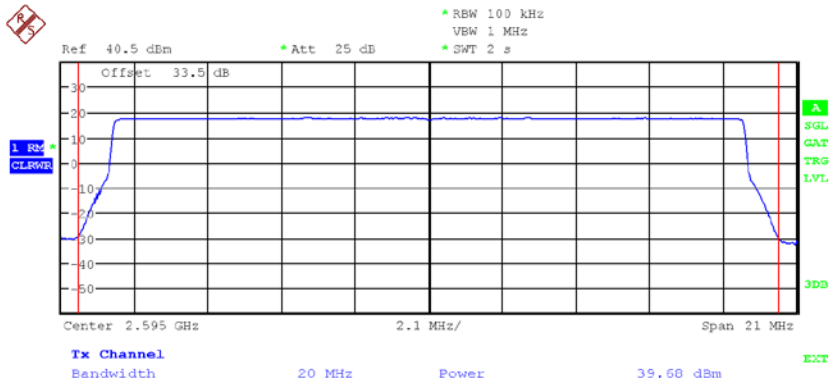


Figure 12 RF Power Output – QPSK (2595.0 MHz) (20MHz Channel BW)

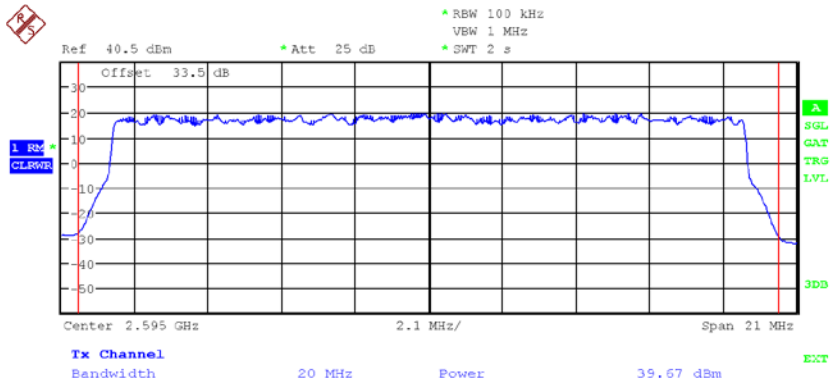


Figure 13 RF Power Output – 16QAM (2595.0 MHz) (20MHz Channel BW)

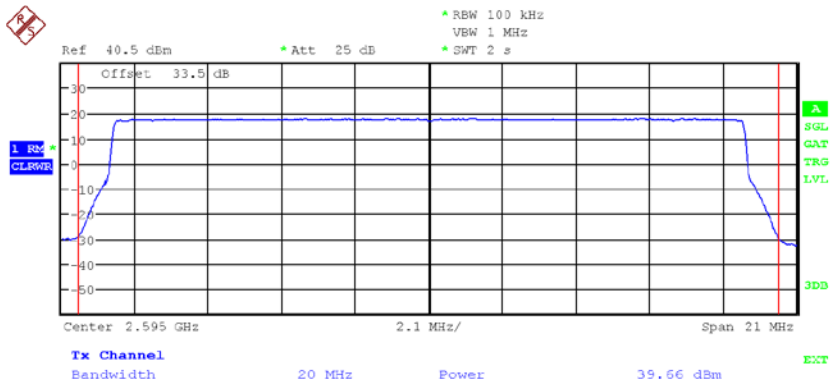
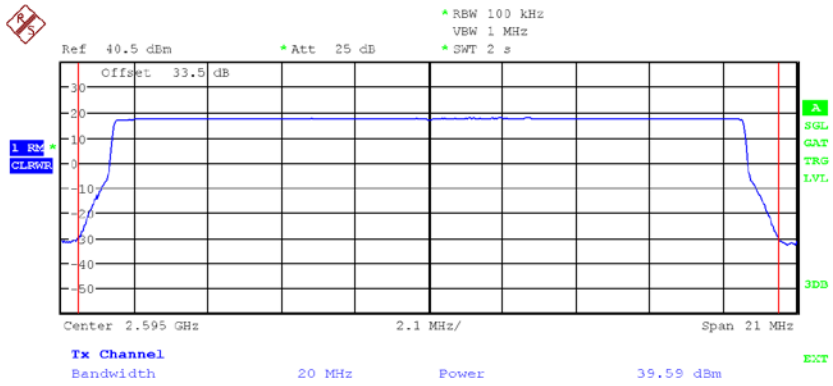


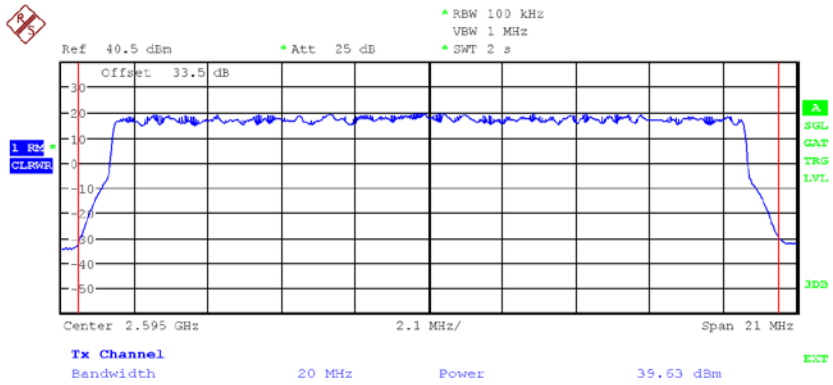
Figure 14 RF Power Output – 64QAM (2595.0 MHz) (20MHz Channel BW)

Config B ANT2:



Date: 27.FEB.2013 11:47:32

Figure 15 RF Power Output – QPSK (2595.0 MHz) (20MHz Channel BW)



Date: 27.FEB.2013 12:02:08

Figure 16 RF Power Output – 16QAM (2595.0 MHz) (20MHz Channel BW)

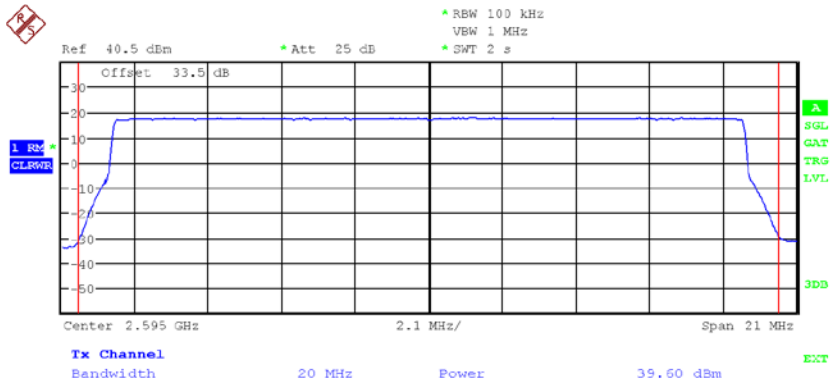


Figure 17RF Power Output – 64QAM (2595.0 MHz) (20MHz Channel BW)

5.2.2. Test No. 2: Modulation Characteristics

No additional measurements are required for the modulation characteristics. Please refer to test no. 3, occupied bandwidth on pages 38.

5.2.3. Test No. 3: Occupied Bandwidth

The value ‘OBW’ is the measured occupied bandwidth.

Config A ANT1:

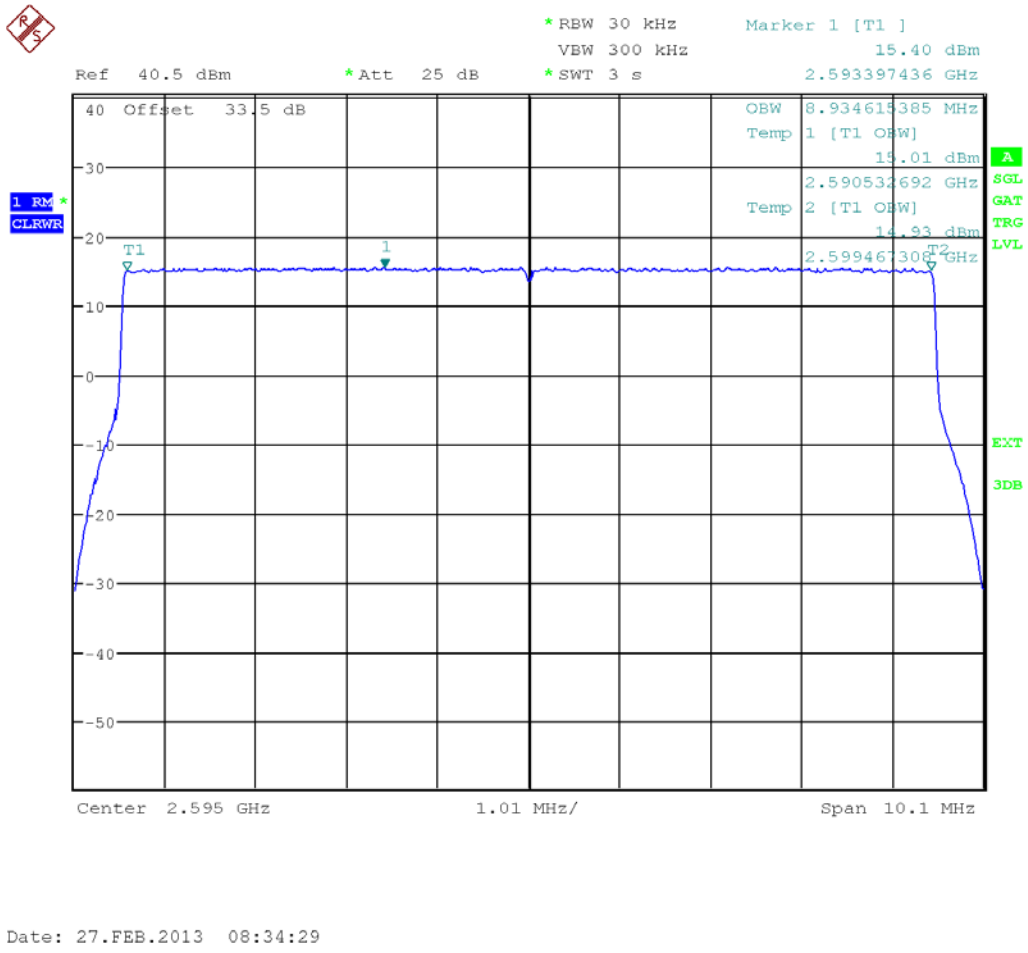


Figure 18 Occupied Bandwidth – QPSK (2595.0 MHz) (10MHz Channel BW)

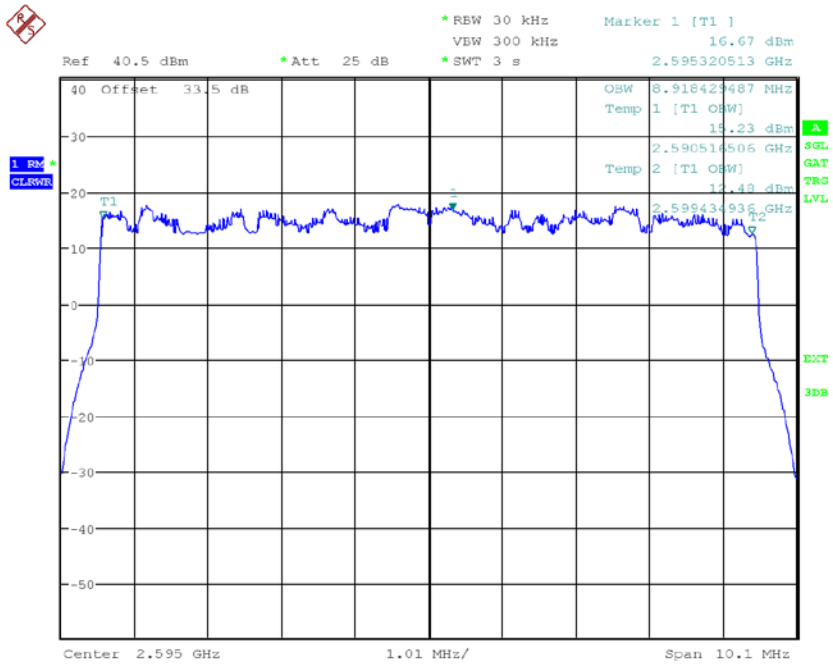


Figure 19 Occupied Bandwidth – 16QAM (2595.0 MHz) (10MHz Channel BW)

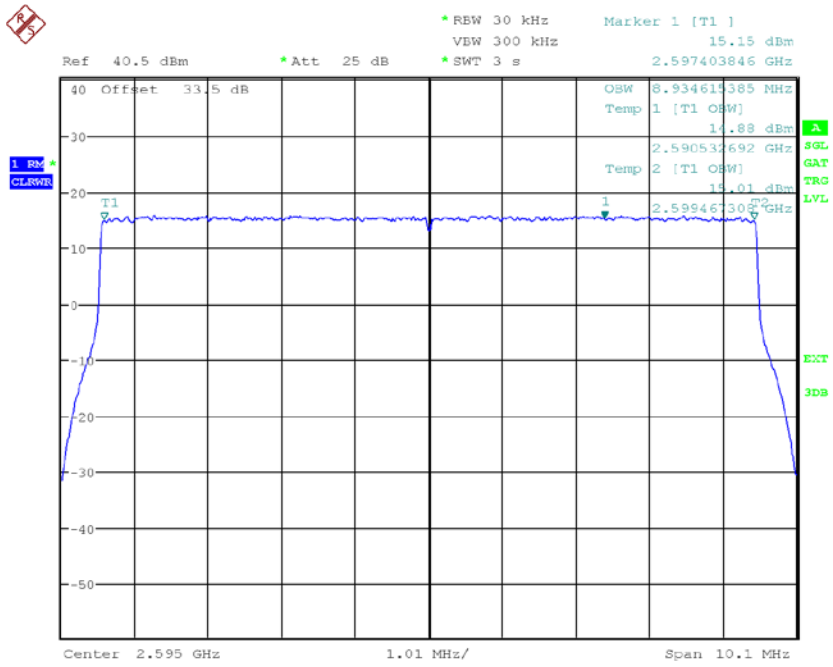


Figure 20 Occupied Bandwidth – 64QAM (2595.0 MHz) (10MHz Channel BW)

Config A ANT2:

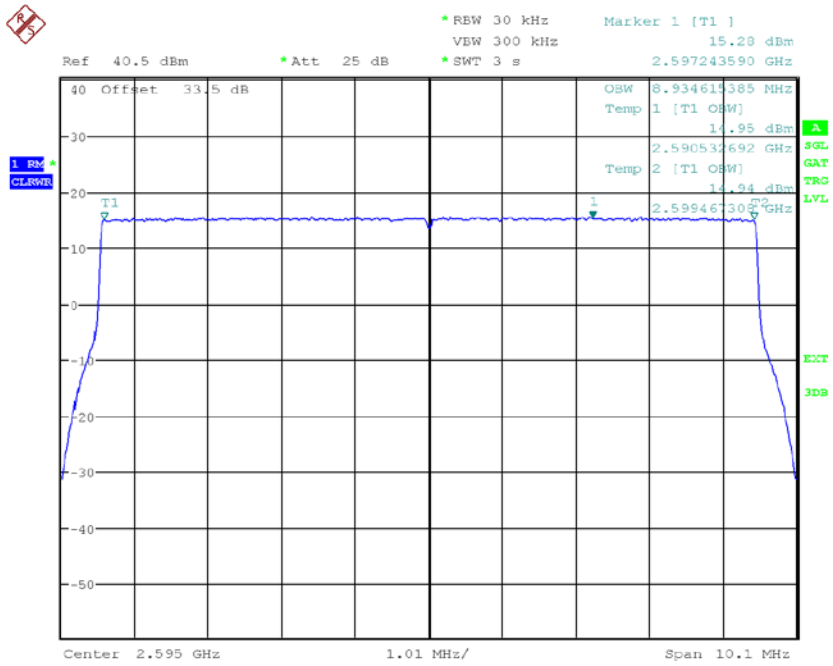


Figure 21 Occupied Bandwidth – QPSK (2595.0 MHz) (10MHz Channel BW)

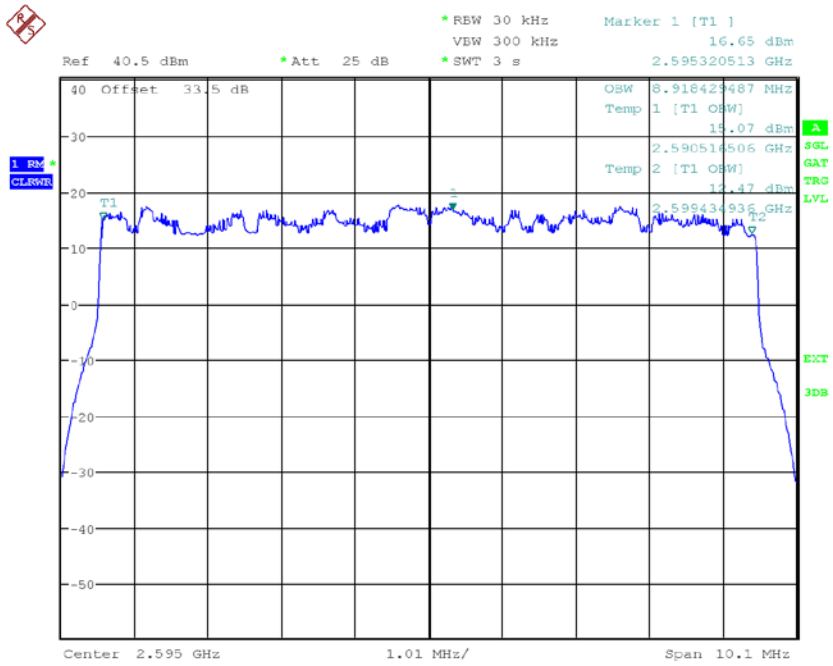


Figure 22 Occupied Bandwidth – 16QAM (2595.0 MHz) (10MHz Channel BW)

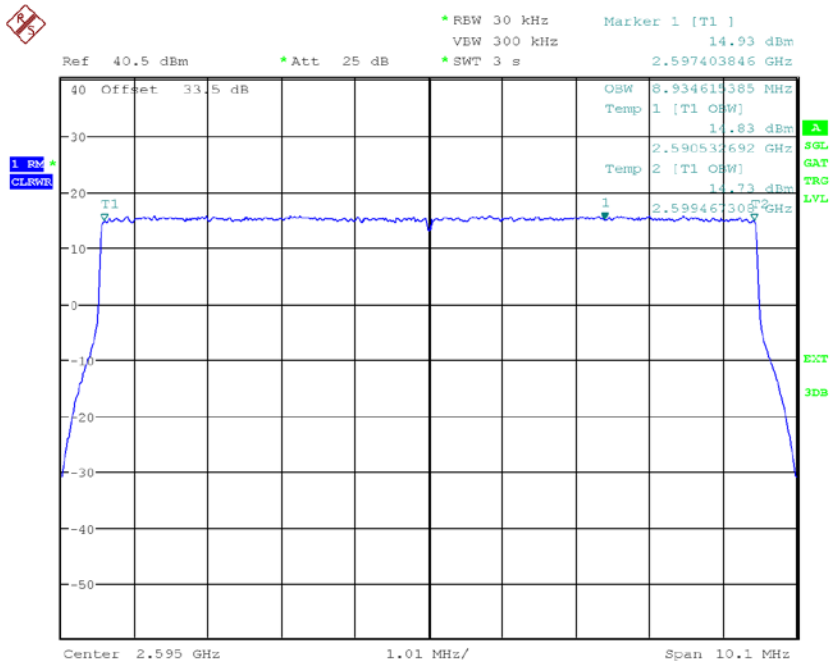


Figure 23 Occupied Bandwidth – 64QAM (2595.0 MHz) (10MHz Channel BW)

Config B ANT1:

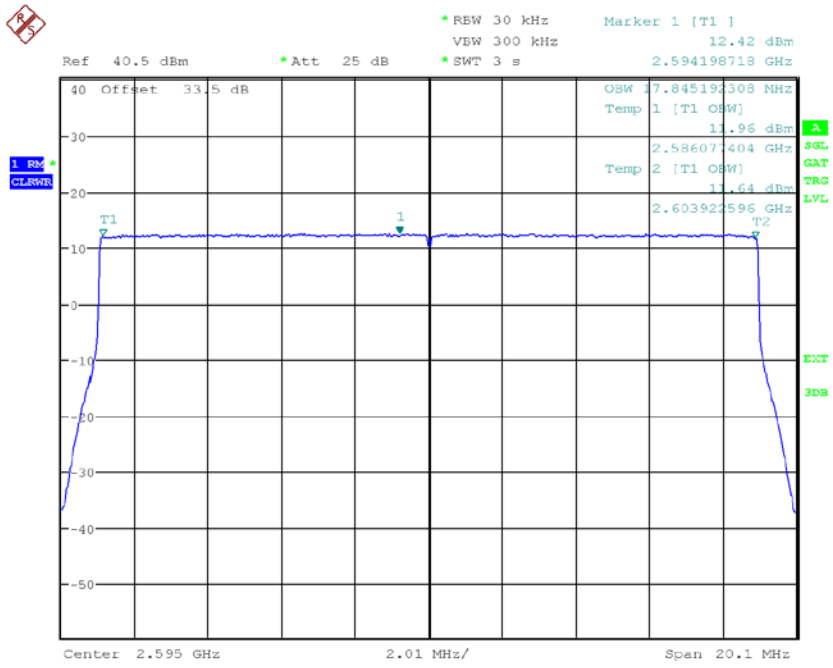


Figure 24 Occupied Bandwidth – QPSK (2595.0 MHz) (20MHz Channel BW)

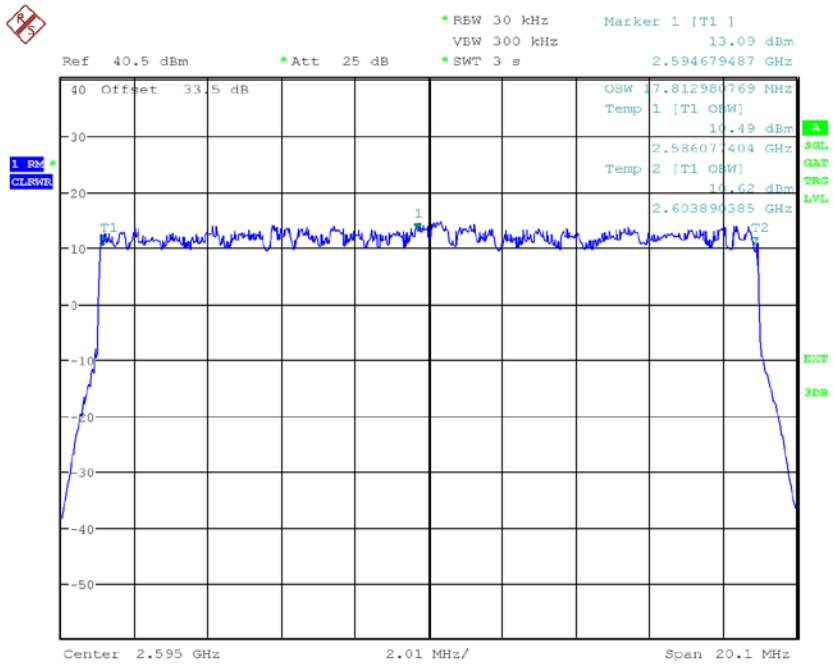


Figure 25 Occupied Bandwidth – 16QAM (2595.0 MHz) (20MHz Channel BW)

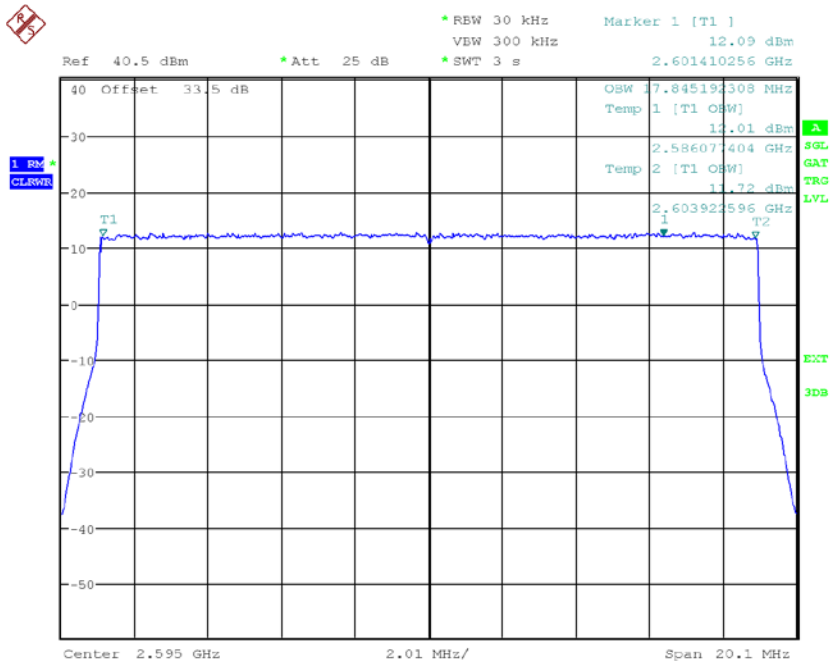


Figure 26 Occupied Bandwidth – 64QAM (2595.0 MHz) (20MHz Channel BW)

Config B ANT2:

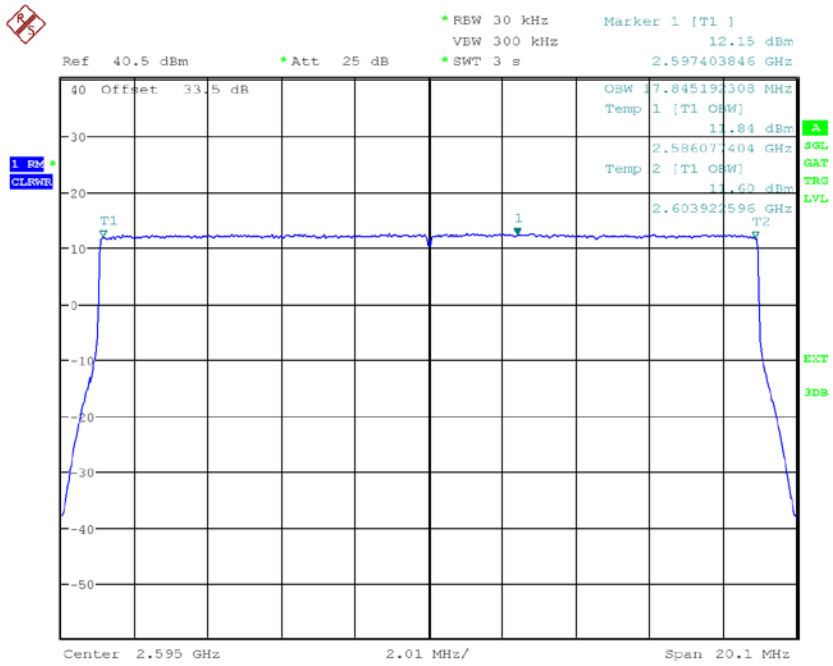


Figure 27 Occupied Bandwidth – QPSK (2595.0 MHz) (20MHz Channel BW)

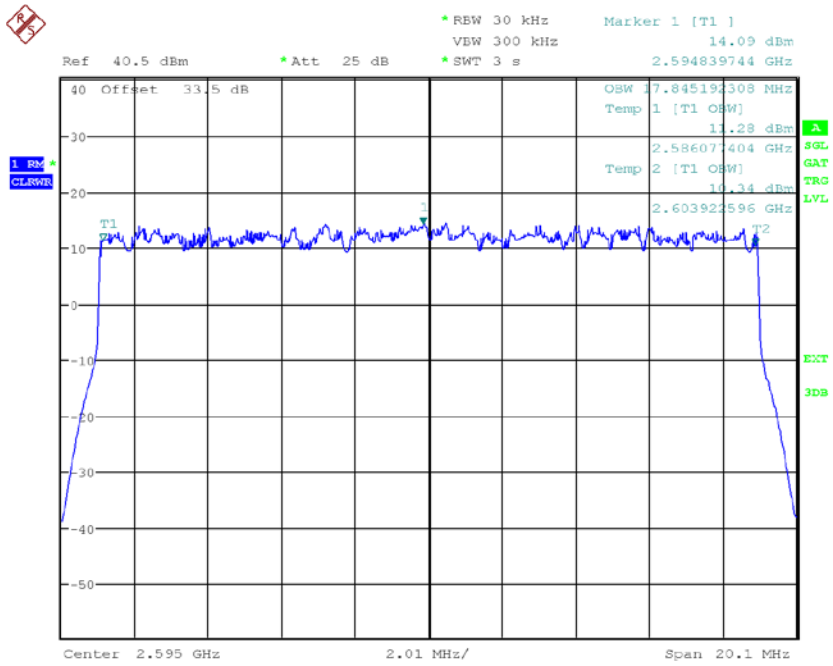


Figure 28 Occupied Bandwidth – 16QAM (2595.0 MHz) (20MHz Channel BW)

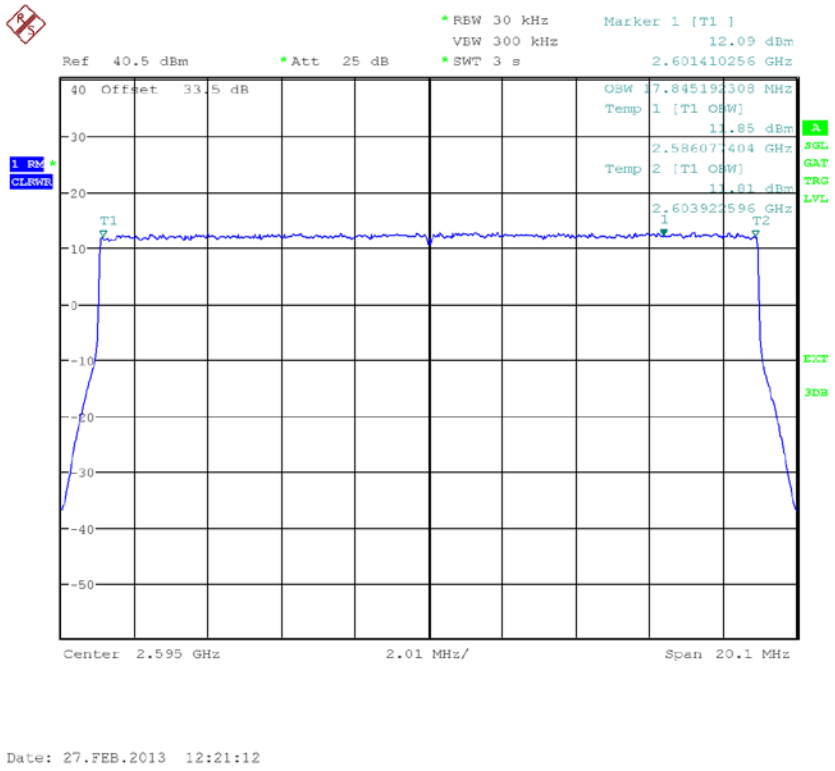


Figure 29 Occupied Bandwidth – 64QAM (2595.0 MHz) (20MHz Channel BW)

5.2.4. Test No. 4: Spurious Emissions at the Antenna Terminals

The external attenuation (cable loss of the setup) can be seen as the 'Offset' value in the screenshots. The external attenuation is frequency dependant. Thus the various 'Offset' values in the screenshots may differ.

Config A ANT1:

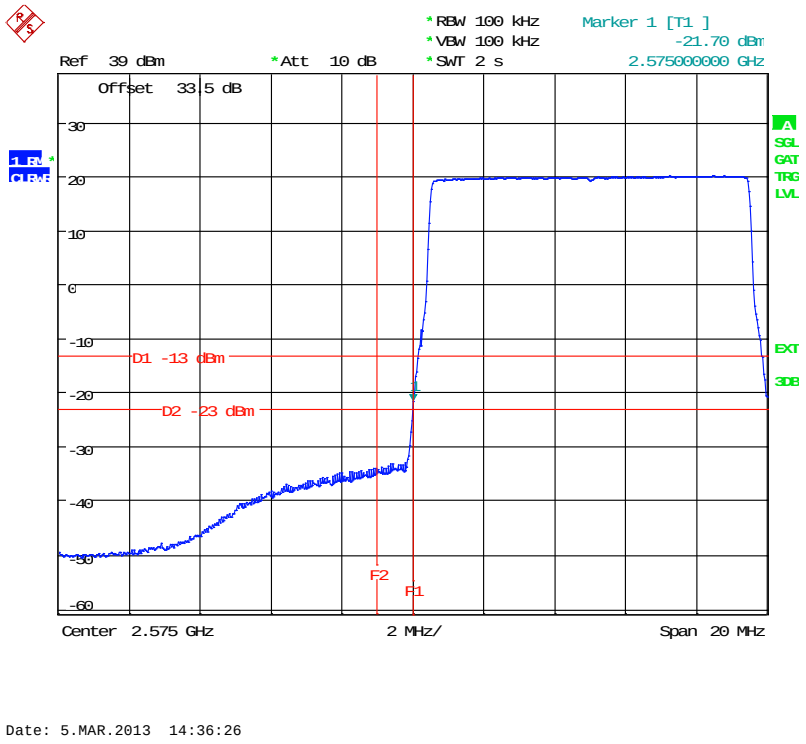


Figure 30 Spurious Emissions (Lower Band Edge) – QPSK (2580.0 MHz) (10MHz Channel BW)

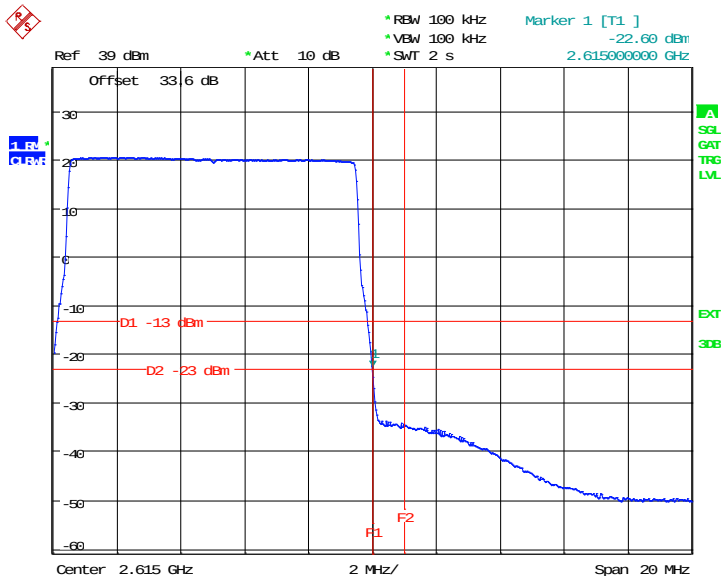


Figure 31 Spurious Emissions (Upper Band Edge) – QPSK (2610.0 MHz) (10MHz Channel BW)

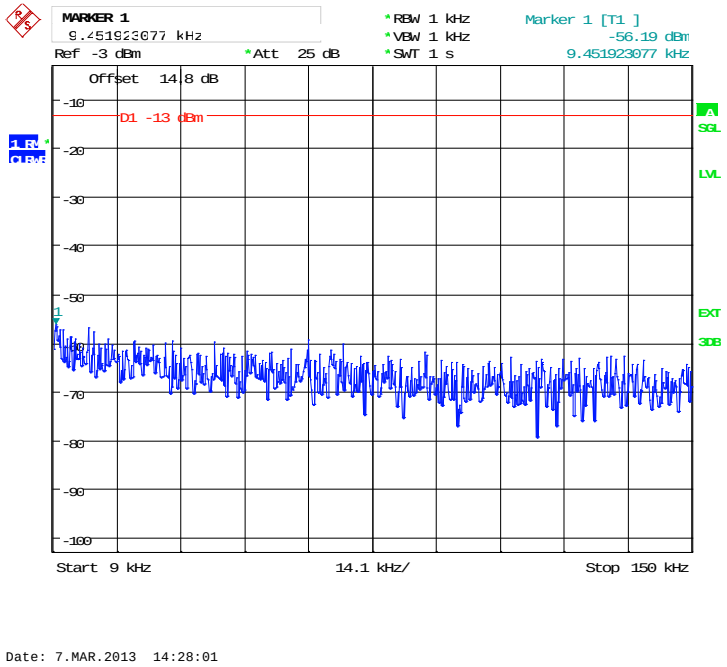


Figure 32 Figure 5 27: Spurious Emissions (9kHz – 150kHz) – QPSK (2595.0 MHz) (10MHz Channel BW)

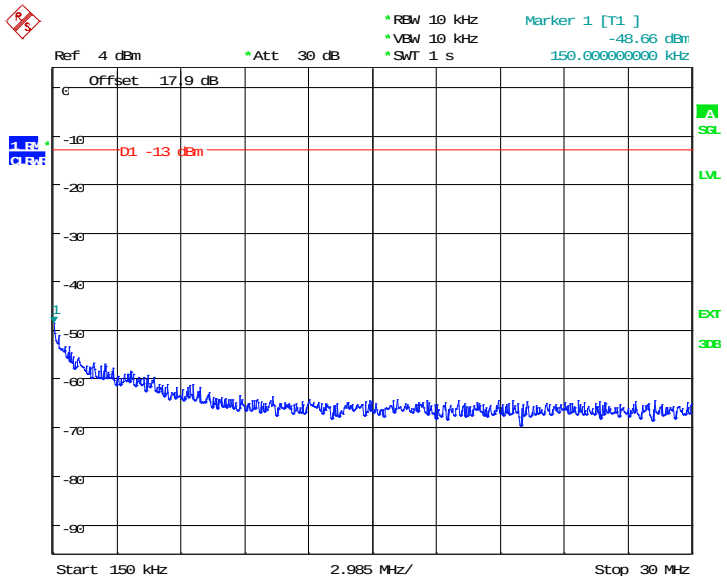


Figure 33 Figure 5 28: Spurious Emissions (150kHz – 30MHz) – QPSK (2595.0 MHz) (10MHz Channel BW)

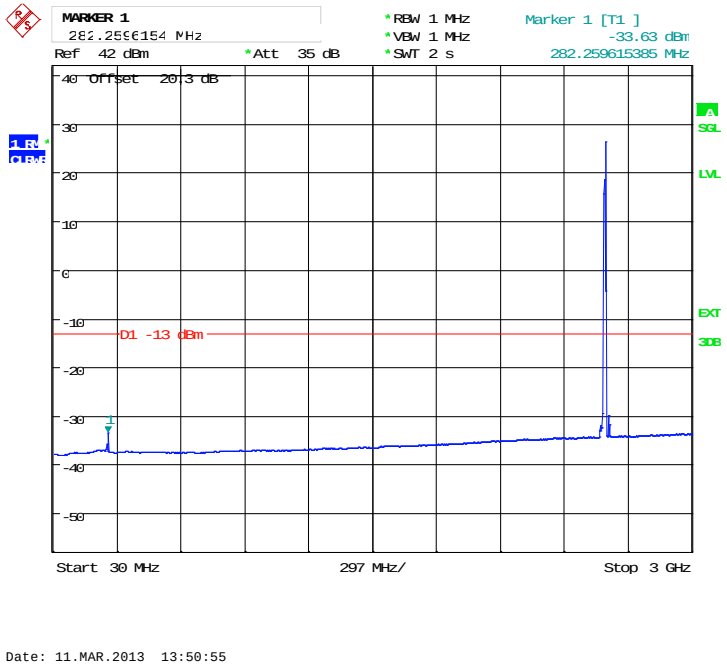


Figure 34 Spurious Emissions (30MHz – 3GHz) – QPSK (2595.0 MHz) (10MHz Channel BW)

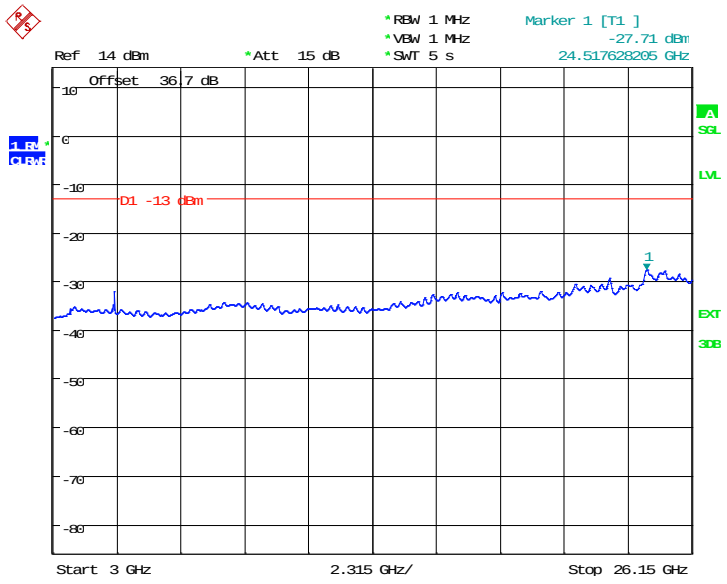


Figure 35 Spurious Emissions (3GHz – 26.150GHz) – QPSK (2595.0 MHz) (10MHz Channel BW)

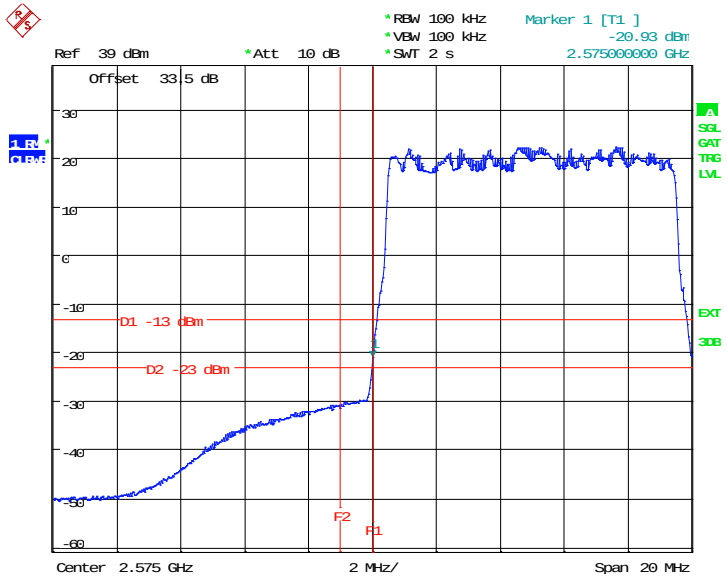


Figure 36 Spurious Emissions (Lower Band Edge) – 16QAM (2580.0 MHz) (10MHz Channel BW)

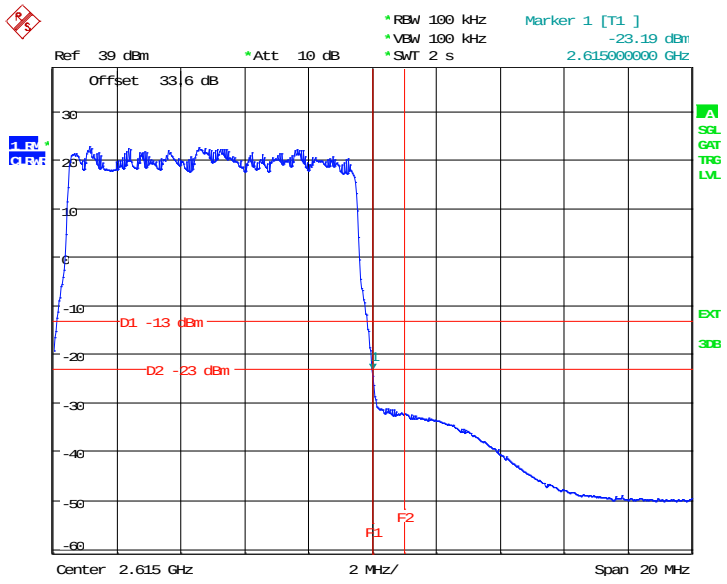


Figure 37 Spurious Emissions (Upper Band Edge) – 16QAM (2610.0 MHz) (10MHz Channel BW)

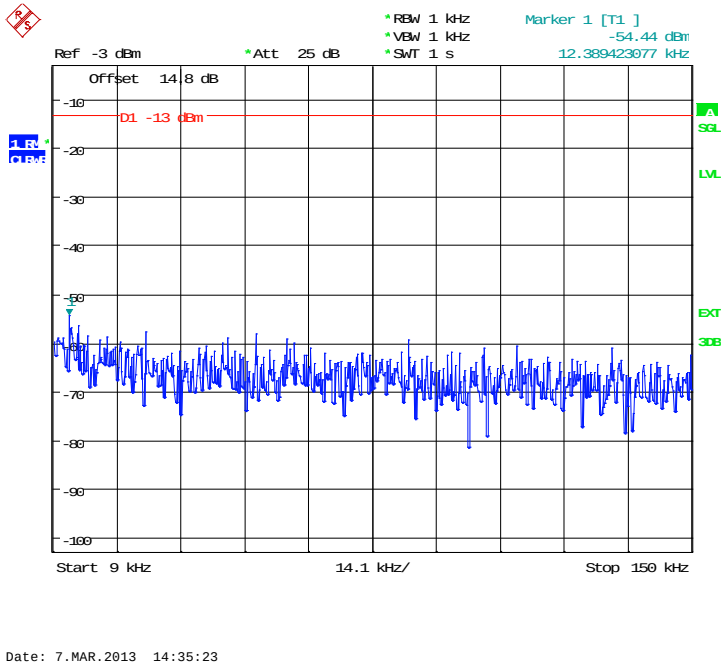


Figure 38 Spurious Emissions (9kHz – 150kHz) – 16QAM (2595.0 MHz) (10MHz Channel BW)

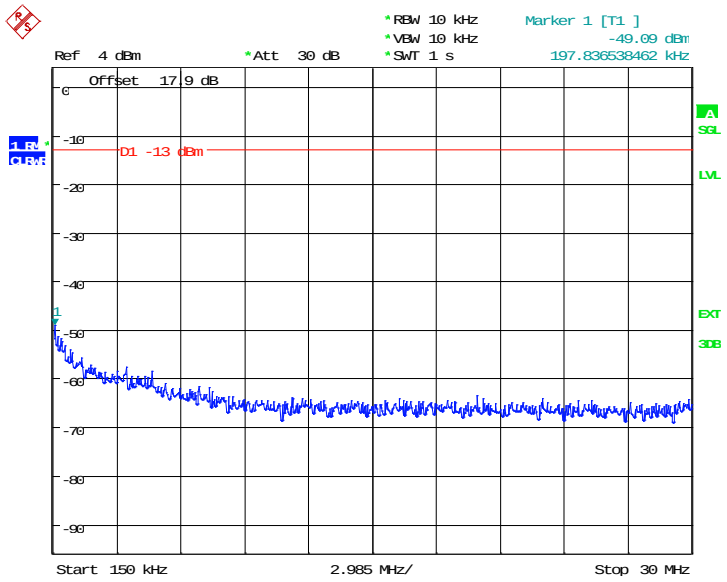


Figure 39 Spurious Emissions (150kHz – 30MHz) – 16QAM (2595.0 MHz) (10MHz Channel BW)

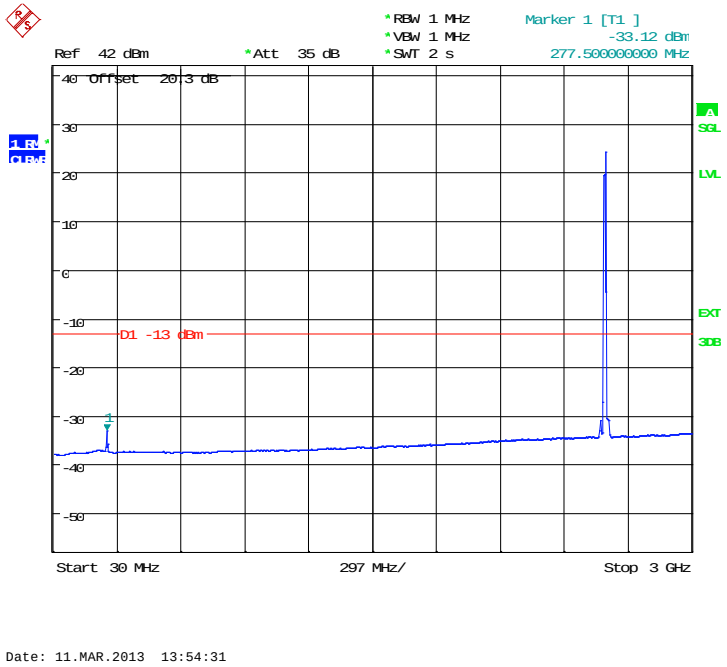


Figure 40 Spurious Emissions (30MHz – 3GHz) – 16QAM (2595.0 MHz) (10MHz Channel BW)

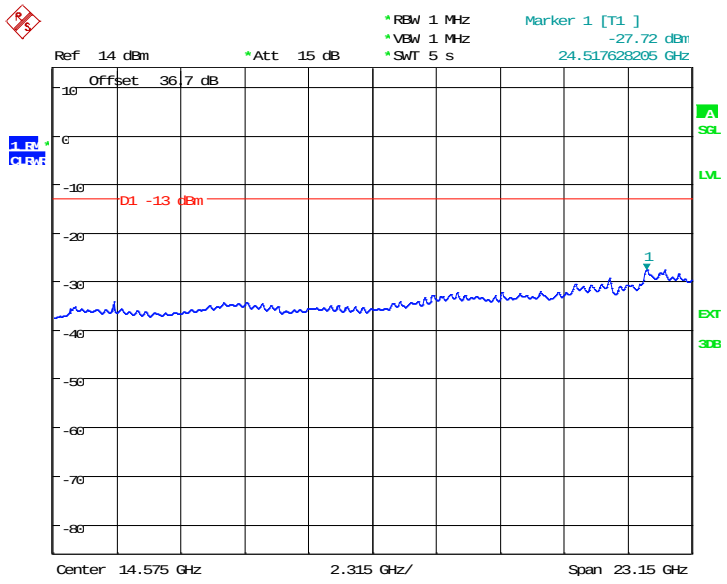


Figure 41 Spurious Emissions (3GHz – 26.150GHz) – 16QAM (2595.0 MHz) (10MHz Channel BW)

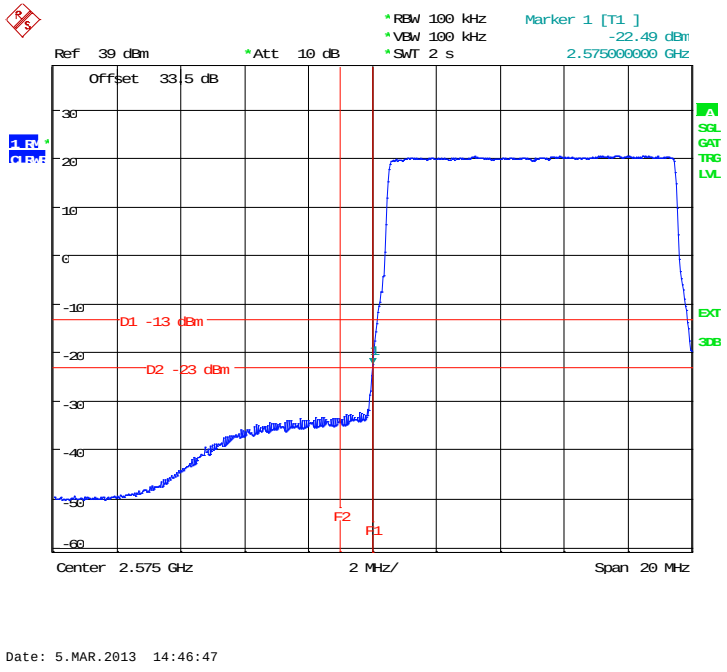


Figure 42 Spurious Emissions (Lower Band Edge) – 64QAM (2580.0 MHz) (10MHz Channel BW)

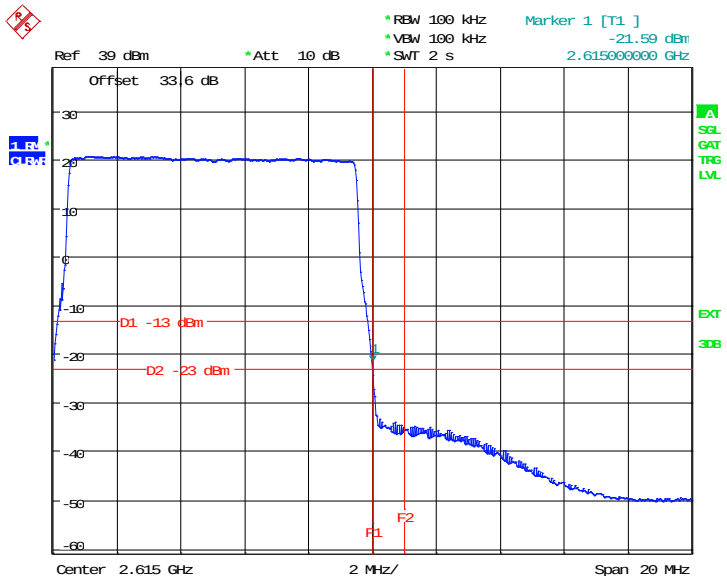


Figure 43 Spurious Emissions (Upper Band Edge) – 64QAM (2610.0 MHz) (10MHz Channel BW)

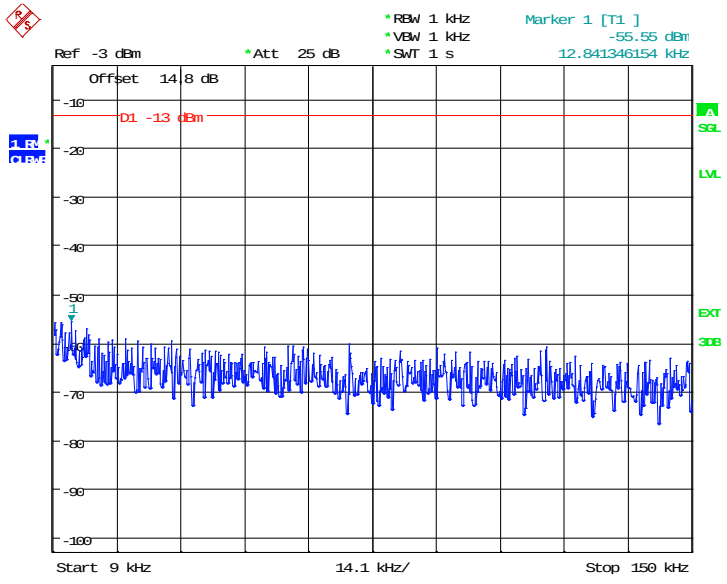
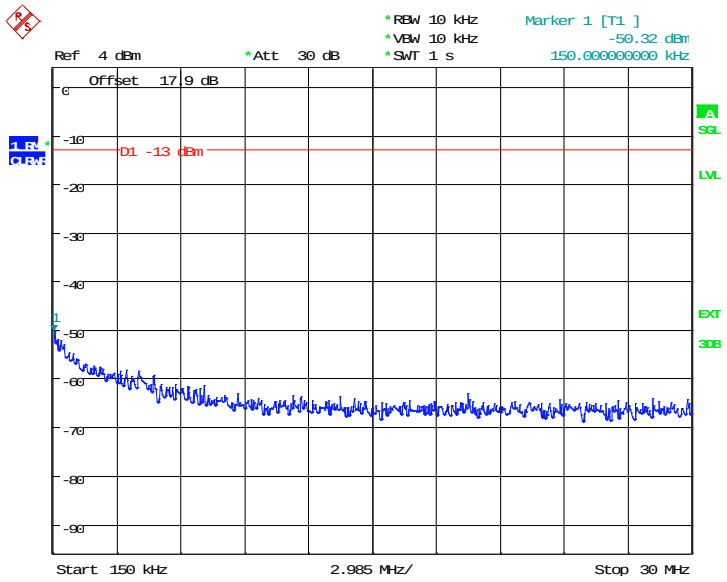
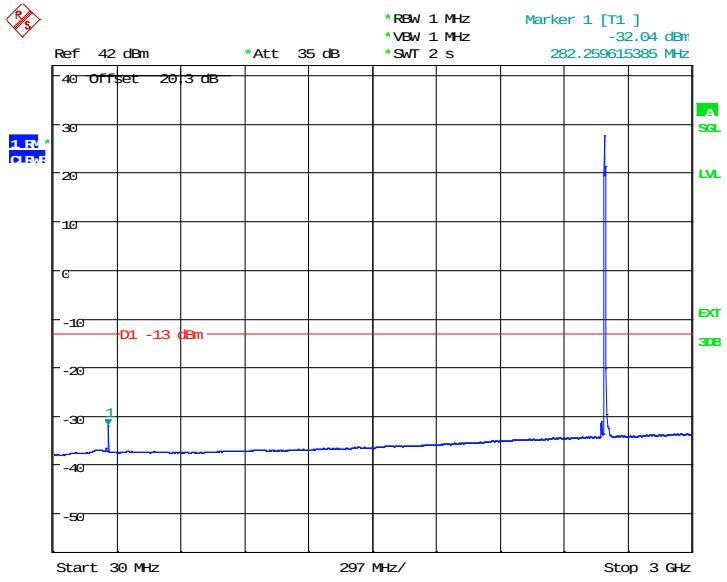


Figure 44 Spurious Emissions (9kHz – 150kHz) – 64QAM (2595.0 MHz) (10MHz Channel BW)



Date: 8.MAR.2013 13:48:40

Figure 45 Spurious Emissions (150kHz – 30MHz) – 64QAM (2595.0 MHz) (10MHz Channel BW)



Date: 11.MAR.2013 13:57:17

Figure 46 Spurious Emissions (30MHz – 3GHz) – 64QAM (2595.0 MHz) (10MHz Channel BW)

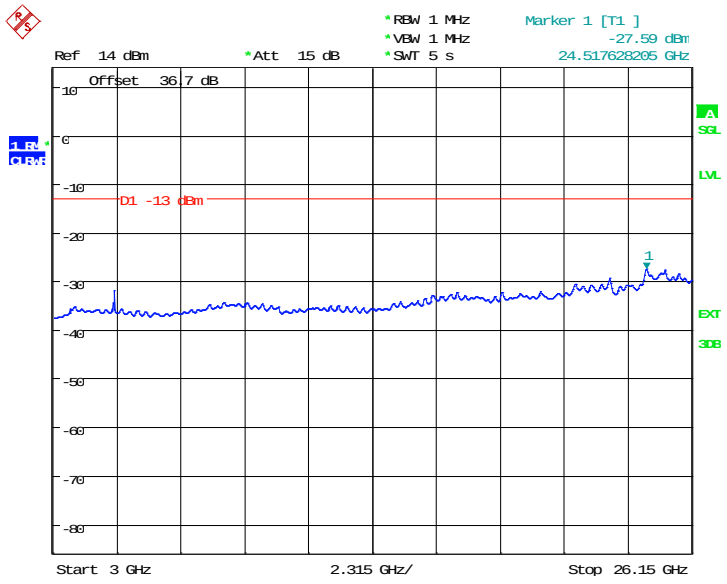


Figure 47 Spurious Emissions (3GHz – 26.150GHz) – 64QAM (2595.0 MHz) (10MHz Channel BW)

Config A ANT2:

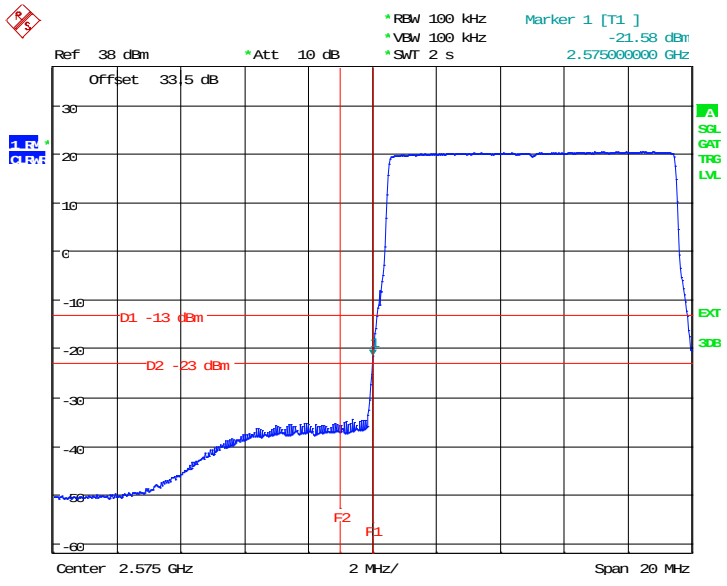


Figure 48 Spurious Emissions (Lower Band Edge) – QPSK (2580.0 MHz) (10MHz Channel BW)

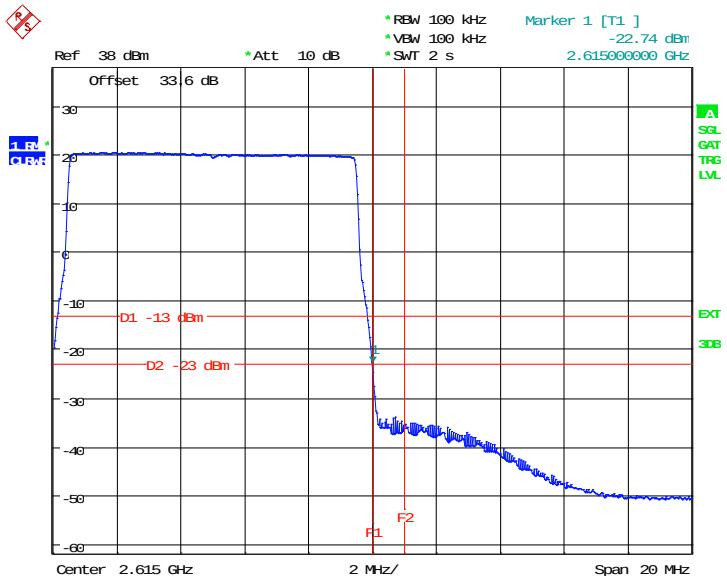


Figure 49 Spurious Emissions (Upper Band Edge) – QPSK (2610.0 MHz) (10MHz Channel BW)

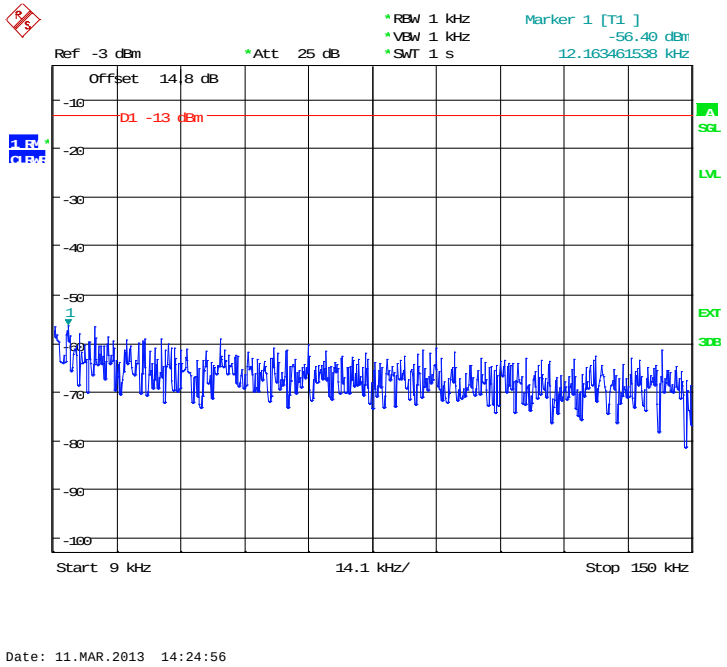


Figure 50 Spurious Emissions (9kHz – 150kHz) – QPSK (2595.0 MHz) (10MHz Channel BW)

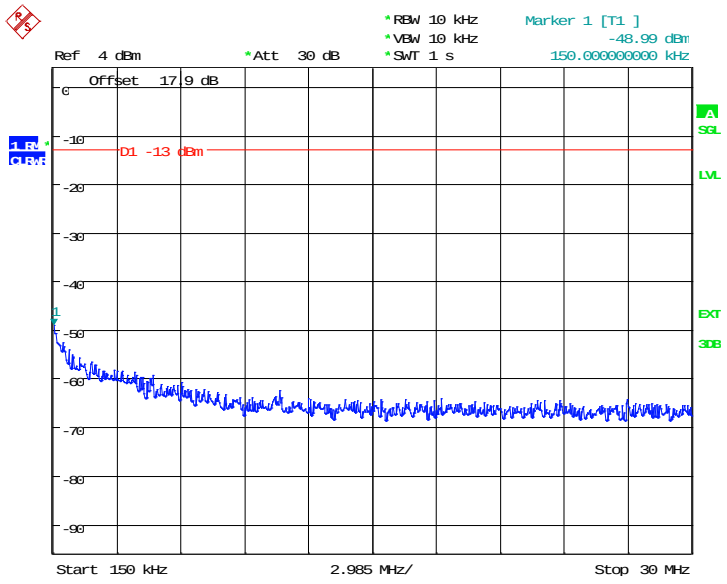


Figure 51 Spurious Emissions (150kHz – 30MHz) – QPSK (2595.0 MHz) (10MHz Channel BW)

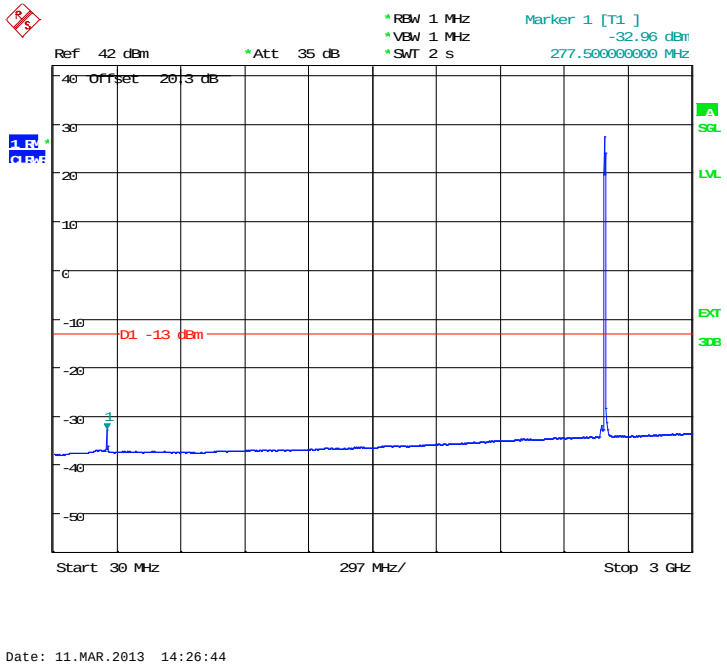
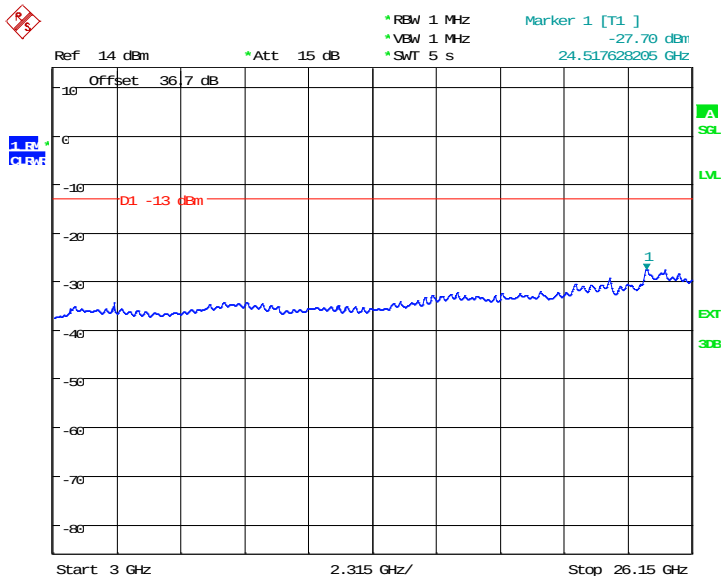
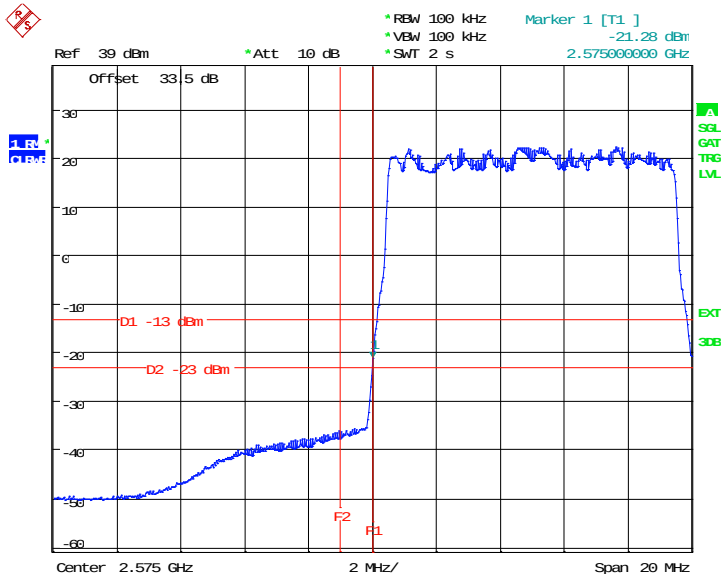


Figure 52 Spurious Emissions (30MHz – 3GHz) – QPSK (2595.0 MHz) (10MHz Channel BW)



Date: 11.MAR.2013 14:27:29

Figure 53 Spurious Emissions (3GHz – 26.150GHz) – QPSK (2595.0 MHz) (10MHz Channel BW)



Date: 5.MAR.2013 14:23:29

Figure 54 Spurious Emissions (Lower Band Edge) – 16QAM (2580.0 MHz) (10MHz Channel BW)

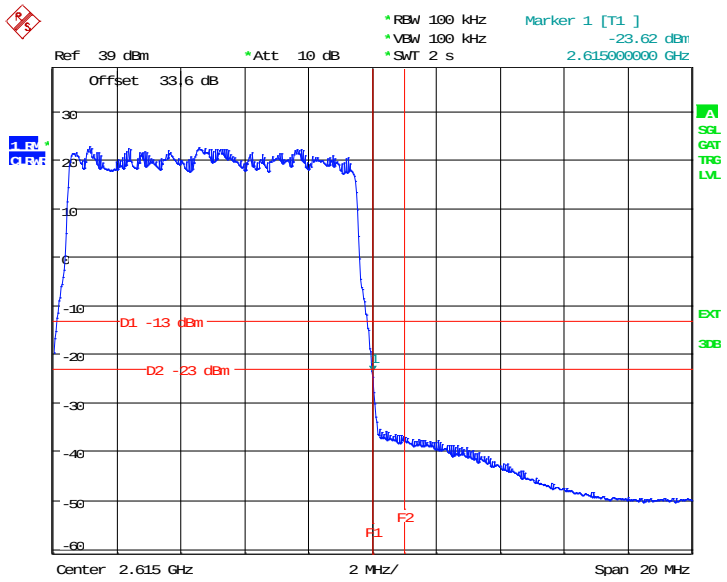


Figure 55 Spurious Emissions (Upper Band Edge) – 16QAM (2610.0 MHz) (10MHz Channel BW)

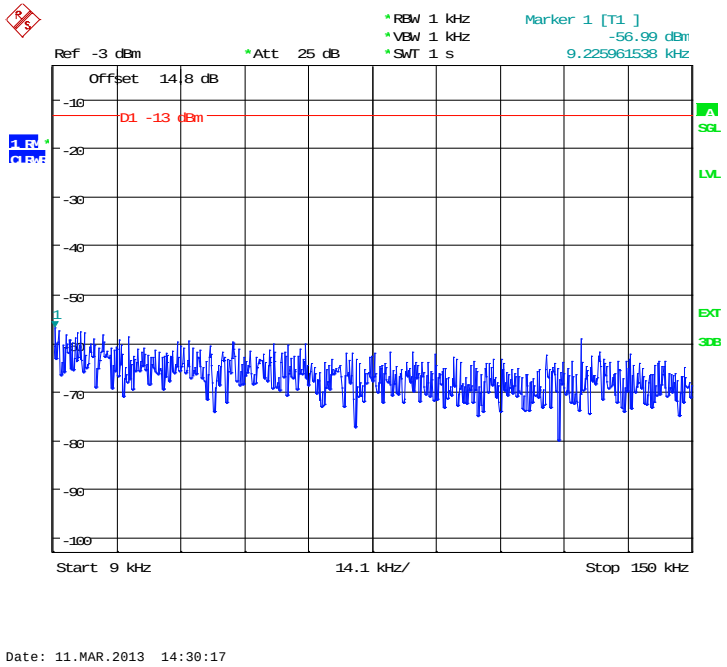


Figure 56 Spurious Emissions (9kHz – 150kHz) – 16QAM (2595.0 MHz) (10MHz Channel BW)

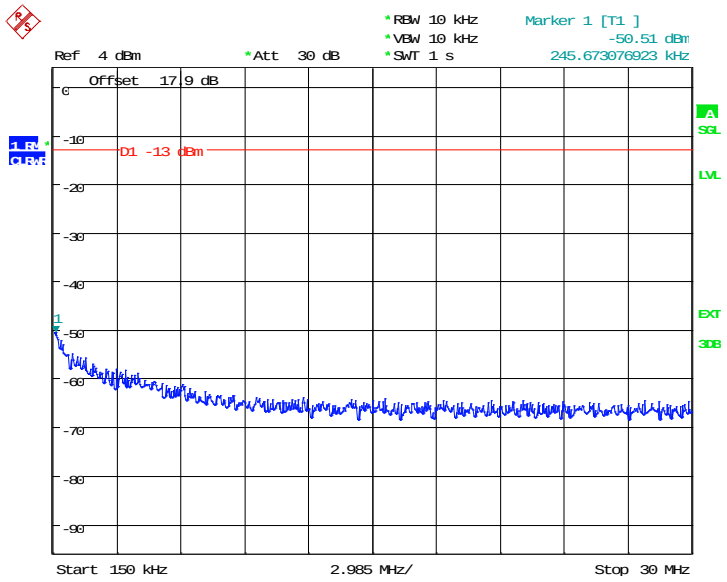


Figure 57 Spurious Emissions (150kHz – 30MHz) – 16QAM (2595.0 MHz) (10MHz Channel BW)

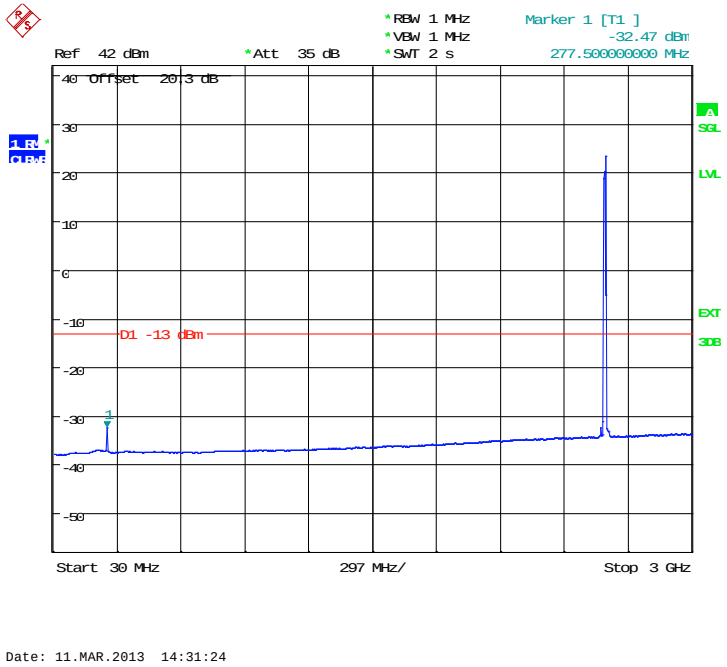
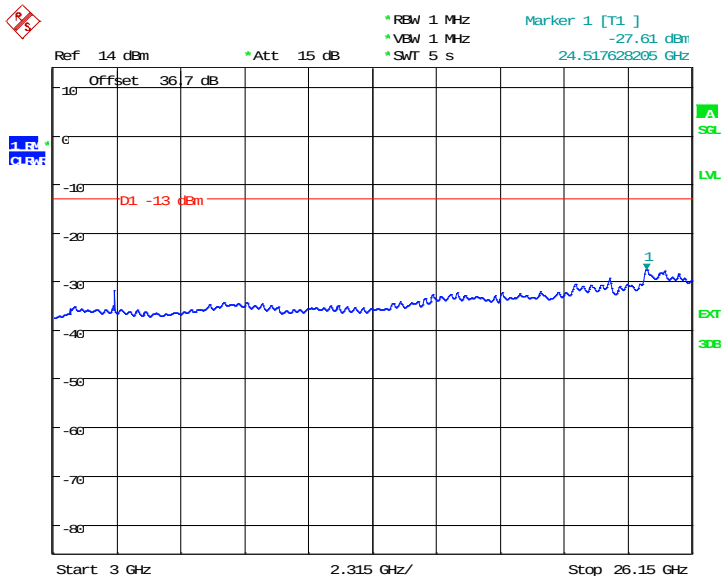
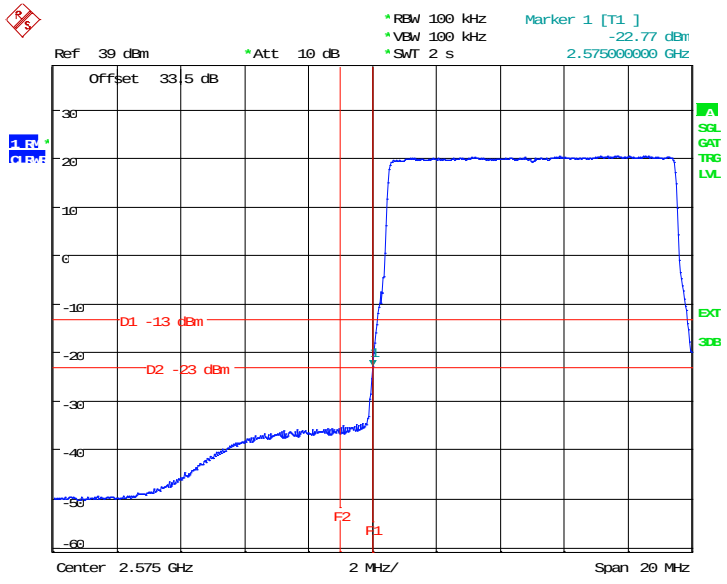


Figure 58 Spurious Emissions (30MHz – 3GHz) – 16QAM (2595.0 MHz) 10MHz Channel BW)



Date: 11.MAR.2013 14:32:02

Figure 59 Spurious Emissions (3GHz – 26.150GHz) – 16QAM (2595.0 MHz) (10MHz Channel BW)



Date: 5.MAR.2013 14:29:57

Figure 60 Spurious Emissions (Lower Band Edge) – 64QAM (2580.0 MHz) (10MHz Channel BW)