



Inter|**Lab**[®]

FCC Measurement/Technical Report on

WLAN transceiver build in
Intrinsically Safe PDA i.roc[®]
Ci70

Report Reference: MDE_ECOM_1202_FCCI

Test Laboratory:

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40880 Ratingen



Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

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0 Summary

0.1 Technical Report Summary

Type of Authorization

Certification for an Intentional Radiator (Digital Device / Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15 (10-1-12 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J – Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

Part 15, Subpart E – Unlicensed National Information Infrastructure Devices

§ 15.403 Definitions

§ 15.407 General technical requirements

Notes:

The tests were selected and performed with reference to the FCC Public Notice "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D01 General UNII Test Procedures v01r01, 2012-05-03", Method SA-1

ANSI C63.4-2009 is applied.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.

DFS is not considered in this test report

For DFS Test Results please see test report: INMC0648 Rev.1



Measurement Summary

FCC Part 15, Subpart C

§ 15.207

Conducted Emissions (AC power line)

The measurement was performed according to ANSI C63.4

2009

OP-Mode	Setup	Port	Final Result
SB2_1a	Setup_03	AC Port (power line)	passed

FCC Part 15, Subpart E

§ 15.403 (i)

26dB Bandwidth

The measurement was performed according to FCC § 15.31

10-1-12

OP-Mode	Setup	Port	Final Result
SB1_1a	Setup_02	Temp.ant.connector	No result
SB1_2a	Setup_02	Temp.ant.connector	No result
SB1_3a	Setup_02	Temp.ant.connector	No result
SB2_1a	Setup_02	Temp.ant.connector	No result
SB2_2a	Setup_02	Temp.ant.connector	No result
SB2_3a	Setup_02	Temp.ant.connector	No result
SB3_1a	Setup_02	Temp.ant.connector	No result
SB3_2a	Setup_02	Temp.ant.connector	No result
SB3_3a	Setup_02	Temp.ant.connector	No result
SB4_1a	Setup_02	Temp.ant.connector	No result
SB4_2a	Setup_02	Temp.ant.connector	No result
SB4_3a	Setup_02	Temp.ant.connector	No result
SB1_1n	Setup_02	Temp.ant.connector	No result
SB1_2n	Setup_02	Temp.ant.connector	No result
SB1_3n	Setup_02	Temp.ant.connector	No result
SB2_1n	Setup_02	Temp.ant.connector	No result
SB2_2n	Setup_02	Temp.ant.connector	No result
SB2_3n	Setup_02	Temp.ant.connector	No result
SB3_1n	Setup_02	Temp.ant.connector	No result
SB3_2n	Setup_02	Temp.ant.connector	No result
SB3_3n	Setup_02	Temp.ant.connector	No result
SB4_1n	Setup_02	Temp.ant.connector	No result
SB4_2n	Setup_02	Temp.ant.connector	No result
SB4_3n	Setup_02	Temp.ant.connector	No result

No result: The test is performed to determine the conducted power limits!
Therefore no final verdict is given.



FCC Part 15, Subpart E

§ 15.407 (a)(1,2,3)

Maximum Conducted Output Power

The measurement was performed according to FCC § 15.31

10-1-12

OP-Mode	Setup	Port	Final Result
SB1_1a	Setup_02	Temp.ant.connector	passed
SB1_2a	Setup_02	Temp.ant.connector	passed
SB1_3a	Setup_02	Temp.ant.connector	passed
SB2_1a	Setup_02	Temp.ant.connector	passed
SB2_2a	Setup_02	Temp.ant.connector	passed
SB2_3a	Setup_02	Temp.ant.connector	passed
SB3_1a	Setup_02	Temp.ant.connector	passed
SB3_2a	Setup_02	Temp.ant.connector	passed
SB3_3a	Setup_02	Temp.ant.connector	passed
SB4_1a	Setup_02	Temp.ant.connector	passed
SB4_2a	Setup_02	Temp.ant.connector	passed
SB4_3a	Setup_02	Temp.ant.connector	passed
SB1_1n	Setup_02	Temp.ant.connector	passed
SB1_2n	Setup_02	Temp.ant.connector	passed
SB1_3n	Setup_02	Temp.ant.connector	passed
SB2_1n	Setup_02	Temp.ant.connector	passed
SB2_2n	Setup_02	Temp.ant.connector	passed
SB2_3n	Setup_02	Temp.ant.connector	passed
SB3_1n	Setup_02	Temp.ant.connector	passed
SB3_2n	Setup_02	Temp.ant.connector	passed
SB3_3n	Setup_02	Temp.ant.connector	passed
SB4_1n	Setup_02	Temp.ant.connector	passed
SB4_2n	Setup_02	Temp.ant.connector	passed
SB4_3n	Setup_02	Temp.ant.connector	passed



FCC Part 15, Subpart E

§ 15.407 (a)(1,2,3)

Peak Power Spectral Density

The measurement was performed according to FCC § 15.31

10-1-12

OP-Mode	Setup	Port	Final Result
SB1_1a	Setup_02	Temp.ant.connector	passed
SB1_2a	Setup_02	Temp.ant.connector	passed
SB1_3a	Setup_02	Temp.ant.connector	passed
SB2_1a	Setup_02	Temp.ant.connector	passed
SB2_2a	Setup_02	Temp.ant.connector	passed
SB2_3a	Setup_02	Temp.ant.connector	passed
SB3_1a	Setup_02	Temp.ant.connector	passed
SB3_2a	Setup_02	Temp.ant.connector	passed
SB3_3a	Setup_02	Temp.ant.connector	passed
SB4_1a	Setup_02	Temp.ant.connector	passed
SB4_2a	Setup_02	Temp.ant.connector	passed
SB4_3a	Setup_02	Temp.ant.connector	passed
SB1_1n	Setup_02	Temp.ant.connector	passed
SB1_2n	Setup_02	Temp.ant.connector	passed
SB1_3n	Setup_02	Temp.ant.connector	passed
SB2_1n	Setup_02	Temp.ant.connector	passed
SB2_2n	Setup_02	Temp.ant.connector	passed
SB2_3n	Setup_02	Temp.ant.connector	passed
SB3_1n	Setup_02	Temp.ant.connector	passed
SB3_2n	Setup_02	Temp.ant.connector	passed
SB3_3n	Setup_02	Temp.ant.connector	passed
SB4_1n	Setup_02	Temp.ant.connector	passed
SB4_2n	Setup_02	Temp.ant.connector	passed
SB4_3n	Setup_02	Temp.ant.connector	passed



FCC Part 15, Subpart E

§ 15.407 (a)(6)

Peak Excursion

The measurement was performed according to FCC § 15.31

10-1-12

OP-Mode	Setup	Port	Final Result
SB1_1a	Setup_02	Temp.ant.connector	passed
SB1_2a	Setup_02	Temp.ant.connector	passed
SB1_3a	Setup_02	Temp.ant.connector	passed
SB2_1a	Setup_02	Temp.ant.connector	passed
SB2_2a	Setup_02	Temp.ant.connector	passed
SB2_3a	Setup_02	Temp.ant.connector	passed
SB3_1a	Setup_02	Temp.ant.connector	passed
SB3_2a	Setup_02	Temp.ant.connector	passed
SB3_3a	Setup_02	Temp.ant.connector	passed
SB4_1a	Setup_02	Temp.ant.connector	passed
SB4_2a	Setup_02	Temp.ant.connector	passed
SB4_3a	Setup_02	Temp.ant.connector	passed
SB1_1n	Setup_02	Temp.ant.connector	passed
SB1_2n	Setup_02	Temp.ant.connector	passed
SB1_3n	Setup_02	Temp.ant.connector	passed
SB2_1n	Setup_02	Temp.ant.connector	passed
SB2_2n	Setup_02	Temp.ant.connector	passed
SB2_3n	Setup_02	Temp.ant.connector	passed
SB4_1n	Setup_02	Temp.ant.connector	passed
SB4_2n	Setup_02	Temp.ant.connector	passed
SB4_3n	Setup_02	Temp.ant.connector	passed



FCC Part 15, Subpart E

§ 15.407 (b)(1,5,6)

Undesirable Emissions / General Field Strength Limits;
Restricted Band and Radiated Emission Limits

The measurement was performed according to FCC § 15.31 / 10-1-12 /
ANSI C63.4 2009

OP-Mode	Setup	Port	Final Result
SB1_1a	Setup_01	Enclosure	passed
SB1_2a	Setup_01	Enclosure	passed
SB1_3a	Setup_01	Enclosure	passed
SB2_1a	Setup_01	Enclosure	passed
SB2_2a	Setup_01	Enclosure	passed
SB2_3a	Setup_01	Enclosure	passed
SB3_1a	Setup_01	Enclosure	passed
SB3_2a	Setup_04	Enclosure	passed
SB3_3a	Setup_01	Enclosure	passed
SB4_1a	Setup_01	Enclosure	passed
SB4_2a	Setup_01	Enclosure	passed
SB4_3a	Setup_01	Enclosure	passed
SB1_1n	Setup_01	Enclosure	passed
SB1_2n	Setup_01	Enclosure	passed
SB1_3n	Setup_01	Enclosure	passed
SB2_1n	Setup_01	Enclosure	passed
SB2_2n	Setup_01	Enclosure	passed
SB2_3n	Setup_01	Enclosure	passed
SB3_1n	Setup_01	Enclosure	passed
SB3_2n	Setup_04	Enclosure	passed
SB3_3n	Setup_01	Enclosure	passed
SB4_1n	Setup_01	Enclosure	passed
SB4_2n	Setup_01	Enclosure	passed
SB4_3n	Setup_01	Enclosure	passed

FCC Part 15, Subpart E

§ 15.407 (g)

Frequency Stability

The measurement was performed according to FCC § 15.31 10-1-12

OP-Mode	Setup	Port	Final Result
SB1_1	Setup_01	Temp.ant.connector	passed
SB2_1	Setup_01	Temp.ant.connector	passed
SB3_1	Setup_01	Temp.ant.connector	passed

This test report replaces the 7 Layers test report with the reference MDE_ECOM_1202_FCCI.

Responsible for Accreditation Scope: _____

Responsible for Test Report: _____



1 Administrative Data

1.1 Testing Laboratory

Company Name: 7Layers AG
Address Borsigstr. 11
40880 Ratingen
Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716 .

The test facility is also accredited by the following accreditation organisation:
Laboratory accreditation no.: DAKKS D-PL-12140-01-01

Responsible for Accreditation Scope: Dipl.-Ing. Bernhard Retka
Dipl.-Ing. Robert Machulec
Dipl.-Ing. Andreas Petz
Dipl.-Ing. Marco Kullik

Report Template Version: 2012-05-26

1.2 Project Data

Responsible for testing and report: Dipl.-Ing. Marco Kullik
Date of Test(s): 2012-12-23 to 2013-08-14
Date of Report: 2013-08-16

1.3 Applicant Data

Company Name: ECOM Instruments GmbH
Address: Industriestraße 2
97959 Assamstadt
Germany
Contact Person: Mr. H. Fiederlein

1.4 Manufacturer Data

Company Name: please see applicant data

Address:

Contact Person:



2 Test object Data

2.1 General EUT Description

Equipment under Test:	WLAN transceiver
Type Designation:	Ci70
Kind of Device:	Intrinsically Safe PDA i.roc®
(optional)	
Voltage Type:	DC (internal battery)
Voltage Level:	3.7 V
Tested Modulation Type:	OFDM, BPSK

General product description:

The EUT is a WLAN transceiver, part of the Intrinsically Safe i.roc® Ci70 –Ex. It is a handheld PDA, which contains the wireless technologies WLAN 2.4 GHz with **b,g** and **n** modes, WLAN 5 GHz with **a** and **n** modes and Bluetooth. The EUT can be additionally equipped with different RFID modules in combinations with laser scanner.

Specific product description related to focus of this measurement report:

The WLAN (Wireless Local Area Network) Transceiver is operating in the 5 GHz band in the range 5.15 – 5.25 GHz, 5.25 – 5.35 GHz, 5.47 – 5.725 GHz and 5. and uses the Direct Sequence Spread Spectrum (DSSS) Modulation.

It supports the modes IEE802.11a and IEE802.11n (up to 72.2 Mbps data rate / MCS7) in the 5 GHz band.

The EUT cannot be charged directly via an AC/DC adapter, this is only possible via an additional docking station.

The Ci70 includes the RC12 Module from Intermec Technologies Corporation

The EUT provides the following ports:

Ports

Temporary antenna connector
Enclosure
System Port (incl. DC power)
AC-Mains Port (AE 1)

The main components of the EUT are listed and described in Chapter 2.2



2.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
EUT A (Code: 4E000a01)	Intrinsically Safe PDA (numeric)	Ci70	22321245032	P5.2	1.50.19.0013
Remark: Gain of integral antenna = 2.1 dBi					
EUT B (Code: 4E001d01)	Intrinsically Safe PDA (numeric)	Ci70	22321245055	P5.2	1.50.19.0013
Remark: EUT B is equipped with a temporary antenna connector.					
EUT C (Code: 4E000b01)	Intrinsically Safe PDA (numeric)	Ci70	22321245059	P5.2	1.50.19.0013
Remark: Gain of integral antenna = 2.1 dBi					

NOTE: The short description is used to simplify the identification of the EUT in this test report.

2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
AE 1 (Code: 4E000ACD)	AC/DC adapter	9004AE01	01	-	34351101811	-
AE 2 (Code: 4E000DSDnew)	Dual Dock	1002UU02	01	-	222D1100216	-

2.4 Auxiliary Equipment

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Auxiliary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	Serial no.	HW Status	SW Status	FCC ID
-	-	-	-	-	-	-

2.5 EUT Setups

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup No.	Combination of EUTs	Description and Rationale
Setup_01	EUT A	setup for radiated measurements
Setup_02	EUT B	setup for conducted measurements
Setup_03	EUT A + AE 1 + AE 2	setup for the test AC Mains conducted
Setup_04	EUT C	setup for radiated measurements

2.6 Operating Modes

This chapter describes the operating modes of the EUT's used for testing.

Op. Mode	Description of Operating Modes	Remarks
SB1_1a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 36, Frequency 5180 MHz
SB1_2a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 44, Frequency 5220 MHz
SB1_3a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 48, Frequency 5240 MHz
SB2_1a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 52, Frequency 5260 MHz
SB2_2a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 56, Frequency 5280 MHz
SB3_3a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 64, Frequency 5320 MHz
SB3_1a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 100, Frequency 5500 MHz
SB3_2a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 116, Frequency 5580 MHz
SB3_3a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 140, Frequency 5700 MHz
SB4_1a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 149, Frequency 5745 MHz
SB4_2a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 157, Frequency 5785 MHz
SB4_3a	TX-mode, the EUT transmits in mode 802.11a, 6 Mbps	Worst case data rate 6 Mbps, Channel 161, Frequency 5805 MHz
SB1_1n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 36, Frequency 5180 MHz
SB1_2n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 44, Frequency 5220 MHz
SB1_3n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 48, Frequency 5240 MHz
SB2_1n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 52, Frequency 5260 MHz
SB2_2n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 56, Frequency 5280 MHz
SB2_3n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 64, Frequency 5320 MHz
SB3_1n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 100, Frequency 5500 MHz
SB3_2n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 116, Frequency 5580 MHz
SB3_3n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 140, Frequency 5700 MHz



SB4_1n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 149, Frequency 5745 MHz
SB4_2n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 157, Frequency 5785 MHz
SB4_3n	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Worst case data rate 7.2 Mbps, Channel 161, Frequency 5805 MHz
SB1_1	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Channel 36, Frequency 5180 MHz
SB2_1	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Channel 52, Frequency 5260 MHz
SB3_1	TX-mode, the EUT transmits in mode 802.11n, 7.2 Mbps	Channel 100, Frequency 5500 MHz

2.6.1 Special software used for testing

The WLAN mode of the EUT is set as local TX mode via the program "rtt-wince" installed on the PDA. The software is provided by the applicant.

2.7 Product labeling

2.7.1 FCC ID label

Please refer to the documentation of the applicant.

2.7.2 Location of the label on the EUT

Please refer to the documentation of the applicant.



3 Test Results

3.1 Conducted emissions (AC power line)

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.4

3.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4. The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50 μ H || 50 Ohm Line Impedance Stabilization Network (LISN), which meets the requirements of ANSI C63.4, Annex B, in the frequency range of the measurements. The LISN's unused connections were terminated with 50 Ohm loads.

The measurement procedure consists of two steps. It is implemented into the EMI test software ES-K1 from R&S.

Step 1: Preliminary scan

Intention of this step is, to determine the conducted EMI-profile of the EUT.

EMI receiver settings:

- Detector: Peak - Maxhold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 9 kHz
- Measuring time / Frequency step: 20 ms
- Measurement on phase + neutral lines of the power cords
- AC Mains supplied at 120 V / 60 Hz.

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2: Final measurement

Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.

EMI receiver settings:

- Detector: Quasi-Peak
- IF-Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:

- 1) Neutral lead - reference ground (PE grounded)
- 2) Phase lead - reference ground (PE grounded)
- 3) Neutral lead - reference ground (PE floating)
- 4) Phase lead - reference ground (PE floating)

The highest value is reported. The chosen operating mode is selected as representative mode to generate "worst-case" conditions, i.e. high power consumption.



3.1.2 Test Requirements / Limits

FCC Part 15, Subpart E, §15.407 (b), (6) and §15.207

Frequency Range (MHz)	QP Limit (dBµV)	AV Limit (dBµV)
0.15 – 0.5	66 to 56	56 to 46
0.5 – 5	56	46
5 – 30	60	50

Used conversion factor: Limit (dBµV) = 20 log (Limit (µV)/1µV).

3.1.3 Test Protocol

Temperature: 27 °C
 Air Pressure: 1017 hPa
 Humidity: 30 %

Op. Mode	Setup	Port
SB2_1a	Setup_03	AC port

Power line	Frequency MHz	Measured value QP dBµV	Measured value AV dBµV	QP Limit dBµV	AV Limit dBµV	Margin QP dB	Margin AV dB
N	-	-	-	-	-	-	-
L	-	-	-	-	-	-	-

Remark: No final measurement was performed because no frequencies (peaks) were found within the offset for acceptance analysis during the preliminary scan. Please see annex for the measurement plot.

3.1.4 Test result: RF Power Output

FCC Part 15, Subpart C	Op. Mode	Result
	SB2_1a	passed

3.2 26 dB Bandwidth

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.2.1 Test Description

The Equipment Under Test (EUT) was setup to perform the occupied bandwidth measurements.

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The results recorded were measured with the modulation, producing the worst-case (widest) 26 dB bandwidth.

The EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- Resolution Bandwidth (RBW): 200 kHz
- Video Bandwidth (VBW): 300 kHz
- Detector: Peak
- Trace: Maxhold
- Sweeps: > 200
- Sweeptime: coupled

3.2.2 Test Requirements / Limits

There exist no applicable limits. The test was performed to determine the limits for the "Maximum Conducted Output Power" test case. Therefore no result was applied.

3.2.3 Test Protocol

Temperature: 24 °C Port: Temporary antenna port
 Air Pressure: 1018 hPa
 Humidity: 31 %

UNII - subband	Data Mode	a	n
	CH / Freq. / MHz	26 BW / MHz	26 BW / MHz
1.a) 5150 – 5250 MHz	36 / 5180	22.31	23.21
	44 / 5220	22.24	22.89
	48 / 5240	22.37	22.95
1.b) 5250 – 5350 MHz	52 / 5260	22.37	22.89
	56 / 5280	22.24	22.95
	64 / 5320	22.05	23.65
1.c) 5470 – 5725 MHz	100 / 5500	23.27	23.27
	116 / 5580	22.98	23.01
	140 / 5700	23.08	23.08
1.d) 5725 – 5825 MHz	149 / 5745	21.92	22.95
	157 / 5785	21.99	22.95
	161 / 5805	21.99	23.08

Remark: Please see annex for worst case measurement plots in every sub-band (bold values).



3.2.4 Test result: 26 dB Bandwidth

FCC Part 15, Subpart E	Op. Mode	Result
	SB1_1a	No result
	SB1_2a	No result
	SB1_3a	No result
	SB2_1a	No result
	SB2_2a	No result
	SB2_3a	No result
	SB3_1a	No result
	SB3_2a	No result
	SB3_3a	No result
	SB4_1a	No result
	SB4_2a	No result
	SB4_3a	No result
	SB1_1n	No result
	SB1_2n	No result
	SB1_3n	No result
	SB2_1n	No result
	SB2_2n	No result
	SB2_3n	No result
	SB3_1n	No result
	SB3_2n	No result
	SB3_3n	No result
	SB4_1n	No result
	SB4_2n	No result
	SB4_3n	No result



3.3 Maximum Conducted Output Power

Standard FCC Part 15, Subpart E

The test was performed according to: FCC §15.31

3.3.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the Maximum Conducted Output Power measurements.

The results recorded were measured with the modulation which produces the worst-case (highest) output power.

The EUT was connected to spectrum analyser via a short coax cable with a known loss.

Analyser settings:

- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Detector: RMS
- Trace: averaging
- Sweeps: 100
- Sweeptime: auto

Note:

The analyser settings are according FCC Public Note "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D01 General UNII Test Procedures v01r01, 2012-05-03".

method **SA-1**.

The duty cycle in the used operating mode was: 98.6 %.

3.3.2 Test Requirements / Limits

FCC Part 15, Subpart E, §15.407 (a) (1)

For systems using digital modulation techniques in the 5.15 – 5.25 GHz bands:

Limit: 50 mW (17 dBm) or $4 \text{ dBm} + 10 \log (26 \text{ dB bandwidth} / \text{MHz})$ what ever is the lesser.

FCC Part 15, Subpart E, §15.407 (a) (2)

For systems using digital modulation techniques in the 5.25 – 5.35 GHz and 5.47 – 5.725 GHz bands:

Limit: 250 mW (24 dBm) or $11 \text{ dBm} + 10 \log (26 \text{ dB bandwidth} / \text{MHz})$ what ever is the lesser.

FCC Part 15, Subpart E, §15.407 (a) (3)

For systems using digital modulation techniques in the 5.725 – 5.825GHz bands:

Limit: 1 W (30 dBm) or $17 \text{ dBm} + 10 \log (26 \text{ dB bandwidth} / \text{MHz})$ what ever is the lesser.

3.3.3 Test Protocol

Temperature: 24 °C Port: Temporary antenna port
 Air Pressure: 1018 hPa
 Humidity: 31 %

UNII-subband	Data Mode	a		n	
	CH / Freq. / MHz	Power ¹⁾ / dBm	Limit ²⁾ / dBm	Power / dBm	Limit ²⁾ / dBm
5.a) 5150 - 5250 MHz	36 / 5180	11.4	17.0	11.4	17.0
	40 / 5220	11.6	17.0	11.5	17.0
	48 / 5240	12.1	17.0	12.0	17.0
5.b) 5250 - 5350 MHz	52 / 5260	12.9	24.0	12.7	24.0
	60 / 5280	13.0	24.0	12.9	24.0
	64 / 5320	13.5	24.0	13.6	24.0
5.c) 5470 - 5725 MHz	100 / 5500	13.3	24.0	13.3	24.0
	116 / 5580	13.1	24.0	13.5	24.0
	140 / 5700	11.4	24.0	11.3	24.0
5.d) 5725 - 5825 MHz	149 / 5745	10.8	30.0	10.8	30.0
	157 / 5785	10.9	30.0	10.7	30.0
	161 / 5805	10.4	30.0	10.3	30.0

Notes:

- 1) Measurement method SA-1 was used.
- 2) The calculated limit uses the different formulas according the different UNII-subbands and the measured 26 dB bandwidth.

Remark Please see annex for worst case measurement plots in every sub-band (bold values).

3.3.4 Test result: Maximum conducted Output Power

FCC Part 15, Subpart E	Op. Mode	Result
	SB1_1a	passed
	SB1_2a	passed
	SB1_3a	passed
	SB2_1a	passed
	SB2_2a	passed
	SB2_3a	passed
	SB3_1a	passed
	SB3_2a	passed
	SB3_3a	passed
	SB4_1a	passed
	SB4_2a	passed
	SB4_3a	passed
	SB1_1n	passed
	SB1_2n	passed
	SB1_3n	passed
	SB2_1n	passed
	SB2_2n	passed
	SB2_3n	passed
	SB3_1n	passed
	SB3_2n	passed
	SB3_3n	passed
	SB4_1n	passed
	SB4_2n	passed
	SB4_3n	passed



3.4 Peak Power Spectral Density

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

3.4.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the Peak Power Spectral Density measurements.

The results recorded were measured with the modulation which produces the worst-case (highest) output power.

The EUT was connected to spectrum analyser via a short coax cable with a known loss.

Analyser settings:

- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Detector: RMS
- Trace: averaging
- Sweeps: 100
- Sweeptime: auto

Note:

The analyser settings are according FCC Public Note "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D01 General UNII Test Procedures v01r01, 2012-05-03", method **SA-1**.

3.4.2 Test Requirements / Limits

FCC Part 15, Subpart E, § 15.407 (a), (1,2,3)

FCC Part 15, Subpart E, §15.407 (a) (1)

For systems using digital modulation techniques in the 5.15 – 5.25 GHz bands:

Limit: 4 dBm/MHz

FCC Part 15, Subpart E, §15.407 (a) (2)

For systems using digital modulation techniques in the 5.25 – 5.35 GHz and 5.47 – 5.725 GHz bands:

Limit: 11 dBm/MHz

FCC Part 15, Subpart E, §15.407 (a) (3)

For systems using digital modulation techniques in the 5.725 – 5.825GHz bands:

Limit: 17 dBm/MHz

3.4.3 Test Protocol

Temperature: 24 °C
 Air Pressure: 1018 hPa
 Humidity: 34 %

UNII-subband	Data Mode	a		n	
	CH / Freq. / MHz	PPSD ¹⁾ / dBm	Limit / dBm	PPSD ¹⁾ / dBm	Limit / dBm
5.a) 5150 - 5250 MHz	36 / 5180	0.7	4.0	0.6	4.0
	40 / 5220	0.9	4.0	0.7	4.0
	48 / 5240	1.5	4.0	1.3	4.0
5.b) 5250 - 5350 MHz	52 / 5260	2.2	11.0	2.1	11.0
	60 / 5280	2.5	11.0	2.2	11.0
	64 / 5320	3.2	11.0	2.9	11.0
5.c) 5470 - 5725 MHz	100 / 5500	2.8	11.0	2.5	11.0
	116 / 5600	1.6	11.0	2.4	11.0
	140 / 5700	0.9	11.0	0.6	11.0
5.d) 5725 - 5825 MHz	149 / 5745	0.5	17.0	0.5	17.0
	157 / 5785	0.6	17.0	0.4	17.0
	161 / 5805	0.2	17.0	0.0	17.0

Notes: Measurement method SA-1 was used.

Remark: Please see annex for worst case measurement plots in every sub-band (bold values).

3.4.4 Test result: Peak Power Spectral Density

FCC Part 15, Subpart E	Op. Mode	Result
	SB1_1a	passed
	SB1_2a	passed
	SB1_3a	passed
	SB2_1a	passed
	SB2_2a	passed
	SB2_3a	passed
	SB3_1a	passed
	SB3_2a	passed
	SB3_3a	passed
	SB4_1a	passed
	SB4_2a	passed
	SB4_3a	passed
	SB1_1n	passed
	SB1_2n	passed
	SB1_3n	passed
	SB2_1n	passed
	SB2_2n	passed
	SB2_3n	passed
	SB3_1n	passed
	SB3_2n	passed
	SB3_3n	passed
	SB4_1n	passed
	SB4_2n	passed
	SB4_3n	passed



3.5 Peak Excursion

Standard FCC Part 15, Subpart E

The test was performed according to: FCC §15.31

3.5.1 Test Description

The Equipment Under Test (EUT) was set up in a shielded room to perform the Peak Excursion measurements.

The results recorded were measured with the modulation which produces the worst-case (highest) output power.

The EUT was connected to spectrum analyser via a short coax cable with a known loss.

Analyser settings:

- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Detector: Peak
- Trace: Maxhold
- Sweeps: 200
- Sweeptime: 100 ms

Note:

The analyser settings are according FCC Public Note "Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E, 789033 D01 General UNII Test Procedures v01r01, 2012-05-03",

3.5.2 Test Requirements / Limits

FCC Part 15, Subpart E, § 15.407 (a), (6)

Peak excursion must not exceed 13 dB compared to the Peak Power Spectral Density values.

3.5.3 Test Protocol

Temperature: 24 °C
 Air Pressure: 1018 hPa
 Humidity: 34 %

UNII- subband	Data Mode	a			n		
	CH / Freq. / MHz	Peak / dBm	PPSD / dBm	Excursion / dB	Peak / dBm	PPSD / dBm	Excursion / dB
5.a) 5150 - 5250 MHz	36 / 5180	10.7	0.7	10.0	9.8	0.6	9.2
	40 / 5220	10.6	0.9	9.7	10.1	0.7	9.4
	48 / 5240	11.1	1.5	9.6	10.9	1.3	9.6
5.b) 5250 - 5350 MHz	52 / 5260	12.1	2.2	9.9	11.6	2.1	9.5
	60 / 5280	12.2	2.5	9.7	11.6	2.2	9.4
	64 / 5320	12.7	3.2	9.5	12.4	2.9	9.5
5.c) 5470 - 5725 MHz	100 / 5500	12.5	2.8	9.7	11.9	2.5	9.4
	116 / 5580	13.1	1.6	11.5	13.5	2.4	11.1
	140 / 5700	10.5	0.9	9.6	10.3	0.6	9.7
5.d) 5725 - 5825 MHz	149 / 5745	10.3	0.5	9.8	9.7	0.5	9.2
	157 / 5785	10.2	0.6	9.6	9.5	0.4	9.1
	161 / 5805	9.8	0.2	9.6	9.7	0.0	9.7

Note: Please see annex for worst case measurement plots [Peak value measurements] in every sub-band (bold values).

3.5.4 Test result: Peak Excursion

FCC Part 15, Subpart E	Op. Mode	Result
	SB1_1a	passed
	SB1_2a	passed
	SB1_3a	passed
	SB2_1a	passed
	SB2_2a	passed
	SB2_3a	passed
	SB3_1a	passed
	SB3_2a	passed
	SB3_3a	passed
	SB4_1a	passed
	SB4_2a	passed
	SB4_3a	passed
	SB1_1n	passed
	SB1_2n	passed
	SB1_3n	passed
	SB2_1n	passed
	SB2_2n	passed
	SB2_3n	passed
	SB3_1n	passed
	SB3_2n	passed
	SB3_3n	passed
	SB4_1n	passed
	SB4_2n	passed
	SB4_3n	passed

3.6 Undesirable Emissions / General Field Strength Limits; Restricted Band and Radiated Emission Limits

Standard FCC Part 15, Subpart C & E

The test was performed according to: ANSI C63.4

3.6.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.4 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m in the semi-anechoic chamber. The test was performed at the distance between the EUT and the receiving antenna as listed below.

The measurement procedure is implemented into the EMI test software ES-K1 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is performed at 2 axes. A pre-check is also performed while the EUT is powered from both AC and DC (battery) power in order to find the worst-case operating condition.

1. Measurement up to 30 MHz

The Loop antenna HFH2-Z2 is used.

Step 1: pre-measurement

- Anechoic chamber
- Antenna distance: 10 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 – 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF-Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: final measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.

- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF-Bandwidth: 200 Hz – 10 kHz
- Measuring time / Frequency step: 100 ms

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan

Preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 30 – 1000 MHz
- Frequency steps: 60 kHz
- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 μ s
- Turntable angle range: -180° to 180°
- Turntable step size: 90°



- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: second measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is, to find out the approximate turntable angle and antenna height for each frequency.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: -180° to 180°
- Turntable step size: 45°
- Height variation range: 1 – 4 m
- Height variation step size: 0.5 m
- Polarisation: horizontal + vertical

After this step the EMI test system has determined the following values for each frequency (of step 1):

- Frequency
- Azimuth value (of turntable)
- Antenna height

The last two values have now the following accuracy:

- Azimuth value (of turntable): 45°
- Antenna height: 0.5 m

Step 3: final measurement

In this step the accuracy of the turntable azimuth and antenna height will be improved.

This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will be slowly varied by $\pm 22.5^{\circ}$ around this value. During this action the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position the antenna height is also slowly varied by ± 25 cm around the antenna height determined. During this action the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: -22.5° to $+ 22.5^{\circ}$ around the determined value
- Height variation range: -0.25 m to $+0.25$ m around the determined value

Step 4: final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- Detector: Quasi-Peak(< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

3. Measurement above 1 GHz

The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

The Equipment Under Test (EUT) was set up on a non-conductive support at 1.4 m height in the fully-anechoic chamber. The measurement distance was reduced to 1 m. The results were extrapolated by the extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements, inverse linear-distance squared for the power reference level measurements). Due to the fact that in this frequency range a double ridged wave guided horn antenna (up to 18 GHz) and a horn antenna (18–25 GHz) are used, the steps 2-4 are omitted. Step 1 was performed with one height of the receiving antenna only.

EMI receiver settings:

- Detector: Peak, Average
- IF Bandwidth = 1 MHz

3.6.2 Test Requirements / Limits

FCC Part 15 Subpart E , §15.407 (b)(1), (2), (3), (6), (7)

(1) For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz

(2) For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.

(3) For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of -27 dBm/MHz.

... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit(dBµV/m @10m)
0.009 – 0.49	2400/F(kHz)	300	Limit (dBµV/m)+59.1dB
0.49 – 1.705	24000/F(kHz)	30	Limit (dBµV/m)+19.1dB
1.705 – 30	30	30	Limit (dBµV/m)+19.1dB

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limit (dBµV/m)
30 – 88	100	3	40.0
88 – 216	150	3	43.5
216 – 960	200	3	46.0
above 960	500	3	54.0

§15.35(b)

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: $\text{Limit (dB}\mu\text{V/m)} = 20 \log (\text{Limit } (\mu\text{V/m})/1\mu\text{V/m)}$

3.6.3 Test Protocol

Temperature: 21 – 25 °C
 Air Pressure: 1003 – 1024hPa
 Humidity: 36 – 42 %

3.6.3.1 Measurement up to 30 MHz

Op. Mode	Setup	Port
SBx_2a	Setup_01	Enclosure

Antenna Position	Frequency MHz	Corrected value dB μ V/m		Limit dB μ V/m	Limit dB μ V/m	Margin to limit dB	Margin to limit dB
		PK	AV	PK	AV	PK	AV
0°	-	-	-	-	-	-	-
90°	-	-	-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found therefore step 2 was not performed.

3.6.3.2 Measurement above 30 MHz

Op. Mode	Setup	Port
SBx_1a	Setup_01	Enclosure

Polarisation	Frequency MHz	Corrected value dB μ V/m			Limit dB μ V/m	Limit dB μ V/m	Limit dB μ V/m	Margin to limit dB	Margin to limit dB
		QP	PK	AV	QP	PK	AV	QP/PK	AV
Hor. + Vert.	-	-	-	-	-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Op. Mode	Setup	Port
SBx_2a	Setup_01/Setup_04	Enclosure

Polarisation	Frequency MHz	Corrected value dB μ V/m			Limit dB μ V/m	Limit dB μ V/m	Limit dB μ V/m	Margin to limit dB	Margin to limit dB
		QP	PK	AV	QP	PK	AV	QP/PK	AV
Hor. + Vert.	-	-	-	-	-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Op. Mode **Setup** **Port**
 SBx_3a Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Margin to limit dB	Margin to limit dB
		QP	PK	AV	QP	PK	AV	QP/PK	AV
Hor. + Vert.	-	-	-	-	-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Op. Mode **Setup** **Port**
 SBx_1n Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Margin to limit dB	Margin to limit dB
		QP	PK	AV	QP	PK	AV	QP/PK	AV
Hor. + Vert.	-	-	-	-	-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Op. Mode **Setup** **Port**
 SBx_2n Setup_01/Setup_04 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Margin to limit dB	Margin to limit dB
		QP	PK	AV	QP	PK	AV	QP/PK	AV
Hor. + Vert.	-	-	-	-	-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Op. Mode **Setup** **Port**
 SBx_3n Setup_01 Enclosure

Polarisation	Frequency MHz	Corrected value dBµV/m			Limit dBµV/m	Limit dBµV/m	Limit dBµV/m	Margin to limit dB	Margin to limit dB
		QP	PK	AV	QP	PK	AV	QP/PK	AV
Hor. + Vert.	-	-	-	-	-	-	-	-	-

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Note: "x" in Op-Mode in every table stands for sub-band 1 – 4.



**3.6.4 Test result Undesirable Emissions / General Field Strength Limits;
Restricted Band and Radiated Emission Limits**

FCC Part 15, Subpart C	Op. Mode	Result
	SB1_1a	passed
	SB1_2a	passed
	SB1_3a	passed
	SB2_1a	passed
	SB2_2a	passed
	SB2_3a	passed
	SB3_1a	passed
	SB3_2a	passed
	SB3_3a	passed
	SB4_1a	passed
	SB4_2a	passed
	SB4_3a	passed
	SB1_1n	passed
	SB1_2n	passed
	SB1_3n	passed
	SB2_1n	passed
	SB2_2n	passed
	SB2_3n	passed
	SB3_1n	passed
	SB3_2n	passed
	SB3_3n	passed
	SB4_1n	passed
	SB4_2n	passed
	SB4_3n	passed



3.7 Frequency Stability

Standard FCC Part 15, Subpart E

3.7.1 Test Description

The Equipment Under Test (EUT) was set up in an temperature chamber to perform the frequency stability test.

The results recorded, were measured while the EUT is transmitting on the required frequency.

The EUT was connected to spectrum analyser via a short coax cable with a known loss.

Analyser settings:

- Frequency Counter activated, Resolution 1 Hz

3.7.2 Test Requirements / Limits

FCC Part 15, Subpart E, § 15.407 (g)

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

3.7.3 Test Protocol

Temperature: 24 °C
 Air Pressure: 1008 hPa
 Humidity: 39 %

Channel 36					
518000000 Hz	Temp [°C]	Voltage [%]	Voltage [VDC]	Frequency [Hz]	Frequency Error [Hz]
	-30	100	3.7	517999852	148
	-20	100	3.7	517999880	120
	-10	100	3.7	518000009	-9
	0	100	3.7	518000044	-44
	10	100	3.7	517999982	18
	20	100	3.7	517999944	57
	20	BE*)	3.2	517999929	70
	20	115	4.3	517999942	58
	30	100	3.7	517999928	72
	40	100	3.7	518000163	-163
	50	100	3.7	517999901	99

*) Battery Endpoint

Channel 52					
5260000000 Hz	Temp [°C]	Voltage [%]	Voltage [VDC]	Frequency [Hz]	Frequency Error [Hz]
	-30	100	3.7	5259998591	1409
	-20	100	3.7	5259998874	1126
	-10	100	3.7	5260000077	-77
	0	100	3.7	5260000440	-440
	10	100	3.7	5259999823	177
	20	100	3.7	5259999404	596
	20	BE*)	3.2	5259999258	742
	20	115	4.3	5259999364	635
	30	100	3.7	5259999209	791
	40	100	3.7	5260001487	-1487
	50	100	3.7	5259999035	965

*) Battery Endpoint

Channel 100					
5500000000 Hz	Temp [°C]	Voltage [%]	Voltage [VDC]	Frequency [Hz]	Frequency Error [Hz]
	-30	100	3.7	5499998534	1466
	-20	100	3.7	5499998996	1004
	-10	100	3.7	5499999913	87
	0	100	3.7	5500000450	-450
	10	100	3.7	5499999825	175
	20	100	3.7	5499999340	660
	20	BE*)	3.2	5499999197	803
	20	115	4.3	5499999335	665
	30	100	3.7	5499998991	1009
	40	100	3.7	5500001521	-1521
	50	100	3.7	5499999032	968

*) Battery Endpoint

3.7.4 Test result: Frequency Stability

FCC Part 15, Subpart E	Op. Mode	Result
	SB1_1	passed
	SB2_1	passed
	SB3_1	passed



4 Test Equipment

The calibration, hardware and software states are shown for the testing period.

Test Equipment Anechoic Chamber

Lab ID: Lab 3
Manufacturer: Frankonia
Description: Anechoic Chamber for radiated testing
Type: 10.58x6.38x6.00 m³

Single Devices for Anechoic Chamber

Single Device Name	Type	Serial Number	Manufacturer
Air compressor	none	-	Atlas Copco
Anechoic Chamber	10.58 x 6.38 x 6.00 m ³ FCC listing 96716 3m Part15/18 IC listing 3699A-1 3m	none	Frankonia 2011/01/11 2014/01/10 2011/02/07 2014/02/06
Controller Maturo	MCU	961208	Maturo GmbH
EMC camera	CE-CAM/1	-	CE-SYS
EMC camera Nr.2	CCD-400E	0005033	Mitsubishi
Filter ISDN	B84312-C110-E1	-	Siemens&Matsushita
Filter Universal 1A	BB4312-C30-H3	-	Siemens&Matsushita

Test Equipment Auxiliary Equipment for Conducted emissions

Lab ID: Lab 1
Manufacturer: Rohde & Schwarz GmbH & Co.KG
Description: EMI Conducted Auxiliary Equipment

Single Devices for Auxiliary Equipment for Conducted emissions

Single Device Name	Type	Serial Number	Manufacturer
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.
Two-Line V-Network	ESH 3-Z5 Calibration	828304/029	Rohde & Schwarz GmbH & Co. KG 2013/03/01 2015/02/28
Two-Line V-Network	ESH 3-Z5 Calibration	829996/002	Rohde & Schwarz GmbH & Co. KG 2013/03/01 2015/02/28

Test Equipment Auxiliary Equipment for Radiated emissions

Lab ID: Lab 3
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Auxiliary Equipment for Radiated emissions

Single Device Name	Type	Serial Number	Manufacturer	Last Execution	Next Exec.
Antenna mast	AS 620 P	620/37	HD GmbH		
Biconical dipole	VUBA 9117 Calibration Details	9117-108	Schwarzbeck		
	Standard Calibration			2012/01/18	2015/01/17
Broadband Amplifier 18MHz-26GHz	JS4-18002600-32-5P	849785	Miteq		
Broadband Amplifier 1GHz-4GHz	AFS4-01000400-1Q-10P-4	-	Miteq		
Broadband Amplifier 30MHz-18GHz	JS4-00101800-35-5P	896037	Miteq		
Cable "ESI to EMI Antenna"	EcoFlex10	W18.01-2+W38.01- 2	Kabel Kusch		
Cable "ESI to Horn Antenna"	UFB311A+UFB293C	W18.02-2+W38.02- 2	Rosenberger Micro-Coax		
Double-ridged horn	HF 906 Standard Calibration	357357/001	Rohde & Schwarz GmbH & Co. KG	2012/05/18	2015/05/17
Double-ridged horn	HF 906 Standard Calibration	357357/002	Rohde & Schwarz GmbH & Co. KG	2012/06/26	2015/06/25
High Pass Filter	4HC1600/12750-1.5-KK	9942011	Trilithic		
High Pass Filter	5HC2700/12750-1.5-KK	9942012	Trilithic		
High Pass Filter	5HC3500/12750-1.2-KK	200035008	Trilithic		
High Pass Filter	WHKX 7.0/18G-8SS	09	Wainwright		
Horn Antenna Schwarzbeck 15-26 GHz BBHA 9170	BBHA 9170				
Log.-per. Antenna	HL 562 Ultralog Standard Calibration	830547/003	Rohde & Schwarz GmbH & Co. KG	2012/12/14	2015/12/13
Loop Antenna	HFH2-Z2 Standard calibration	829324/006	Rohde & Schwarz GmbH & Co. KG	2011/10/27	2014/10/26
Pyramidal Horn Antenna 26,5 GHz	3160-09	00083069	EMCO Elektronik GmbH		
Pyramidal Horn Antenna 40 GHz	3160-10	00086675	EMCO Elektronik GmbH		

Single Devices for Auxiliary Equipment for Radiated emissions (continued)

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	TD1.5-10kg/024/3790709	Maturo GmbH

Test Equipment Auxiliary Test Equipment

Lab ID: Lab 3, Lab 4
Manufacturer: see single devices
Description: Single Devices for various Test Equipment
Type: various
Serial Number: none

Single Devices for Auxiliary Test Equipment

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
AC Power Source	Chroma 6404	64040001304	Chroma ATE INC.
Broadband Power Divider N (Aux)	1506A / 93459	LM390	Weinschel Associates
Broadband Power Divider SMA	WA1515	A855	Weinschel Associates
Digital Multimeter 03 (Multimeter)	Fluke 177 Customized calibration	86670383	Fluke Europe B.V. 2011/10/19 2013/10/18
Fibre optic link Satellite (Aux)	FO RS232 Link	181-018	Pontis
Fibre optic link Transceiver (Aux)	FO RS232 Link	182-018	Pontis
Isolating Transformer	LTS 604	1888	Thalheimer Transformatorwerke GmbH
Notch Filter Ultra Stable (Aux)	WRCA800/960-6EEK	24	Wainwright
Vector Signal Generator	SMIQ 03B	832492/061	Rohde & Schwarz GmbH & Co.KG

Test Equipment Digital Signalling Devices

Lab ID: Lab 1, Lab 3, Lab 4
Description: Signalling equipment for various wireless technologies.

Single Devices for Digital Signalling Devices

Single Device Name	Type	Serial Number	Manufacturer	
Bluetooth Signalling Unit CBT	CBT	100589	Rohde & Schwarz GmbH & Co. KG	
	Standard calibration		2011/11/24	2014/11/23
CMW500	CMW500	107500	Rohde & Schwarz GmbH & Co.KG	
	Calibration Details		Last Execution	Next Exec.
	Initial factory calibration		2012/01/26	2014/01/25
Universal Radio Communication Tester	CMU 200	102366	Rohde & Schwarz GmbH & Co. KG	
	HW/SW Status		Date of Start	Date of End
	Hardware: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B56V14, B68 3v04, PCMCIA, U65V04 Software: K21 4v21, K22 4v21, K23 4v21, K24 4v21, K42 4v21, K43 4v21, K53 4v21, K56 4v22, K57 4v22, K58 4v22, K59 4v22, K61 4v22, K62 4v22, K63 4v22, K64 4v22, K65 4v22, K66 4v22, K67 4v22, K68 4v22, K69 4v22 Firmware: µP1 8v50 02.05.06 ---		2007/07/16	
Universal Radio Communication Tester	CMU 200	837983/052	Rohde & Schwarz GmbH & Co. KG	
	Standard calibration		2011/12/07	2014/12/06
	HW/SW Status		Date of Start	Date of End
	HW options: B11, B21V14, B21-2, B41, B52V14, B52-2, B53-2, B54V14, B56V14, B68 3v04, B95, PCMCIA, U65V02 SW options: K21 4v11, K22 4v11, K23 4v11, K24 4v11, K27 4v10, K28 4v10, K42 4v11, K43 4v11, K53 4v10, K65 4v10, K66 4v10, K68 4v10, Firmware: µP1 8v40 01.12.05 ---		2007/01/02	
	SW: K62, K69		2008/11/03	



Test Equipment Emission measurement devices

Lab ID: Lab 1, Lab 3
Description: Equipment for emission measurements
Serial Number: see single devices

Single Devices for Emission measurement devices

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>	
Personal Computer	Dell	30304832059	Dell	
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard calibration		2012/05/22	2013/05/21
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz GmbH & Co. KG	
Powermeter	NRVS	836333/064	Rohde & Schwarz GmbH & Co. KG	
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	Standard calibration		2012/05/21	2013/05/20
Signal Generator	SMR 20	846834/008	Rohde & Schwarz GmbH & Co. KG	
	<i>Calibration Details</i>		<i>Last Execution</i>	<i>Next Exec.</i>
	standard calibration		2011/05/12	2014/05/11
Spectrum Analyzer	ESIB 26	830482/004	Rohde & Schwarz GmbH & Co. KG	
	Standard Calibration		2011/12/05	2013/12/04
	<i>HW/SW Status</i>		<i>Date of Start</i>	<i>Date of End</i>
	Firmware-Update 4.34.4 from 3.45 during calibration		2009/12/03	



Test Equipment Radio Lab Test Equipment

Lab ID: Lab 4
Description: Radio Lab Test Equipment

Single Devices for Radio Lab Test Equipment

Single Device Name	Type	Serial Number	Manufacturer
Broadband Power Divider SMA	WA1515	A856	Weinschel Associates
Coax Attenuator 10dB SMA 2W	4T-10	F9401	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3702	Weinschel Associates
Coax Attenuator 10dB SMA 2W	56-10	W3711	Weinschel Associates
Coax Cable Huber&Suhner	Sucotest 2,0m		Rosenberger Micro-Coax
Coax Cable Rosenberger Micro Coax FA210A0010003030 SMA/SMA 1,0m	FA210A0010003030	54491-2	Rosenberger Micro-Coax
Power Meter	NRVD	828110/016	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i> Standard calibration		<i>Last Execution</i> <i>Next Exec.</i>
Power Sensor	NRV-Z1	836219/005	Rohde & Schwarz GmbH & Co. KG
Powermeter	NRVS	836333/064	Rohde & Schwarz GmbH & Co. KG
RF Step Attenuator RSP	RSP	833695/001	Rohde & Schwarz GmbH & Co.KG
Rubidium Frequency Standard	Datum, Model: MFL	2689/001	Datum-Beverly
	Standard calibration		
Sensor Head A	NRV-Z1	827753/005	Rohde & Schwarz GmbH & Co.KG
	<i>Calibration Details</i> Standard calibration		<i>Last Execution</i> <i>Next Exec.</i>
Signal Generator	SMY02	829309/018	Rohde & Schwarz GmbH & Co. KG
	Standard calibration		2011/11/04 2014/11/03
Signal Generator SME	SME03	827460/016	Rohde & Schwarz GmbH & Co.KG
	Standard calibration		2011/11/25 2014/11/24
Signal Generator SMP	SMP02	836402/008	Rohde & Schwarz GmbH & Co. KG
Spectrum Analyser	FSIQ26	840061/005	Rohde & Schwarz GmbH & Co. KG
	<i>Calibration Details</i> Standard calibration		<i>Last Execution</i> <i>Next Exec.</i> 2013/02/12 2015/02/11
Temperature Chamber Vötsch 03	VT 4002	58566002150010	Vötsch
	<i>Calibration Details</i> Customized calibration		<i>Last Execution</i> <i>Next Exec.</i> 2012/03/12 2014/03/11



Single Devices for Radio Lab Test Equipment (continued)

<i>Single Device Name</i>	<i>Type</i>	<i>Serial Number</i>	<i>Manufacturer</i>
Vector Signal Generator	SMIQ 03B	837747/020	Rohde & Schwarz GmbH & Co. KG

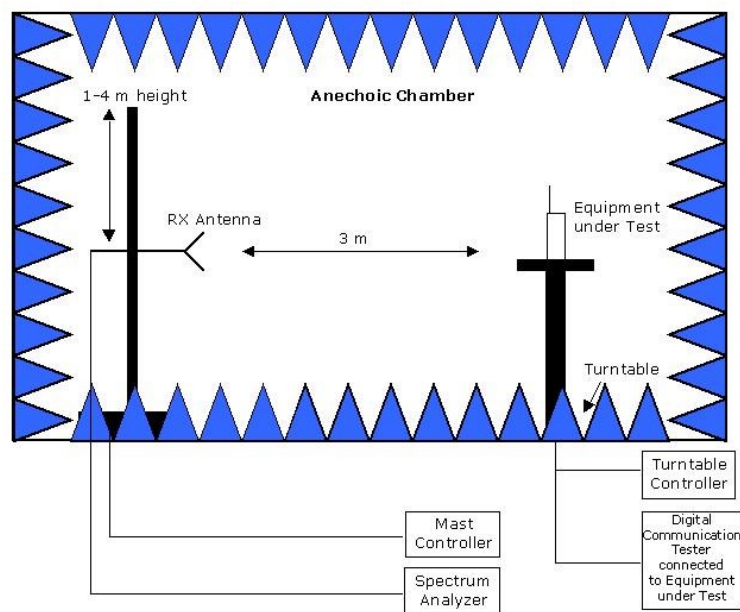
Test Equipment Shielded Room 02

Lab ID:	Lab 1
<i>Manufacturer:</i>	Frankonia
<i>Description:</i>	Shielded Room for conducted testing
<i>Type:</i>	12 qm
<i>Serial Number:</i>	none

5 Photo Report

Photos are included in an external report.

6 Setup Drawings



Remark: Depending on the frequency range suitable antenna types, attenuators or preamplifiers are used.

Drawing 1: Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting groundplane.

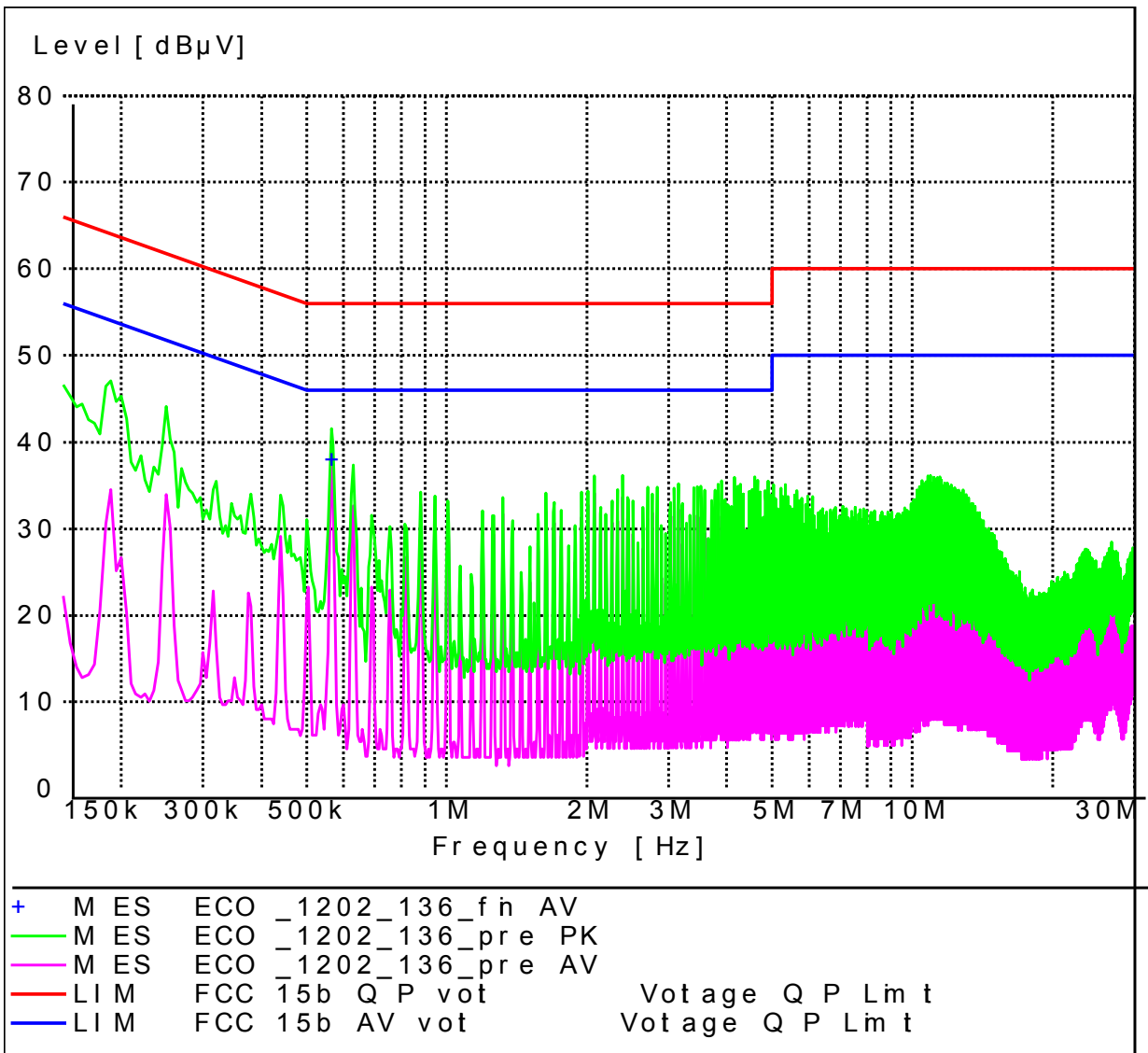
7 Annex measurement plots

7.1 AC Mains conducted

Op. Mode

SB1_1a

Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	5.0 kHz	MaxPeak Average	20.0 ms	9 kHz	ESH3-Z5



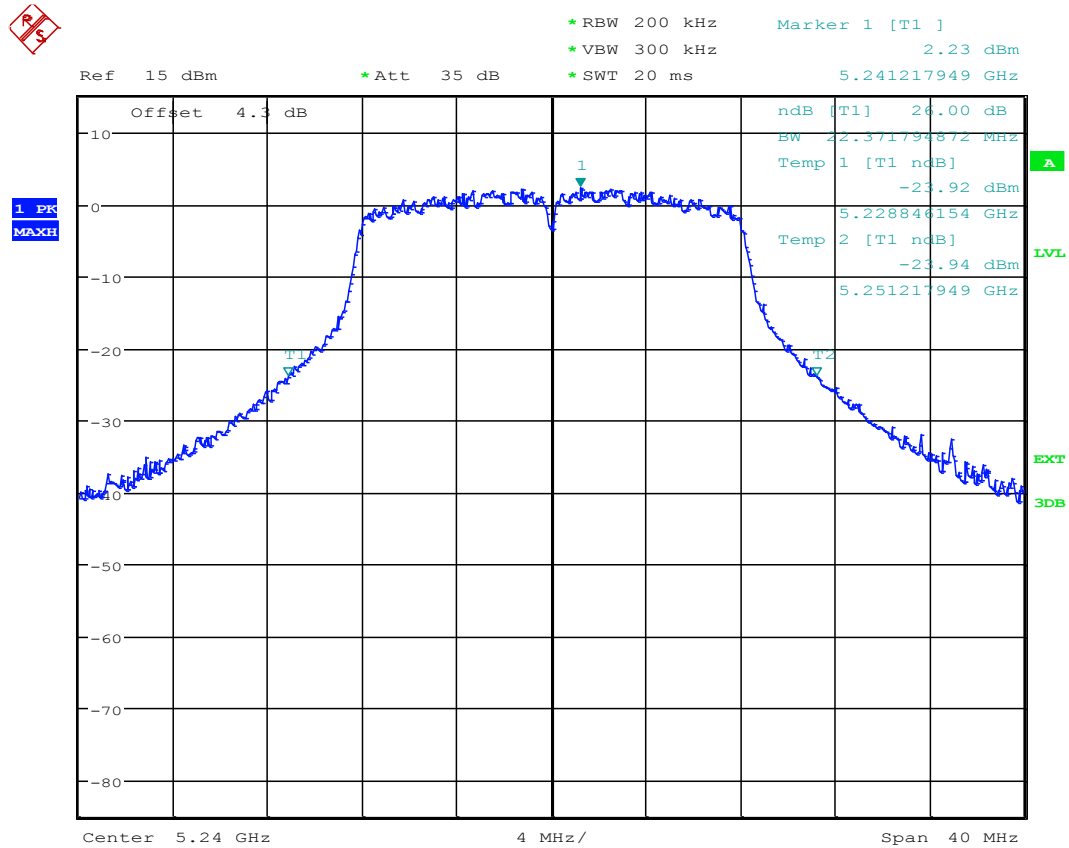
Frequency	Level	Transd	Limit	Margin	Line	PE
MHz	dBµV	dB	dBµV	dB		
0.565000	37.90	10.1	46	8.1	N	FLO

7.2 26 dB bandwidth

7.2.1 Occupied bandwidth WLAN a

Op. Mode

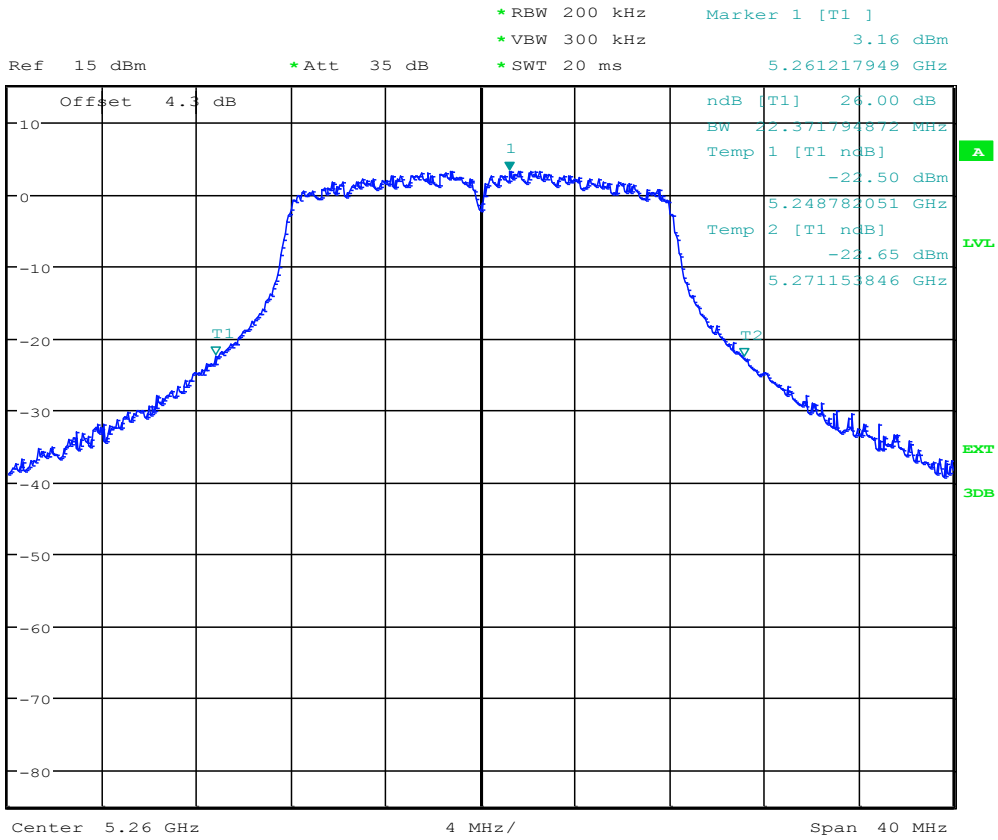
SB1_3a



Date: 19.JUL.2013 13:12:18

Op. Mode

SB2_1a



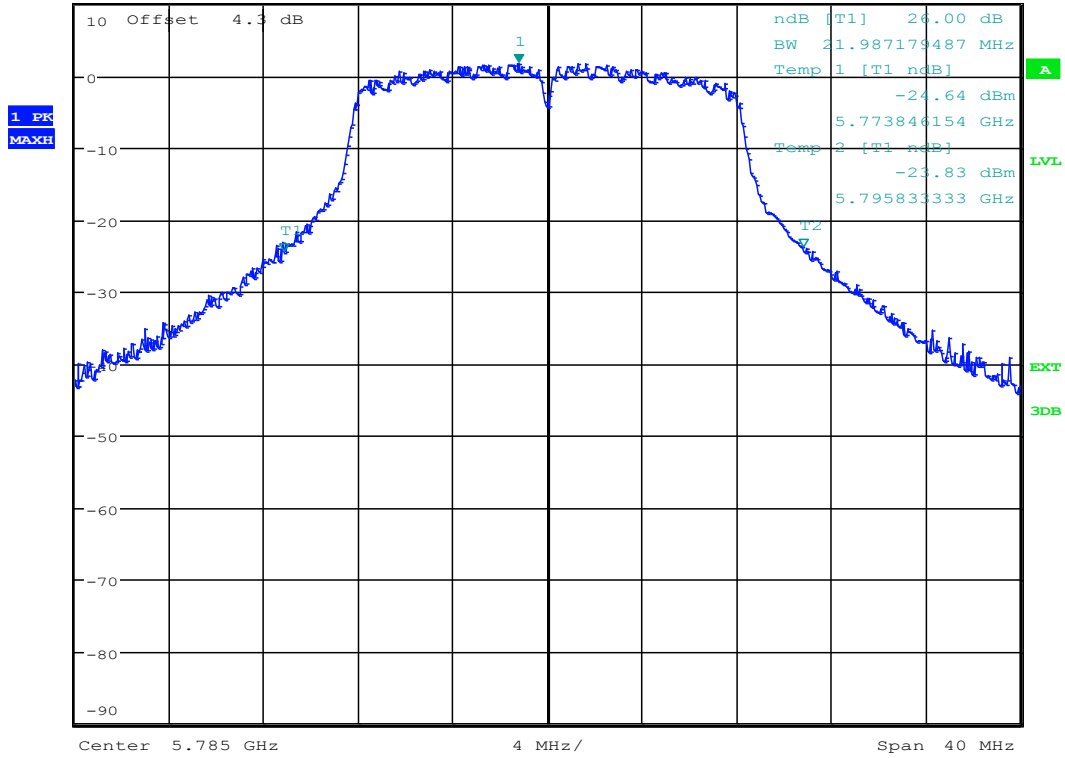
Date: 19.JUL.2013 13:14:34

Op. Mode

SB4_2a



*RBW 200 kHz Marker 1 [T1] 1.79 dBm
 *VBW 300 kHz 5.783782051 GHz
 Ref 10 dBm Att 35 dB SWT 20 ms

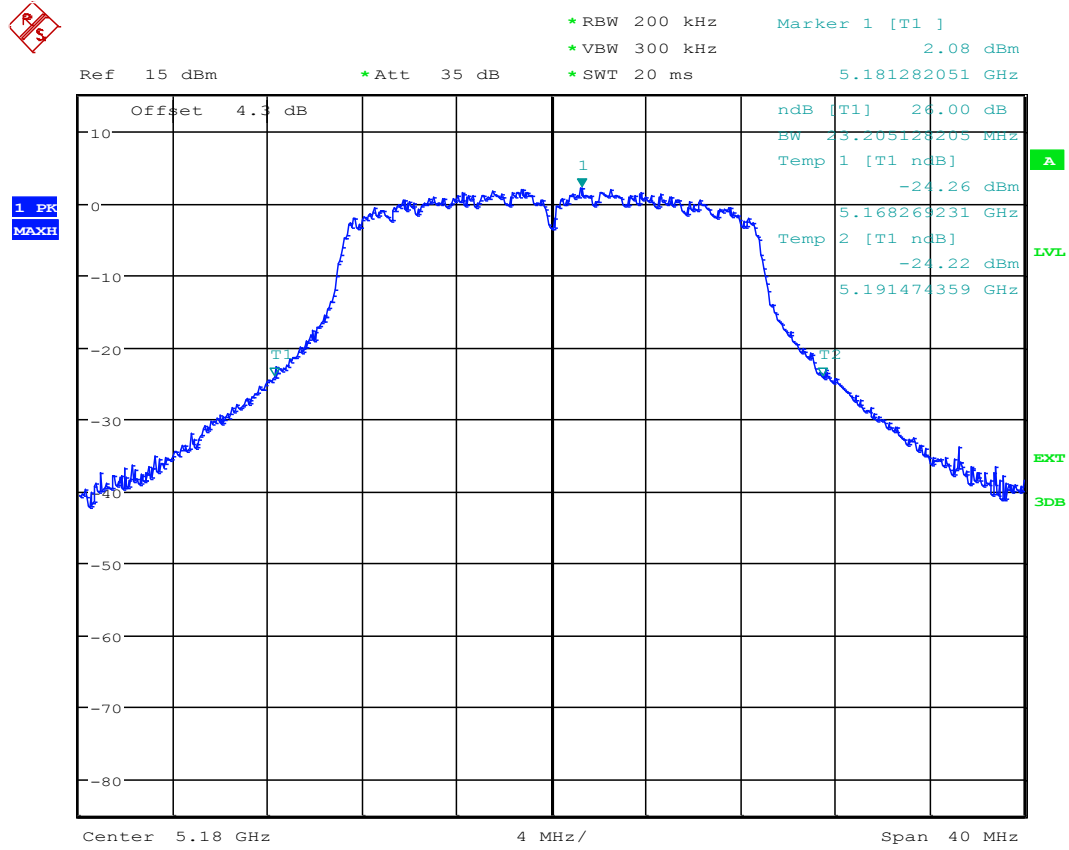


Date: 19.JUL.2013 09:29:52

7.2.2 Occupied bandwidth WLAN n

Op. Mode

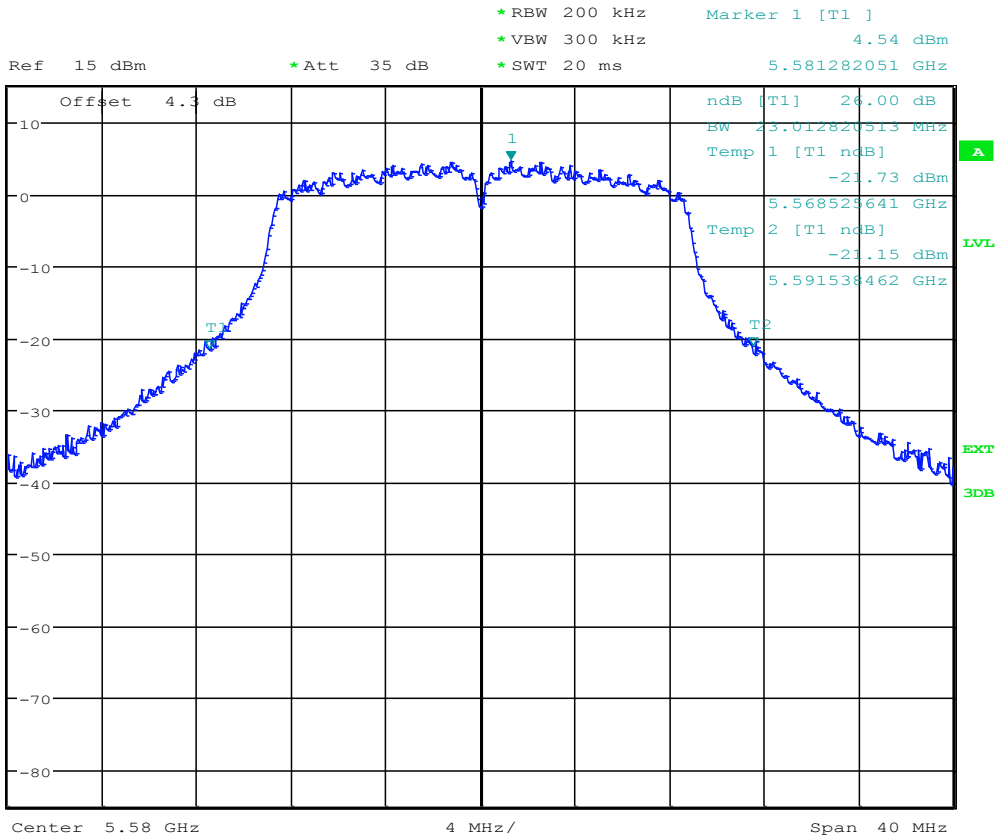
SB1_1n



Date: 19.JUL.2013 13:39:32

Op. Mode

SB3_2n



Date: 14.AUG.2013 16:27:09

Op. Mode

SB4_1n

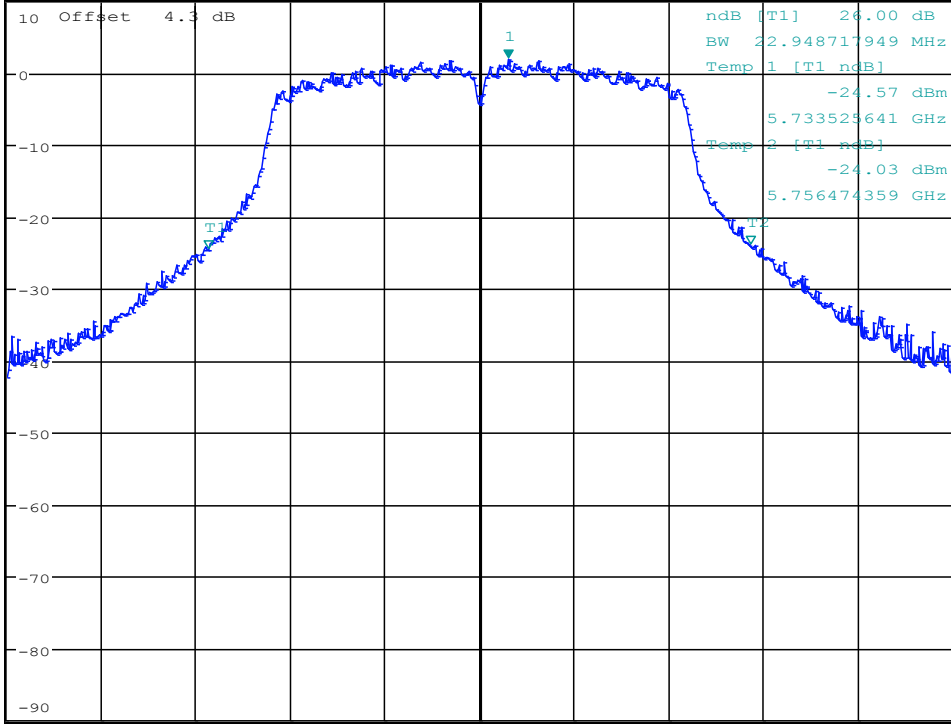


*RBW 200 kHz Marker 1 [T1]
 *VBW 300 kHz 1.84 dBm
 SWT 20 ms 5.746217949 GHz

Ref 10 dBm

Att 35 dB

1 PK
 MAXH



Date: 19.JUL.2013 09:35:42

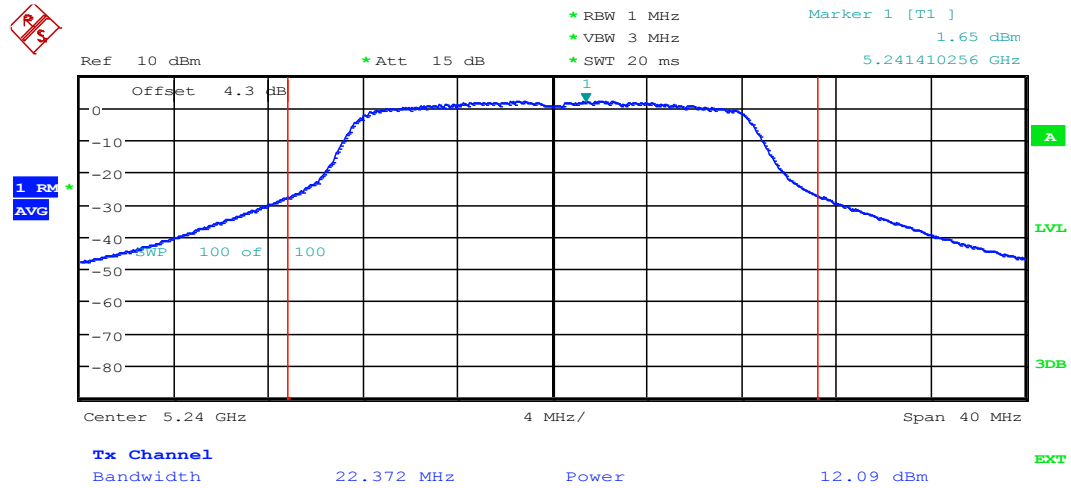


7.3 Maximum Conducted Output Power

7.3.1 Maximum Conducted Output WLAN a

Op. Mode

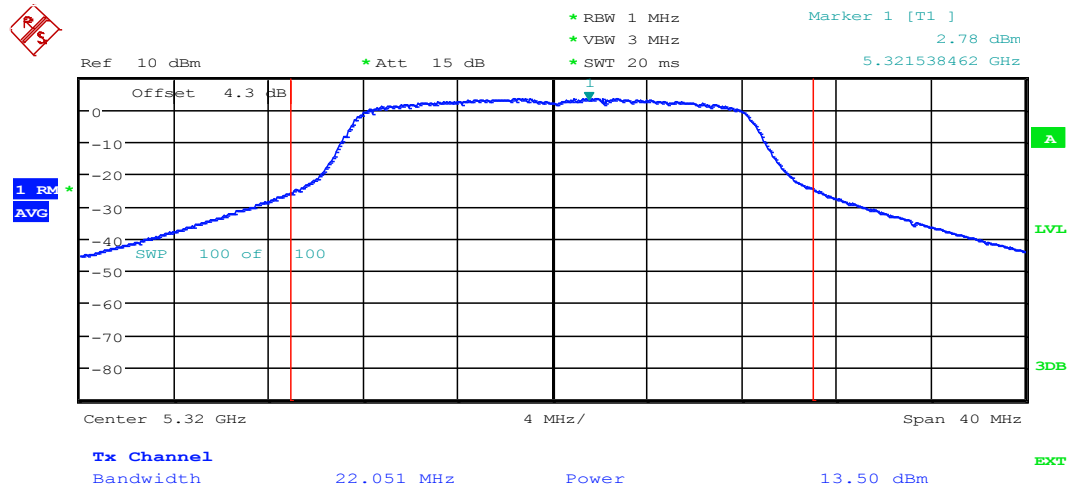
SB1_3a



Date: 22.JUL.2013 07:52:37

Op. Mode

SB2_3a

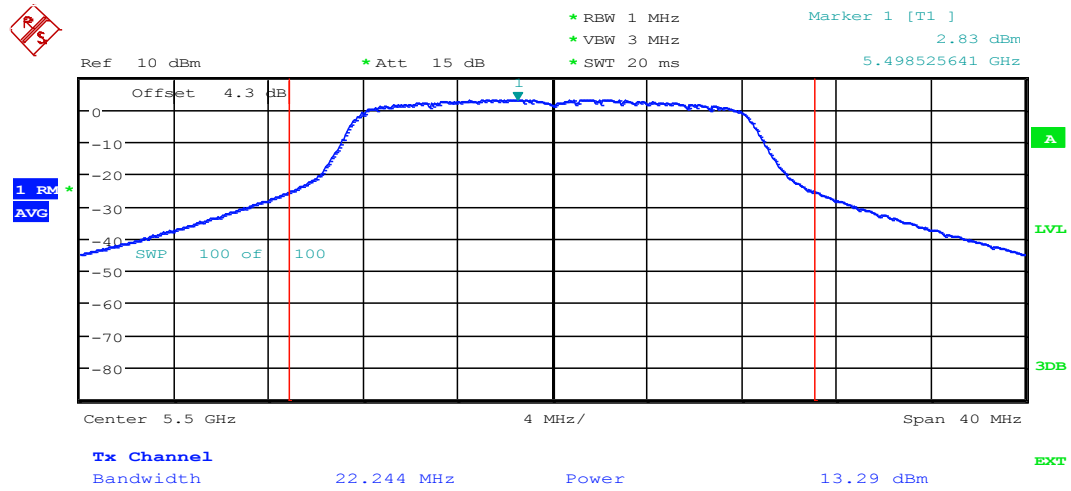


Date: 22.JUL.2013 07:56:06



Op. Mode

SB3_1a

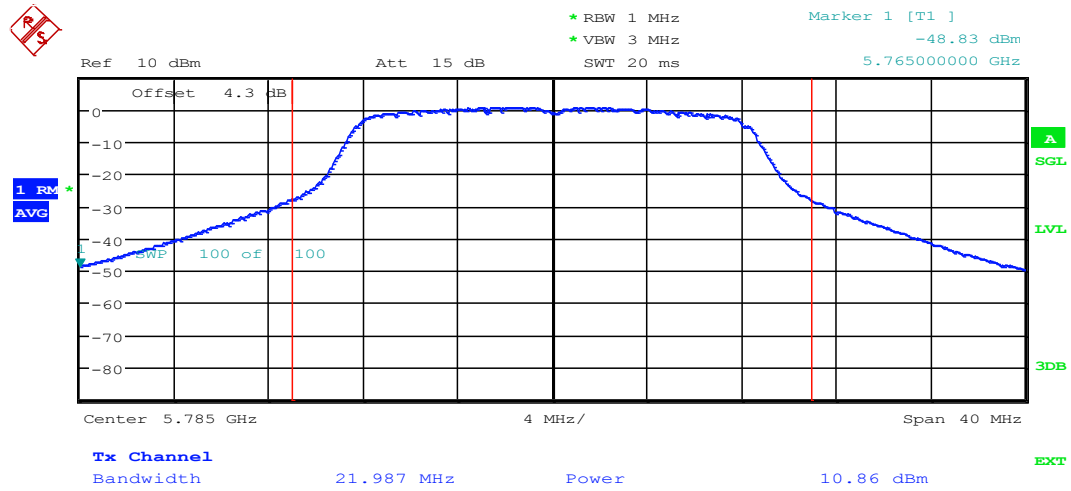


Date: 22.JUL.2013 08:08:57



Op. Mode

SB4_2a

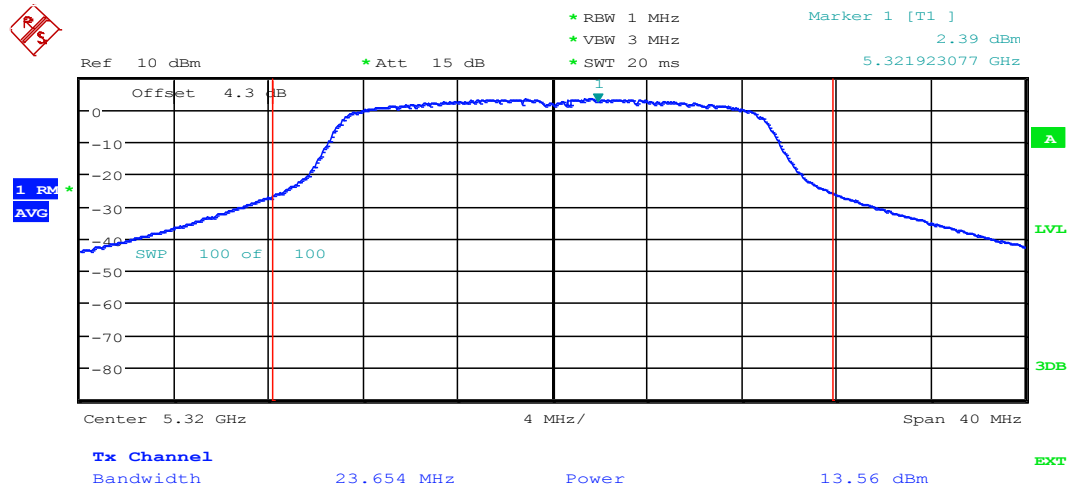


Date: 19.JUL.2013 09:49:44



Op. Mode

SB2_3n

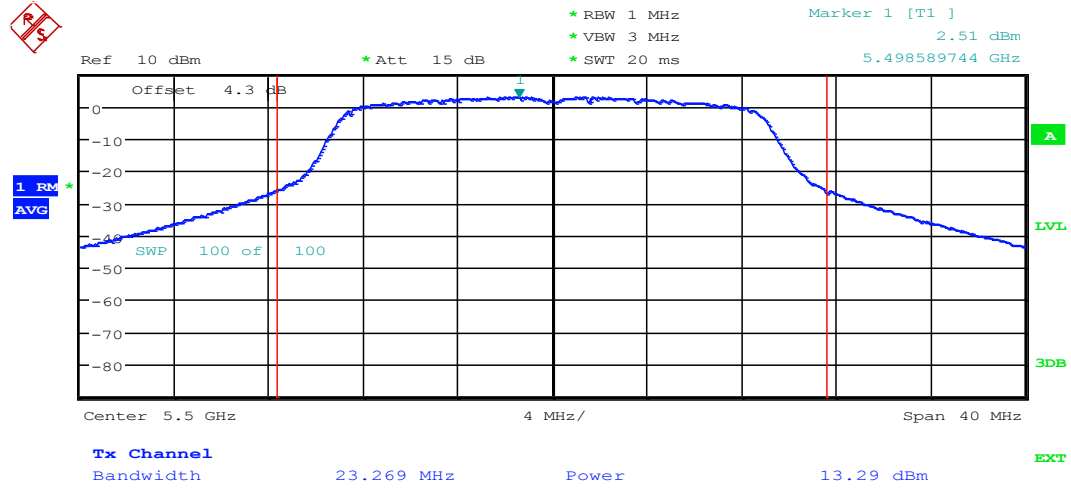


Date: 22.JUL.2013 08:03:12



Op. Mode

SB3_1n

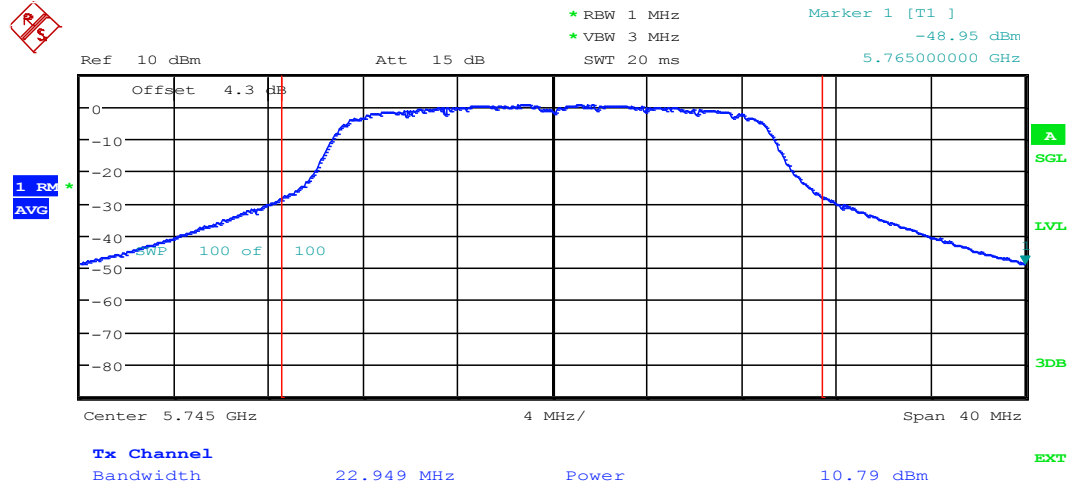


Date: 22.JUL.2013 08:03:47



Op. Mode

SB4_1n



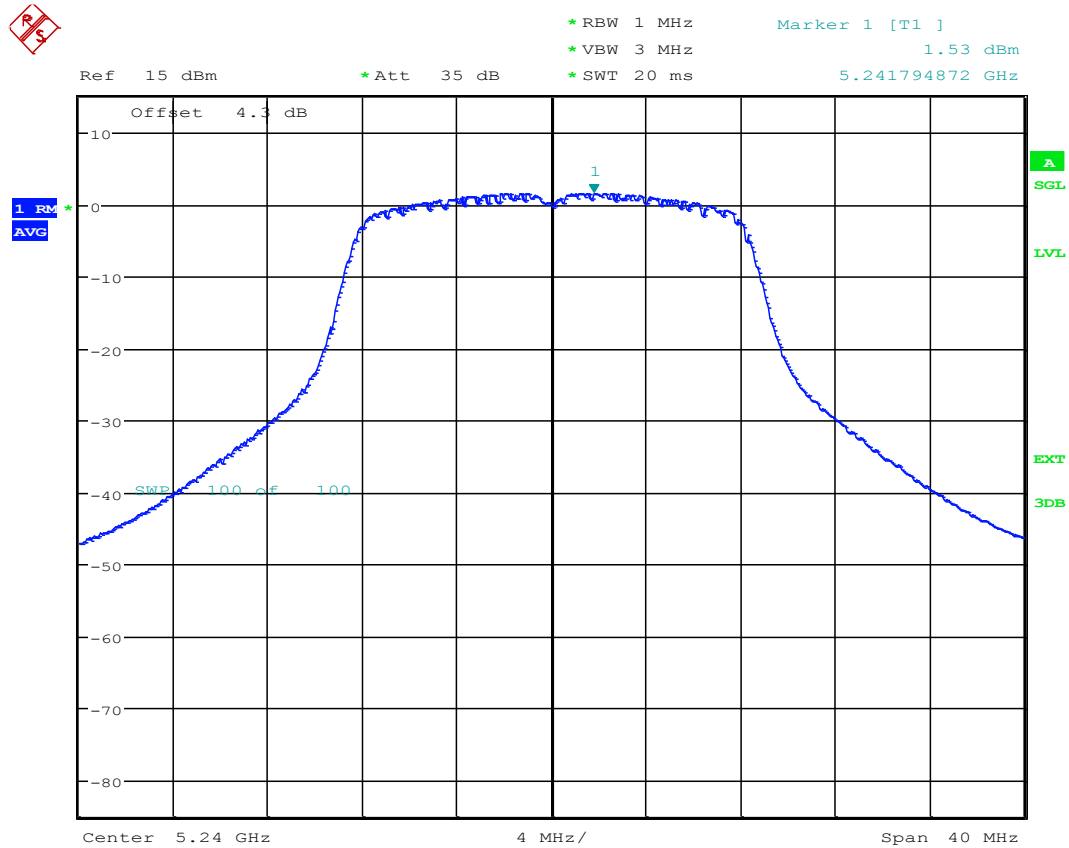
Date: 19.JUL.2013 09:54:17

7.4 Peak Power Spectral Density

7.4.1 Peak Power Spectral Density WLAN a

Op. Mode

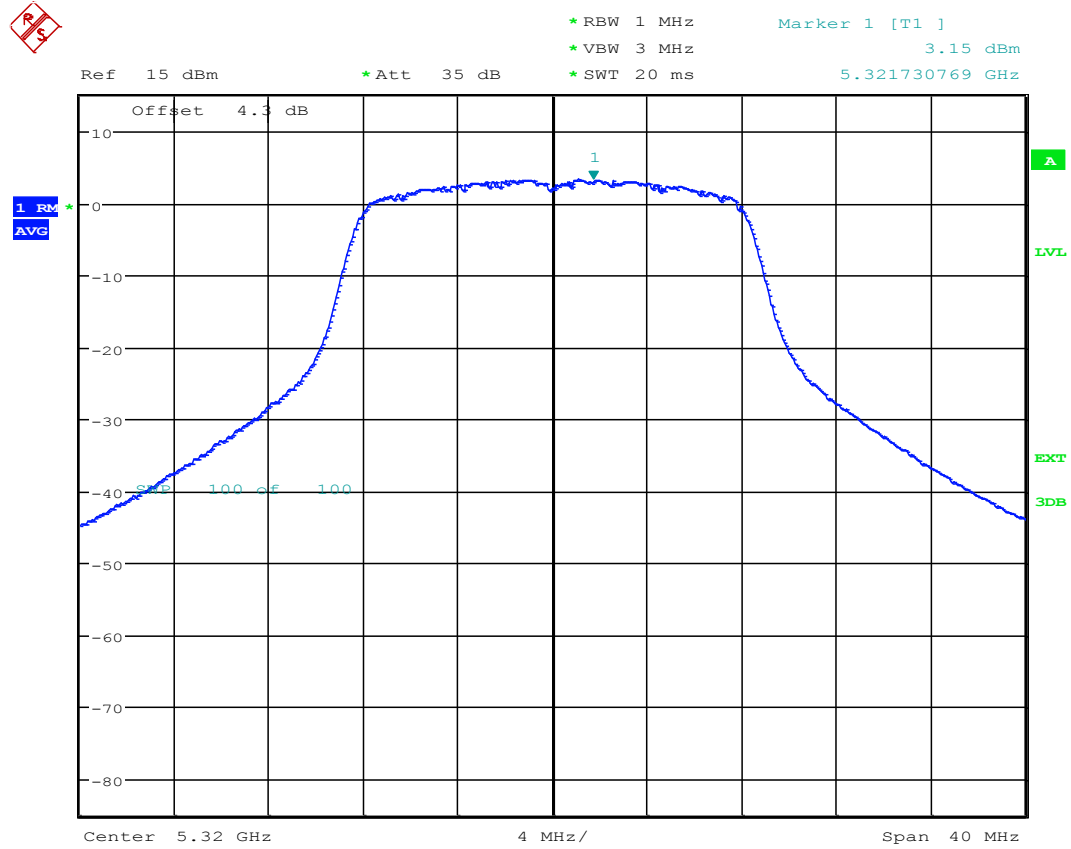
SB1_3a



Date: 19.JUL.2013 13:50:43

Op. Mode

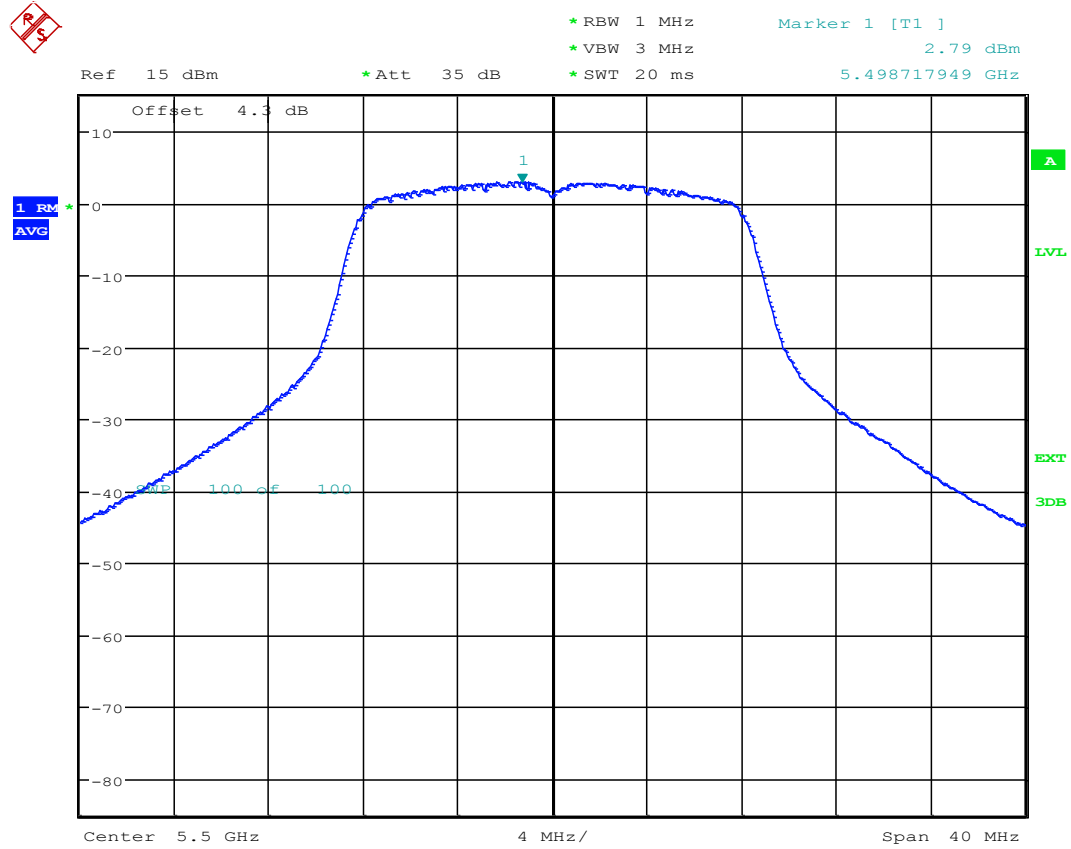
SB2_3a



Date: 22.JUL.2013 07:25:49

Op. Mode

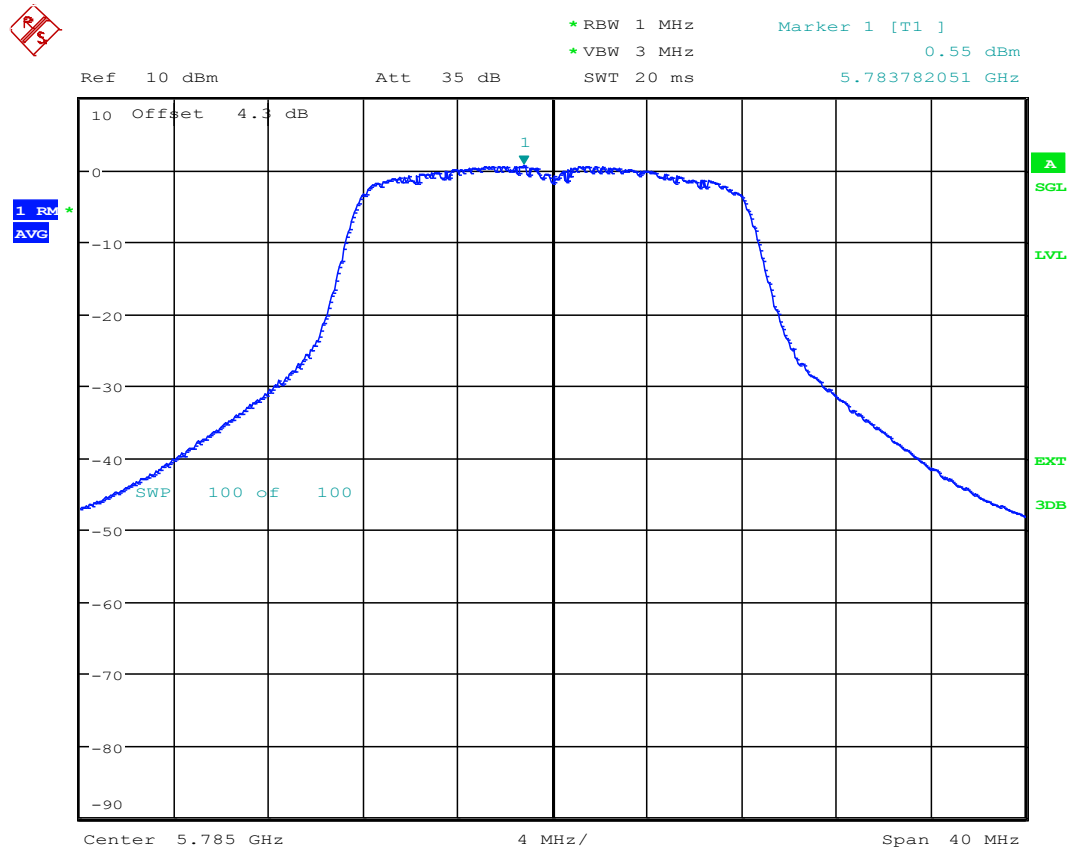
SB3_1a



Date: 22.JUL.2013 07:37:28

Op. Mode

SB4_2a

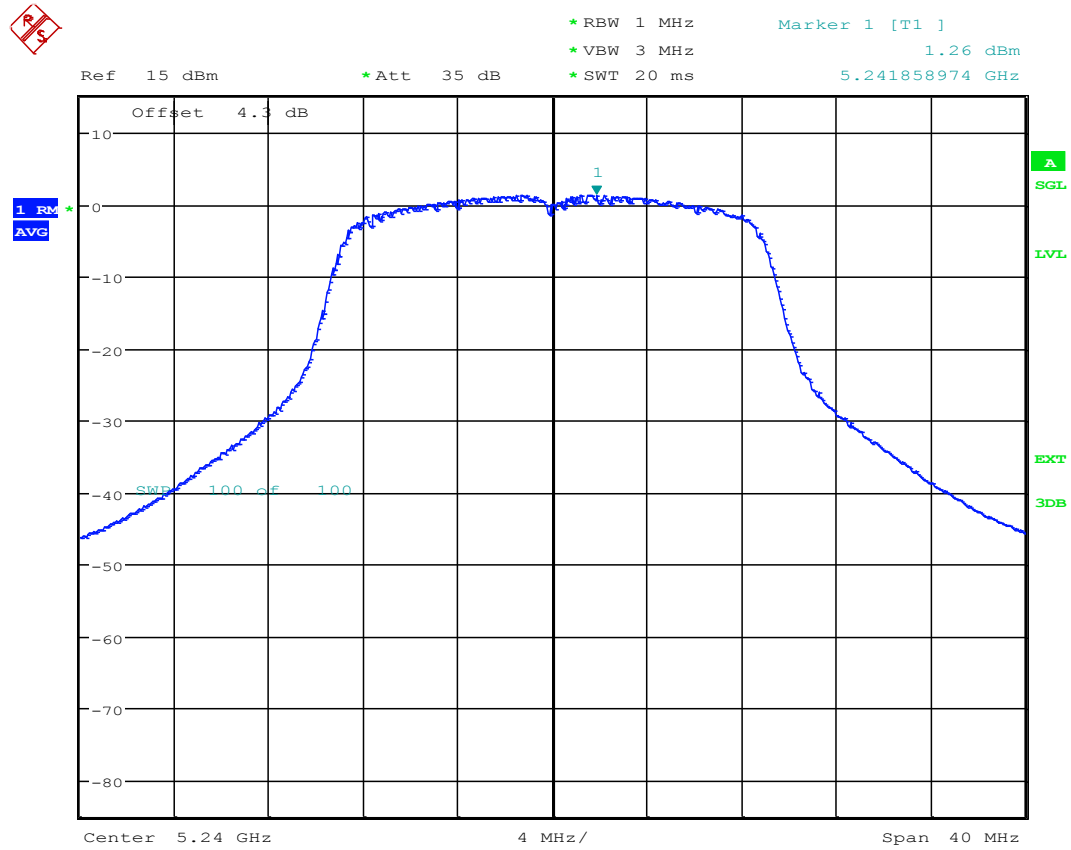


Date: 19.JUL.2013 09:45:13

7.4.2 Peak Power Spectral Density WLAN n

Op. Mode

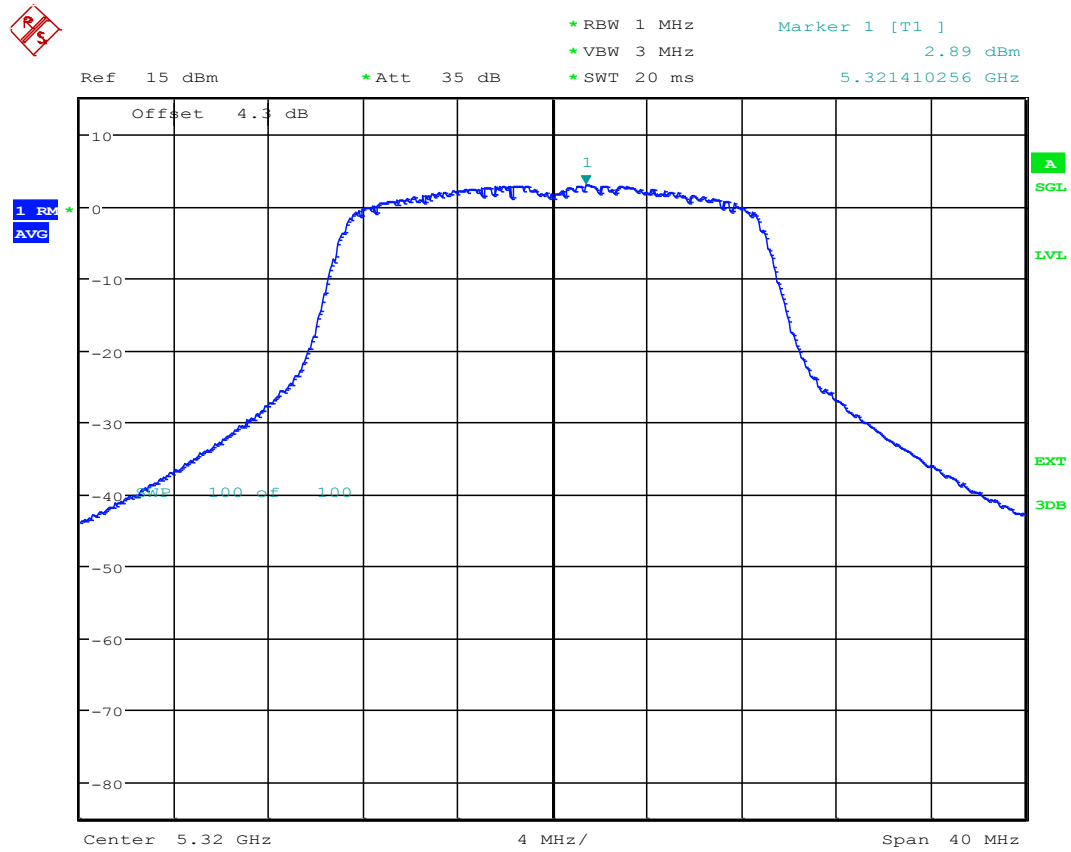
SB1_3n



Date: 19.JUL.2013 13:51:46

Op. Mode

SB2_3n



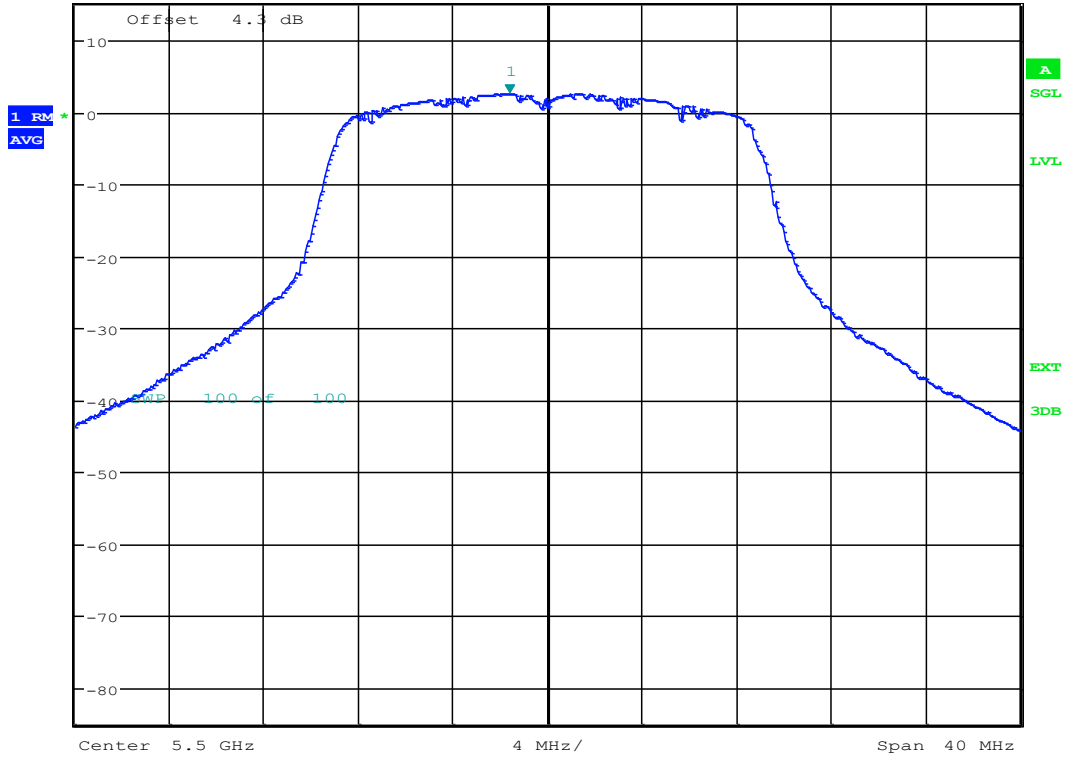
Date: 19.JUL.2013 14:16:14

Op. Mode

SB3_1n



Ref 15 dBm *Att 35 dB *RBW 1 MHz Marker 1 [T1]
*VBW 3 MHz 2.51 dBm
*SWT 20 ms 5.498397436 GHz



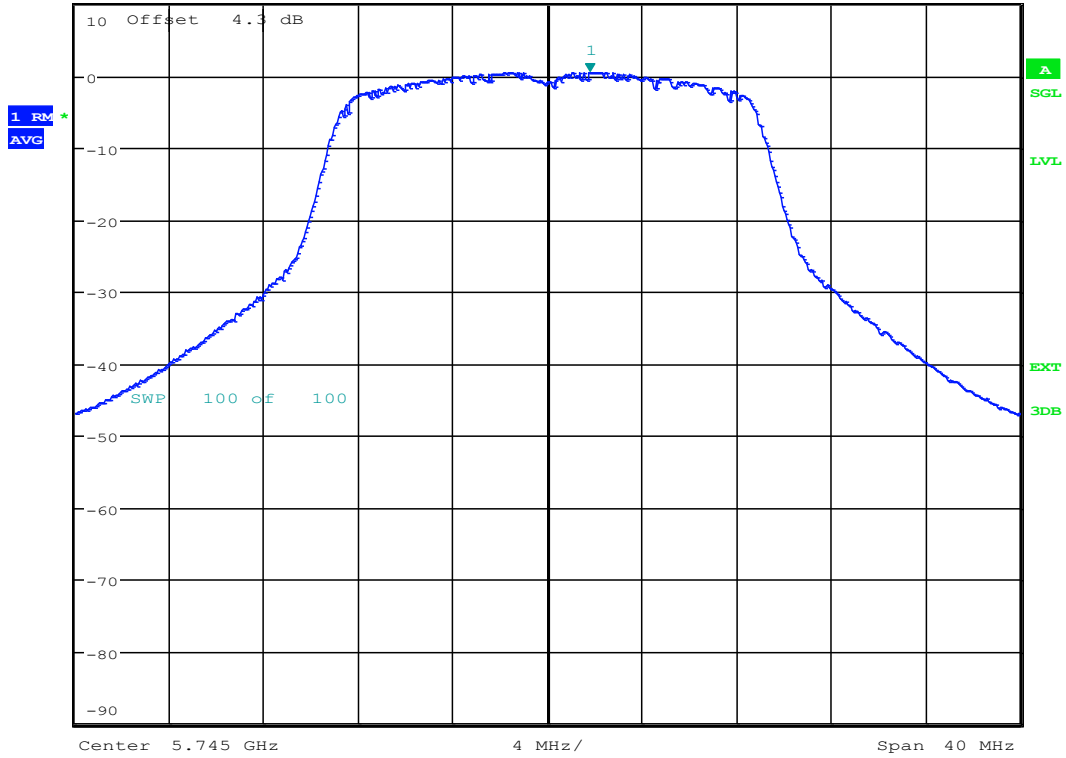
Date: 19.JUL.2013 14:16:54

Op. Mode

SB4_1n



*RBW 1 MHz Marker 1 [T1]
 *VBW 3 MHz 0.50 dBm
 Ref 10 dBm Att 35 dB SWT 20 ms 5.746794872 GHz



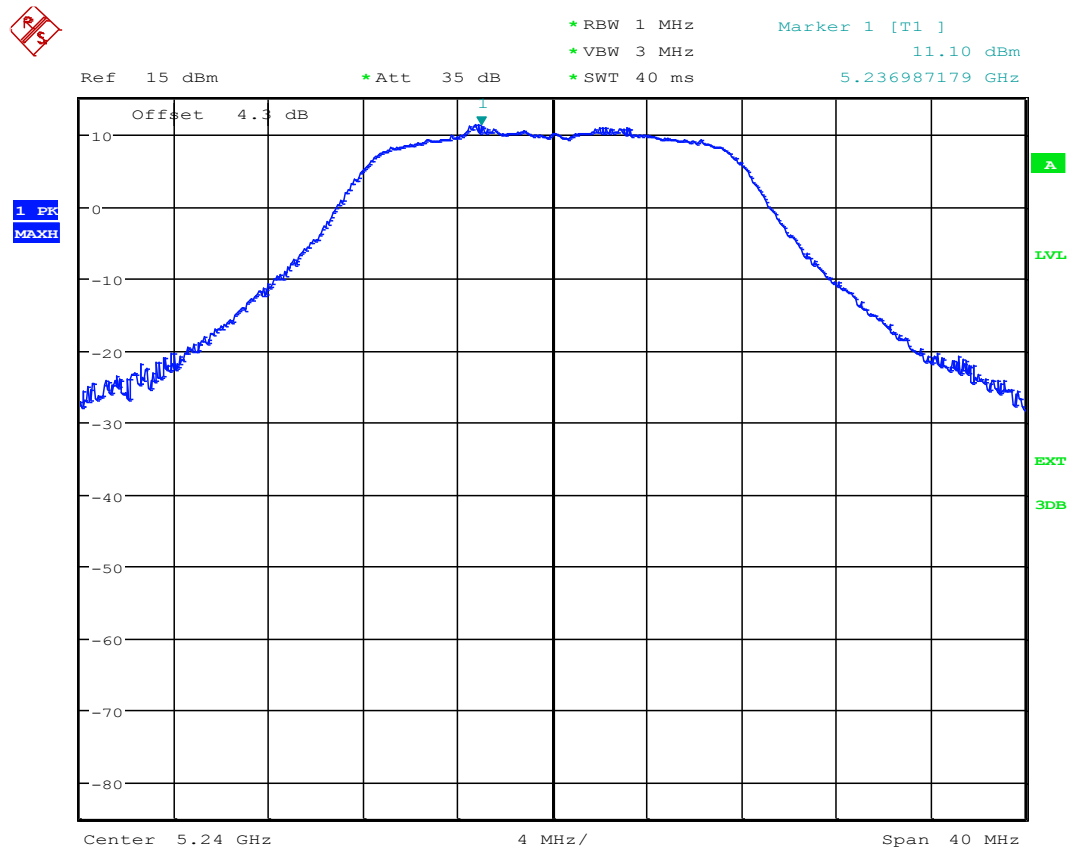
Date: 19.JUL.2013 09:40:53

7.5 Peak Excursion

7.5.1 Peak Excursion WLAN a

Op. Mode

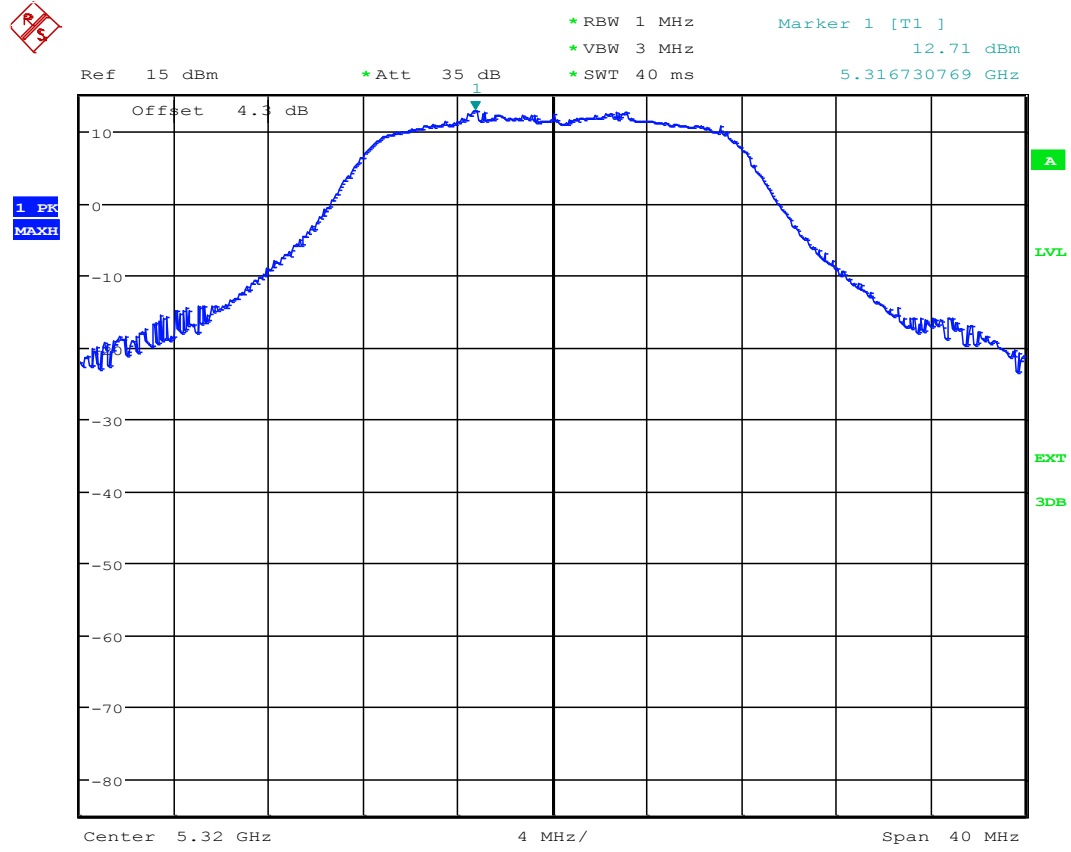
SB1_3a



Date: 22.JUL.2013 08:14:37

Op. Mode

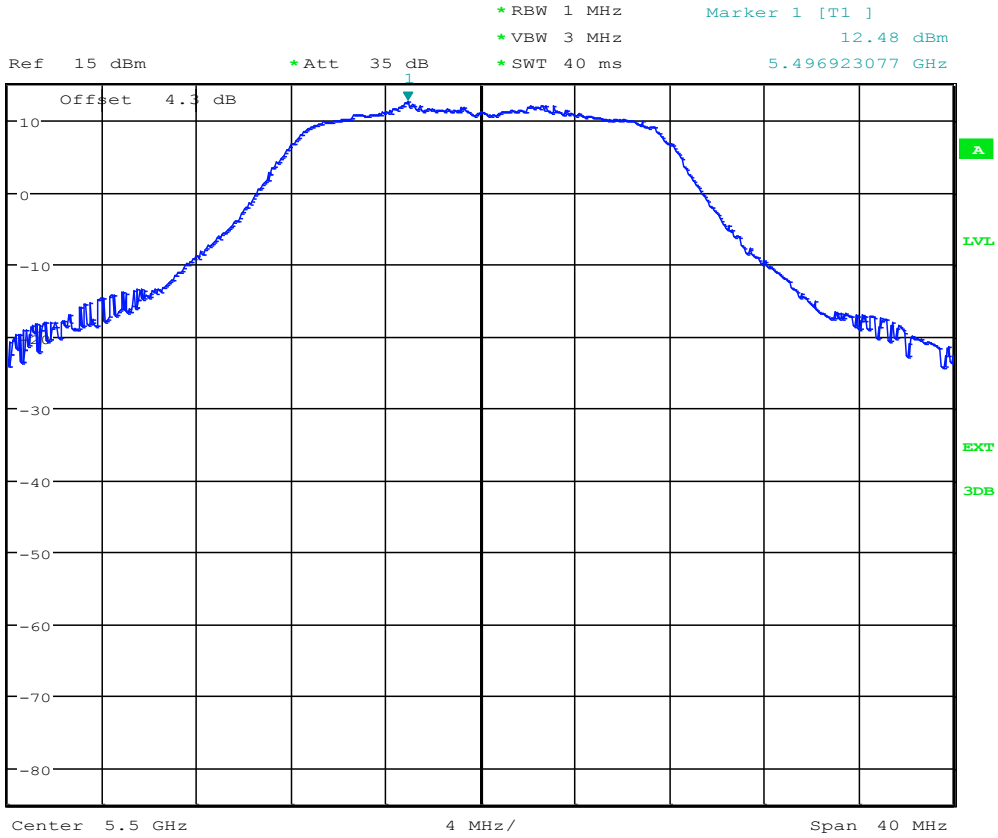
SB2_3a



Date: 22.JUL.2013 08:17:59

Op. Mode

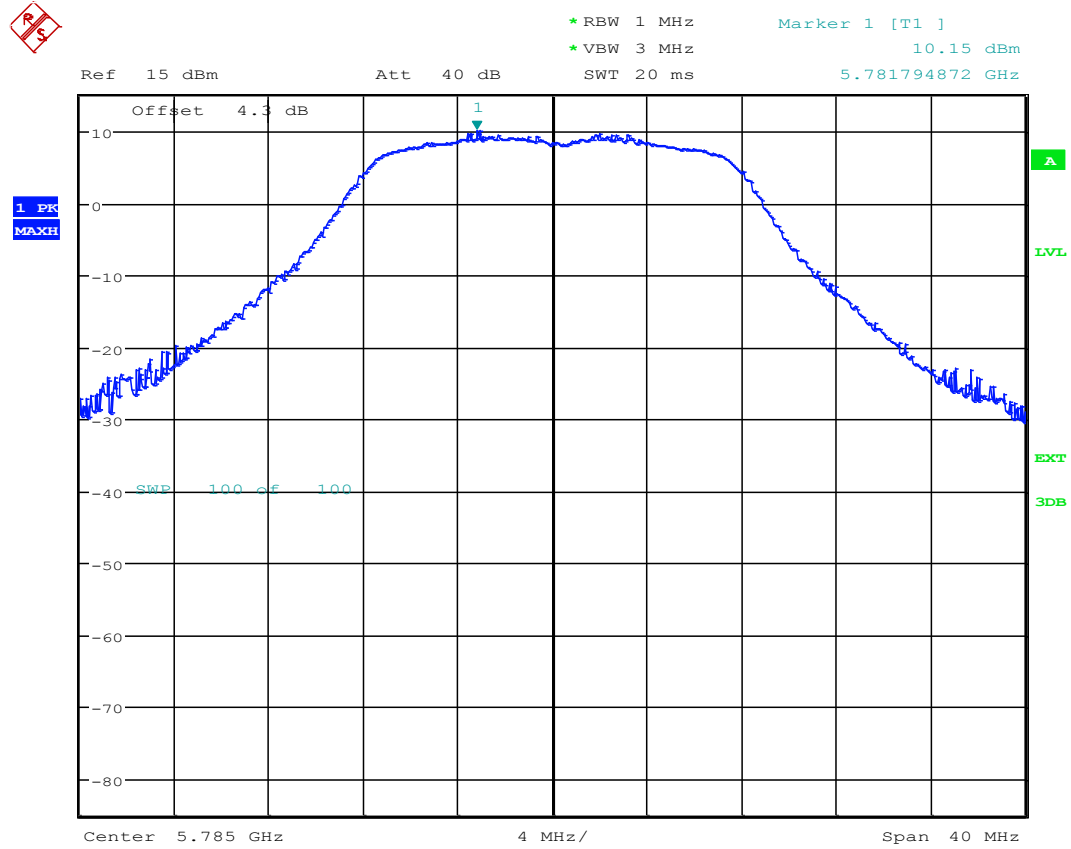
SB3_1a



Date: 22.JUL.2013 08:19:16

Op. Mode

SB4_2a

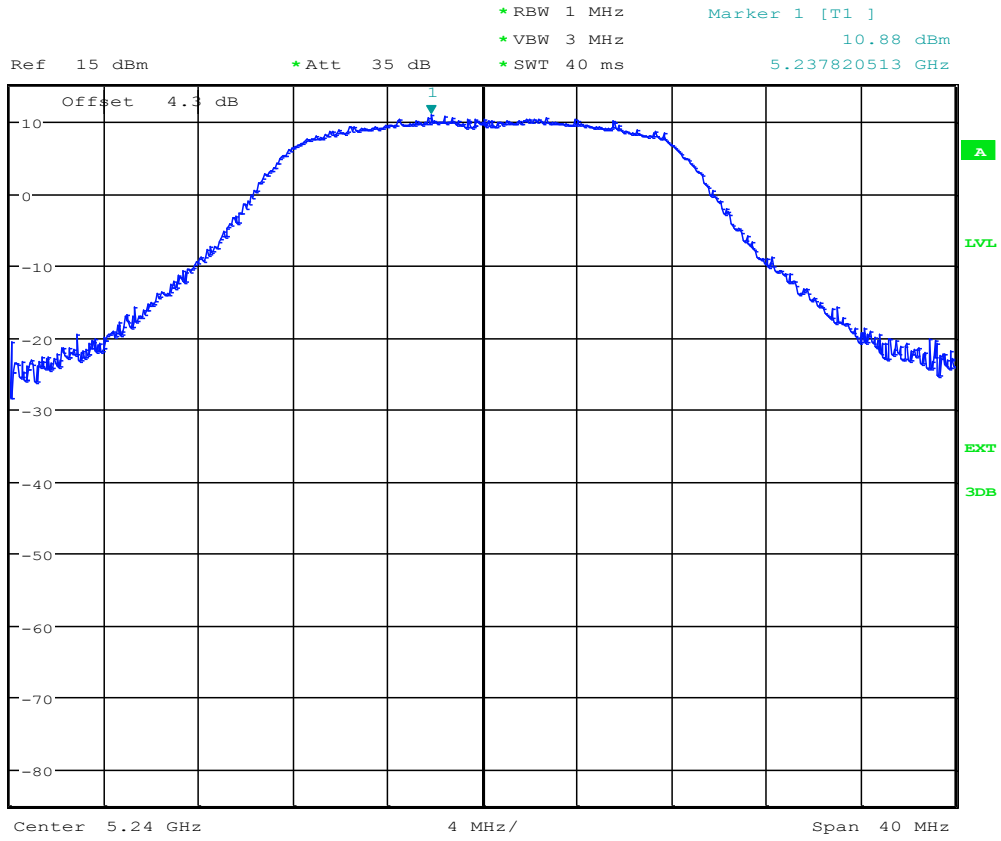


Date: 19.JUL.2013 10:05:05

7.5.2 Peak Excursion WLAN n

Op. Mode

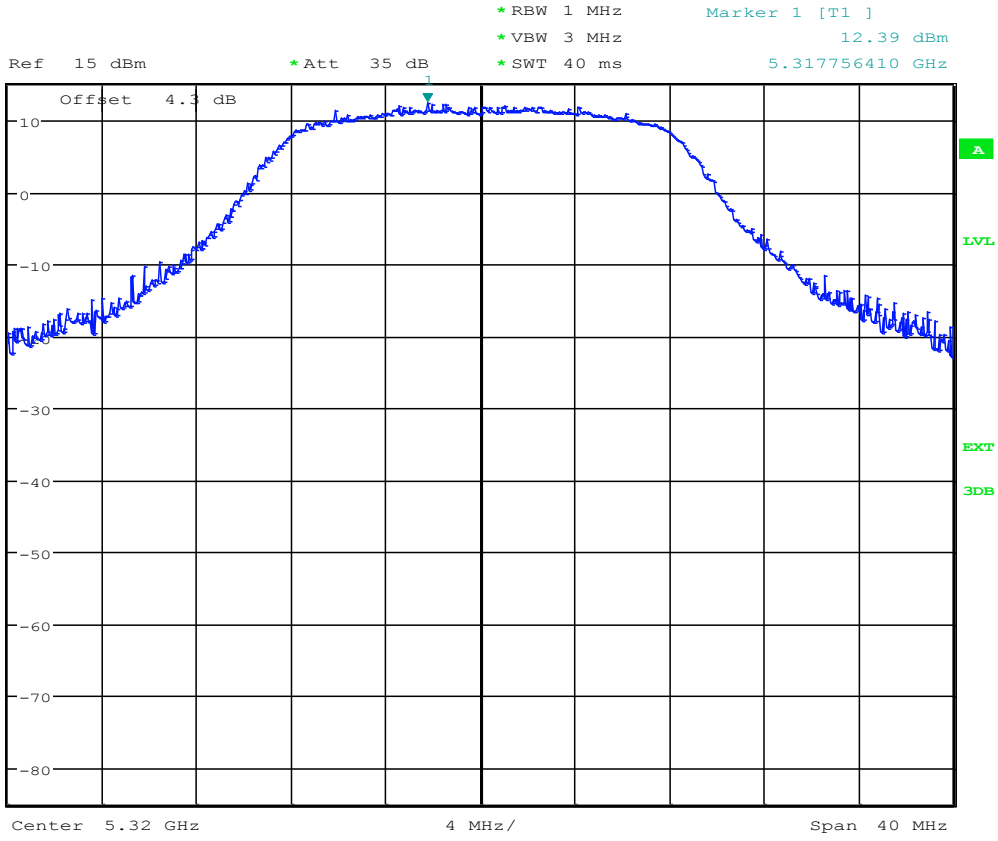
SB1_3n



Date: 22.JUL.2013 08:25:02

Op. Mode

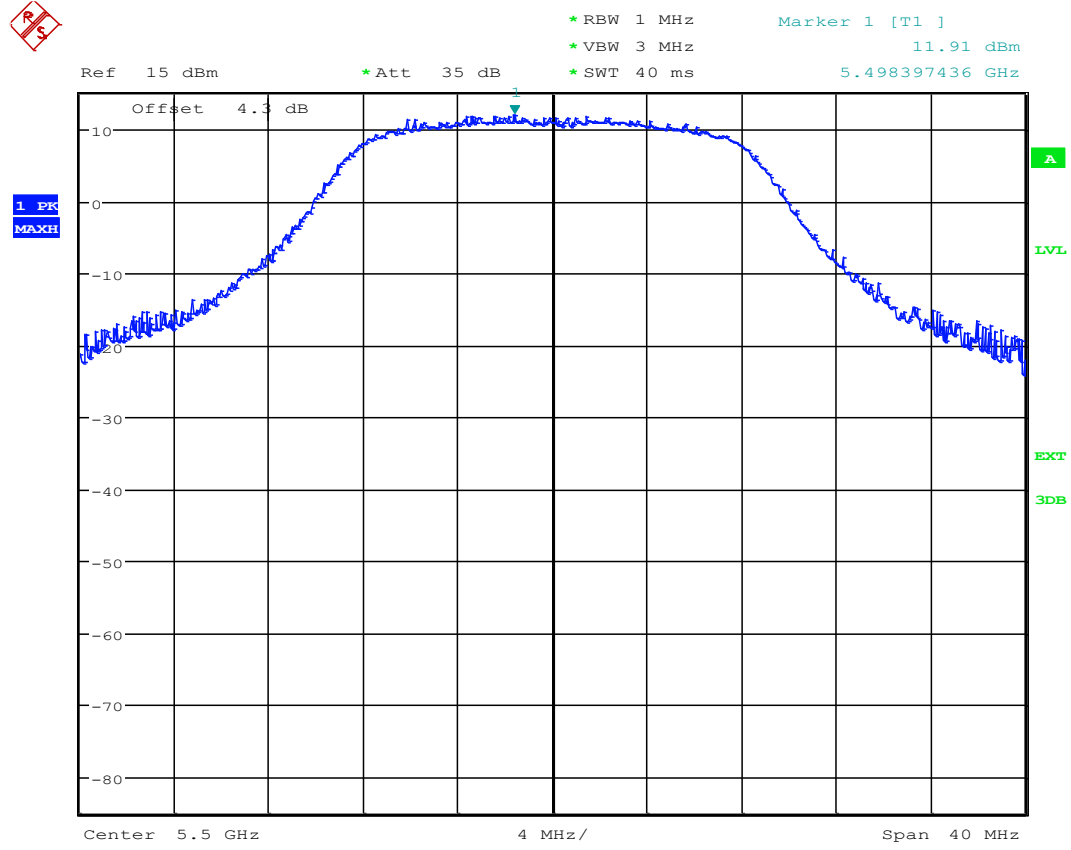
SB2_3n



Date: 22.JUL.2013 08:28:11

Op. Mode

SB3_1n

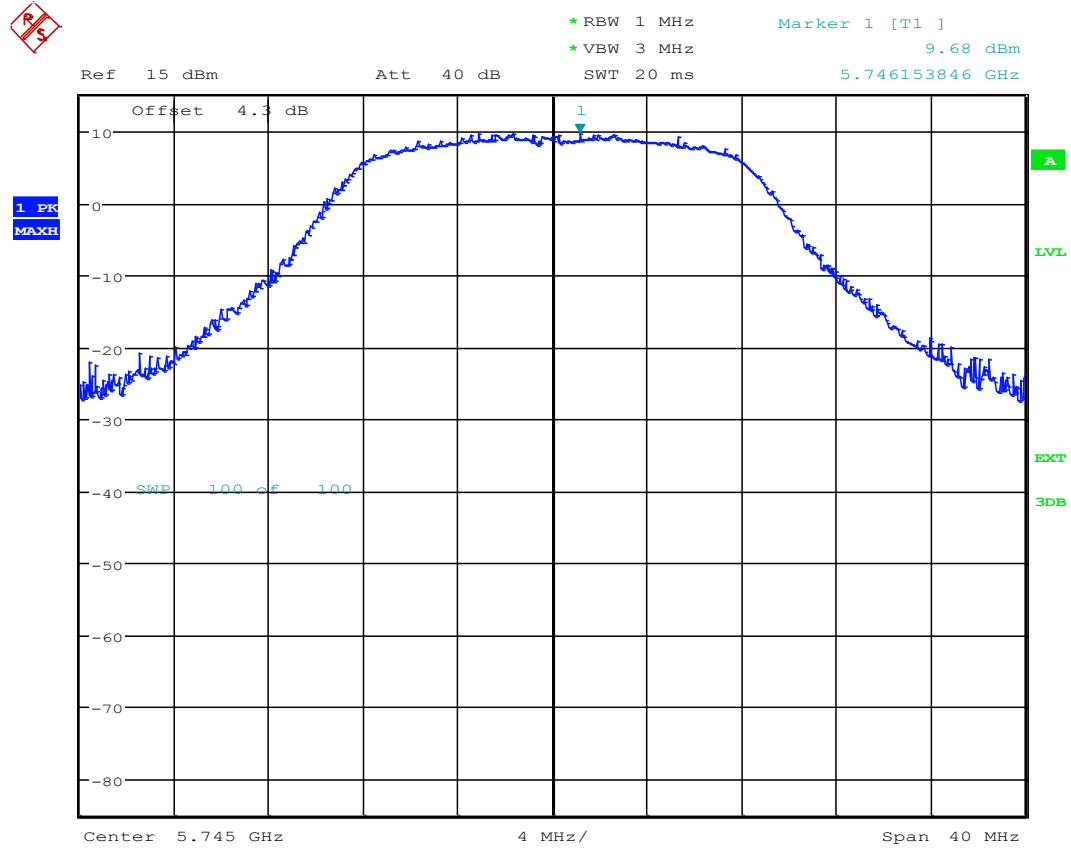


Date: 22.JUL.2013 08:29:17



Op. Mode

SB4_1n



Date: 19.JUL.2013 09:58:58