FCC Measurement/Technical Report on

WLAN and Bluetooth module JODY-W164-07A

FCC ID: XPYJODYW164-07A
IC: 8595A-JODYW16407A

Test Report Reference: MDE_UBLOX_1701_FCCd

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

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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1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization
Certification for an Intentional Radiator.

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 (10-1-15 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

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz

Note 1: (DTS Equipment)
The tests were selected and performed with reference to the FCC Public Notice "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, 558074 D01 DTS Meas Guidance v04, 2017-04-05". ANSI C63.10–2013 is applied.

Note 2:
Not all possible operating modes were tested. Worst case operating modes were determined at the beginning of the test period.

Note 3:
Bluetooth LE mode like Bluetooth BDR uses GFSK modulation while Bluetooth BDR uses a higher output power. Therefore Bluetooth BDR mode worst case for "Transmitter spurious radiated emissions" and "Band Edge Compliance Radiated" and covers also Bluetooth LE mode.

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 1.3 Measurement Summary / Signatures.

1.2 FCC-IC CORRELATION TABLE

Correlation of measurement requirements for DTS (e.g. WLAN 2.4 GHz, BT LE) equipment from FCC and IC

DTS equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 4: 8.8
Occupied bandwidth	§ 15.247 (a) (2)	RSS-247 Issue 2: 5.2 (a)
Peak conducted output power	§ 15.247 (b) (3), (4)	RSS-247 Issue 2: 5.4 (d)
Transmitter spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen Issue 4: 6.13 / 8.9/8.10; RSS-247 Issue 2: 5.5
Transmitter spurious radiated emissions	§ 15.247 (d); § 15.209 (a)	RSS-Gen Issue 4: 6.13 / 8.9/8.10; RSS-247 Issue 2: 5.5
Band edge compliance	§ 15.247 (d)	RSS-247 Issue 2: 5.5
Power density	§ 15.247 (e)	RSS-247 Issue 2: 5.2 (b)
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	–	–

1.3 MEASUREMENT SUMMARY / SIGNATURES

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247 § 15.207

Conducted Emissions at AC Mains
The measurement was performed according to ANSI C63.10 Final Result

OP-Mode Operating mode	Setup	FCC	IC
worst case	S03_7_AB01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247 § 15.247 (a) (2)

Occupied Bandwidth (6 dB)
The measurement was performed according to ANSI C63.10 Final Result

OP-Mode Radio Technology, Operating Frequency	Setup	FCC	IC
Bluetooth BDR, high	S01_7_AB01	Passed	Passed
Bluetooth BDR, low	S01_7_AB01	Passed	Passed
Bluetooth BDR, mid	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, high	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, low	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, mid	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, high	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, low	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, mid	S01_7_AB01	Passed	Passed
Bluetooth LE, high	S01_7_AA01	Passed	Passed
Bluetooth LE, low	S01_7_AA01	Passed	Passed
Bluetooth LE, mid	S01_7_AA01	Passed	Passed
WLAN b, high	S01_7_AA01	Passed	Passed
WLAN b, low	S01_7_AA01	Passed	Passed
WLAN b, mid	S01_7_AA01	Passed	Passed
WLAN g, high	S01_7_AA01	Passed	Passed
WLAN g, low	S01_7_AA01	Passed	Passed
WLAN g, mid	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, high	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, low	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, mid	S01_7_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247 IC RSS-Gen & IC TRC; Ch. 6.6 & Ch. 8

Occupied Bandwidth (99%)
The measurement was performed according to ANSI C63.10 Final Result

OP-Mode Radio Technology, Operating Frequency	Setup	FCC	IC
Bluetooth BDR, high	S01_7_AB01	N/A	Performed
Bluetooth BDR, low	S01_7_AB01	N/A	Performed
Bluetooth BDR, mid	S01_7_AB01	N/A	Performed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247	IC RSS-Gen & IC TRC; Ch. 6.6 & Ch. 8

Occupied Bandwidth (99%)

The measurement was performed according to ANSI C63.10 — Final Result

OP-Mode Radio Technology, Operating Frequency	Setup	FCC	IC
Bluetooth EDR 2, high	S01_7_AB01	N/A	Performed
Bluetooth EDR 2, low	S01_7_AB01	N/A	Performed
Bluetooth EDR 2, mid	S01_7_AB01	N/A	Performed
Bluetooth EDR 3, high	S01_7_AB01	N/A	Performed
Bluetooth EDR 3, low	S01_7_AB01	N/A	Performed
Bluetooth EDR 3, mid	S01_7_AB01	N/A	Performed
Bluetooth LE, high	S01_7_AA01	N/A	Performed
Bluetooth LE, low	S01_7_AA01	N/A	Performed
Bluetooth LE, mid	S01_7_AA01	N/A	Performed
WLAN b, high	S01_7_AA01	N/A	Performed
WLAN b, low	S01_7_AA01	N/A	Performed
WLAN b, mid	S01_7_AA01	N/A	Performed
WLAN g, high	S01_7_AA01	N/A	Performed
WLAN g, low	S01_7_AA01	N/A	Performed
WLAN g, mid	S01_7_AA01	N/A	Performed
WLAN n 20 MHz, high	S01_7_AA01	N/A	Performed
WLAN n 20 MHz, low	S01_7_AA01	N/A	Performed
WLAN n 20 MHz, mid	S01_7_AA01	N/A	Performed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247	§ 15.247 (b) (3)

Peak Power Output

The measurement was performed according to ANSI C63.10 — Final Result

OP-Mode Radio Technology, Operating Frequency, Measurement method	Setup	FCC	IC
Bluetooth BDR, high, conducted	S01_7_AB01	Passed	Passed
Bluetooth BDR, low, conducted	S01_7_AB01	Passed	Passed
Bluetooth BDR, mid, conducted	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, high, conducted	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, low, conducted	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, mid, conducted	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, high, conducted	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, low, conducted	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, mid, conducted	S01_7_AB01	Passed	Passed
Bluetooth LE, high, conducted	S01_7_AA01	Passed	Passed
Bluetooth LE, low, conducted	S01_7_AA01	Passed	Passed
Bluetooth LE, mid, conducted	S01_7_AA01	Passed	Passed
WLAN b, high, conducted	S01_7_AA01	Passed	Passed
WLAN b, low, conducted	S01_7_AA01	Passed	Passed
WLAN b, mid, conducted	S01_7_AA01	Passed	Passed
WLAN g, high, conducted	S01_7_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247 § 15.247 (b) (3)

Peak Power Output

The measurement was performed according to ANSI C63.10 Final Result

OP-Mode Radio Technology, Operating Frequency, Measurement method	Setup	FCC	IC
WLAN g, low, conducted	S01_7_AA01	Passed	Passed
WLAN g, mid, conducted	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, high, conducted	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, low, conducted	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, mid, conducted	S01_7_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247 § 15.247 (d)

Spurious RF Conducted Emissions and Conducted Emissions in Restricted Bands

The measurement was performed according to ANSI C63.10 Final Result

OP-Mode Radio Technology, Operating Frequency, Measurement method	Setup	FCC	IC
Bluetooth BDR, high, conducted	S01_7_AA01	Passed	Passed
Bluetooth BDR, low, conducted	S01_7_AA01	Passed	Passed
Bluetooth BDR, mid, conducted	S01_7_AA01	Passed	Passed
Bluetooth EDR 2, high, conducted	S01_7_AA01	Passed	Passed
Bluetooth EDR 2, low, conducted	S01_7_AA01	Passed	Passed
Bluetooth EDR 2, mid, conducted	S01_7_AA01	Passed	Passed
Bluetooth EDR 3, high, conducted	S01_7_AA01	Passed	Passed
Bluetooth EDR 3, low, conducted	S01_7_AA01	Passed	Passed
Bluetooth EDR 3, mid, conducted	S01_7_AA01	Passed	Passed
Bluetooth LE, high, conducted	S01_7_AA01	Passed	Passed
Bluetooth LE, low, conducted	S01_7_AA01	Passed	Passed
Bluetooth LE, mid, conducted	S01_7_AA01	Passed	Passed
WLAN b, high, conducted	S01_7_AA01	Passed	Passed
WLAN b, low, conducted	S01_7_AA01	Passed	Passed
WLAN b, mid, conducted	S01_7_AA01	Passed	Passed
WLAN g, high, conducted	S01_7_AA01	Passed	Passed
WLAN g, low, conducted	S01_7_AA01	Passed	Passed
WLAN g, mid, conducted	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, high, conducted	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, low, conducted	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, mid, conducted	S01_7_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C § 15.247 (d) §15.247

Transmitter Spurious Radiated Emissions
The measurement was performed according to ANSI C63.10 Final Result

OP-Mode Radio Technology, Operating Frequency, Measurement range	Setup	FCC	IC
Bluetooth BDR, high, 1 GHz - 26 GHz	S02_7_AB01	Passed	Passed
Bluetooth BDR, high, 30 MHz - 1 GHz	S02_7_AB01	Passed	Passed
Bluetooth BDR, low, 1 GHz - 26 GHz	S02_7_AB01	Passed	Passed
Bluetooth BDR, low, 30 MHz - 1 GHz	S02_7_AB01	Passed	Passed
Bluetooth BDR, mid, 1 GHz - 26 GHz	S02_7_AB01	Passed	Passed
Bluetooth BDR, mid, 30 MHz - 1 GHz	S02_7_AB01	Passed	Passed
Bluetooth BDR, mid, 9 kHz - 30 MHz	S02_7_AB01	Passed	Passed
Bluetooth EDR 2, high, 1 GHz - 26 GHz Remark: only 1-8GHz	S02_7_AB01	Passed	Passed
Bluetooth EDR 2, low, 1 GHz - 26 GHz Remark: only 1-8GHz	S02_7_AB01	Passed	Passed
Bluetooth EDR 2, mid, 1 GHz - 26 GHz Remark: only 1-8GHz	S02_7_AB01	Passed	Passed
WLAN b, high, 1 GHz - 26 GHz	S02_7_AB01	Passed	Passed
WLAN b, high, 30 MHz - 1 GHz	S02_7_AB01	Passed	Passed
WLAN b, low, 1 GHz - 26 GHz	S02_7_AB01	Passed	Passed
WLAN b, low, 30 MHz - 1 GHz	S02_7_AB01	Passed	Passed
WLAN b, mid, 1 GHz - 26 GHz	S02_7_AB01	Passed	Passed
WLAN b, mid, 30 MHz - 1 GHz	S02_7_AB01	Passed	Passed
WLAN b, mid, 9 kHz - 30 MHz	S02_7_AB01	Passed	Passed
WLAN g, high, 1 GHz - 26 GHz Remark: only 1-8GHz	S02_7_AB01	Passed	Passed
WLAN g, low, 1 GHz - 26 GHz Remark: only 1-8GHz	S02_7_AB01	Passed	Passed
WLAN g, mid, 1 GHz - 26 GHz Remark: only 1-8GHz	S02_7_AB01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C § 15.247 (d) §15.247

Band Edge Compliance Conducted
The measurement was performed according to ANSI C63.10 Final Result

OP-Mode Radio Technology, Operating Frequency, Band Edge	Setup	FCC	IC
Bluetooth BDR, high, high	S01_7_AB01	Passed	Passed
Bluetooth BDR, low, low	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, high, high	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, low, low	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, high, high	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, low, low	S01_7_AB01	Passed	Passed
Bluetooth LE, high, high	S01_7_AA01	Passed	Passed
Bluetooth LE, low, low	S01_7_AA01	Passed	Passed
WLAN b, high, high	S01_7_AA01	Passed	Passed
WLAN b, low, low	S01_7_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247	§ 15.247 (d)		
Band Edge Compliance Conducted The measurement was performed according to ANSI C63.10		Final Result	
OP-Mode Radio Technology, Operating Frequency, Band Edge	Setup	FCC	IC
WLAN g, high, high	S01_7_AA01	Passed	Passed
WLAN g, low, low	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, high, high	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, low, low	S01_7_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247	§ 15.247 (d)		
Band Edge Compliance Radiated The measurement was performed according to ANSI C63.10		Final Result	
OP-Mode Radio Technology, Operating Frequency, Band Edge	Setup	FCC	IC
Bluetooth BDR, high, high	S02_7_AB01	Passed	Passed
Bluetooth EDR 2, high, high	S02_7_AB01	Passed	Passed
Bluetooth EDR 3, high, high	S02_7_AB01	Passed	Passed
WLAN b, high, high	S02_7_AB01	Passed	Passed
WLAN g, high, high	S02_7_AB01	Passed	Passed
WLAN n 20 MHz, high, high	S02_7_AB01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247	§ 15.247 (e)		
Power Density The measurement was performed according to ANSI C63.10		Final Result	
OP-Mode Radio Technology, Operating Frequency	Setup	FCC	IC
Bluetooth BDR, high	S01_7_AB01	Passed	Passed
Bluetooth BDR, low	S01_7_AB01	Passed	Passed
Bluetooth BDR, mid	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, high	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, low	S01_7_AB01	Passed	Passed
Bluetooth EDR 2, mid	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, high	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, low	S01_7_AB01	Passed	Passed
Bluetooth EDR 3, mid	S01_7_AB01	Passed	Passed
Bluetooth LE, high	S01_7_AA01	Passed	Passed
Bluetooth LE, low	S01_7_AA01	Passed	Passed
Bluetooth LE, mid	S01_7_AA01	Passed	Passed
WLAN b, high	S01_7_AA01	Passed	Passed
WLAN b, low	S01_7_AA01	Passed	Passed
WLAN b, mid	S01_7_AA01	Passed	Passed
WLAN g, high	S01_7_AA01	Passed	Passed
WLAN g, low	S01_7_AA01	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C § 15.247 (e)
§15.247

Power Density
The measurement was performed according to ANSI C63.10

Final Result

OP-Mode	**Setup**	**FCC**	**IC**
Radio Technology, Operating Frequency			
WLAN g, mid	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, high	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, low	S01_7_AA01	Passed	Passed
WLAN n 20 MHz, mid	S01_7_AA01	Passed	Passed

N/A: Not applicable
N/P: Not performed

(responsible for accreditation scope)
Dipl.-Ing. Marco Kullik

(responsible for testing and report)
Dipl.-Ing. Daniel Gall

7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

2 ADMINISTRATIVE DATA

2.1 TESTING LABORATORY

Company Name:	7layers GmbH
Address:	Borsigstr. 11 40880 Ratingen Germany

This facility has been fully described in a report submitted to the ISED and accepted under the registration number: Site# 3699A-1.

The test facility is also accredited by the following accreditation organisation:

Laboratory accreditation no:	DAkkS D-PL-12140-01-00
FCC Designation Number:	DE0015
FCC Test Firm Registration:	929146
Responsible for accreditation scope:	Dipl.-Ing. Marco Kullik
Report Template Version:	2017-07-14

2.2 PROJECT DATA

Responsible for testing and report:	Dipl.-Ing. Daniel Gall
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2018-05-18
Testing Period:	2017-11-07 to 2018-01-22

2.3 APPLICANT DATA

Company Name:	u-blox AG
Address:	Zürcherstrasse 68 8800 Thalwil Switzerland
Contact Person:	Mr. Filip Kruzela

2.4 MANUFACTURER DATA

Company Name:	Please see applicant data

3 TEST OBJECT DATA

3.1 GENERAL EUT DESCRIPTION

Kind of Device product description	The EUT is a module supporting WLAN in the 2.4 GHz and 5 GHz bands as well as Bluetooth (BT) 4.2 including Bluetooth Low Energy (BT LE)
Product name	JODY-W164-07A
Type	JODY-W164-07A
Declared EUT data by the supplier	
Voltage Type	DC
Voltage Level	3.3 V
Tested Modulation Types and Data Rates	BT: GFSK Modulation, DHx packets (Bluetooth and Bluetooth Low Energy), 1 Mbps π/4 DQPSK Modulation, 2-DHx packets, 2 Mbps 8-DPSK Modulation, 3-DHx packets, 3 Mbps WLAN: Mode b: DSSS Modulation, 1Mbps Mode g/n: OFDM Modulation, 6Mbps / MCS 0 (20 MHz only)
Specific product description for the EUT	The JODY-W1 is a compact automotive grade module that provides Wi-Fi, Bluetooth, and Bluetooth low energy communication. The JODY-W164-07A module can be operated in the following modes: Wi-Fi (SISO) 802.11ac in 2.4 / 5 GHz real simultaneous dual band Dual-mode Bluetooth v4.2, can be operated fully simultaneous with both Wi-Fi modes It is equipped with two antenna pins connected to two SMA antenna connectors on the evaluation board. Maximum supported band width in 2.4 GHz WLAN mode: 20 MHz, 5 GHz WLAN mode: 80 MHz
The EUT provides the following ports:	DC Power Supply Antenna ports Signal ports
Special software used for testing	The test modes were set using scripts that were run on a board computer with Linux operating system provided by the applicant.

The main components of the EUT are listed and described in chapter 3.2 EUT Main components.

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3.2 EUT MAIN COMPONENTS

Sample Name	Sample Code	Description
EUT 7A	DE1015082aa01	Module on evaluation board
Sample Parameter	Value	
Integral Antenna	None, two external 50 Ohm connectors on evaluation board. Antenna gain used for evaluation of test results: 2dBi	
Serial No.	001	
HW Version	00	
SW Version	P8.1	
Comment		

Sample Name	Sample Code	Description
EUT 7B	DE1015082ab01	Module on evaluation board
Sample Parameter	Value	
Integral Antenna	None, two external 50 Ohm connectors on evaluation board. Antenna gain used for evaluation of test results: 2dBi	
Serial No.	002	
HW Version	00	
SW Version	P8.1	
Comment		

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

3.3 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.

Device	Details (Manufacturer, Type Model, OUT Code)	Description
Evaluation Board	UBLOX, REV. B, - , -	Board the EUT is mounted to, providing ports to the EUT (DC, Antennas, wired communication)

3.4 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.

Device	Details (Manufacturer, HW, SW, S/N)	Description
Board Computer	Toradex, Ixora, - , -, -	Computer used for setting the test modes
AC/DC power supply (115 V 60 Hz)	PeakTech, -, -, 081062045	PeakTech 6005D

3.5 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	Combination of EUTs	Description and Rationale
S01_7_AA01	EUT 7A, Evaluation Board, Board Computer	Representative setup conducted tests
S01_7_AB01	EUT 7B, Evaluation Board, Board Computer	Representative setup conducted tests
S02_7_AB01	EUT 7B, Evaluation Board	Representative setup radiated tests
S03_7_AB01	EUT 7B, Evaluation Board, AC/DC power supply (115 V 60 Hz)	Representative setup AC conducted emissions test

3.6 OPERATING MODES

This chapter describes the operating modes of the EUTs used for testing.

3.6.1 TEST CHANNELS

WLAN	2.4 GHz ISM 2400 - 2483.5 MHz				
20 MHz Test Channels:	Low [1]		mid	High [1]	
Channel:	1	2	6	10	11
Frequency [MHz]	2412	2417	2437	2457	2462

	2.4 GHz ISM 2400 - 2483.5 MHz		
BT Test Channels:	low	mid	high
Channel:	0	39	78
Frequency [MHz]	2402	2441	2480

	2.4 GHz ISM 2400 - 2483.5 MHz		
BT LE Test Channels:	low	mid	high
Channel:	0	19	39
Frequency [MHz]	2402	2440	2480

1) Since in WLAN mode g and n the lowest and highest channels have lower output power than the other channels, additional testing was performed for the second lowest and highest channels in those modes.

Output power per channel and mode to be set in EUT WLAN script acc. to customer declaration:

Channel No.	1	2	3	4	5	6	7	8	9	10	11
Channel freq. [MHz]	2412	2417	2422	2427	2432	2437	2442	2447	2452	2457	2462
WLAN mode b	18	18	18	18	18	18	18	18	18	18	18
WLAN mode g	13	15	15	15	15	15	15	15	15	15	13
WLAN mode n	13	15	15	15	15	15	15	15	15	15	13

3.7 PRODUCT LABELLING

3.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

3.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

4 TEST RESULTS

4.1 CONDUCTED EMISSIONS AT AC MAINS

Standard FCC Part 15 Subpart C

The test was performed according to:
ANSI C63.10

4.1.1 TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C 63.10
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 50µH || 50 Ohm Line Impedance Stabilization Network (LISN). 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 EMC-32 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 & Average
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 2.5 kHz
- IF–Bandwidth: 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)
- Measurement on phase + neutral lines of the power cords

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.

4.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §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).

4.1.3 TEST PROTOCOL

Temperature: 24 °C
Air Pressure: 986 hPa
Humidity: 37 %

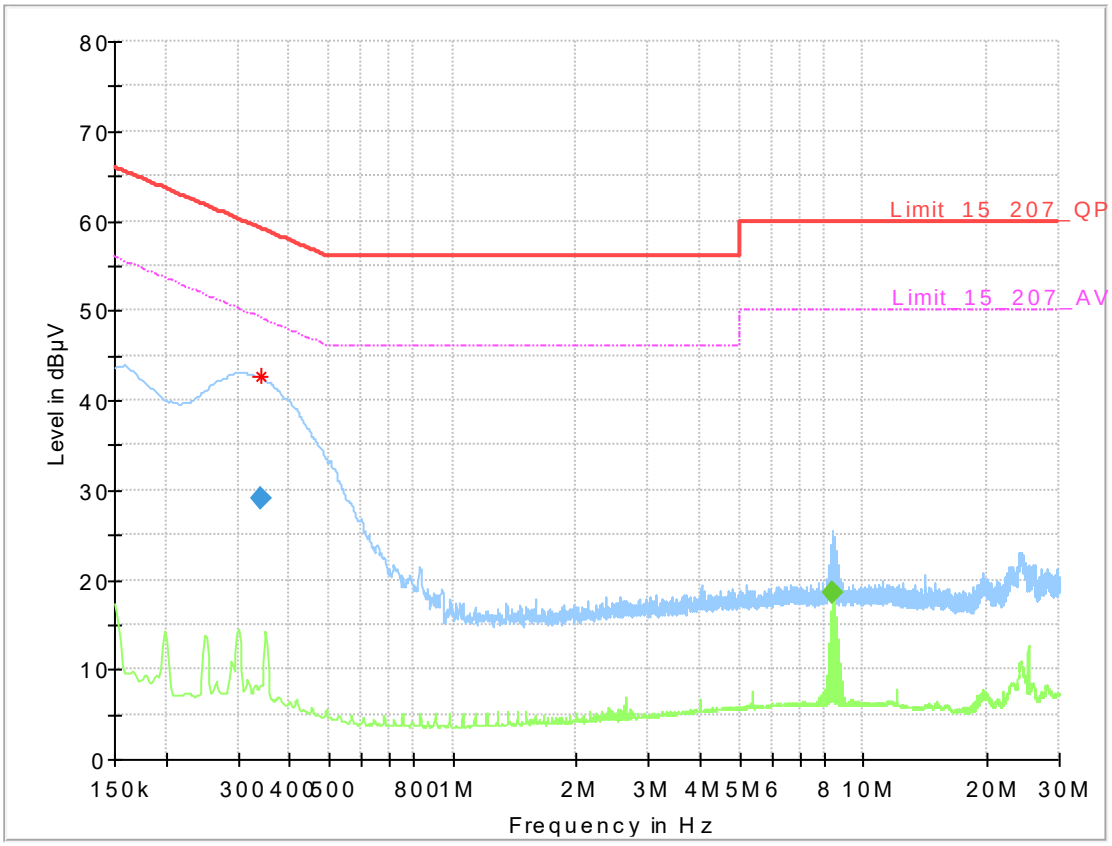
Power line	Frequency [MHz]	Measured value QP [dBµV]	Measured value AV [dBµV]	QP Limit [dBµV]	AV Limit [dBµV]	Margin QP [dB]	Margin AV [dB]
N	-	-	-	-	-	> 20	> 20
L	-	-	-	-	-	> 20	> 20

Remark: Measured at 120 V 60 Hz input of lab power supply, WLAN 2.4 GHz, CH 6, set EUT target power: 18 dBm

4.1.4MEASUREMENT PLOT

Common Information

Test Description:	Conducted Emissions
Test Standard:	FCC §15.207
EUT / Setup Code:	DE1015082ab01
Operating Conditions:	120 V 60 Hz, BT TX on 2441 MHz
Operator Name:	Gal
Comment:	
Legend:	Trace: blue = PK, green = CISPR AV; Star: red or blue = critical frequency; Rhombus: blue = final QP, green = final CISPR AV
Tested Port / used LISN:	AC mains => ESH3-Z5
Termination of other ports:	N/A



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.341250	28.99	---	59.17	30.18	1000.0	9.000	L1	GND	10.1
8.425500	---	18.65	50.00	31.35	1000.0	9.000	N	FLO	10.5

4.1.5TEST EQUIPMENT USED

Conducted Emissions

4.2 OCCUPIED BANDWIDTH (6 DB)

Standard FCC Part 15 Subpart C

The test was performed according to:
ANSI C63.10

4.2.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up 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 which produce the worst-case (smallest) emission bandwidth.

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

Analyzer settings:

See worst case analyser plots.

4.2.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.247 (a) (2)
Systems using digital modulation techniques may operate in the 902-928 MHz and 2400-2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.2.3 TEST PROTOCOL

Ambient temperature: 25 °C
Air Pressure: 1000 hPa
Humidity: 38 %

BT GFSK (1-DH1)

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	0	2402	0.51	0.5	0.01
	39	2441	0.51	0.5	0.01
	78	2480	0.51	0.5	0.01

BT π/4 DQPSK (2-DH1)

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	0	2402	1.10	0.5	0.60
	39	2441	1.10	0.5	0.60
	78	2480	1.10	0.5	0.60

BT 8-DPSK (3-DH1)

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	0	2402	1.11	0.5	0.61
	39	2441	1.10	0.5	0.60
	78	2480	1.10	0.5	0.60

BT LE GFSK

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	0	2402	0.75	0.5	0.25
	19	2440	0.75	0.5	0.25
	39	2480	0.75	0.5	0.25

WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	1	2412	8.0	0.5	7.5
	6	2437	8.0	0.5	7.5
	11	2462	8.0	0.5	7.5

WLAN g-Mode; 20 MHz; 6 Mbit/s

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	1	2412	16.2	0.5	15.7
	2	2417	16.0	0.5	15.5
	6	2437	16.4	0.5	15.9
	10	2457	16.0	0.5	15.5
	11	2462	16.3	0.5	15.8

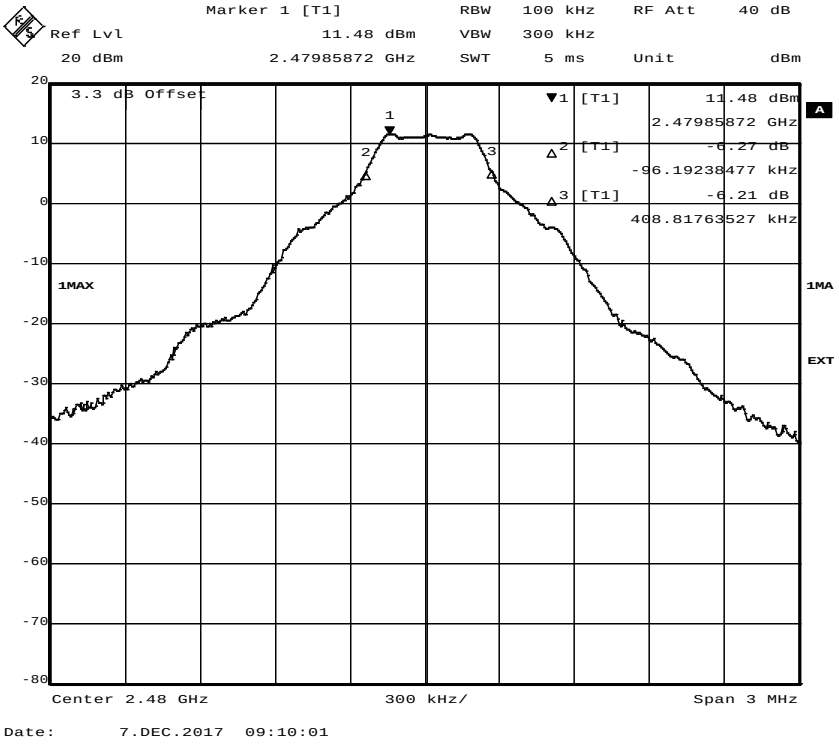
WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	1	2412	17.3	0.5	16.8
	2	2417	16.5	0.5	16.0
	6	2437	17.6	0.5	17.1
	10	2457	16.7	0.5	16.2
	11	2462	17.1	0.5	16.6

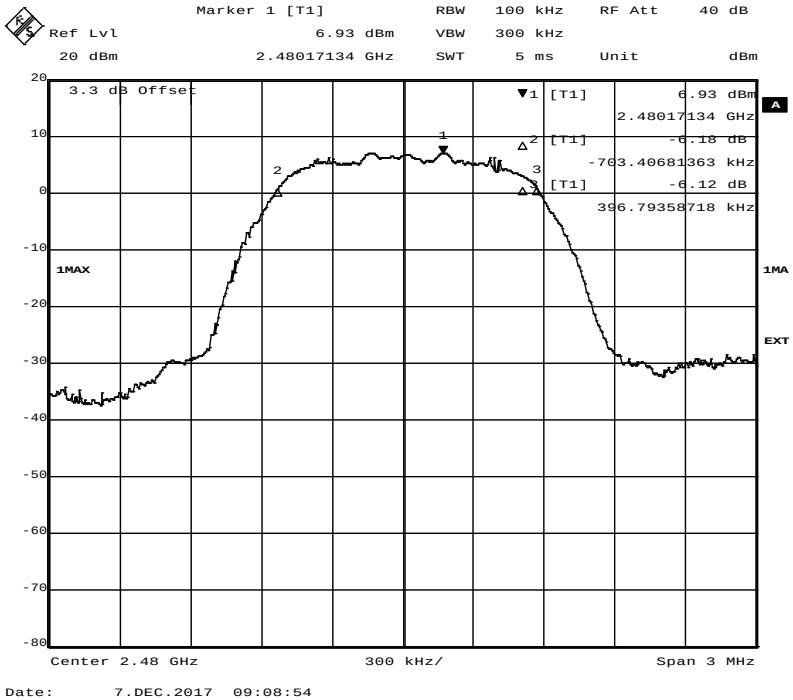
Remark: Please see next sub-clause for the measurement plot.

4.2.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

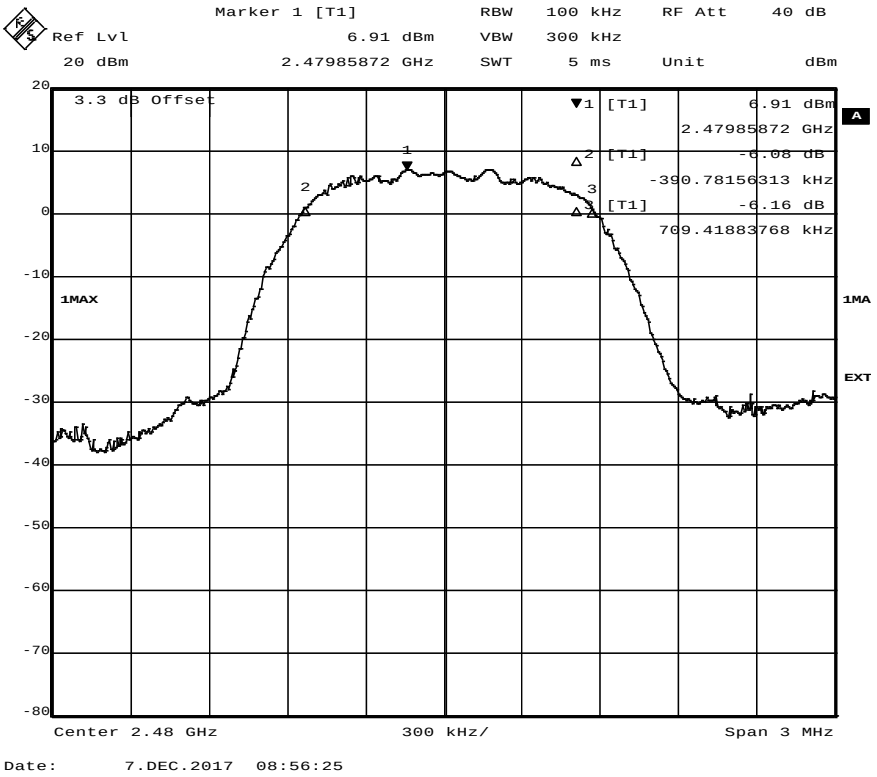
Radio Technology = BT GFSK (1-DH1), Operating Frequency = high (S01_7_AB01)



Radio Technology = BT π/4 DQPSK (2-DH1), Operating Frequency = high (S01_7_AB01)

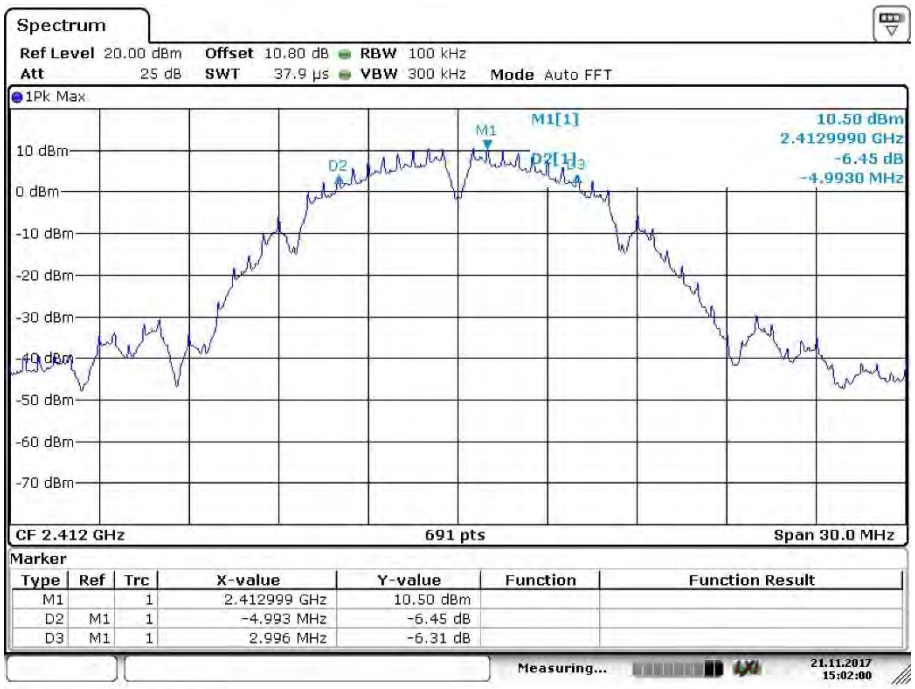


Radio Technology = BT 8-DPSK (3-DH1), Operating Frequency = high (S01_7_AB01)



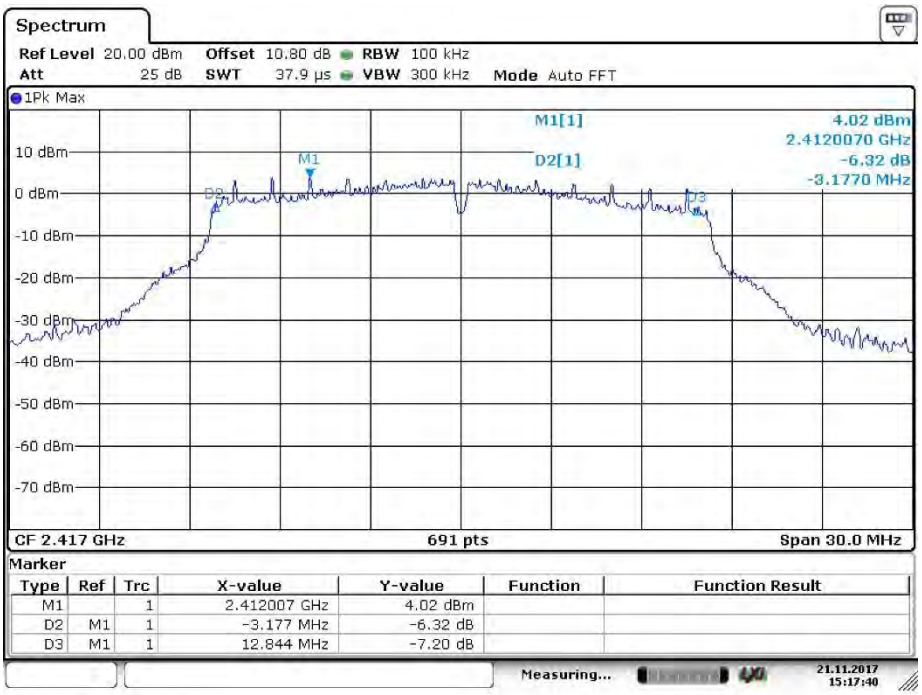
Radio Technology = Bluetooth LE, Operating Frequency = high (S01_7_AA01)

Radio Technology = WLAN b, Operating Frequency = low
(S01_7_AA01)



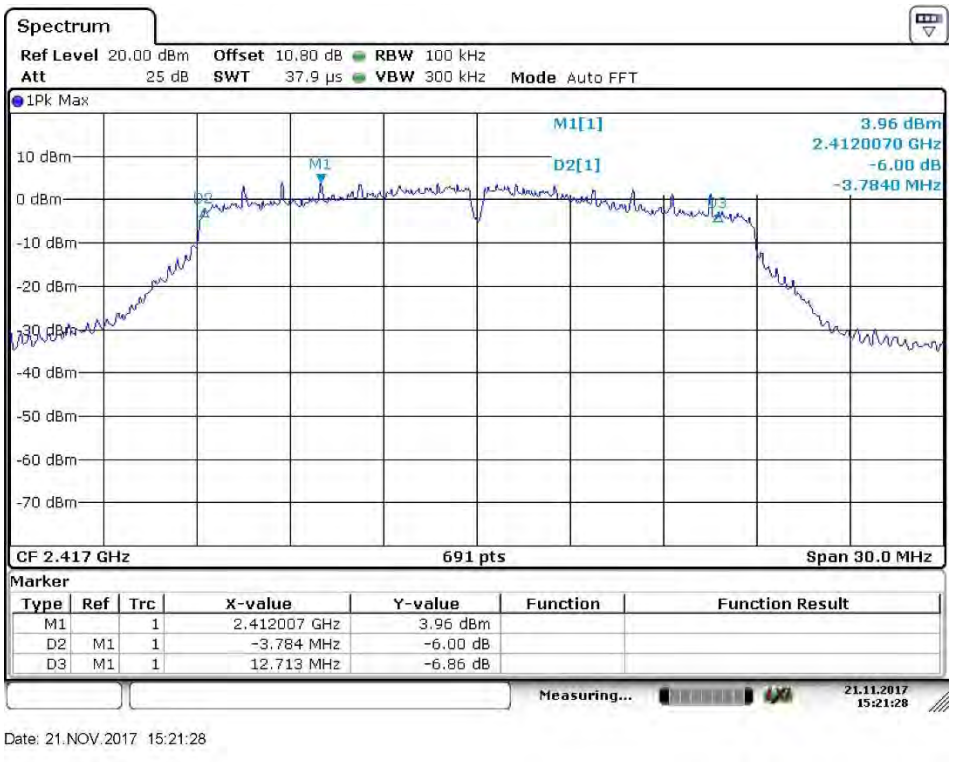
Date: 21.NOV.2017 15:02:00

Radio Technology = WLAN g, Operating Frequency = low
(S01_7_AA01)



Date: 21.NOV.2017 15:17:40

Radio Technology = WLAN n 20 MHz, Operating Frequency = low (S01_7_AA01)



4.2.5 TEST EQUIPMENT USED

- R&S TS8997
- Regulatory Bluetooth RF Test Solution

4.3 OCCUPIED BANDWIDTH (99%)

Standard FCC Part 15 Subpart C

The test was performed according to:
ANSI C63.10

4.3.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up 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 EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:

See measurement plots.

The 99 % measurement function of the spectrum analyser function was used to determine the 99 % bandwidth.

4.3.2 TEST REQUIREMENTS / LIMITS

No applicable limit.

4.3.3 TEST PROTOCOL

Ambient temperature: 25 °C
Air Pressure: 1000 hPa
Humidity: 38 %

BT GFSK (1-DH1)

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	0	2402	1.00
	39	2441	0.99
	78	2480	1.00

BT π/4 DQPSK (2-DH1)

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	0	2402	1.09
	39	2441	1.09
	78	2480	1.09

BT 8-DPSK (3-DH1)

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	0	2402	1.15
	39	2441	1.16
	78	2480	1.15

BT LE GFSK

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	0	2402	1.05
	19	2440	1.05
	39	2480	1.06

WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	1	2412	10.6
	6	2437	10.4
	11	2462	10.4

WLAN g-Mode; 20 MHz; 6 Mbit/s

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	1	2412	17.0
	2	2417	17.1
	6	2437	17.7
	10	2457	17.3
	11	2462	17.1

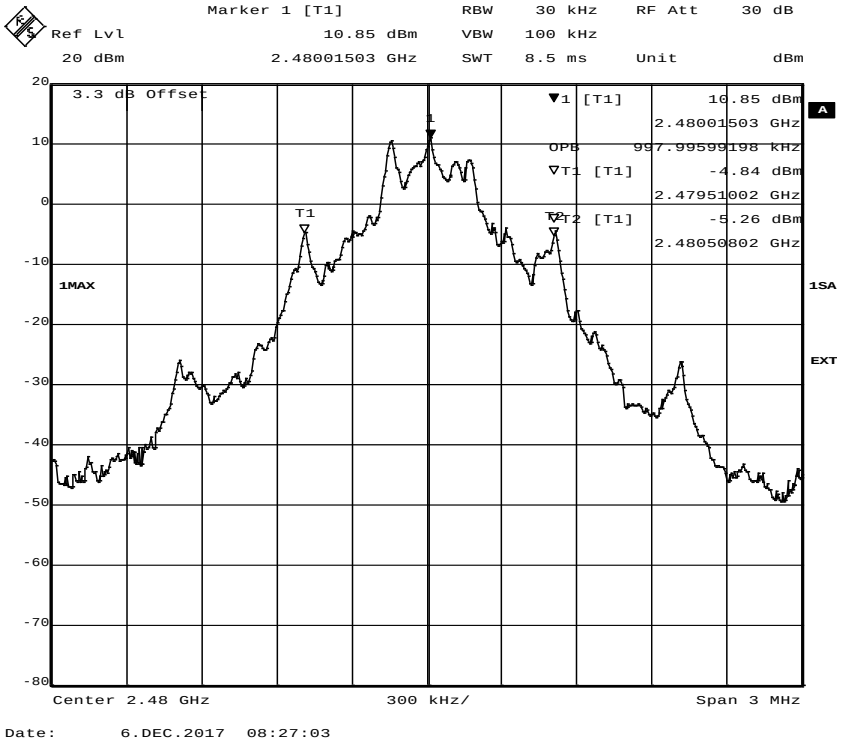
WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	1	2412	18.1
	2	2417	18.2
	6	2437	18.6
	10	2457	18.3
	11	2462	18.2

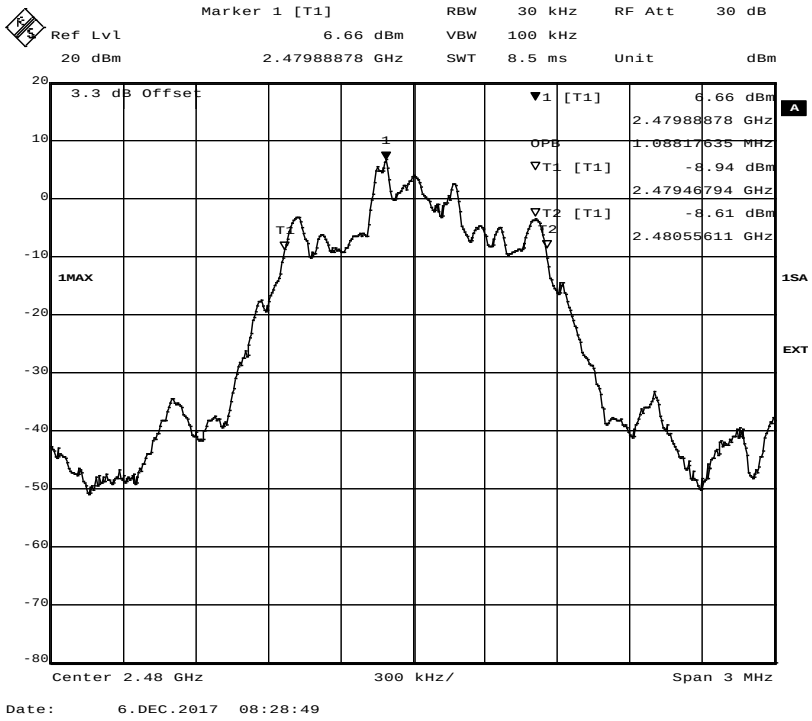
Remark: Please see next sub-clause for the measurement plot.

4.3.4 MEASUREMENT PLOTS (HIGHEST VALUE PER MODE)

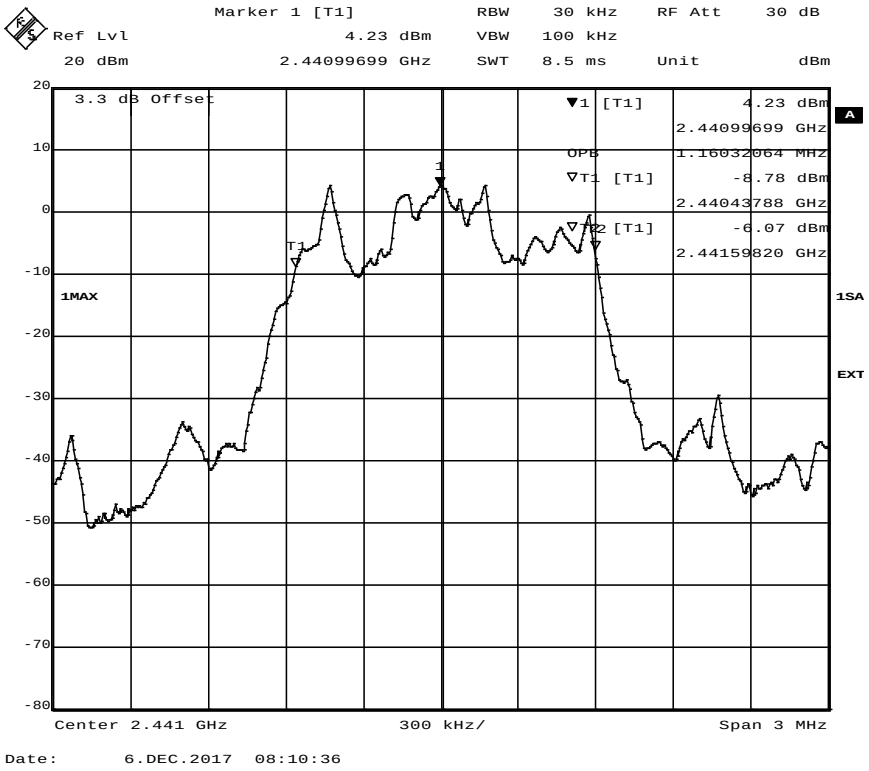
Radio Technology = BT GFSK (1-DH1), Operating Frequency = high (S01_7_AB01)



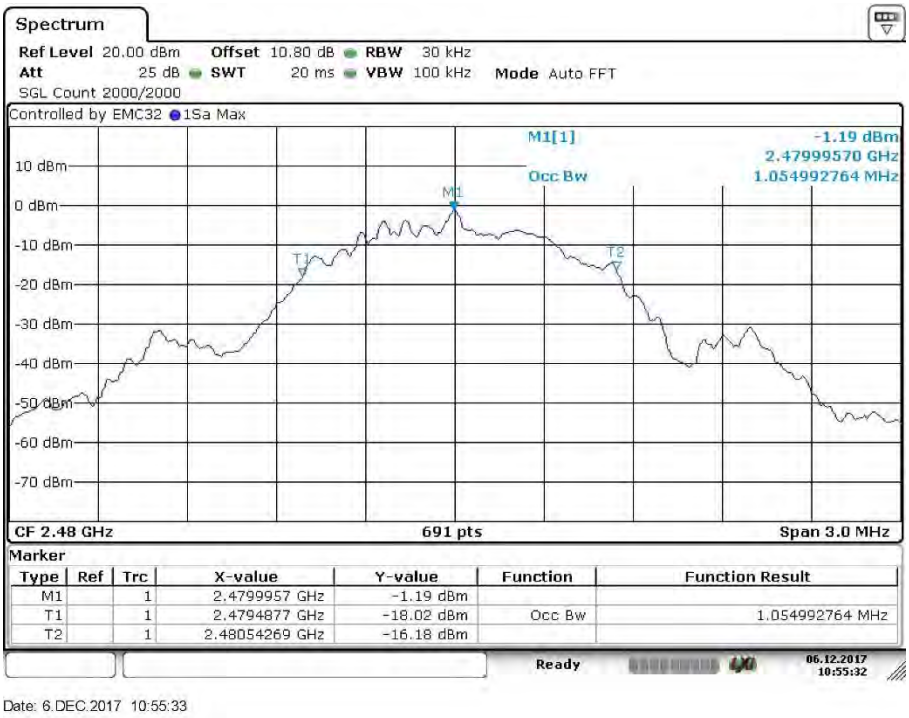
Radio Technology = BT π/4 DQPSK (2-DH1), Operating Frequency = high (S01_7_AB01)



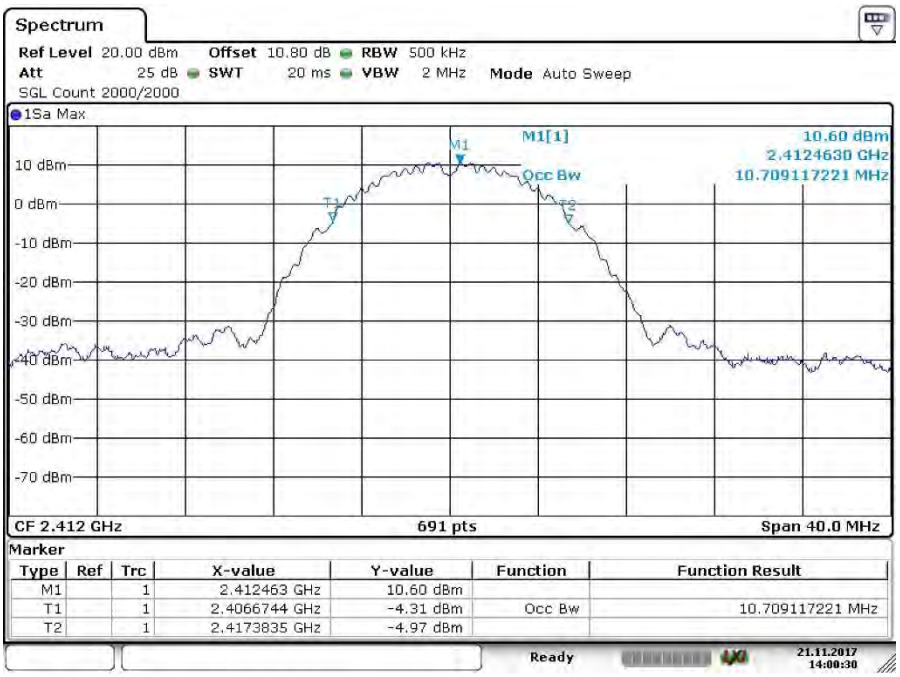
Radio Technology = BT 8-DPSK (3-DH1), Operating Frequency = mid (S01_7_AB01)



Radio Technology = Bluetooth LE, Operating Frequency = high (S01_7_AA01)

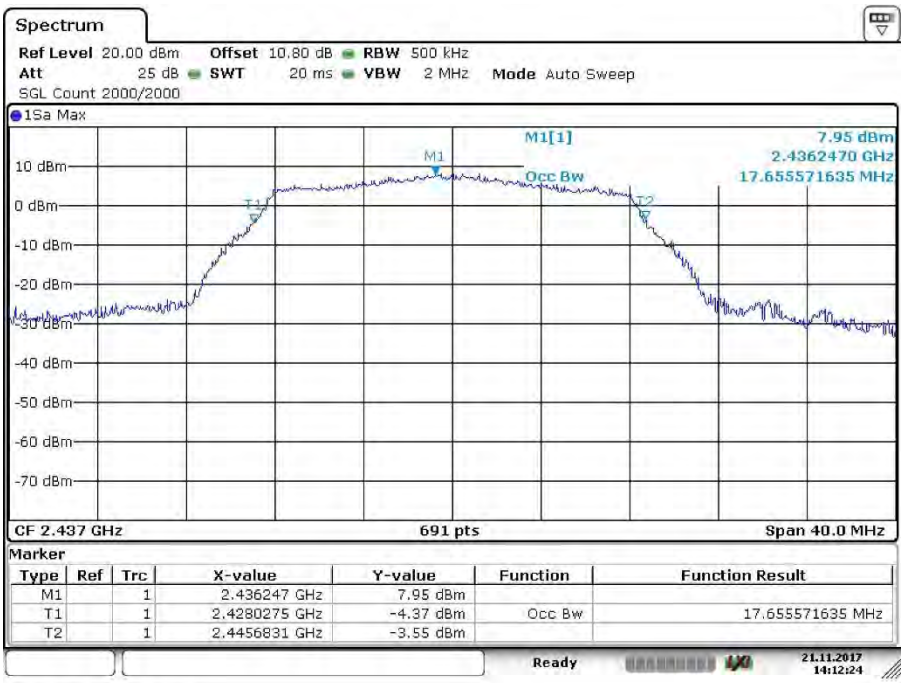


Radio Technology = WLAN b, Operating Frequency = low
(S01_7_AA01)



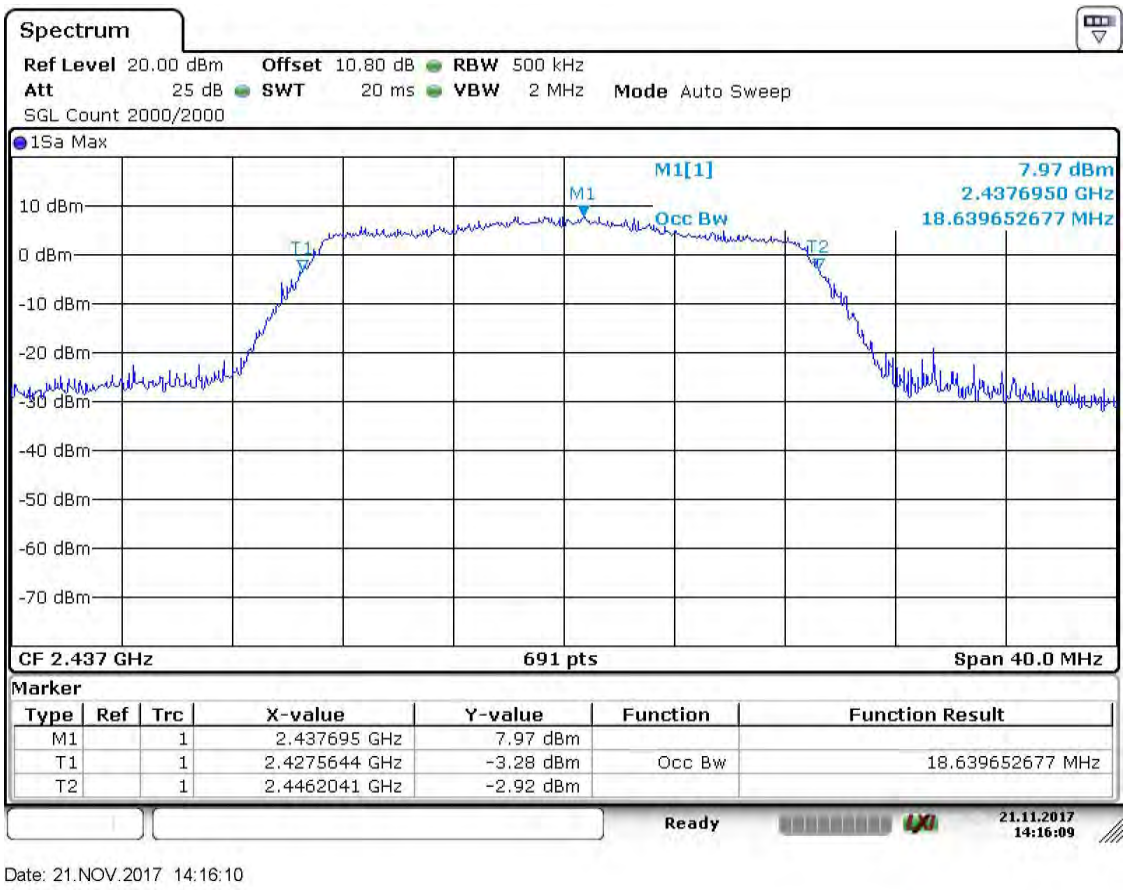
Date: 21.NOV.2017 14:00:31

Radio Technology = WLAN g, Operating Frequency = mid
(S01_7_AA01)



Date: 21.NOV.2017 14:12:24

Radio Technology = WLAN n 20 MHz, Operating Frequency = mid
(S01_7_AA01)



WLAN n Ch. 1

4.3.5 TEST EQUIPMENT USED

- R&S TS8997
- Regulatory Bluetooth RF Test Solution

4.4 PEAK POWER OUTPUT

Standard FCC Part 15 Subpart C

The test was performed according to:
ANSI C63.10

4.4.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up to perform the output power measurements. The results recorded were measured with the modulation which produces the worst-case (highest) output power. The reference level of the spectrum analyzer was set higher than the output power of the EUT.

Peak conducted power:
The EUT was connected to the spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- See analyser plots for BT and BT LE

Conducted power:
The EUT was connected to a power meter via a short coax cable with a known loss.

4.4.2 TEST REQUIREMENTS / LIMITS

DTS devices:
FCC Part 15, Subpart C, §15.247 (b) (3)
For systems using digital modulation techniques in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1 watt.

==> Maximum conducted peak output power: 30 dBm (excluding antenna gain, if antennas with directional gains that do not exceed 6 dBi are used).

Frequency Hopping Systems:
FCC Part 15, Subpart C, §15.247 (b) (1)
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

FCC Part 15, Subpart C, §15.247 (b) (2)
For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.
Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW)

4.4.3 TEST PROTOCOL

Ambient temperature: 25 °C
Air Pressure: 1000 hPa
Humidity: 38 %

BT GFSK (1-DH1)

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	11.5	30.0	18.5	13.5
	19	2440	11.7	30.0	18.3	13.7
	39	2480	11.7	30.0	18.3	13.7

BT π/4 DQPSK (2-DH1)

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	9.6	30.0	20.4	11.6
	19	2440	9.8	30.0	20.2	11.8
	39	2480	9.4	30.0	20.6	11.4

BT 8-DPSK (3-DH1)

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	9.6	30.0	20.4	11.6
	19	2440	9.7	30.0	20.3	11.7
	39	2480	9.4	30.0	20.6	11.4

BT LE

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	7.8	30.0	22.2	9.8
	19	2440	7.9	30.0	22.1	9.9
	39	2480	7.6	30.0	22.4	9.6

WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	RMS Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	1	2412	18.1	30.0	11.9	20.1
	6	2437	16.4	30.0	13.6	18.4
	11	2462	17.9	30.0	12.1	19.9

WLAN g-Mode; 20 MHz; 6 Mbit/s

Band	Channel No.	Frequency [MHz]	RMS Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	1	2412	13.2	30.0	16.8	15.2
	2	2417	15.7	30.0	14.3	17.7
	6	2437	13.8	30.0	16.2	15.8
	10	2457	14.4	30.0	15.6	16.4
	11	2462	13.4	30.0	16.6	15.4

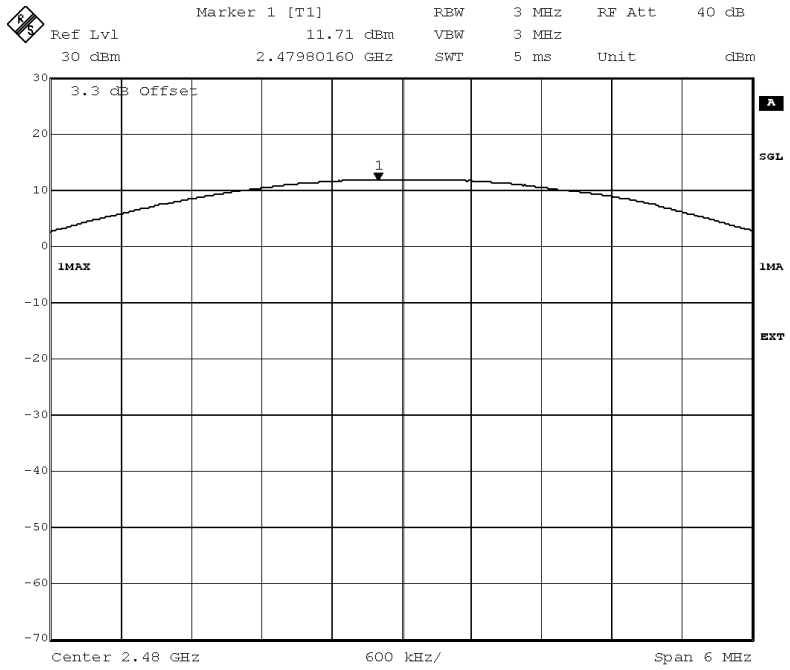
WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0

Band	Channel No.	Frequency [MHz]	RMS Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	1	2412	13.2	30.0	16.8	15.2
	2	2417	15.6	30.0	14.4	17.6
	6	2437	13.7	30.0	16.3	15.7
	10	2457	14.3	30.0	15.7	16.3
	11	2462	13.2	30.0	16.8	15.2

Remark: Please see next sub-clause for the measurement plot.

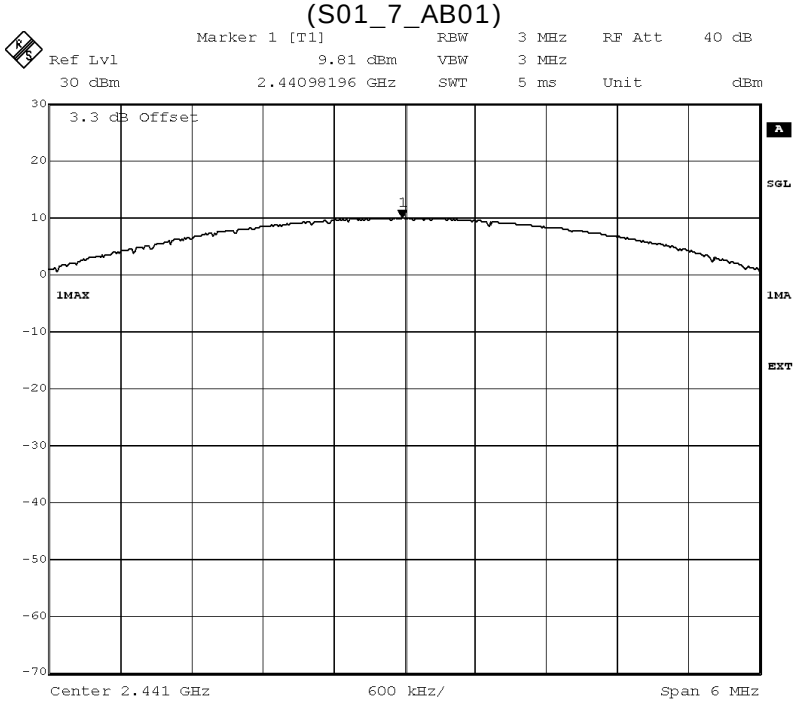
4.4.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

Radio Technology = BT GFSK (1-DH1), Operating Frequency = high (S01_7_AB01)



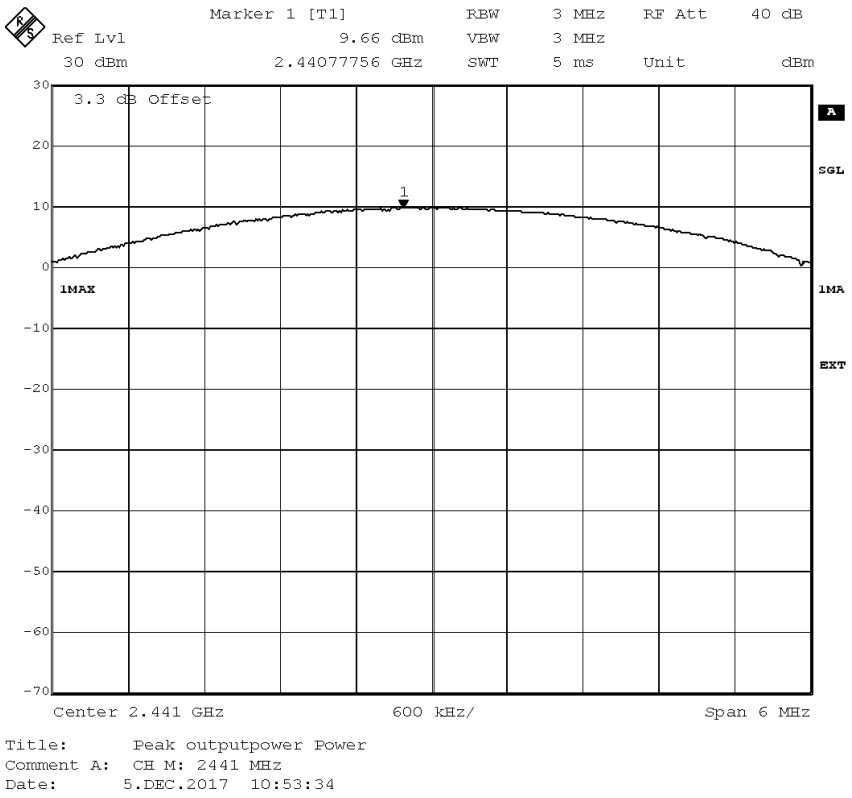
Title: Peak outputpower Power
Comment A: CH T: 2480 MHz
Date: 5.DEC.2017 11:14:12

Radio Technology = BT π/4 DQPSK (2-DH1), Operating Frequency = mid (S01_7_AB01)

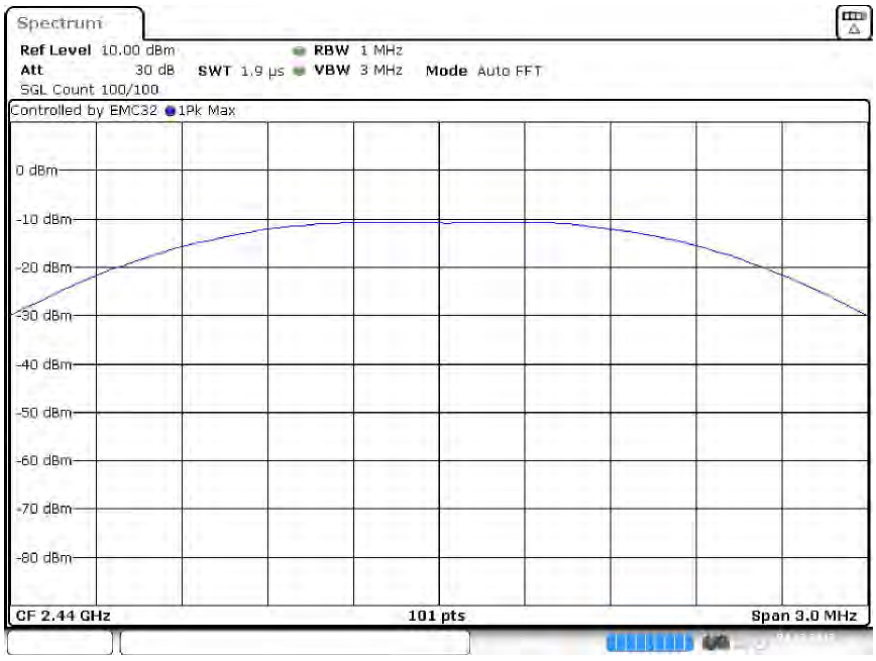


Title: Peak outputpower Power
Comment A: CH M: 2441 MHz
Date: 5.DEC.2017 10:21:08

Radio Technology = BT 8-DPSK (3-DH1), Operating Frequency = mid
(S01_7_AB01)



Radio Technology = Bluetooth LE, Operating Frequency = mid, Measurement method = conducted
(S01_7_AA01)



4.4.5 TEST EQUIPMENT USED

- R&S TS8997
- Regulatory Bluetooth RF Test Solution

4.5 SPURIOUS RF CONDUCTED EMISSIONS AND CONDUCTED EMISSIONS IN RESTRICTED BANDS

Standard FCC Part 15 Subpart C

The test was performed according to:
ANSI C63.10

4.5.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up to perform the spurious emissions measurements. The EUT was connected to spectrum analyzer via a short coax cable with a known loss.

Analyzer settings:

- Frequency range: 9 – 150 kHz
- Resolution Bandwidth (RBW): 300 Hz
- Video Bandwidth (VBW): 1 kHz
- Trace: Maxhold
- Sweeps: 100
- Sweep Time: coupled
- Detector: Peak

- Frequency range: 0.15 – 30 MHz
- Resolution Bandwidth (RBW): 10 kHz
- Video Bandwidth (VBW): 30 kHz
- Trace: Maxhold
- Sweeps: 100
- Sweep Time: coupled
- Detector: Peak

- Frequency range: 30 – 1000 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Trace: Maxhold
- Sweeps: till stable, at least 120
- Sweep Time: coupled
- Detector: Peak

- Frequency range: 1000 – 25000 MHz
- Resolution Bandwidth (RBW): 1000 kHz
- Video Bandwidth (VBW): 3000 kHz
- Trace: Maxhold
- Sweeps: till stable, at least 120
- Sweep Time: coupled
- Detector: Peak

The reference value for the measurement of the spurious RF conducted emissions is determined during the test "band edge compliance conducted". This value is used to calculate the 20 dBc limit.

For automated Final Measurement the following settings were used:

- Center frequency: Peak frequency
- Span: Zero Span
- Resolution Bandwidth (RBW): 1000 kHz
- Video Bandwidth (VBW): 3000 kHz
- Trace: single sweep
- Sweep Time: 1s
- Detector: RMS

For manual final measurement settings see plot.

For the conducted emissions in restricted bands the Value is measured in dBm and then converted to dBµV/m as given in KDB 558074:

1. Measure the conducted output power in dBm.
2. Add the maximum antenna gain in dBi
3. Add the appropriate ground reflection factor
   6 dB for frequencies ≤ 30 MHz;
   4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive; and
   0 dB for frequencies > 1000 MHz).
4. Convert the resultant EIRP level to an equivalent electric field strength level using the following relationship:
   $E = EIRP - 20 \log D + 104.8$
   Where E is the electric field strength in dBµV/m,
   EIRP is the equivalent isotropically radiated power in dBm
   D is the specified measurement distance in m

Value [dBµV/m] = Measured value [dBm] + Maximum Antenna Gain [dBi] + Ground reflection factor − 20 log D + 104.8

4.5.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.247 (c)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

FCC Part 15, Subpart C, §15.247 (d)
... 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)	Limits (dBµV/m)
0.009 – 0.49	2400/F(kHz)@300m	3	(48.5 – 13.8)@300m
0.49 – 1.705	24000/F(kHz)@30m	3	(33.8 – 23.0)@30m
1.705 – 30	30@30m	3	29.5@30m

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (dBµV/m)
30 – 88	100@3m	3	40.0@3m
88 – 216	150@3m	3	43.5@3m
216 – 960	200@3m	3	46.0@3m
960 - 26000	500@3m	3	54.0@3m
26000 - 40000	500@3m	1	54.0@3m

§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: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

4.5.3 TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1012 hPa
Humidity: 41 %

20/30dBc:

BT GFSK (1-DH1)								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level 20 dBc [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	-	-	PEAK	100	11.5	-8.5	>20
39	2441	-	-	PEAK	100	11.6	-8.4	>20
78	2480	-	-	PEAK	100	11.6	-8.4	>20

BT π/4 DQPSK (2-DH1)								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level 20 dBc [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	-	-	PEAK	100	7.5	-12.5	>20
39	2441	-	-	PEAK	100	7.6	-12.4	>20
78	2480	-	-	PEAK	100	7.3	-12.7	>20

BT 8-DPSK (3-DH1)								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level 20 dBc [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	-	-	PEAK	100	7.2	-12.8	>20
39	2441	-	-	PEAK	100	7.2	-12.8	>20
78	2480	-	-	PEAK	100	7.0	-13.0	>20

BT LE GFSK								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level 20 dBc [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	-	-	PEAK	100	7.1	-12.9	>20
19	2440	-	-	PEAK	100	7.3	-12.7	>20
39	2480	-	-	PEAK	100	7.0	-13.0	>20

WLAN b-Mode; 20 MHz; 1 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level 30 dBc [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	-	-	PEAK	100	10.3	-19.7	>10
6	2437	-	-	PEAK	100	8.6	-21.4	>10
11	2462	-	-	PEAK	100	10.5	-19.5	>10

WLAN g-Mode; 20 MHz; 6 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level 30 dBc [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	-	-	PEAK	100	1.6	-28.4	>10
2	2417	-	-	PEAK	100	3.8	-26.2	>10
6	2437	-	-	PEAK	100	1.8	-28.2	>10
10	2457	-	-	PEAK	100	2.6	-27.4	>10
11	2462	-	-	PEAK	100	1.3	-28.7	>10

WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level 30 dBc [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	-	-	PEAK	100	1.7	-28.3	>10
2	2417	-	-	PEAK	100	3.6	-26.4	>10
6	2437	-	-	PEAK	100	1.9	-28.1	>10
10	2457	-	-	PEAK	100	2.9	-27.1	>10
11	2462	-	-	PEAK	100	1.3	-28.7	>10

In Restricted Bands, except for band edge and noise floor values:

BT GFSK (1-DH1)								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
0	2402	2882.8	-51.0	PEAK	1000	46.2	54 [1)]	7.8
0	2402	4804.3	-44.3	PEAK	1000	52.9	54 [1)]	1.1
39	2441	4882.8	-44.9	PEAK	1000	52.3	54 [1)]	1.7
78	2480	6543.2	-45.2	PEAK	1000	52.0	54 [1)]	2.0

BT π/4 DQPSK (2-DH1)								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
0	2402	4804.3	-50.3	PEAK	1000	46.9	54 [1)]	7.1
39	2441	4881.8	-53.3	PEAK	1000	43.9	54 [1)]	10.1
78	2480	4960.3	-54.9	PEAK	1000	42.3	54 [1)]	11.7

BT 8-DPSK (3-DH1)								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
0	2402	4803.8	-51.0	PEAK	1000	46.2	54 [1)]	7.8
39	2441	4882.3	-53.0	PEAK	1000	44.2	54 [1)]	9.8
78	2480	4960.3	-54.4	PEAK	1000	42.8	54 [1)]	11.2

BT LE GFSK								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
0	2402	4803.8	-51.5	PEAK	1000	45.7	54 1)	8.3
19	2440	4880.8	-51.5	PEAK	1000	45.7	54 1)	8.3
39	2480	4960.8	-51.4	PEAK	1000	45.8	54 1)	8.2

WLAN b-Mode; 20 MHz; 1 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
1	2412	4824.3	-36.1	PEAK	1000	61.1	74	12.9
1	2412	4824.3	-46.0	RMS	1000	51.2	54	2.8
6	2437	4874.3	-45.8	PEAK	1000	51.4	54 1)	2.6
11	2462	4924.3	-43.5	PEAK	1000	53.7	54 1)	0.3

WLAN g-Mode; 20 MHz; 6 Mbit/s								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
1	2412	4825.3	-47.4	PEAK	1000	48.9	54 1)	5.1
2	2417	4829.3	-45.4	PEAK	1000	51.8	54 1)	2.2
6	2437	4869.8	-46.7	PEAK	1000	50.5	54 1)	3.5
10	2457	4913.3	-45.6	PEAK	1000	51.6	54 1)	2.4
11	2462	4926.8	-47.3	PEAK	1000	49.9	54 1)	4.1

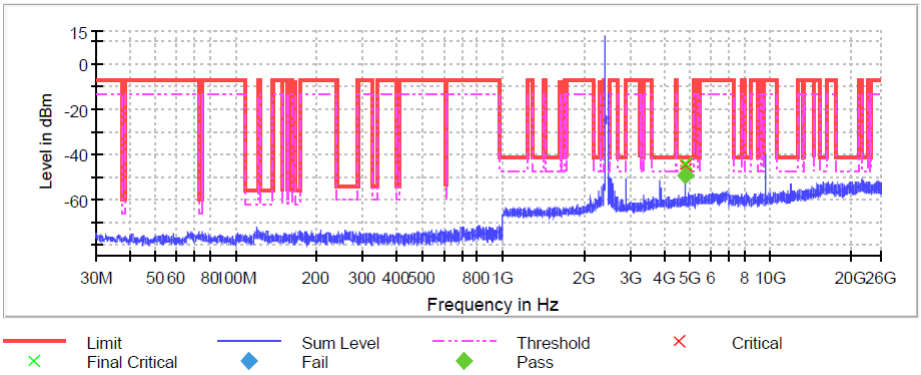
WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0								
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
1	2412	4815.3	-48.6	PEAK	1000	48.6	54 1)	5.4
2	2417	4837.8	-45.5	PEAK	1000	51.7	54 1)	2.3
6	2437	4877.8	-46.7	PEAK	1000	50.5	54 1)	3.5
10	2457	4911.8	-46.6	PEAK	1000	50.6	54 1)	3.4
11	2462	4924.8	-47.9	PEAK	1000	49.3	54 1)	4.7

1) Peak value below Average limit -> no average measurement performed / given.

Remark: Range 9 kHz – 30 MHz tested for BT BDR and WLAN b mode only.
Please see next sub-clause for the measurement plots.

4.5.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

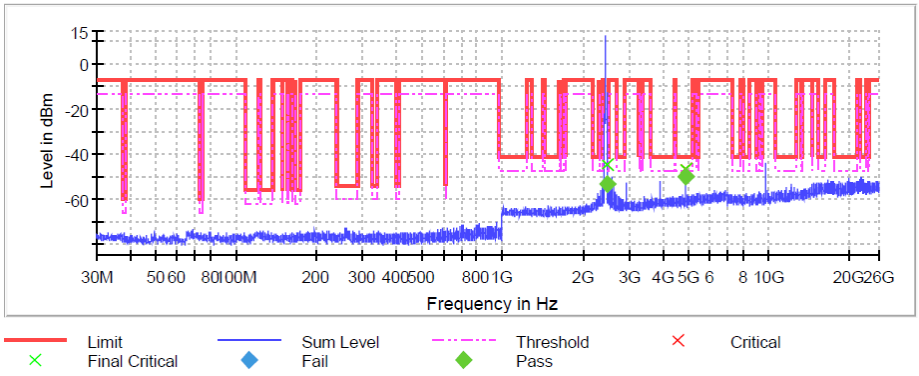
Radio Technology = BT GFSK (1-DH1), Operating Frequency = low
(S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
4804.250000	-44.3	3.1	-41.2
4804.750000	-44.5	3.3	-41.2
4803.750000	-44.5	3.3	-41.2
4805.250000	-47.0	5.8	-41.2
4803.250000	-47.4	6.2	-41.2
2487.750000	-49.1	7.9	-41.2
2488.250000	-50.1	8.9	-41.2
2489.250000	-50.3	9.1	-41.2
22108.750000	-51.0	9.8	-41.2
2882.750000	-51.0	9.8	-41.2
3843.750000	-51.2	10.0	-41.2
3843.250000	-51.2	10.0	-41.2
22086.250000	-51.2	10.0	-41.2
2882.250000	-51.5	10.3	-41.2
22155.250000	-51.6	10.4	-41.2

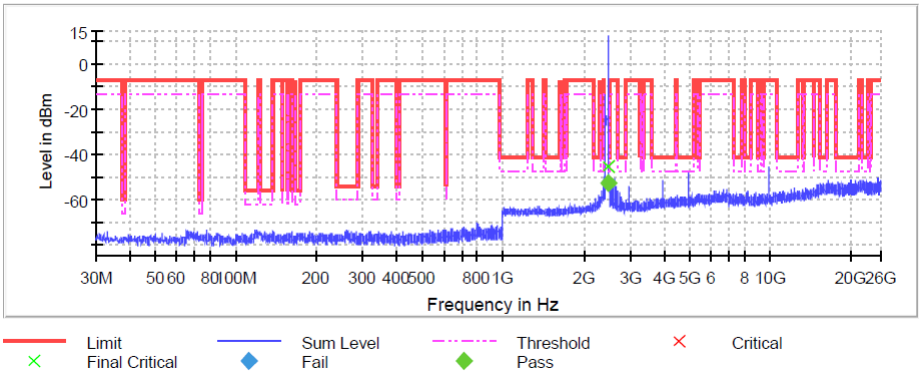
Radio Technology = BT GFSK (1-DH1), Operating Frequency = mid
(S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2485.750000	-44.5	3.3	-41.2
4882.250000	-46.5	5.3	-41.2
4881.750000	-46.6	5.4	-41.2
4882.750000	-46.8	5.6	-41.2
2487.250000	-48.4	7.2	-41.2
4881.250000	-48.8	7.6	-41.2
4883.250000	-48.8	7.6	-41.2
2488.750000	-49.5	8.3	-41.2
19854.250000	-50.9	9.7	-41.2
22188.250000	-51.0	9.8	-41.2
22755.750000	-51.1	9.9	-41.2
22522.250000	-51.4	10.2	-41.2
2489.250000	-51.4	10.2	-41.2
22271.250000	-51.8	10.6	-41.2
18516.750000	-51.8	10.6	-41.2

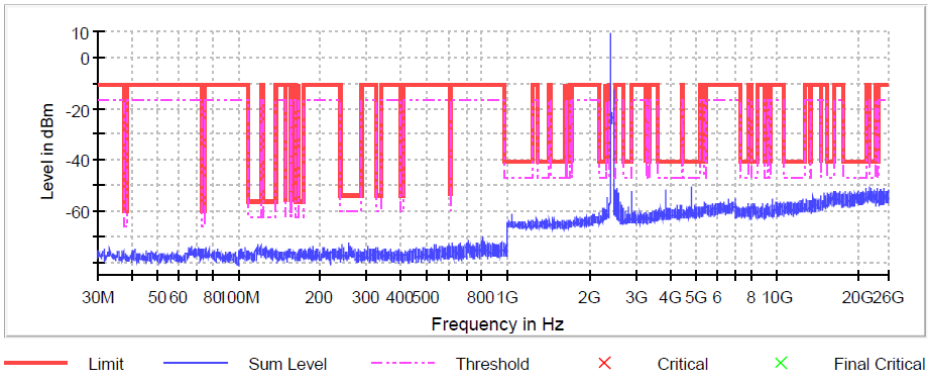
Radio Technology = BT GFSK (1-DH1), Operating Frequency = high
(S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2488.750000	-45.7	4.5	-41.2
2486.750000	-47.4	6.2	-41.2
2484.250000	-48.0	6.8	-41.2
2483.750000	-48.1	6.9	-41.2
2485.250000	-48.1	6.9	-41.2
4960.250000	-48.4	7.2	-41.2
4960.750000	-48.6	7.4	-41.2
4959.750000	-48.8	7.6	-41.2
2489.750000	-48.9	7.7	-41.2
2484.750000	-49.8	8.6	-41.2
4961.250000	-50.8	9.6	-41.2
4959.250000	-51.0	9.8	-41.2
22192.250000	-51.4	10.2	-41.2
22040.250000	-51.6	10.4	-41.2
20085.750000	-51.7	10.5	-41.2

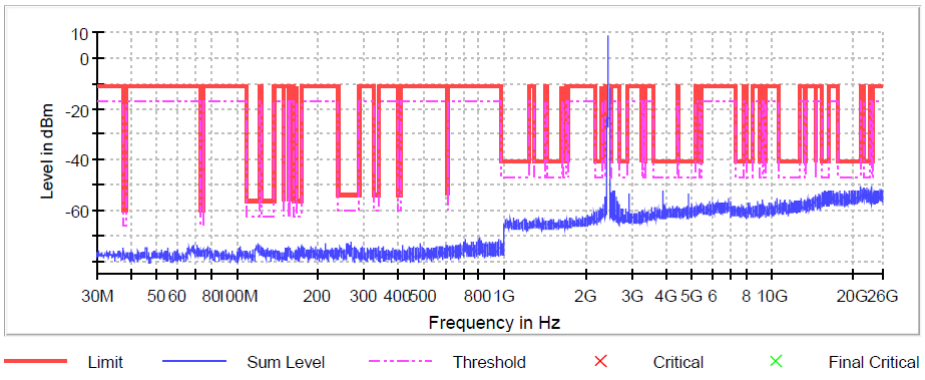
Radio Technology = BT π/4 DQPSK (2-DH1), Operating Frequency = low (S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
4804.750000	-50.3	9.1	-41.2
4804.250000	-50.7	9.5	-41.2
22225.250000	-50.9	9.7	-41.2
23604.750000	-51.1	9.9	-41.2
21395.250000	-51.2	10.0	-41.2
21394.750000	-51.2	10.0	-41.2
22017.250000	-51.4	10.2	-41.2
3843.250000	-51.5	10.3	-41.2
3843.750000	-51.5	10.3	-41.2
22194.750000	-51.6	10.4	-41.2
22221.750000	-51.6	10.4	-41.2
22210.250000	-51.7	10.5	-41.2
22089.750000	-51.8	10.6	-41.2
22238.250000	-51.9	10.7	-41.2
22261.750000	-51.9	10.7	-41.2

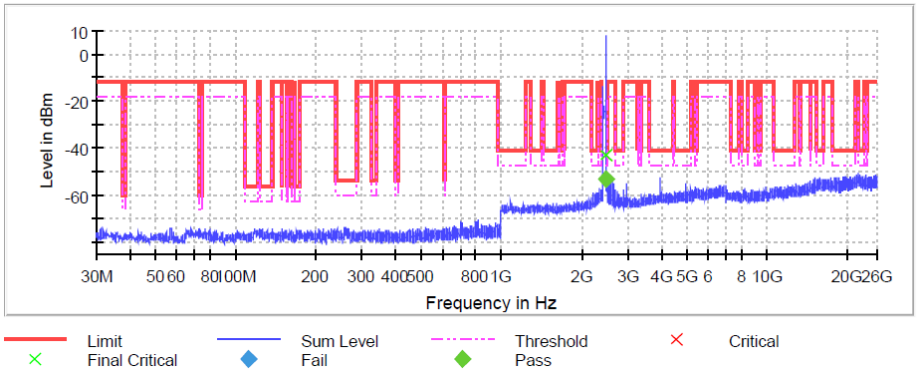
Radio Technology = BT π/4 DQPSK (2-DH1), Operating Frequency = mid (S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2484.750000	-49.9	8.7	-41.2
21395.250000	-50.8	9.6	-41.2
22029.750000	-51.2	10.0	-41.2
22149.250000	-51.3	10.1	-41.2
22756.750000	-51.4	10.2	-41.2
22204.750000	-51.8	10.6	-41.2
22917.250000	-51.8	10.6	-41.2
22294.750000	-51.8	10.6	-41.2
22295.250000	-51.8	10.6	-41.2
22936.250000	-51.8	10.6	-41.2
22105.750000	-51.9	10.7	-41.2
22031.250000	-51.9	10.7	-41.2
21351.250000	-52.0	10.8	-41.2
22199.250000	-52.0	10.8	-41.2
22274.750000	-52.0	10.8	-41.2

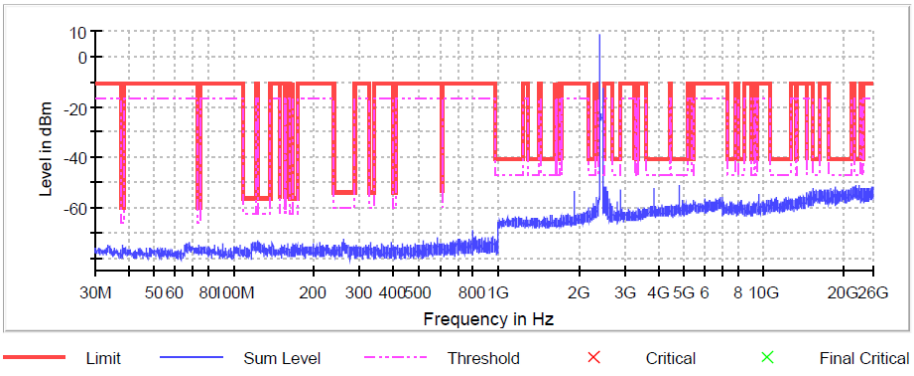
Radio Technology = BT π/4 DQPSK (2-DH1), Operating Frequency = high (S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2484.750000	-42.8	1.6	-41.2
2483.750000	-49.1	7.9	-41.2
22139.750000	-50.4	9.2	-41.2
22353.250000	-51.1	9.9	-41.2
22353.750000	-51.2	10.0	-41.2
22214.250000	-51.3	10.1	-41.2
23606.250000	-51.4	10.2	-41.2
22032.250000	-51.5	10.3	-41.2
2485.250000	-51.5	10.3	-41.2
22065.250000	-51.7	10.5	-41.2
2484.250000	-51.8	10.6	-41.2
23605.750000	-51.9	10.7	-41.2
22012.250000	-51.9	10.7	-41.2
19839.250000	-52.0	10.8	-41.2
21318.250000	-52.0	10.8	-41.2

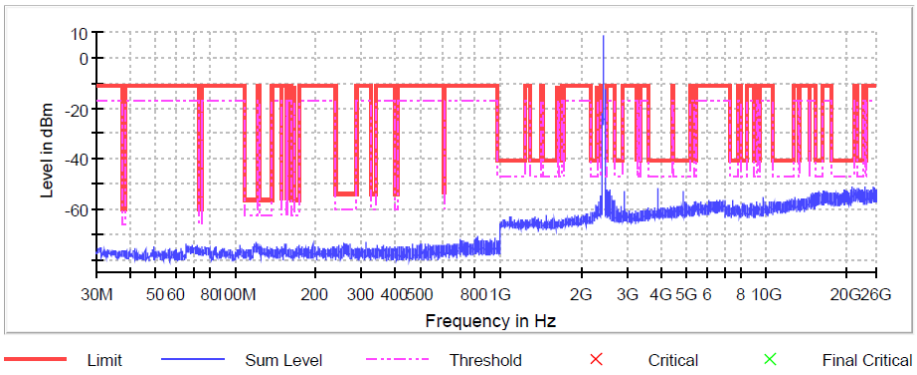
Radio Technology = BT 8-DPSK (3-DH1), Operating Frequency = low
(S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
4803.750000	-51.0	9.8	-41.2
22209.750000	-51.2	10.0	-41.2
22192.250000	-51.2	10.0	-41.2
23104.250000	-51.3	10.1	-41.2
22856.250000	-51.5	10.3	-41.2
22167.750000	-51.6	10.4	-41.2
4804.250000	-51.6	10.4	-41.2
22126.750000	-51.7	10.5	-41.2
22362.750000	-51.8	10.6	-41.2
18584.750000	-51.8	10.6	-41.2
22213.250000	-51.8	10.6	-41.2
22062.250000	-51.9	10.7	-41.2
22919.250000	-51.9	10.7	-41.2
22285.750000	-52.0	10.8	-41.2
22010.250000	-52.0	10.8	-41.2

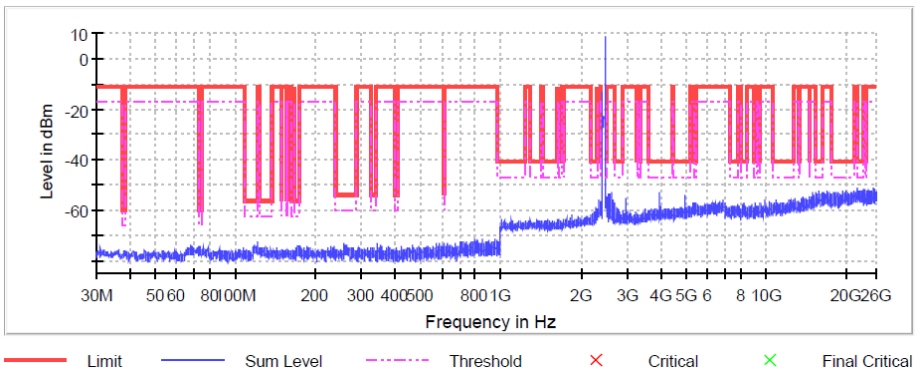
Radio Technology = BT 8-DPSK (3-DH1), Operating Frequency = mid
(S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
21059.250000	-51.4	10.2	-41.2
21390.750000	-51.6	10.4	-41.2
21388.250000	-51.7	10.5	-41.2
22425.250000	-51.8	10.6	-41.2
3905.750000	-51.8	10.6	-41.2
22078.750000	-51.9	10.7	-41.2
3906.250000	-52.0	10.8	-41.2
22097.750000	-52.0	10.8	-41.2
19768.750000	-52.1	10.9	-41.2
22066.750000	-52.2	11.0	-41.2
22064.750000	-52.2	11.0	-41.2
22091.750000	-52.2	11.0	-41.2
22519.250000	-52.2	11.0	-41.2
20897.750000	-52.3	11.1	-41.2
20898.250000	-52.3	11.1	-41.2

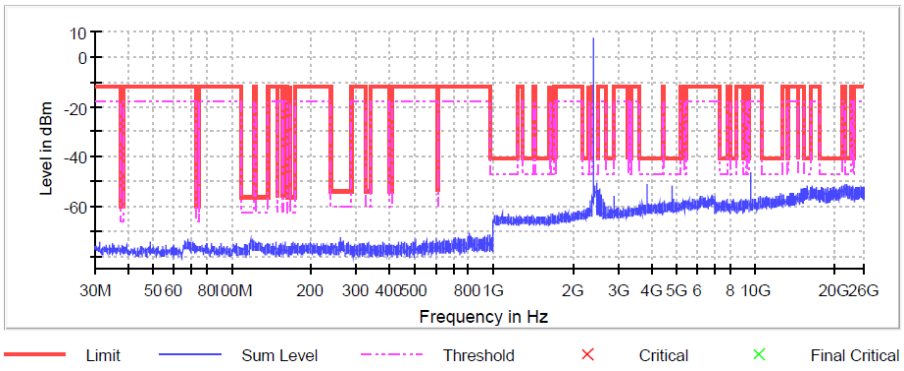
Radio Technology = BT 8-DPSK (3-DH1), Operating Frequency = high
(S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2483.750000	-50.1	8.9	-41.2
2484.250000	-51.1	9.9	-41.2
22115.750000	-51.2	10.0	-41.2
2484.750000	-51.8	10.6	-41.2
22026.750000	-51.8	10.6	-41.2
23617.250000	-52.0	10.8	-41.2
21390.750000	-52.1	10.9	-41.2
22040.250000	-52.1	10.9	-41.2
15849.750000	-52.2	11.0	-41.2
19952.750000	-52.2	11.0	-41.2
22545.750000	-52.2	11.0	-41.2
15849.250000	-52.2	11.0	-41.2
22032.250000	-52.2	11.0	-41.2
22131.250000	-52.2	11.0	-41.2
22052.750000	-52.3	11.1	-41.2

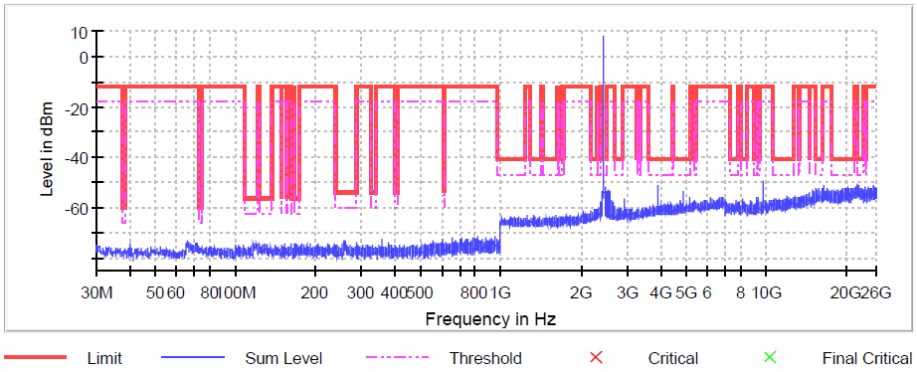
Radio Technology = Bluetooth LE, Operating Frequency = low
(S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
22298.250000	-51.0	9.8	-41.2
3843.250000	-51.0	9.8	-41.2
3843.750000	-51.1	9.9	-41.2
3842.750000	-51.3	10.1	-41.2
22330.250000	-51.3	10.1	-41.2
22330.750000	-51.3	10.1	-41.2
22233.750000	-51.5	10.3	-41.2
22401.250000	-51.6	10.4	-41.2
15837.750000	-51.6	10.4	-41.2
22265.250000	-51.7	10.5	-41.2
23609.750000	-51.7	10.5	-41.2
22227.750000	-51.8	10.6	-41.2
22122.750000	-51.9	10.7	-41.2
22621.250000	-51.9	10.7	-41.2
22112.250000	-52.0	10.8	-41.2

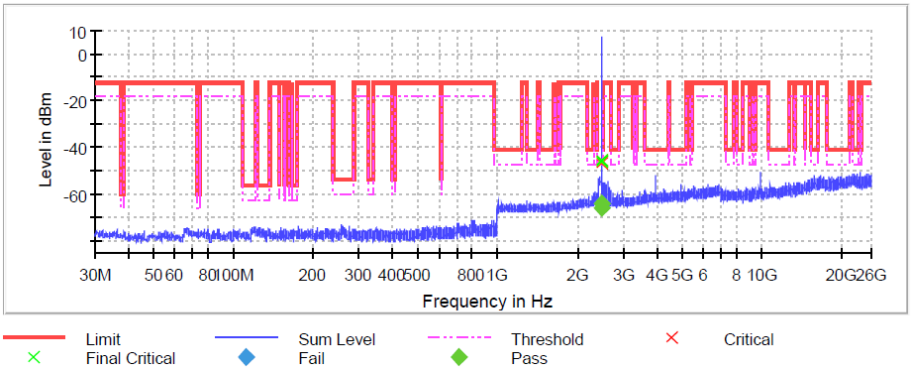
Radio Technology = Bluetooth LE, Operating Frequency = mid
(S01_7_AA01)



Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
22058.250000	-50.7	9.5	-41.2
22146.750000	-51.3	10.1	-41.2
3904.250000	-51.3	10.1	-41.2
22451.750000	-51.5	10.3	-41.2
3904.750000	-51.6	10.4	-41.2
22111.250000	-51.7	10.5	-41.2
22170.250000	-51.7	10.5	-41.2
22018.750000	-52.0	10.8	-41.2
3905.250000	-52.0	10.8	-41.2
22909.250000	-52.1	10.9	-41.2
22514.250000	-52.1	10.9	-41.2
22494.750000	-52.1	10.9	-41.2
22254.750000	-52.1	10.9	-41.2
22197.250000	-52.1	10.9	-41.2
22074.250000	-52.1	10.9	-41.2

Radio Technology = Bluetooth LE, Operating Frequency = high
(S01_7_AA01)

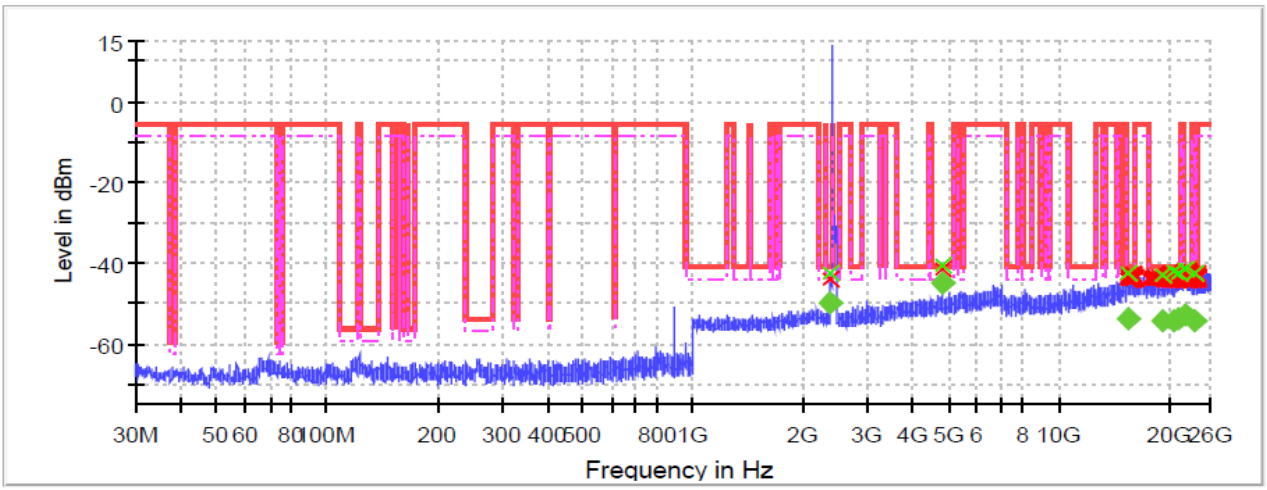


Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2486.750000	-45.7	4.5	-41.2
2485.250000	-46.4	5.2	-41.2
2484.750000	-47.0	5.8	-41.2
2487.750000	-48.8	7.6	-41.2
2488.250000	-49.3	8.1	-41.2
2484.250000	-51.1	9.9	-41.2
22055.750000	-51.1	9.9	-41.2
22110.750000	-51.2	10.0	-41.2
22906.750000	-51.4	10.2	-41.2
2483.750000	-51.5	10.3	-41.2
22463.250000	-51.5	10.3	-41.2
22068.750000	-51.5	10.3	-41.2
22195.750000	-51.8	10.6	-41.2
21336.250000	-51.8	10.6	-41.2
22090.250000	-51.8	10.6	-41.2

Radio Technology = WLAN b-Mode, Operating Frequency = low
(S01_7_AA01)

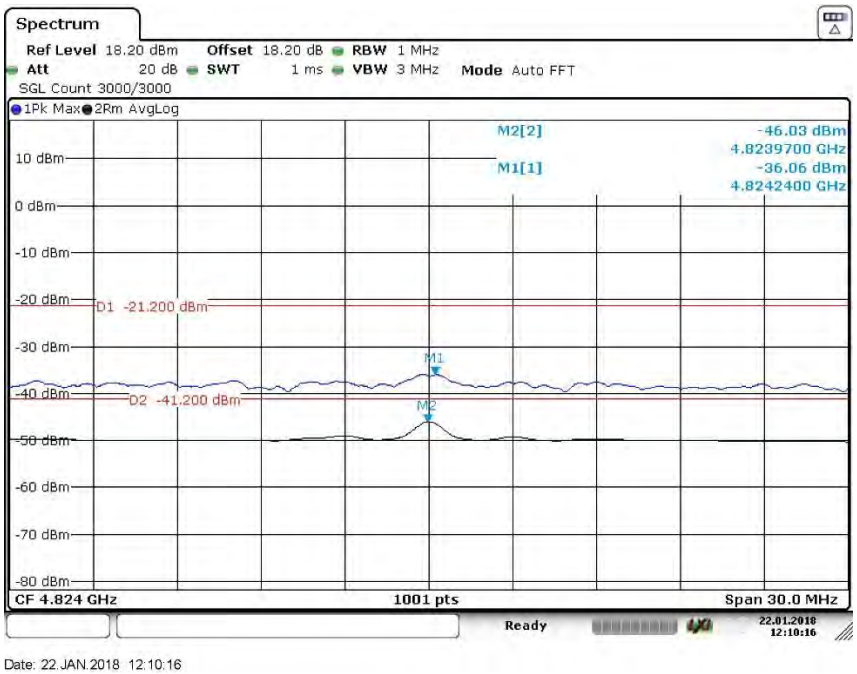
Pre Measurement incl. final of noise floor:



Final measurements

Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15449.75	-42.3	-53.8	-41.2	12.6
19322.25	-43	-54.4	-41.2	13.2
20496.25	-42.2	-54.4	-41.2	13.2
21246.75	-42.4	-54	-41.2	12.8
22147.25	-41.4	-52.9	-41.2	11.7
23670.25	-42.4	-54.2	-41.2	13

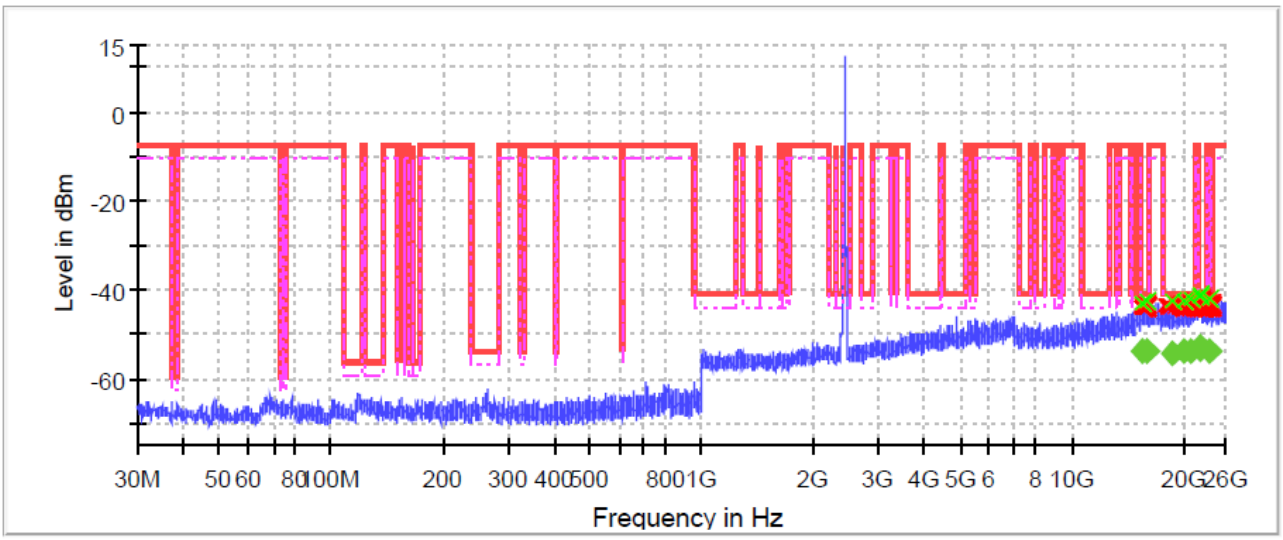
Final Measurement harmonic:



Date: 22.JAN.2018 12:10:16

Radio Technology = WLAN b-Mode, Operating Frequency = mid
(S01_7_AA01)

Pre Measurement incl. final of noise floor:



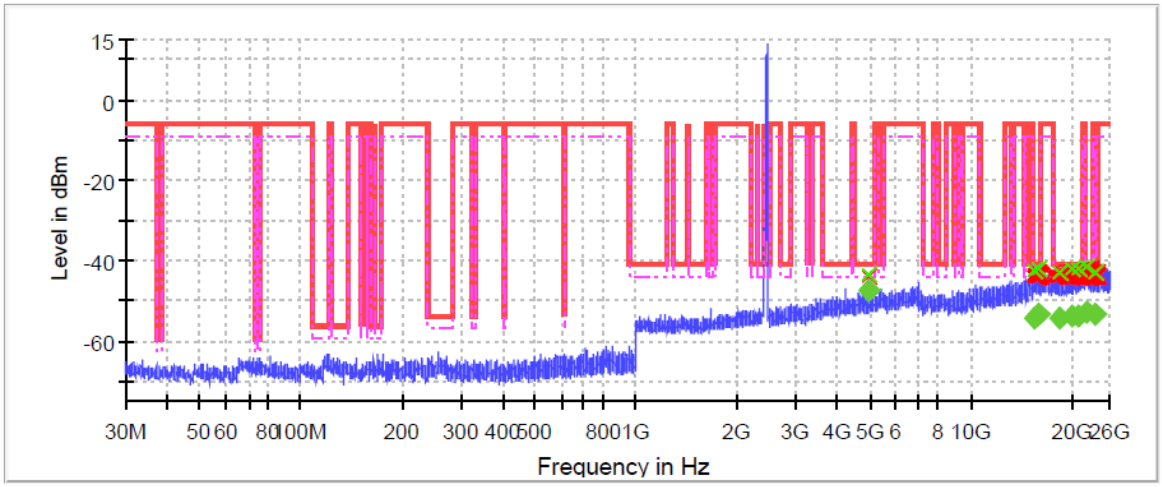
Limit Sum Level Threshold Critical
Final Critical Fail Pass

Final measurements

Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15563.250000	-43.2	-54.0	-41.2	12.8
15830.750000	-42.4	-53.6	-41.2	12.4
18560.250000	-42.5	-54.4	-41.2	13.2
20083.250000	-42.7	-53.9	-41.2	12.7
21088.750000	-42.1	-54.0	-41.2	12.8
22095.250000	-41.7	-53.1	-41.2	11.9
22134.250000	-41.2	-52.9	-41.2	11.7
23611.250000	-42.1	-53.7	-41.2	12.5

Radio Technology = WLAN b-Mode, Operating Frequency = high
(S01_7_AA01)

Pre Measurement incl. final of noise floor:



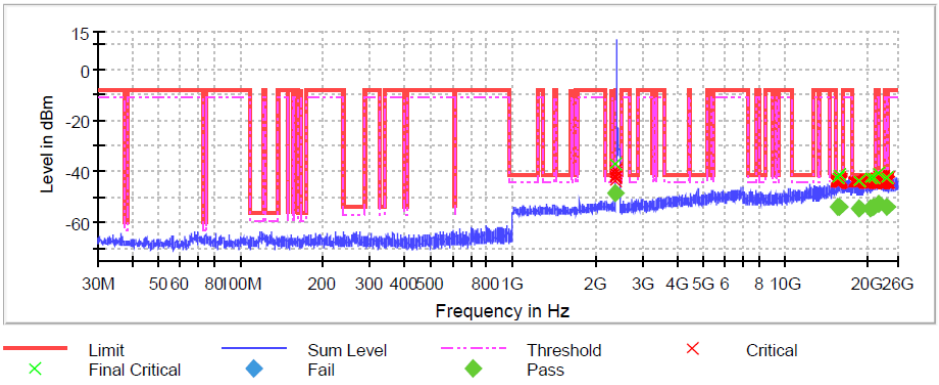
Final measurements

Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15397.25	-42.5	-54.5	-41.2	13.3
15858.25	-41.8	-53.3	-41.2	12.1
18524.75	-42.9	-54.5	-41.2	13.3
20169.75	-42	-54.1	-41.2	12.9
20922.25	-42.1	-53.7	-41.2	12.5
22206.25	-41.6	-52.8	-41.2	11.6
23605.25	-42.8	-53.5	-41.2	12.3

Final Measurement harmonic:

Radio Technology = WLAN g-Mode, Operating Frequency = low
(S01_7_AA01)

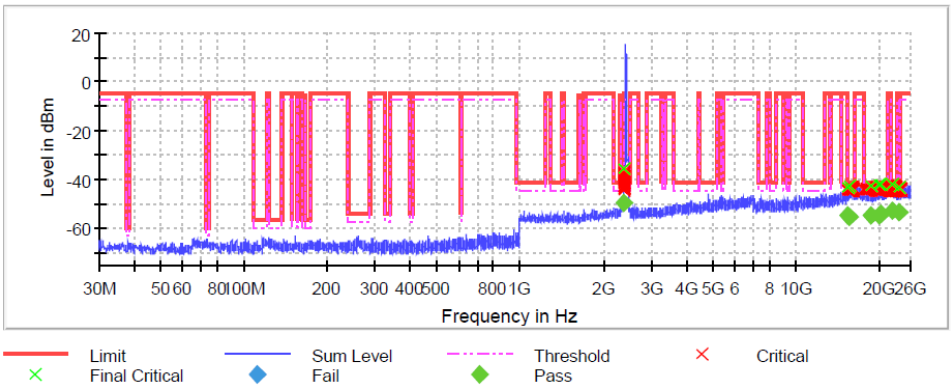
Pre Measurement incl. final of noise floor Ch. 1:



Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15451.25	-43.2	-53.9	-41.2	12.7
15767.25	-42.3	-54.4	-41.2	13.2
18161.75	-43.3	-54.8	-41.2	13.6
19277.75	-43.1	-54.9	-41.2	13.7
19819.75	-42.9	-53.7	-41.2	12.5
21346.75	-41.9	-53.6	-41.2	12.4
22271.75	-41.1	-52.7	-41.2	11.5
23612.25	-43.1	-53.7	-41.2	12.5

Pre Measurement incl. final of noise floor Ch. 2:

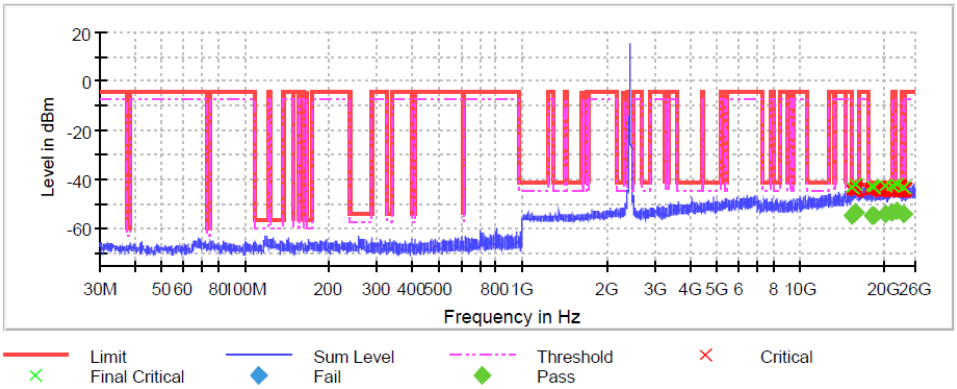


Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15395.75	-43.1	-54.5	-41.2	13.3
15638.25	-42.8	-55	-41.2	13.8
18588.75	-42.5	-54.7	-41.2	13.5
19944.75	-41.9	-54.5	-41.2	13.3
20187.25	-41.8	-54	-41.2	12.8
22265.25	-41.7	-52.8	-41.2	11.6
23607.25	-43.3	-53.2	-41.2	12

Radio Technology = WLAN g-Mode, Operating Frequency = mid
(S01_7_AA01)

Pre Measurement incl. final of noise floor Ch. 6:

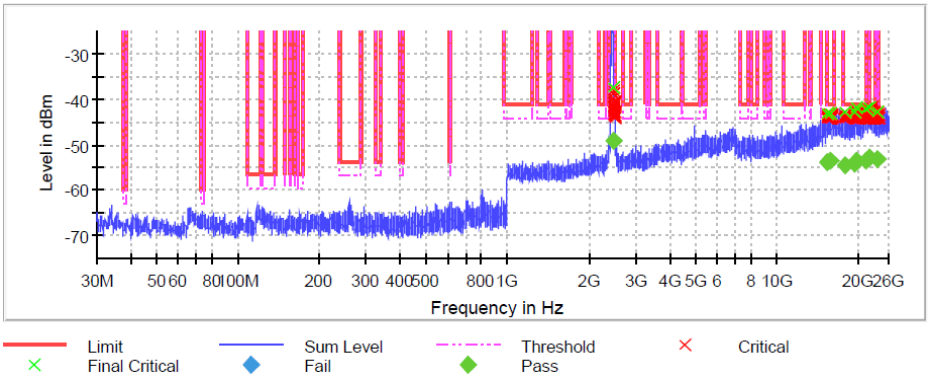


Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15407.25	-42.9	-54.3	-41.2	13.1
15838.75	-41.7	-53.5	-41.2	12.3
18164.75	-42.6	-54.9	-41.2	13.7
18463.25	-42.8	-54.9	-41.2	13.7
20192.25	-42.5	-54	-41.2	12.8
21394.75	-42.3	-53.4	-41.2	12.2
22261.75	-41.6	-52.6	-41.2	11.4
23653.25	-43.1	-54.1	-41.2	12.9

Radio Technology = WLAN g-Mode, Operating Frequency = high
(S01_7_AA01)

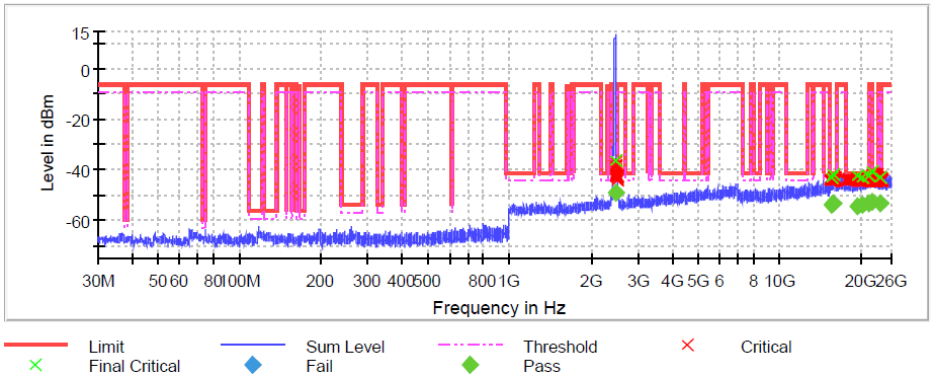
Pre Measurement incl. final of noise floor Ch. 10:



Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15441.25	-43.2	-53.9	-41.2	12.7
15879.25	-43	-53.7	-41.2	12.5
18018.25	-42.7	-54.4	-41.2	13.2
19334.75	-42.7	-54.3	-41.2	13.1
19841.25	-41.7	-53.5	-41.2	12.3
21397.25	-42.3	-53.4	-41.2	12.2
22144.75	-41.9	-52.9	-41.2	11.7
23605.75	-42.8	-53.1	-41.2	11.9

Pre Measurement incl. final of noise floor Ch. 11:

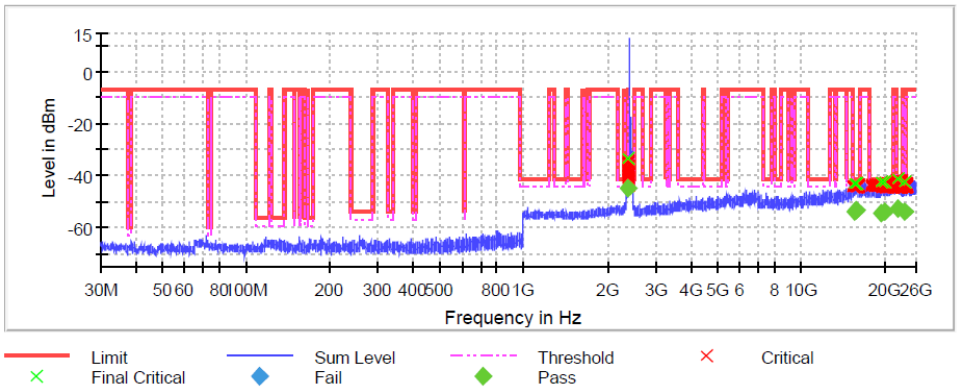


Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15567.75	-43	-54.1	-41.2	12.9
15871.75	-42	-53.5	-41.2	12.3
19345.75	-42.6	-54.4	-41.2	13.2
20147.25	-42.9	-54.1	-41.2	12.9
21393.25	-42.3	-53.4	-41.2	12.2
22146.75	-40.8	-52.8	-41.2	11.6
23608.75	-42.8	-53.2	-41.2	12

Radio Technology = WLAN n-Mode, Operating Frequency = low
(S01_7_AA01)

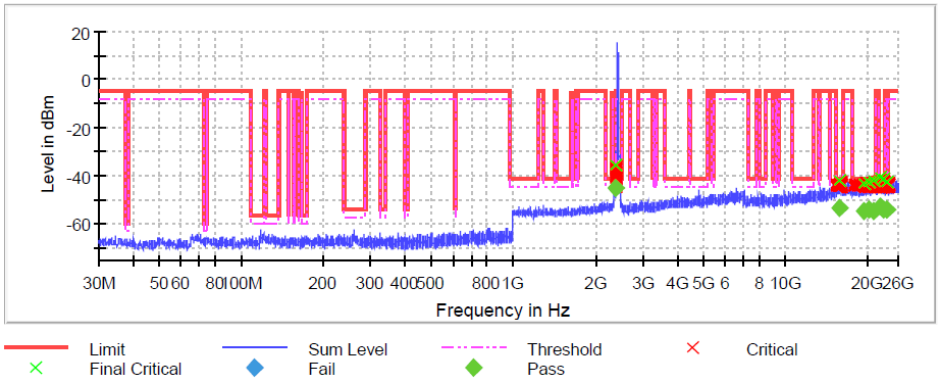
Pre Measurement incl. final of noise floor Ch. 1:



Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15551.75	-43	-54	-41.2	12.8
15857.25	-42.7	-53.3	-41.2	12.1
19345.25	-42.5	-54.3	-41.2	13.1
20128.75	-42.4	-54.1	-41.2	12.9
22207.75	-40.9	-52.8	-41.2	11.6
23638.75	-42.7	-53.9	-41.2	12.7

Pre Measurement incl. final of noise floor Ch. 2:

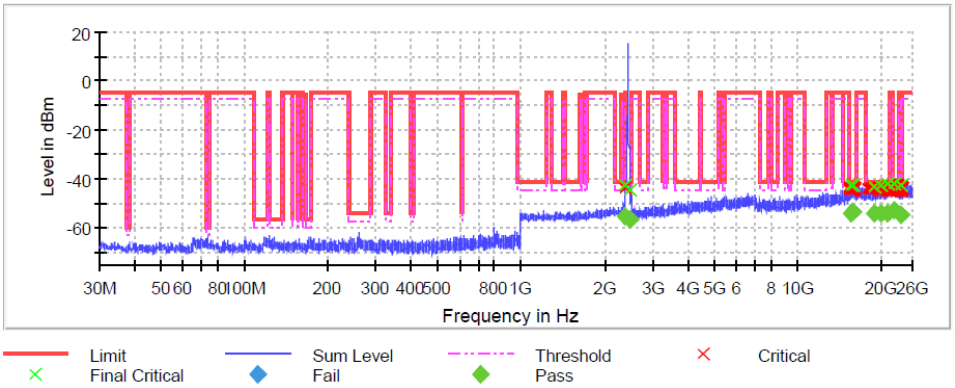


Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15875.25	-42.1	-53.6	-41.2	12.4
19401.75	-43	-54.9	-41.2	13.7
20241.25	-42.3	-54.2	-41.2	13
21003.75	-42	-54.4	-41.2	13.2
22282.75	-40.5	-52.9	-41.2	11.7
22961.75	-41.3	-53.9	-41.2	12.7
23646.25	-42.3	-54	-41.2	12.8

Radio Technology = WLAN n-Mode, Operating Frequency = mid
(S01_7_AA01)

Pre Measurement incl. final of noise floor Ch. 6:

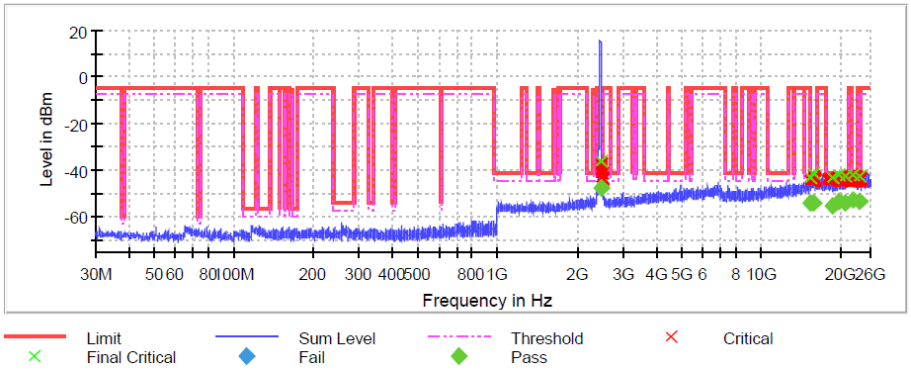


Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15563.75	-42.6	-54.1	-41.2	12.9
15865.75	-42.4	-53.4	-41.2	12.2
19015.75	-43.1	-53.9	-41.2	12.7
19893.75	-42.5	-53.9	-41.2	12.7
21033.75	-41.6	-54	-41.2	12.8
22215.25	-41.6	-52.8	-41.2	11.6
23681.25	-42.4	-54.4	-41.2	13.2

Radio Technology = WLAN n-Mode, Operating Frequency = high
(S01_7_AA01)

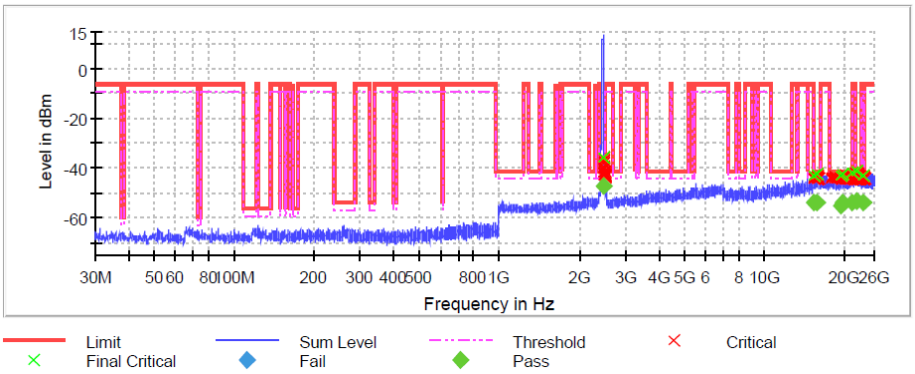
Pre Measurement incl. final of noise floor Ch. 10:



Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15434.75	-43	-53.9	-41.2	12.7
15824.75	-41.3	-53.7	-41.2	12.5
18604.75	-43.2	-55	-41.2	13.8
19842.75	-42.1	-53.5	-41.2	12.3
20878.25	-42.2	-54.1	-41.2	12.9
22215.25	-41.9	-52.8	-41.2	11.6
23601.75	-42.2	-53.2	-41.2	12

Pre Measurement incl. final of noise floor Ch. 11:



Final measurements

Frequency (MHz)	Level Pre (dBm)	level (dBm)	Limit (dBm)	Margin (dB)
15457.25	-43.2	-53.9	-41.2	12.7
15877.75	-42.6	-53.6	-41.2	12.4
19402.25	-43	-54.8	-41.2	13.6
19816.25	-42.3	-53.8	-41.2	12.6
21330.25	-41.9	-53.6	-41.2	12.4
22320.25	-41	-53.1	-41.2	11.9
23638.75	-42.9	-53.9	-41.2	12.7

4.5.5 TEST EQUIPMENT USED

- R&S TS8997

4.6 TRANSMITTER SPURIOUS RADIATED EMISSIONS

Standard FCC Part 15 Subpart C

The test was performed according to:
ANSI C63.10

4.6.1 TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30−1000 MHz was evaluated.
The measurement procedure is implemented into the EMI test software EMC32 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 also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

1. Measurement up to 30 MHz
The Loop antenna HFH2-Z2 is used.

Step 1: pre measurement
- Anechoic chamber
- Antenna distance: 3 m
- Detector: Peak-Maxhold
- Frequency range: 0.009 - 0.15 MHz and 0.15 − 30 MHz
- Frequency steps: 0.05 kHz and 2.25 kHz
- IF−Bandwidth: 0.2 kHz and 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)

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: 0.2 - 10 kHz
- Measuring time / Frequency step: 1 s

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)

- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: –180° to 90°
- 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: Adjustment 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 slowly vary by ± 45° 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 will also slowly vary by ± 100 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: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

Step 3: 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:

Step 1:

The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.

All steps were performed with one height (1.5 m) of the receiving antenna only.

The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.

The turn table step size (azimuth angle) for the preliminary measurement is 45 °.

Step 2:

Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.
The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°
EMI receiver settings (for all steps):
- Detector: Peak, Average
- IF Bandwidth = 1 MHz
Step 3:
Spectrum analyser settings for step 3:
- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF − Bandwidth: 1 MHz
- Measuring time: 1 s

4.6.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.247 (d)
... 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)	Limits (dBµV/m)
0.009 − 0.49	2400/F(kHz)@300m	3	(48.5 − 13.8)@300m
0.49 − 1.705	24000/F(kHz)@30m	3	(33.8 − 23.0)@30m
1.705 − 30	30@30m	3	29.5@30m

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (2).

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (dBµV/m)
30 − 88	100@3m	3	40.0@3m
88 − 216	150@3m	3	43.5@3m
216 − 960	200@3m	3	46.0@3m
960 - 26000	500@3m	3	54.0@3m
26000 - 40000	500@3m	1	54.0@3m

The measured values above 26 GHz are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§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: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

4.6.3 TEST PROTOCOL

Ambient temperature: 22 °C
Air Pressure: 1012 hPa
Humidity: 37 %

BT GFSK (1-DH1)								
Applied duty cycle correction (AV): 0 dB								
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
0	2402	- - -	- - -	- - -	- - -	- - -	- - -	RB
39	2441	- - -	- - -	- - -	- - -	- - -	- - -	RB
78	2480	- - -	- - -	- - -	- - -	- - -	- - -	RB

BT π/4 DQPSK (2-DH1)								
Applied duty cycle correction (AV): 0 dB								
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
0	2402	- - -	- - -	- - -	- - -	- - -	- - -	RB
39	2441	- - -	- - -	- - -	- - -	- - -	- - -	RB
78	2480	- - -	- - -	- - -	- - -	- - -	- - -	RB

BT 8-DPSK (3-DH1)								
Applied duty cycle correction (AV): 0 dB								
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
0	2402	- - -	- - -	- - -	- - -	- - -	- - -	RB
39	2441	- - -	- - -	- - -	- - -	- - -	- - -	RB
78	2480	- - -	- - -	- - -	- - -	- - -	- - -	RB

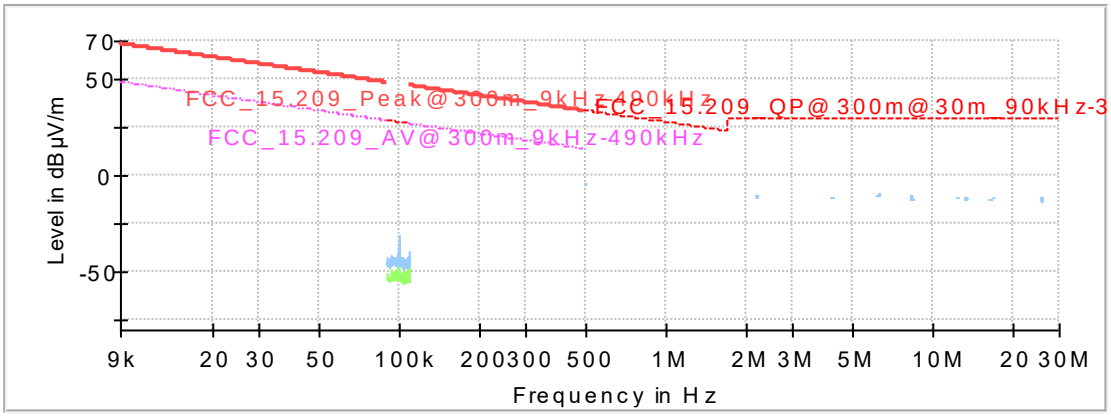
WLAN b-Mode; 20 MHz; 1 Mbit/s								
Applied duty cycle correction (AV): 0 dB								
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
1	2412	- - -	- - -	- - -	- - -	- - -	- - -	RB
6	2437	- - -	- - -	- - -	- - -	- - -	- - -	RB
11	2462	- - -	- - -	- - -	- - -	- - -	- - -	RB

WLAN g-Mode; 20 MHz; 6 Mbit/s								
Applied duty cycle correction (AV): 0 dB								
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
1	2412	- - -	- - -	- - -	- - -	- - -	- - -	RB
6	2437	- - -	- - -	- - -	- - -	- - -	- - -	RB
11	2462	- - -	- - -	- - -	- - -	- - -	- - -	RB

Remark: Antenna port of EUT terminated with 50 Ohm.
Please see next sub-clause for the measurement plot.

4.6.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

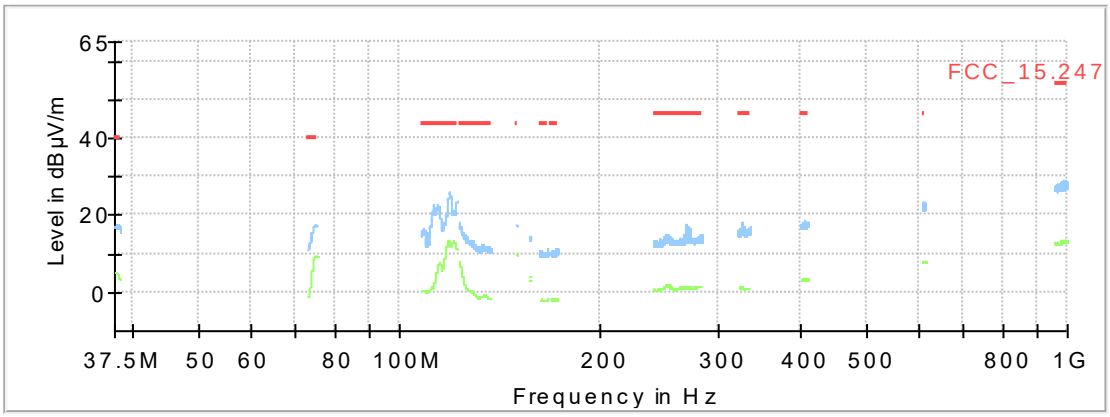
Radio Technology = Bluetooth BDR, Operating Frequency = mid, Measurement range = 9 kHz - 30 MHz
(S02_7_AB01)



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
---	---	---	---	---	---	---	---		---	---	

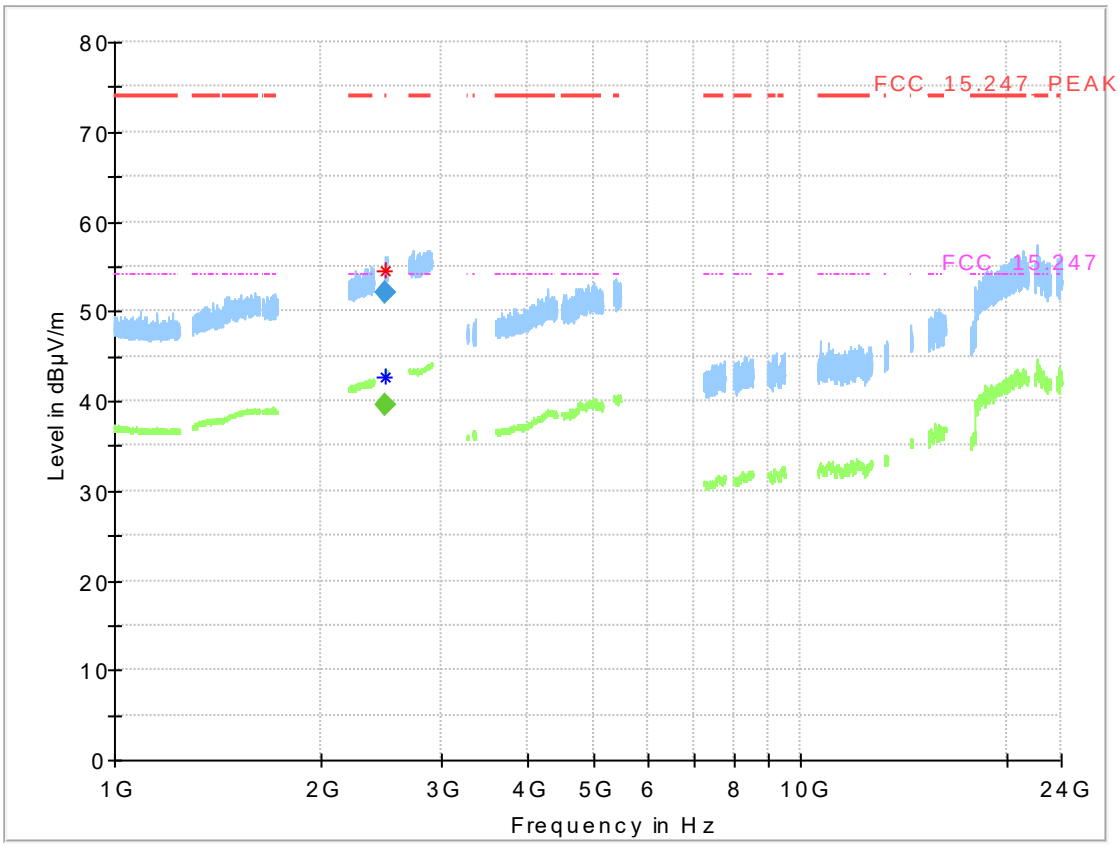
Radio Technology = Bluetooth BDR, Operating Frequency = high, Measurement range = 30 MHz - 1 GHz
(S02_7_AB01)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
---	---	---	---	---	---	---		---	---	

Radio Technology = Bluetooth BDR, Operating Frequency = high, Measurement range = 1 GHz - 26 GHz
(S02_7_AB01)



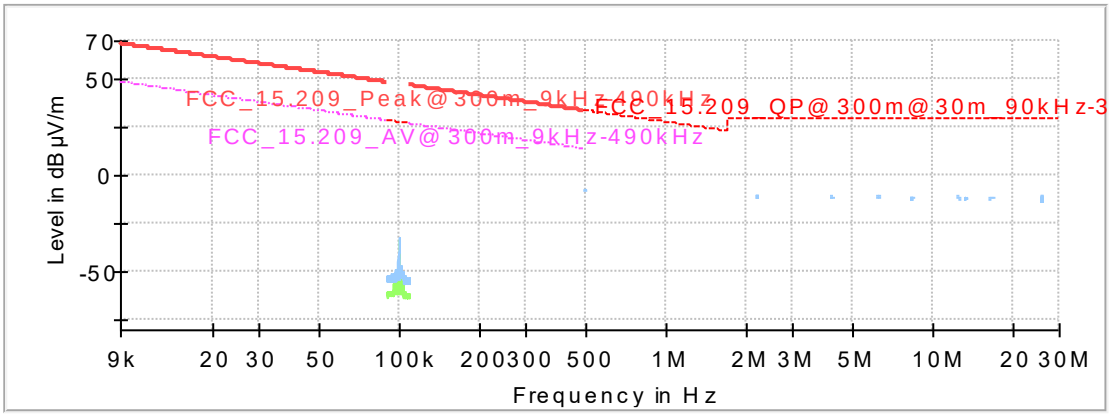
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2484.655000	54.61	---	74.00	19.39	---	---	150.0	V	-130.0	14.7
2484.655000	---	42.79	54.00	11.21	---	---	150.0	H	151.0	14.8

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2484.655000	---	39.47	54.00	14.53	1000.0	1000.000	150.0	H	151.0	14.8
2484.655000	52.13	---	74.00	21.87	1000.0	1000.000	150.0	V	-130.0	14.7

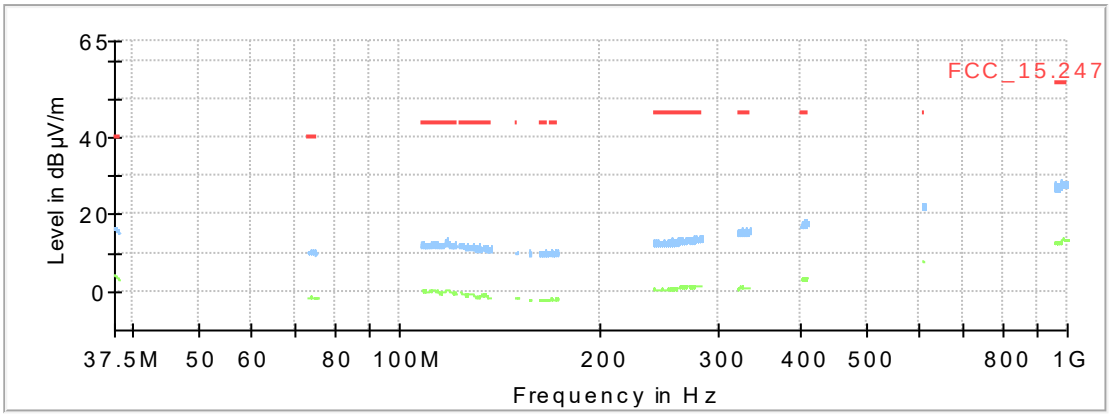
Radio Technology = WLAN b, Operating Frequency = mid, Measurement range = 9 kHz - 30 MHz
(S02_7_AB01)



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
---	---	---	---	---	---	---	---		---	---	

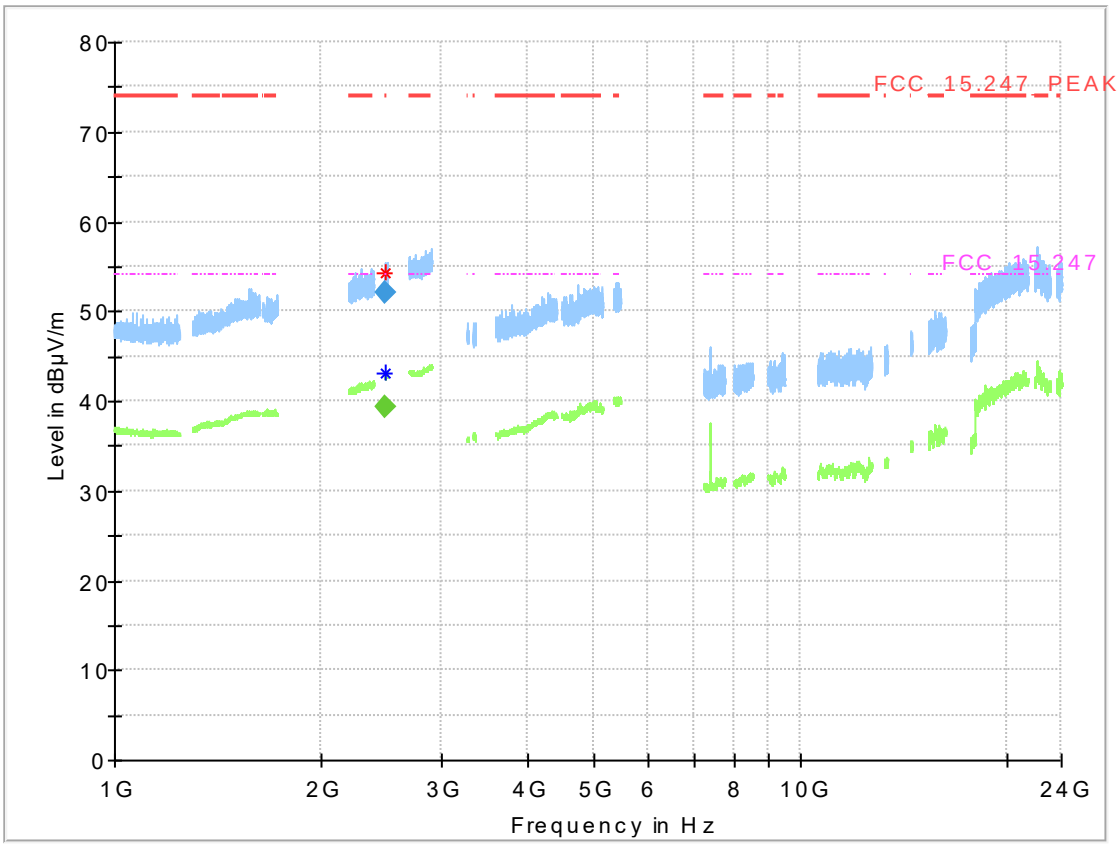
Radio Technology = WLAN b, Operating Frequency = high, Measurement range = 30 MHz - 1 GHz
(S02_7_AB01)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
---	---	---	---	---	---	---		---	---	

Radio Technology = WLAN b, Operating Frequency = high, Measurement range = 1 GHz - 26 GHz
(S02_7_AB01)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2483.665000	54.23	---	74.00	19.77	---	---	150.0	H	20.0	-15.2
2484.077500	---	43.05	54.00	10.95	---	---	150.0	V	79.0	15.2

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2483.665000	52.02	---	74.00	21.98	1000.0	1000.000	150.0	H	20.0	-15.2
2484.077500	---	39.23	54.00	14.77	1000.0	1000.000	150.0	V	79.0	15.2

4.6.5 TEST EQUIPMENT USED

- Radiated Emissions

4.7 BAND EDGE COMPLIANCE CONDUCTED

Standard FCC Part 15 Subpart C

The test was performed according to:
ANSI C63.10

4.7.1 TEST DESCRIPTION

For the conducted measurement, the Equipment Under Test (EUT) is placed in a shielded room. The reference power was measured in the test case "Spurious RF Conducted Emissions". The EUT was connected to the spectrum analyzer via a short coax cable with a known loss.

20/30 dBc:
Analyzer settings:

- Lower Band Edge:
  Minimum frequency: 2397.0 MHz
  Upper Band Edge
  Maximum frequency: 2485.0 MHz
- Span:
  Bluetooth: 6 MHz
  WLAN: 25 / 45 / 85 MHz [depending on channel bandwidth]
- Detector: Peak
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweeptime: 5 ms
- Sweeps: 2000
- Trace: Maxhold

Band Edge at restricted bands:
See Test Case Spurious RF Conducted Emissions and Conducted Emissions in Restricted Bands.

4.7.2 TEST REQUIREMENTS / LIMITS

FCC Part 15.247 (d)
"In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. ...
If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. 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))."

For the conducted measurement the RF power at the band edge shall be "at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power..."

4.7.3 TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1012 hPa
Humidity: 41 %

20/30dBc:

BT GFSK (1-DH1)

Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	2400.0	-43.7	PEAK	100	11.5	-8.5	35.1
78	2480	2483.5	-44.1	PEAK	100	11.6	-8.4	35.7

BT π/4 DQPSK (2-DH1)

Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	2400.0	-44.5	PEAK	100	7.5	-12.5	31.9
78	2480	2483.5	-43.2	PEAK	100	7.3	-12.7	30.5

BT 8-DPSK (3-DH1)

Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	2400.0	-44.1	PEAK	100	7.2	-12.8	31.2
78	2480	2483.5	-44.7	PEAK	100	7.0	-13.0	31.7

BT LE GFSK

Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	2400.0	-50.1	PEAK	100	7.1	-12.9	37.2
78	2480	2483.5	-53.2	PEAK	100	7.0	-13.0	40.2

WLAN b-Mode; 20 MHz; 1 Mbit/s

Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	2400.0	-37.7	PEAK	100	10.3	-19.7	18.0
11	2462	2483.5	-49.4	PEAK	100	10.5	-19.5	29.9

WLAN g-Mode; 20 MHz; 6 Mbit/s

Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	2400.0	-38.2	PEAK	100	1.6	-28.4	9.8
11	2462	2483.5	-47.8	PEAK	100	1.3	-28.7	19.1

WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0

Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	2400.0	-37.7	PEAK	100	1.7	-28.3	9.4
11	2462	2483.5	-47.6	PEAK	100	1.3	-28.7	18.9

Remark: Please see next sub-clause for the measurement plot.

In Restricted Bands:

BT GFSK (1-DH1)

Channel Center Frequency [MHz]	Measured freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
2402	2389.8	2390.0	-54.2	PEAK	1000	43.0	54 [1)]	11.0
2480	2484.8	2483.5	-45.7	PEAK	1000	51.5	54 [1)]	2.5

BT π/4 DQPSK (2-DH1)

Channel Center Frequency [MHz]	Measured freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
2402	2389.3	2390.0	-58.4	PEAK	1000	38.8	54 [1)]	15.2
2480	2483.8	2483.5	-42.8	PEAK	1000	54.4	74	19.6
2480	2483.8	2483.5	-52.9	RMS	1000	44.3	54	9.7

BT 8-DPSK (3-DH1)

Channel Center Frequency [MHz]	Measured freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
2402	2388.3	2390.0	-54.4	PEAK	1000	42.8	54 [1)]	11.2
2480	2484.8	2483.5	-50.1	PEAK	1000	47.1	54 [1)]	6.9

BT LE GFSK

Channel Center Frequency [MHz]	Measured freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
2402	2381.8	2390.0	-57.8	PEAK	1000	39.4	54 [1)]	14.6
2480	2484.8	2483.5	-45.7	PEAK	1000	51.5	54 [1)]	2.5

WLAN b-Mode; 20 MHz; 1 Mbit/s

Channel Center Frequency [MHz]	Measured freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
2412	2387.9	2390.0	-39.9	PEAK	1000	57.3	74	16.7
2412	2387.4	2390.0	-47.6	RMS	1000	49.6	54	4.4
2462	2487.8	2483.5	-41.1	PEAK	1000	56.1	74	17.9
2462	2488.7	2483.5	-50.3	RMS	1000	46.9	54	7.1

WLAN g-Mode; 20 MHz; 6 Mbit/s

Channel Center Frequency [MHz]	Measured freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
2412	2390.0	2390.0	-35.2	PEAK	1000	62.0	74	12
2412	2390.0	2390.0	-47.0	RMS	1000	50.2	54	3.8
2417	2388.1	2390.0	-35.0	PEAK	1000	62.2	74	11.8
2417	2390.0	2390.0	-46.7	RMS	1000	50.5	54	3.5
2457	2484.9	2483.5	-36.4	PEAK	1000	60.8	74	13.2
2457	2483.5	2483.5	-48.4	RMS	1000	48.8	54	5.2
2462	2483.5	2483.5	-35.7	PEAK	1000	61.5	74	12.5
2462	2483.5	2483.5	-47.8	RMS	1000	49.4	54	4.6

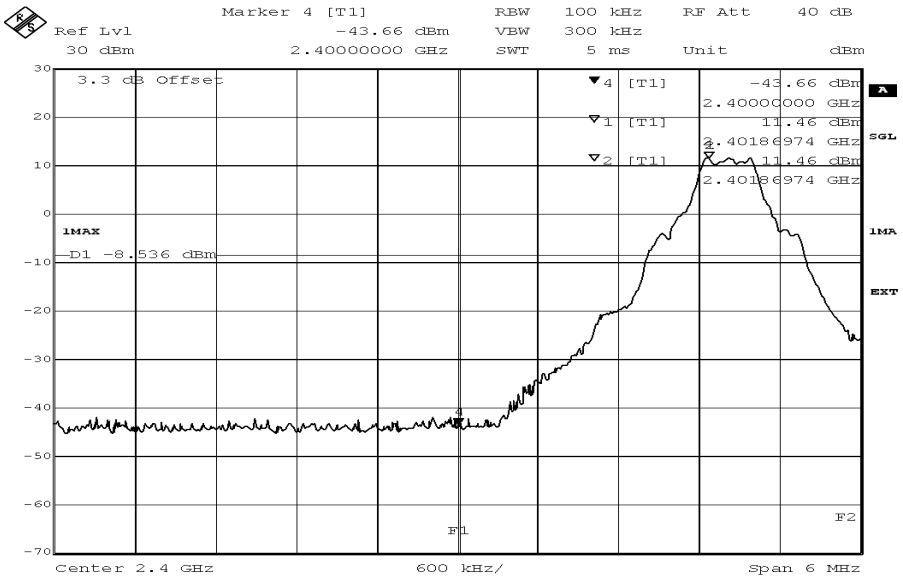
WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0

Channel Center Frequency [MHz]	Measured freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Spurious Level converted [dBµV/m]	Limit [dBm]	Margin to Limit [dB]
2412	2390.0	2390.0	-36.7	PEAK	1000	60.5	74	13.5
2412	2390.0	2390.0	-46.7	RMS	1000	50.5	54	3.5
2417	2389.4	2390.0	-35.6	PEAK	1000	61.6	74	12.4
2417	2390.0	2390.0	-46.0	RMS	1000	51.2	54	2.8
2457	2484.2	2483.5	-34.6	PEAK	1000	62.6	74	11.4
2457	2483.5	2483.5	-47.8	RMS	1000	49.4	54	4.6
2462	2483.7	2483.5	-36.4	PEAK	1000	60.8	74	13.2
2462	2483.5	2483.5	-47.1	RMS	1000	50.1	54	3.9

4.7.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

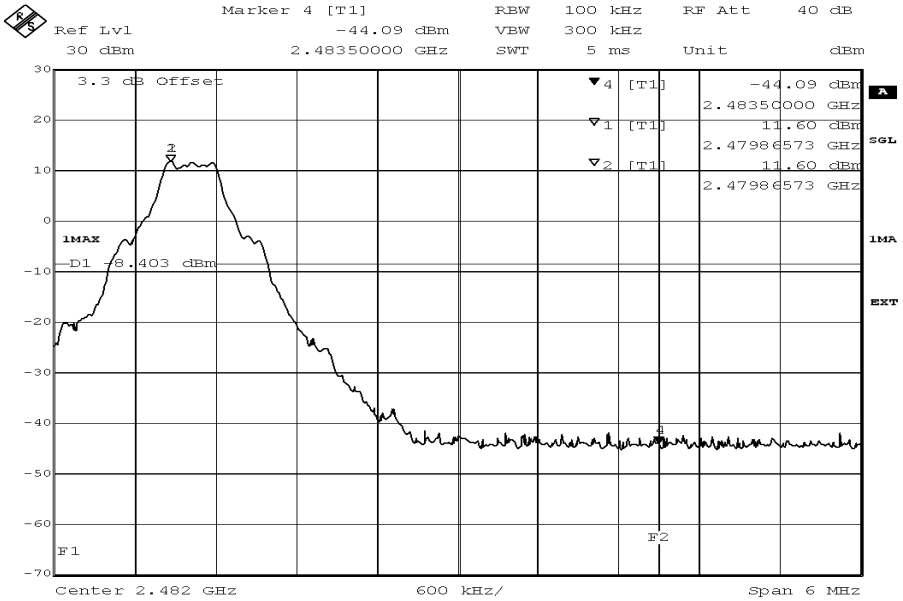
20/30dBc:

Radio Technology = Bluetooth BDR, Operating Frequency = low, Band Edge = low (S01_7_AB01)



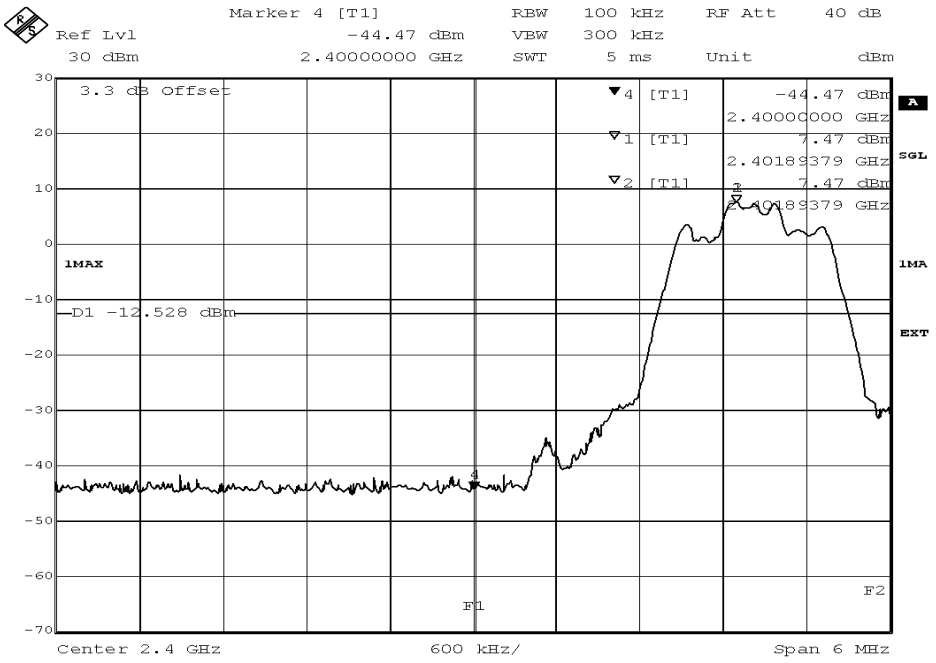
Title: Band Edge Compliance
Comment A: CH B: 2402 MHz
Date: 5.DEC.2017 08:58:09

Radio Technology = Bluetooth BDR, Operating Frequency = high, Band Edge = high (S01_7_AB01)



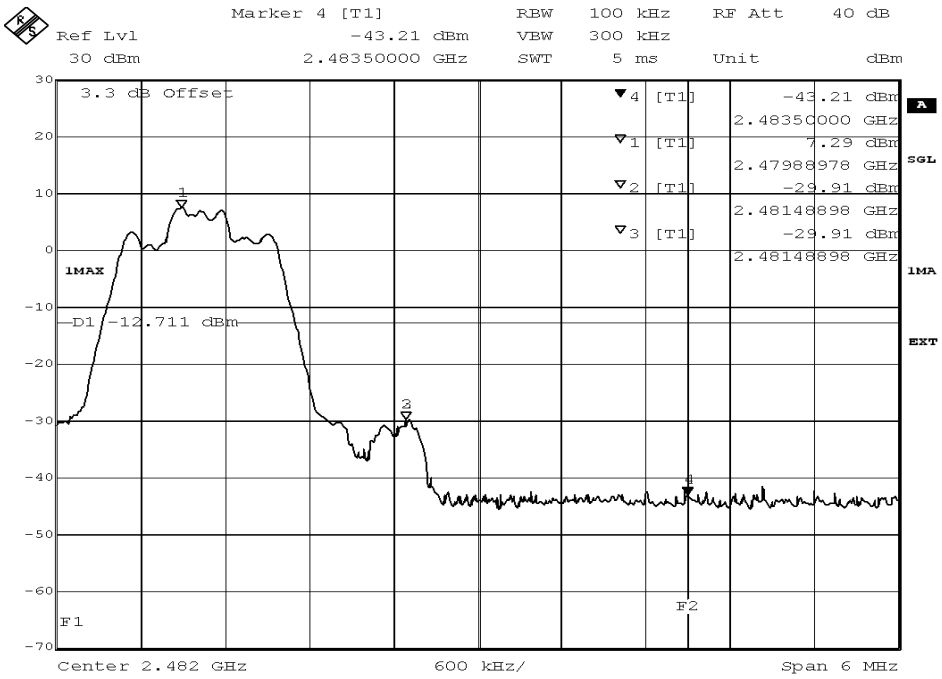
Title: Band Edge Compliance
Comment A: CH T: 2480 MHz
Date: 5.DEC.2017 10:54:32

Radio Technology = Bluetooth EDR 2, Operating Frequency = low, Band Edge = low (S01_7_AB01)



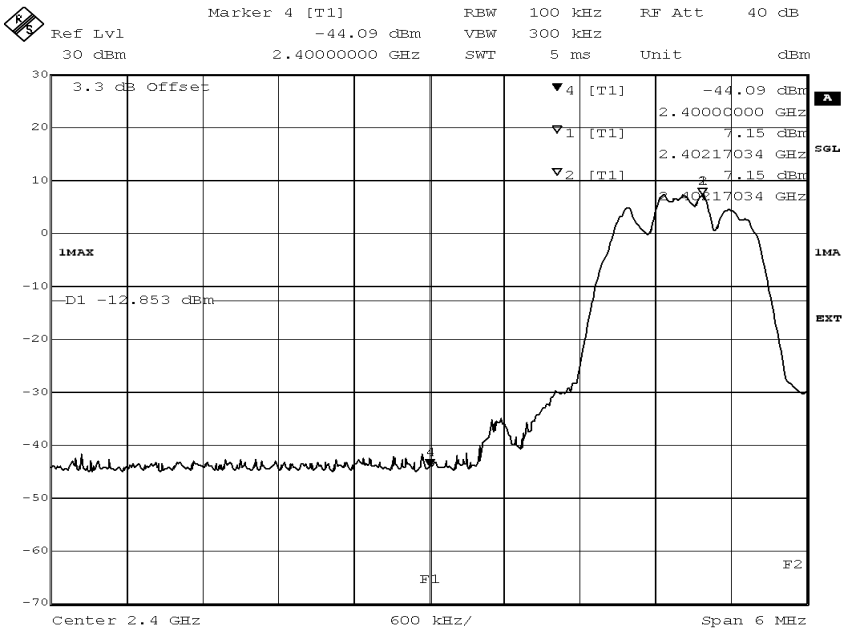
Title: Band Edge Compliance
Comment A: CH B: 2402 MHz
Date: 5.DEC.2017 09:14:18

Radio Technology = Bluetooth EDR 2, Operating Frequency = high, Band Edge = high (S01_7_AB01)



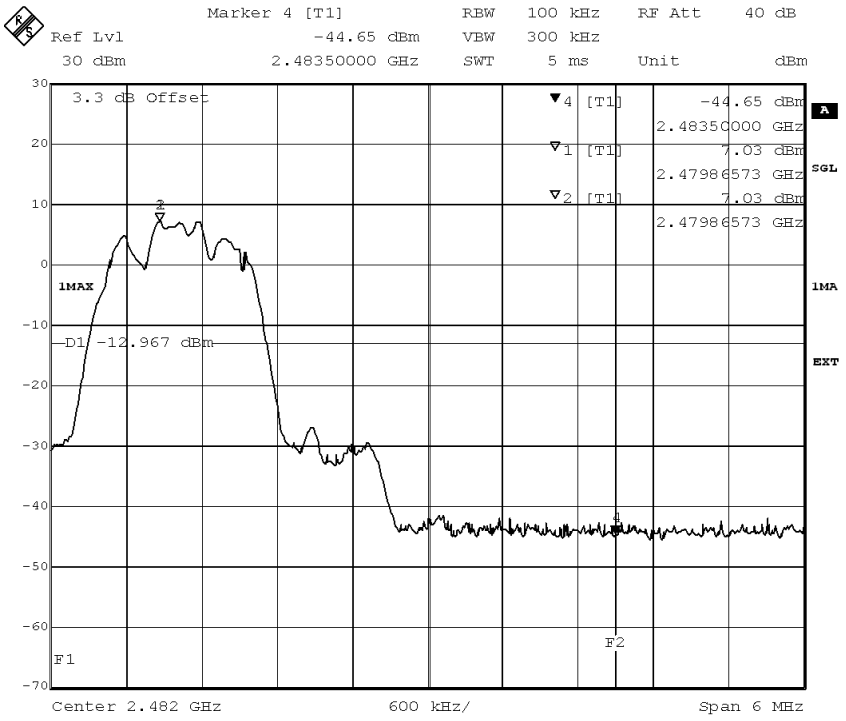
Title: Band Edge Compliance
Comment A: CH T: 2480 MHz
Date: 5.DEC.2017 11:15:09

Radio Technology = Bluetooth EDR 3, Operating Frequency = low, Band Edge = low (S01_7_AB01)



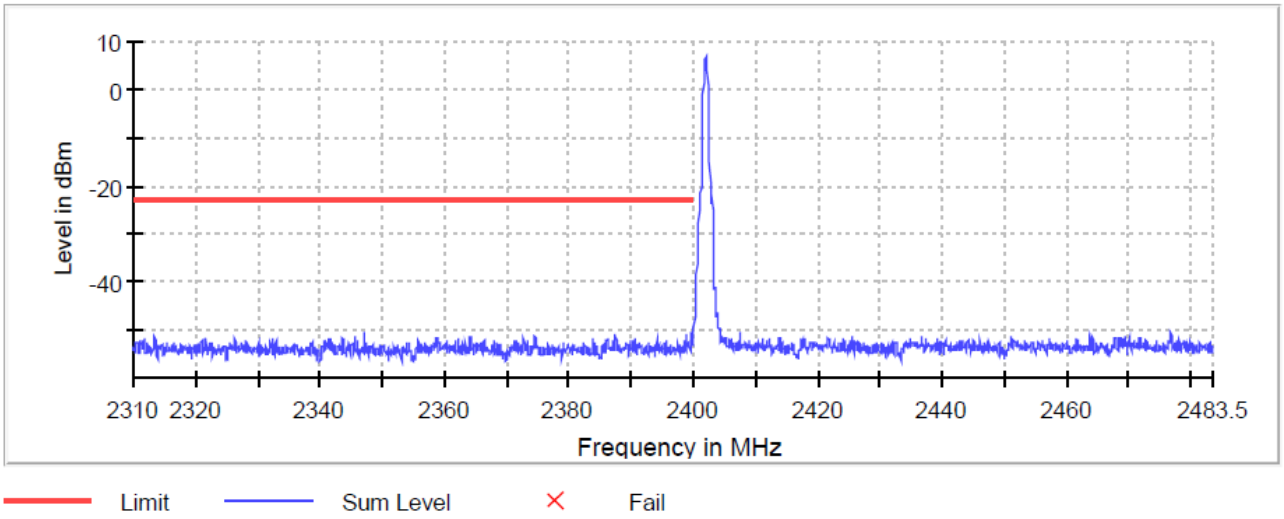
Title: Band Edge Compliance
Comment A: CH B: 2402 MHz
Date: 5.DEC.2017 09:30:55

Radio Technology = Bluetooth EDR 3, Operating Frequency = high, Band Edge = high (S01_7_AB01)

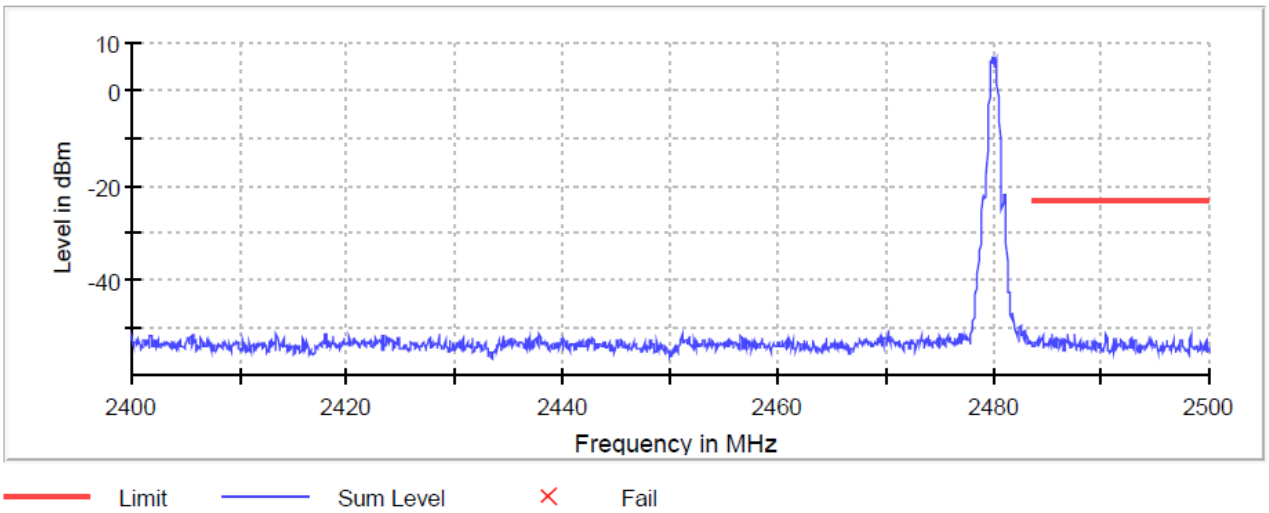


Title: Band Edge Compliance
Comment A: CH T: 2480 MHz
Date: 5.DEC.2017 11:32:07

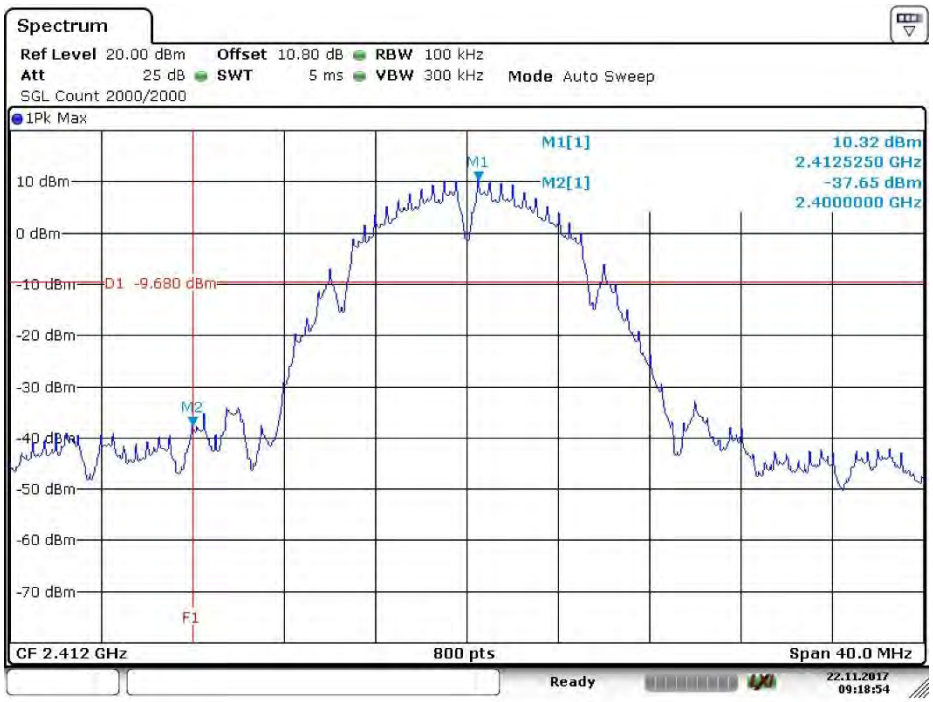
Radio Technology = Bluetooth Low Energy, Operating Frequency = low, Band Edge = low (S01_7_AA01)



Radio Technology = Bluetooth Low Energy, Operating Frequency = high, Band Edge = high (S01_7_AA01)

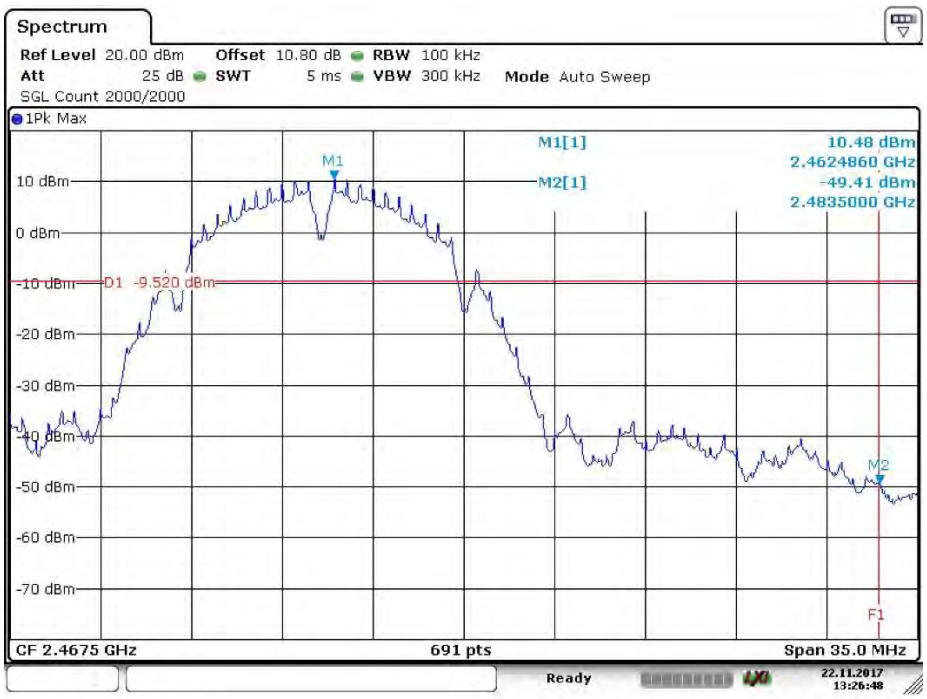


Radio Technology = WLAN b, Operating Frequency = low, Band Edge = low
(S01_7_AA01)



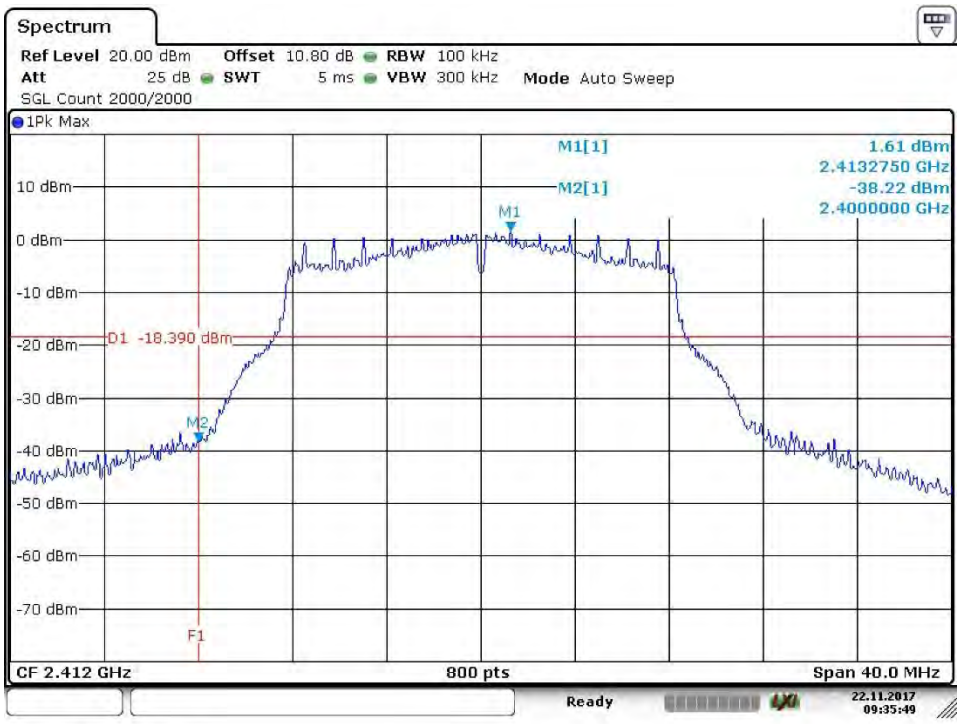
Date: 22.NOV.2017 09:18:53

Radio Technology = WLAN b, Operating Frequency = high, Band Edge = high
(S01_7_AA01)



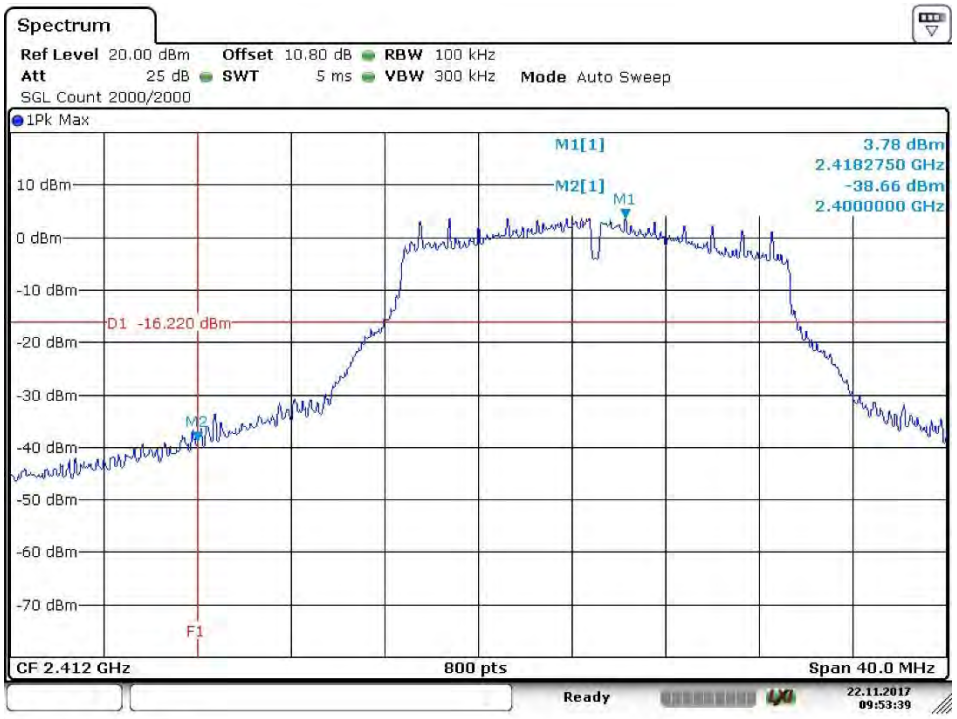
Date: 22.NOV.2017 13:26:48

Radio Technology = WLAN g, Operating Frequency = low, Band Edge = low
(S01_7_AA01)



Date: 22.NOV.2017 09:35:49

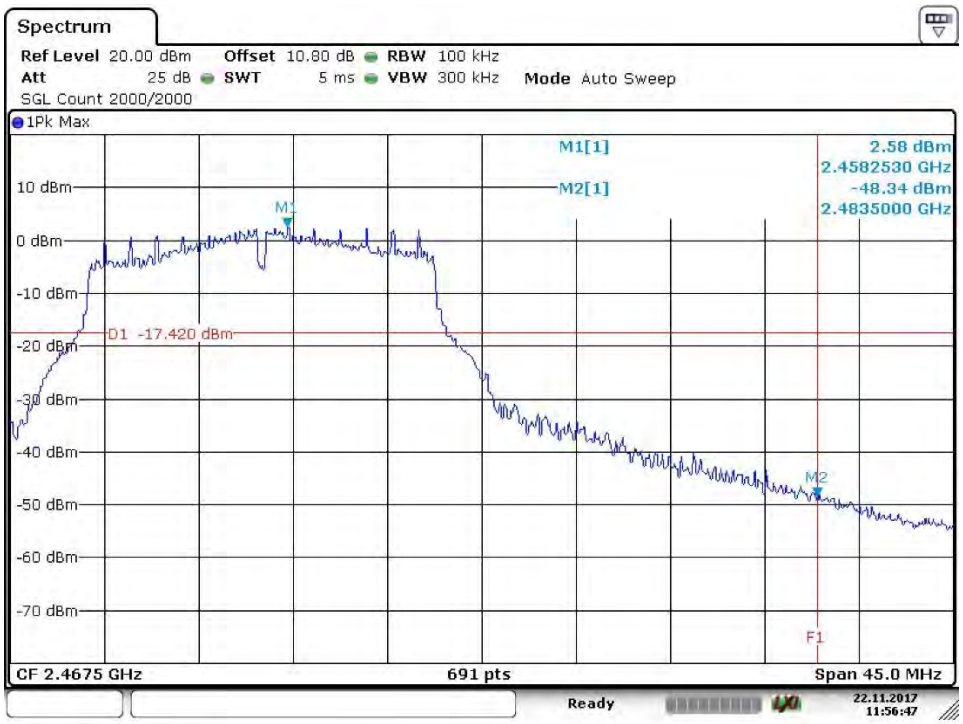
WLAN g Ch. 1



Date: 22.NOV.2017 09:53:39

WLAN g Ch. 2

Radio Technology = WLAN g, Operating Frequency = high, Band Edge = high
(S01_7_AA01)



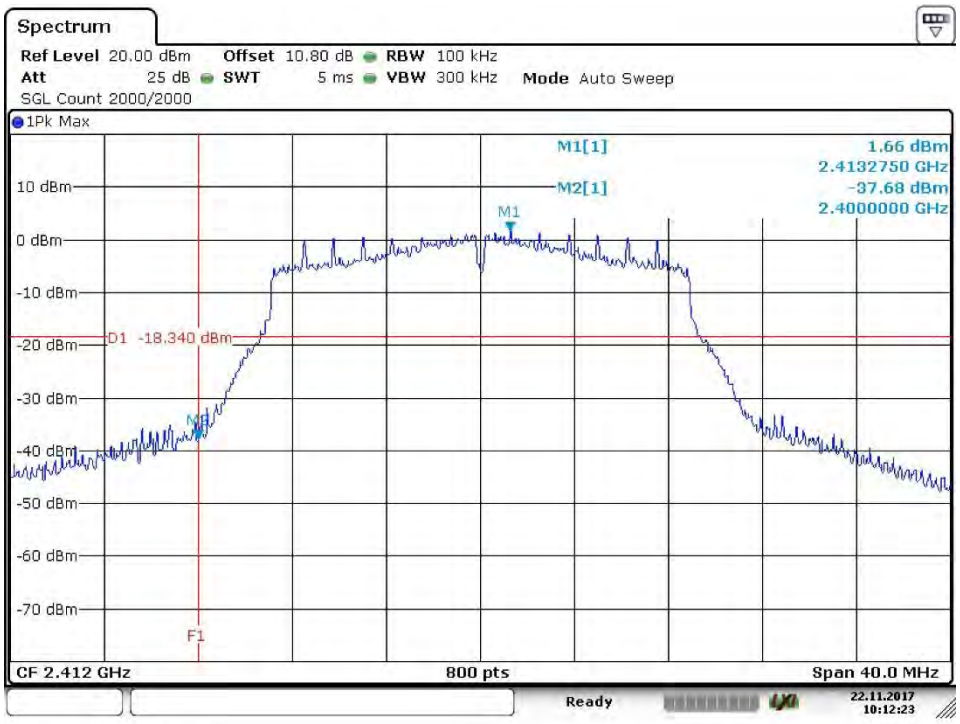
Date: 22.NOV.2017 11:56:48

WLAN g Ch. 10

Date: 22.NOV.2017 13:45:40

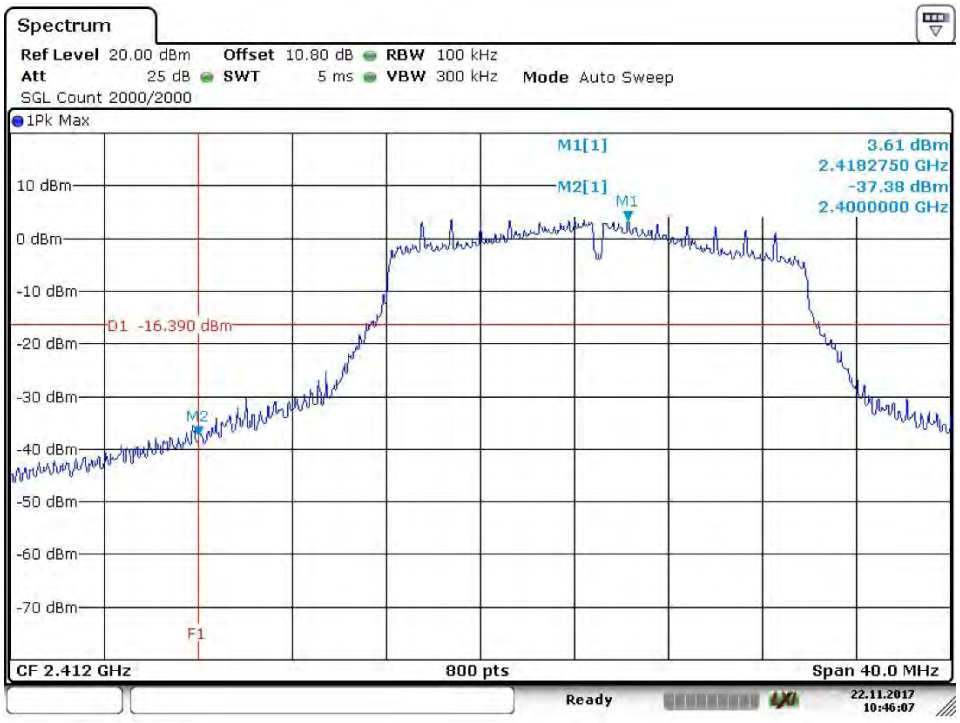
WLAN g Ch. 11

Radio Technology = WLAN n 20 MHz, Operating Frequency = low, Band Edge = low (S01_7_AA01)



Date: 22.NOV.2017 10:12:24

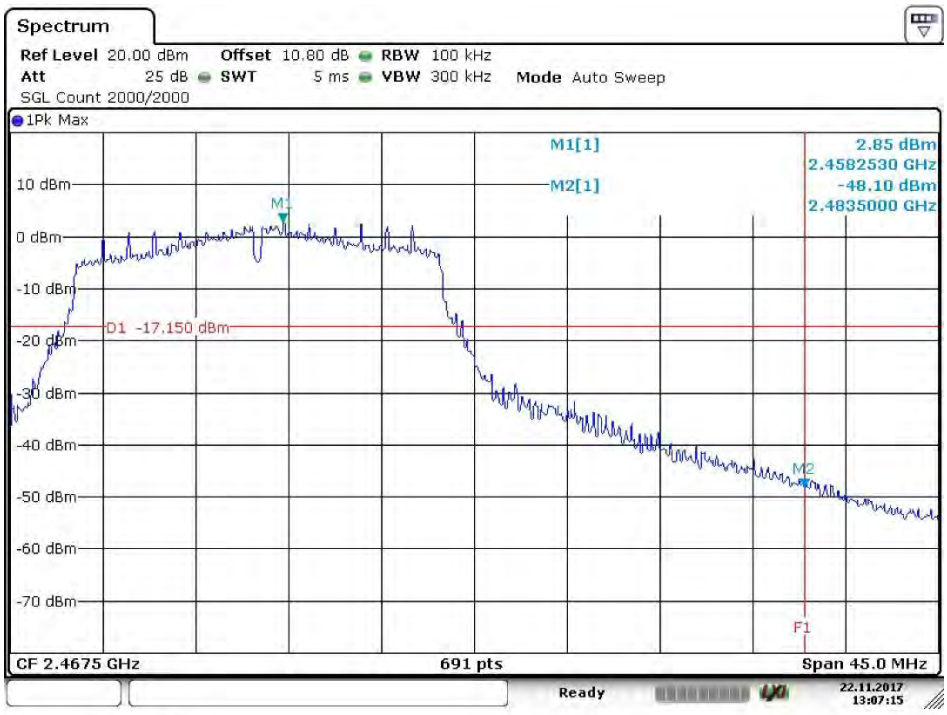
WLAN n Ch. 1



Date: 22.NOV.2017 10:46:07

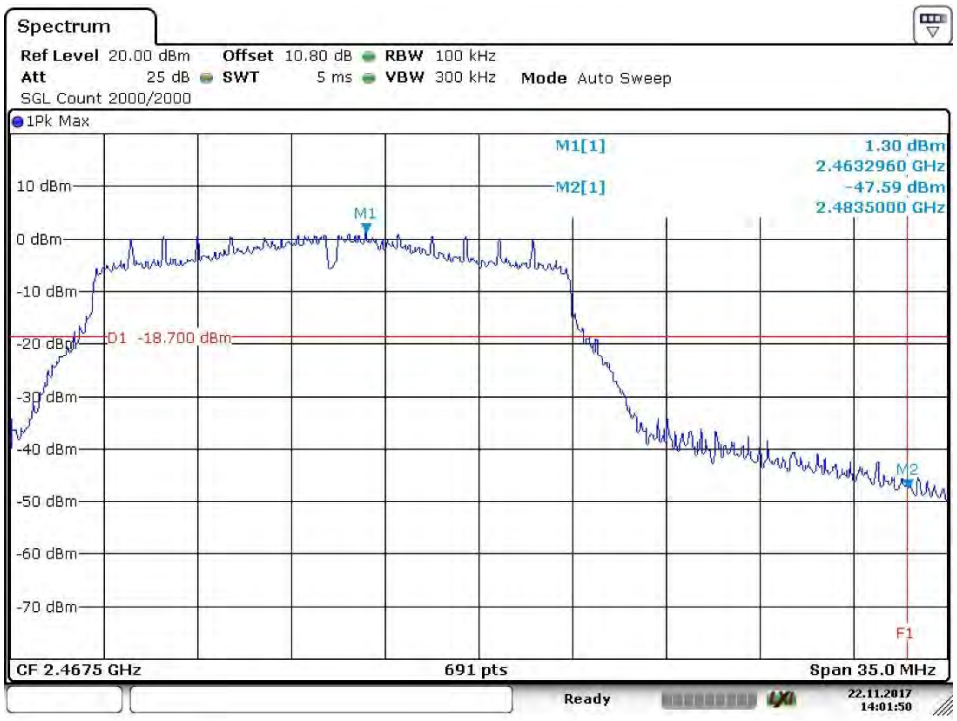
WLAN n Ch. 2

Radio Technology = WLAN n 20 MHz, Operating Frequency = high, Band Edge = high (S01_7_AA01)



Date: 22.NOV.2017 13:07:15

WLAN n Ch. 10

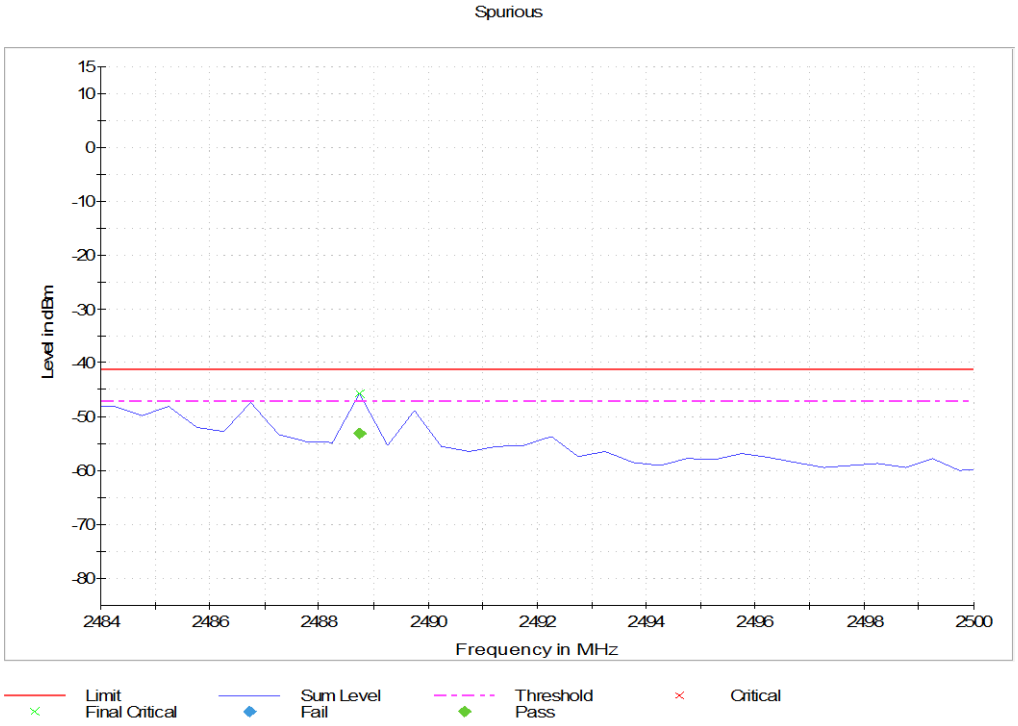


Date: 22.NOV.2017 14:01:50

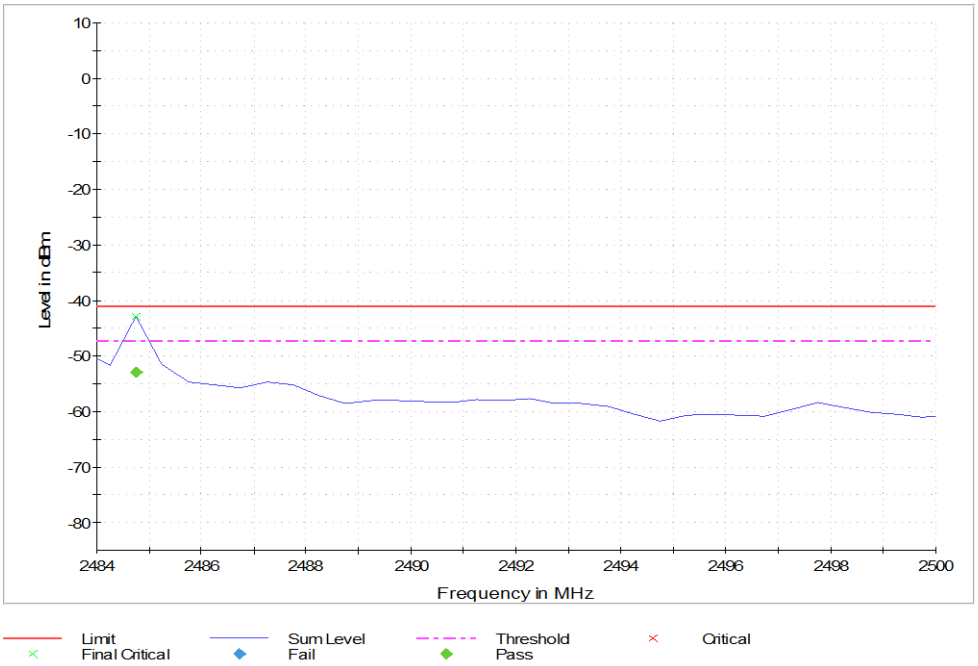
WLAN n Ch. 11

In Restricted Bands:

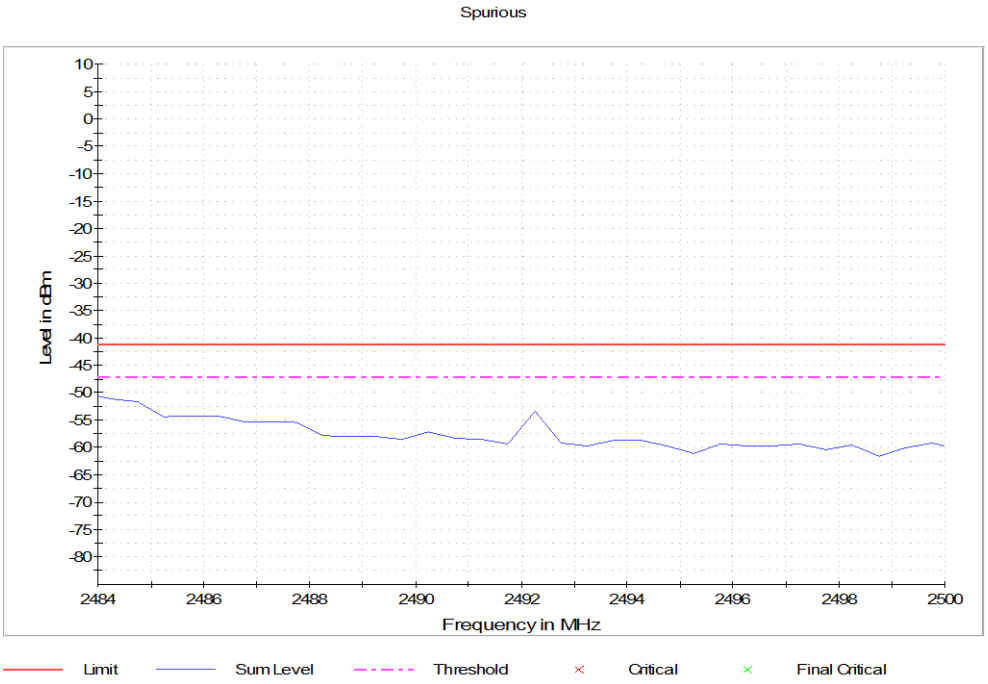
Radio Technology = Bluetooth GFSK (1-DH1), Operating Frequency = high, Band Edge = high (S01_7_AA01)



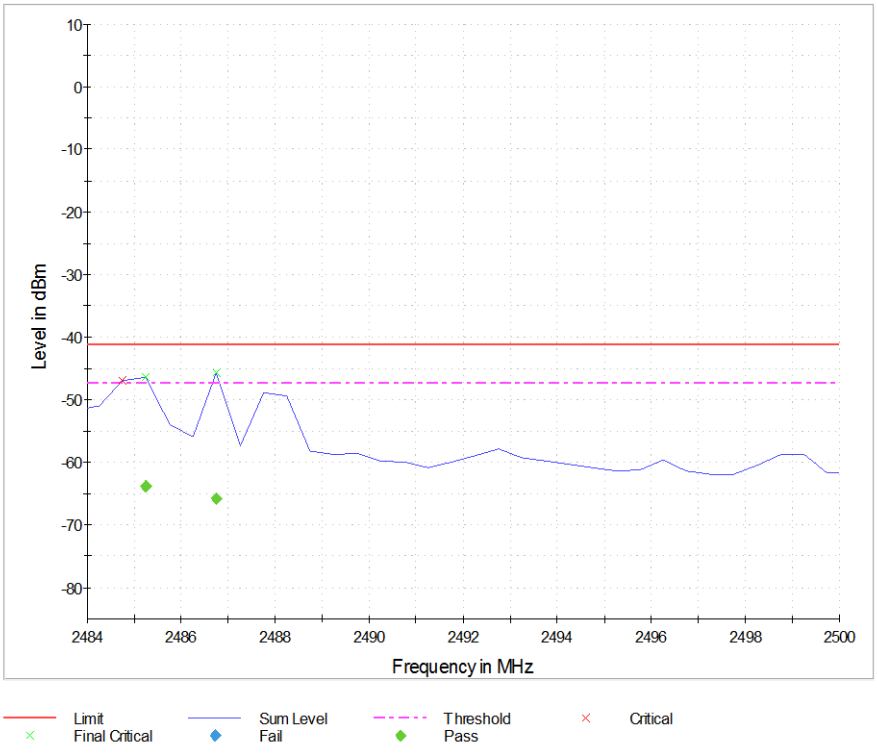
Radio Technology = Bluetooth π/4 DQPSK (2-DH1), Operating Frequency = high, Band Edge = high (S01_7_AA01)



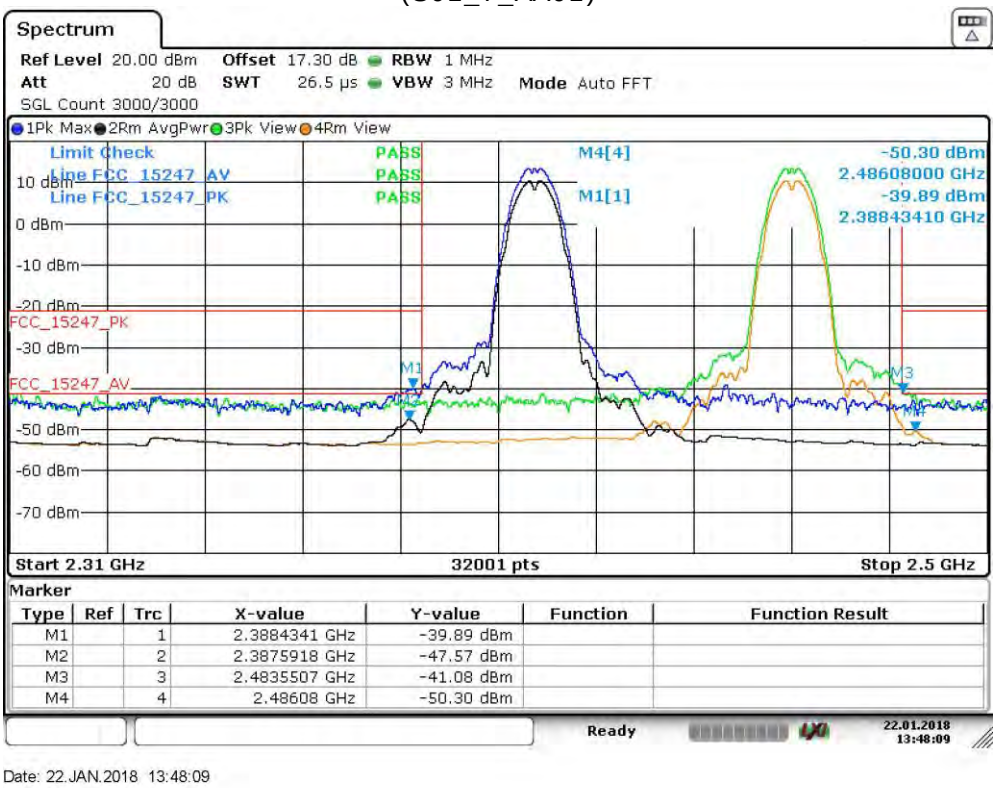
Radio Technology = Bluetooth 8-DPSK (3-DH1), Operating Frequency = high, Band Edge = high
(S01_7_AA01)



Radio Technology = Bluetooth Low Energy, Operating Frequency = high, Band Edge = high
(S01_7_AA01)



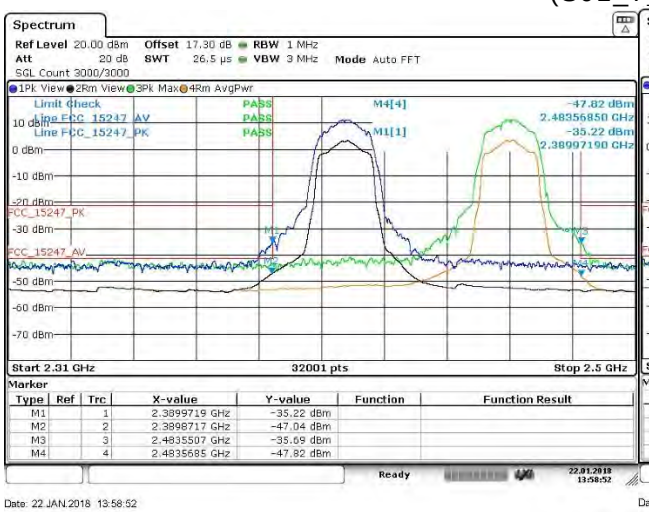
Radio Technology = WLAN b, Operating Frequency = low + high, Band Edge = low + high (S01_7_AA01)



Date: 22.JAN.2018 13:48:09

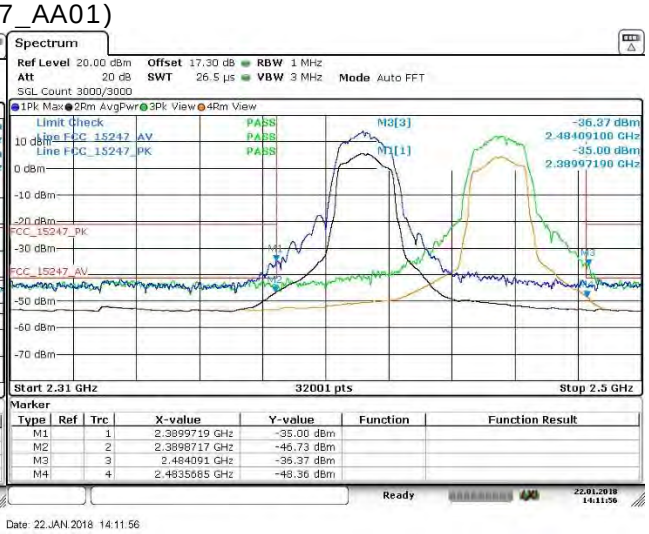
TX on 2412 + 2462 MHz

Radio Technology = WLAN g, Operating Frequency = low + high, Band Edge = low + high (S01_7_AA01)



Date: 22.JAN.2018 13:58:52

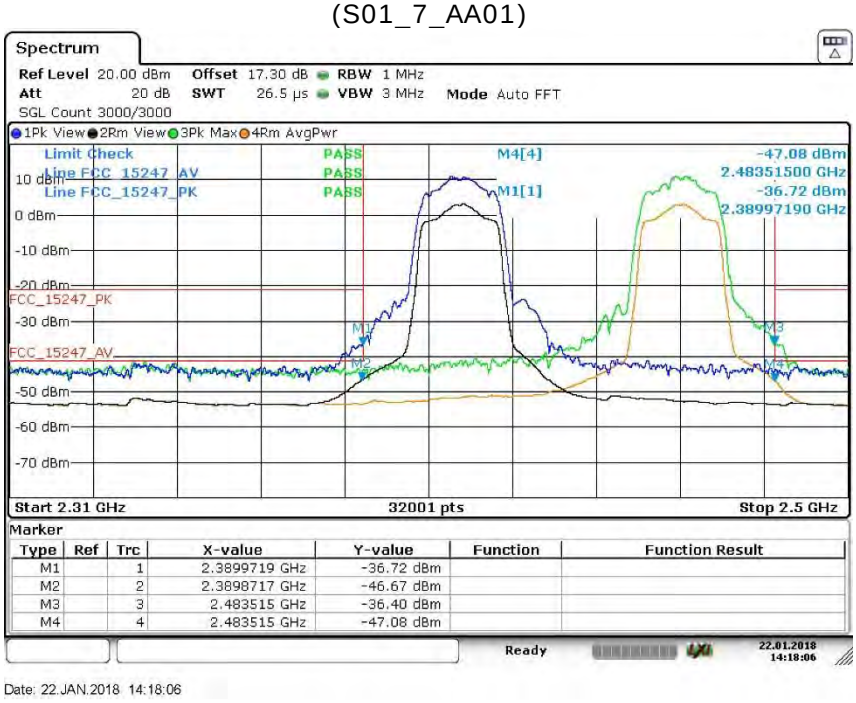
TX on 2412 + 2462 MHz



Date: 22.JAN.2018 14:11:56

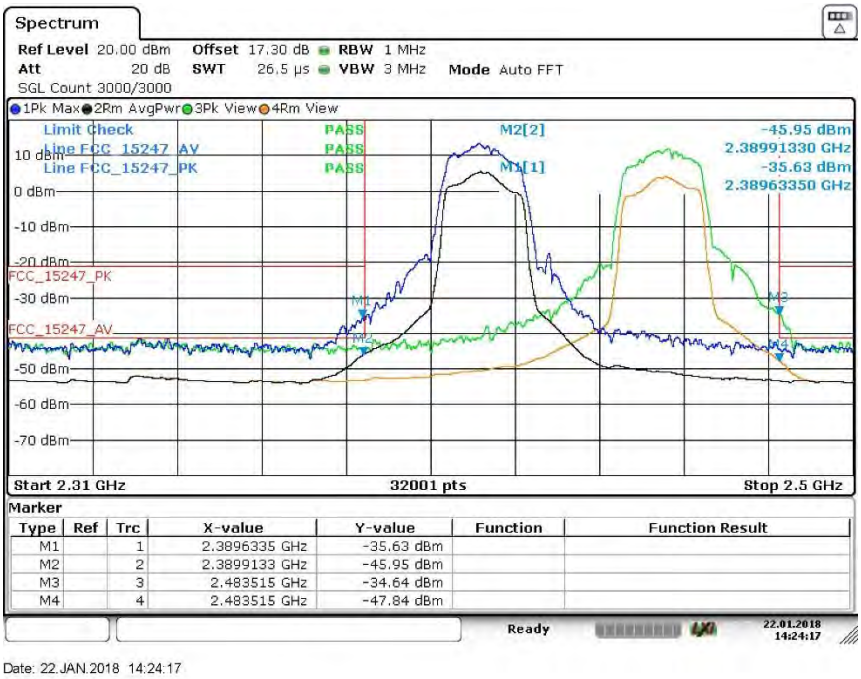
TX on 2417 + 2457 MHz

Radio Technology = WLAN n, Operating Frequency = low + high, Band Edge = low + high (S01_7_AA01)



Date: 22.JAN.2018 14:18:06

TX on 2412 + 2462 MHz



Date: 22.JAN.2018 14:24:17

TX on 2417 + 2457 MHz

4.7.5 TEST EQUIPMENT USED

- Regulatory Bluetooth RF Test Solution
- R&S TS8997

4.8 BAND EDGE COMPLIANCE RADIATED

Standard FCC Part 15 Subpart C

The test was performed according to:
ANSI C63.10

4.8.1 TEST DESCRIPTION

Please see test description for the test case "Spurious Radiated Emissions"

4.8.2 TEST REQUIREMENTS / LIMITS

For band edges connected to a restricted band, the limits are specified in Section 15.209(a)

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

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (dBµV/m)
0.009 – 0.49	2400/F(kHz)@300m	3	(48.5 – 13.8)@300m
0.49 – 1.705	24000/F(kHz)@30m	3	(33.8 – 23.0)@30m
1.705 – 30	30@30m	3	29.5@30m

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC 15.31 (2).

Frequency in MHz	Limit (µV/m)	Measurement distance (m)	Limits (dBµV/m)
30 – 88	100@3m	3	40.0@3m
88 – 216	150@3m	3	43.5@3m
216 – 960	200@3m	3	46.0@3m
960 - 26000	500@3m	3	54.0@3m
26000 - 40000	500@3m	1	54.0@3m

The measured values above 26 GHz are corrected with an inverse linear distance extrapolation factor (20 dB/decade).

§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: Limit (dBµV/m) = 20 log (Limit (µV/m)/1µV/m)

4.8.3 TEST PROTOCOL

Ambient temperature: 22 °C
Air Pressure: 1012 hPa
Humidity: 37 %
BT GFSK (1-DH1)
Applied duty cycle correction (AV): 0 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480	2483.5	54.6	PEAK	1000	74.0	19.4	BE
78	2480	2483.5	42.8	AV	1000	54.0	11.2	BE

BT π/4 DQPSK (2-DH1)
Applied duty cycle correction (AV): 0 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480	2483.5	53.1	PEAK	1000	74.0	20.9	BE
78	2480	2483.5	39.4	AV	1000	54.0	14.6	BE

BT 8-DPSK (3-DH1)
Applied duty cycle correction (AV): 0 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480	2483.5	53.3	PEAK	1000	74.0	20.7	BE
78	2480	2483.5	39.5	AV	1000	54.0	14.5	BE

WLAN b-Mode; 20 MHz; 1 Mbit/s
Applied duty cycle correction (AV): 0 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	54.2	PEAK	1000	74.0	19.8	BE
11	2462	2483.5	39.2	AV	1000	54.0	14.8	BE

WLAN g-Mode; 20 MHz; 6 Mbit/s
Applied duty cycle correction (AV): 0 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	55.2	PEAK	1000	74.0	18.8	BE
11	2462	2483.5	39.3	AV	1000	54.0	14.7	BE

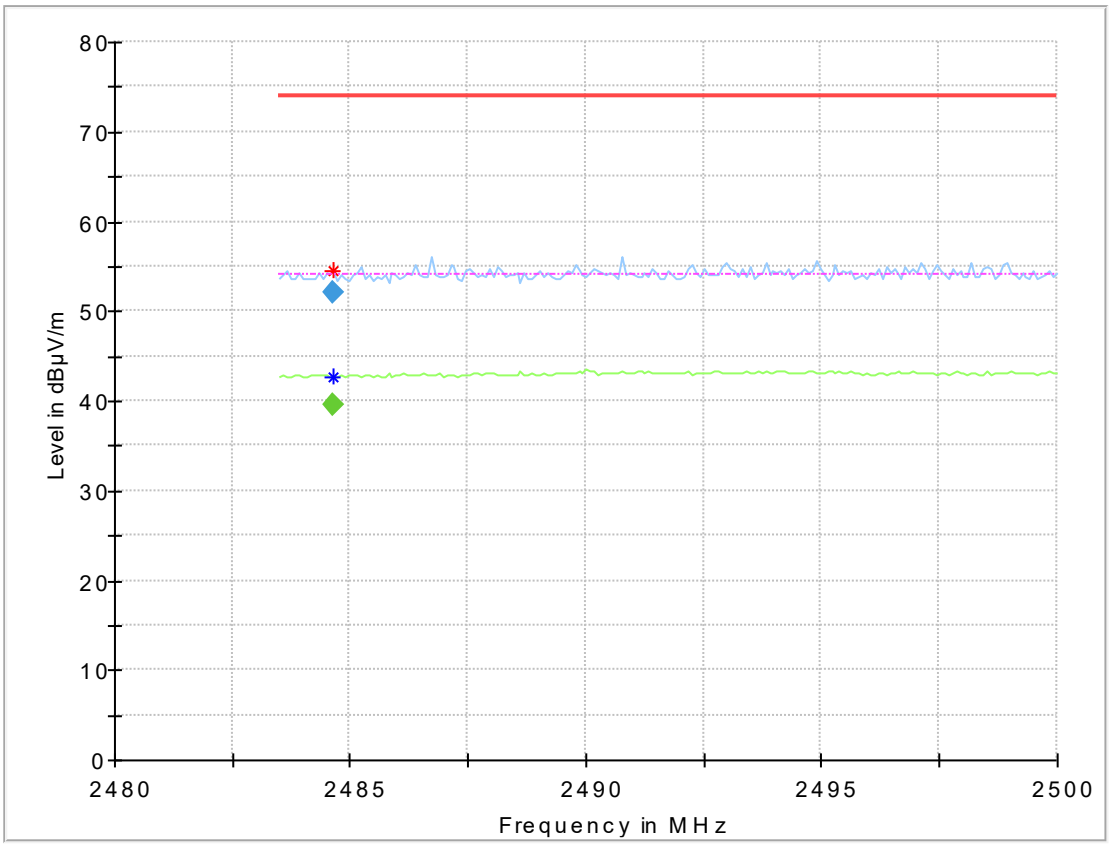
WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0
Applied duty cycle correction (AV): 0 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	55.5	PEAK	1000	74.0	18.5	BE
11	2462	2483.5	39.2	AV	1000	54.0	14.8	BE

Remark: Antenna port of EUT terminated with 50 Ohm.
Please see next sub-clause for the measurement plot.

4.8.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

Radio Technology = Bluetooth BDR, Operating Frequency = high, Band Edge = high (S01_3_AC01)



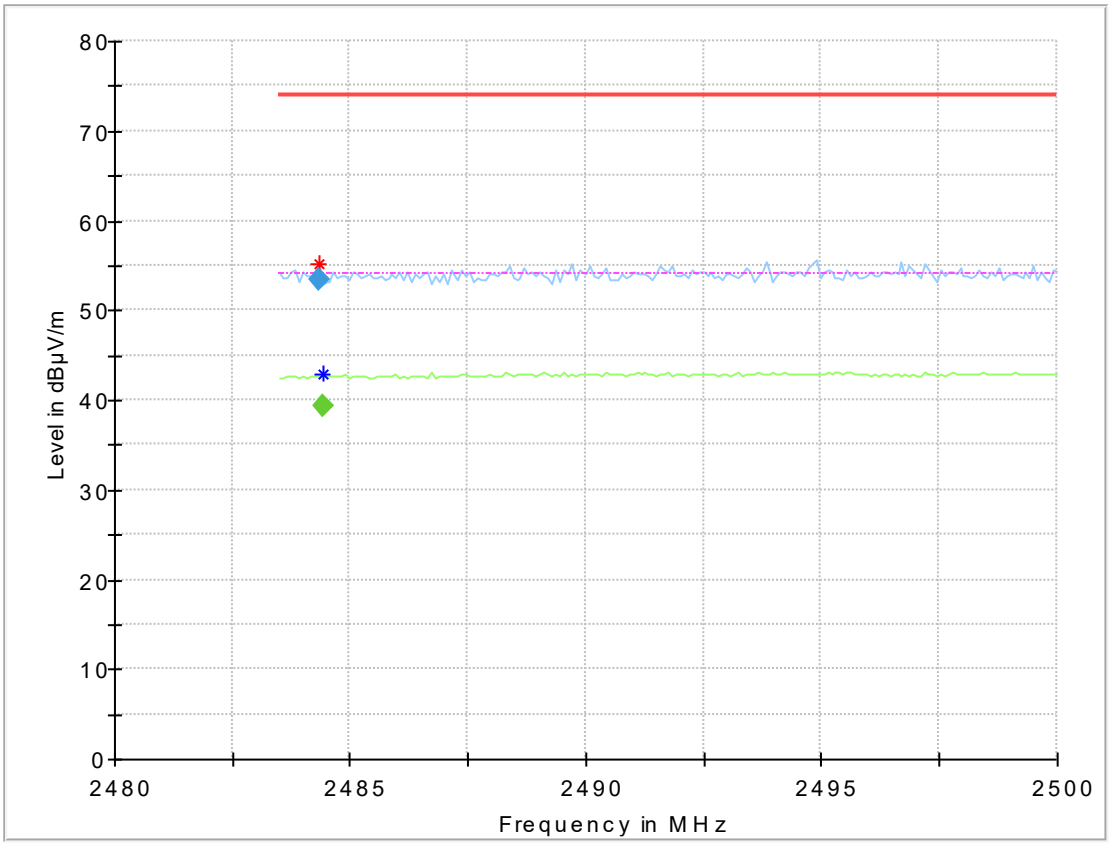
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2484.655000	54.61	---	74.00	19.39	---	---	150.0	V	-130.0	14.7
2484.655000	---	42.79	54.00	11.21	---	---	150.0	H	151.0	14.8

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2484.655000	---	39.47	54.00	14.53	1000.0	1000.000	150.0	H	151.0	14.8
2484.655000	52.13	---	74.00	21.87	1000.0	1000.000	150.0	V	-130.0	14.7

Radio Technology = WLAN g, Operating Frequency = high, Band Edge = high (S01_3_AB01)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2484.325000	55.15	---	74.00	18.85	---	---	150.0	V	-184.0	-9.3
2484.407500	---	42.85	54.00	11.15	---	---	150.0	V	100.0	104.8

Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2484.325000	53.34	---	74.00	20.66	1000.0	1000.000	150.0	V	-184.0	-9.2
2484.407500	---	39.27	54.00	14.73	1000.0	1000.000	150.0	V	101.0	104.8

4.8.5 TEST EQUIPMENT USED

- Radiated Emissions

4.9 POWER DENSITY

Standard FCC Part 15 Subpart C

The test was performed according to:
ANSI C63.10

4.9.1 TEST DESCRIPTION

The Equipment Under Test (EUT) was set up in a shielded room to perform the Power Density measurements.
The results recorded were measured with the modulation which produces the worst-case (highest) power density.

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

Analyzer settings:

- see plots

4.9.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.247 (e)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
...
The same method of determining the conducted output power shall be used to determine the power spectral density.

4.9.3 TEST PROTOCOL

Ambient temperature: 23 °C
Air Pressure: 1012 hPa
Humidity: 41 %

BT GFSK (1-DH1)

Band	Channel No.	Frequency [MHz]	Power Density [dBm/3kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	0	2402	1.6	8.0	6.4
	19	2440	1.5	8.0	6.5
	39	2480	1.5	8.0	6.5

BT π/4 DQPSK (2-DH1)

Band	Channel No.	Frequency [MHz]	Power Density [dBm/3kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	0	2402	-4.7	8.0	12.7
	19	2440	-4.4	8.0	12.4
	39	2480	-4.5	8.0	12.5

BT 8-DPSK (3-DH1)

Band	Channel No.	Frequency [MHz]	Power Density [dBm/3kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	0	2402	-4.5	8.0	12.5
	19	2440	-4.7	8.0	12.7
	39	2480	-4.4	8.0	12.4

BT LE

Band	Channel No.	Frequency [MHz]	Power Density [dBm/10kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	0	2402	-0.8	8.0	8.8
	19	2440	-0.7	8.0	8.7
	39	2480	-0.9	8.0	8.9

WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	Power Density [dBm/100kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	1	2412	1.7	8.0	6.3
	6	2437	0.1	8.0	7.9
	11	2462	1.8	8.0	6.2

WLAN g-Mode; 20 MHz; 6 Mbit/s

Band	Channel No.	Frequency [MHz]	Power Density [dBm/100kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	1	2412	-4.6	8.0	12.6
	2	2417	-2.1	8.0	10.1
	6	2437	-4.4	8.0	12.4
	10	2457	-3.3	8.0	11.3
	11	2462	-4.4	8.0	12.4

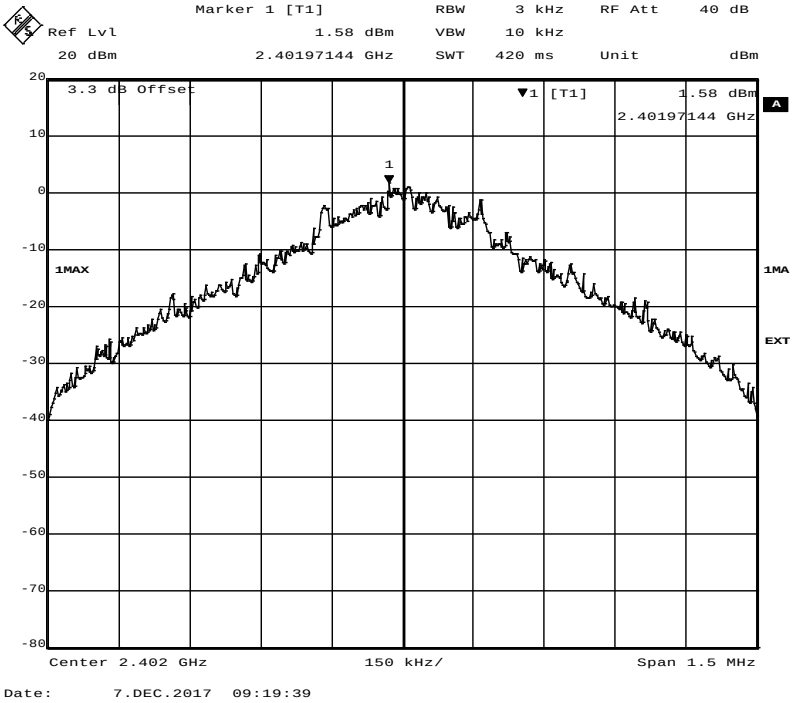
WLAN n-Mode; 20 MHz; 6,5 Mbit/s MCS0

Band	Channel No.	Frequency [MHz]	Power Density [dBm/100kHz]	Limit [dBm/3kHz]	Margin to Limit [dB]
2.4 GHz ISM	1	2412	-4.6	8.0	12.6
	2	2417	-2.3	8.0	10.3
	6	2437	-4.7	8.0	12.7
	10	2457	-3.4	8.0	11.4
	11	2462	-4.7	8.0	12.7

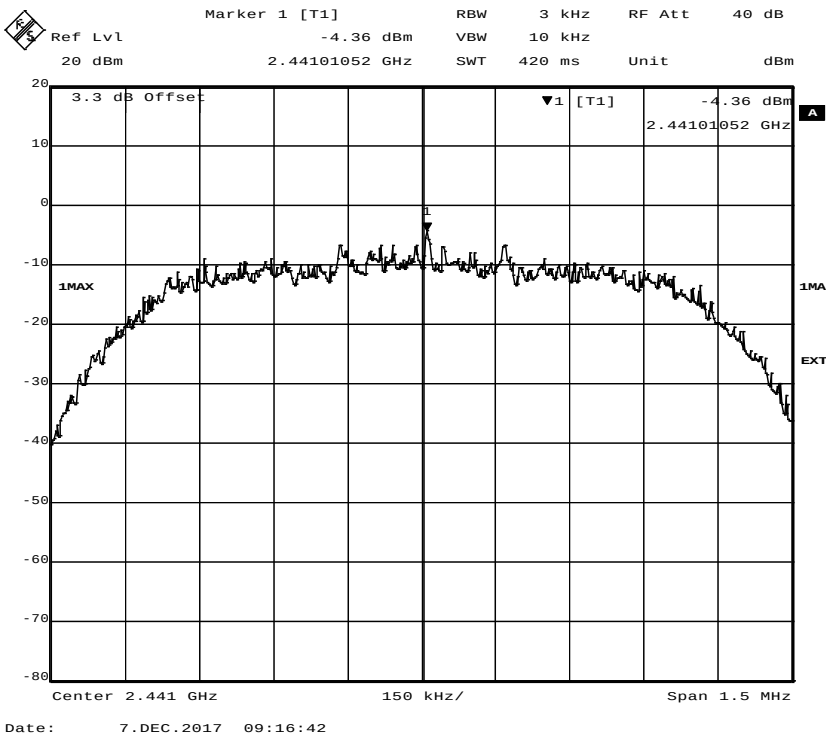
Remark: Please see next sub-clause for the measurement plot.

4.9.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

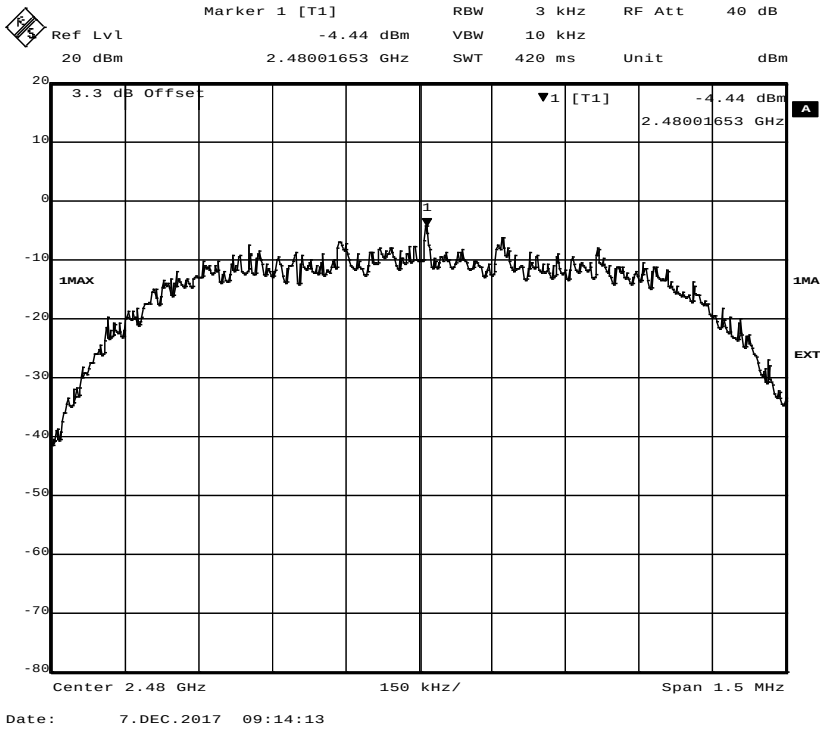
Radio Technology = BT GFSK (1-DH1), Operating Frequency = low
(S01_3_AE01)



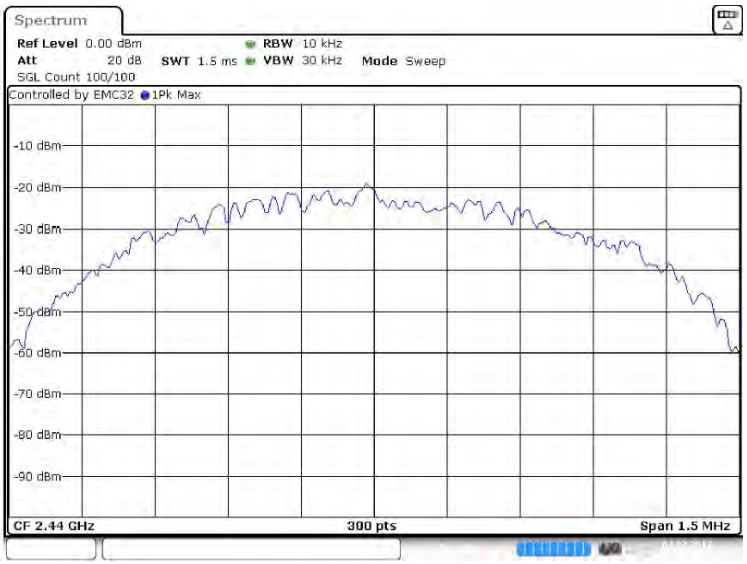
Radio Technology = BT π/4 DQPSK (2-DH1), Operating Frequency = mid
(S01_3_AE01)



Radio Technology = BT 8-DPSK (3-DH1), Operating Frequency = high (S01_3_AE01)



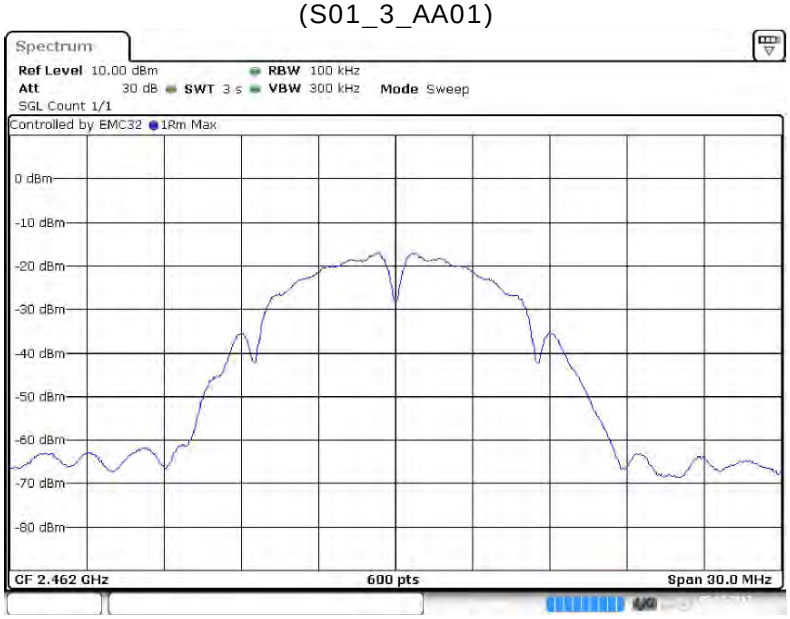
Radio Technology = Bluetooth LE, Operating Frequency = mid (S01_3_AA01)



Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)
2440.000000	2439.982500	-0.664	8.0

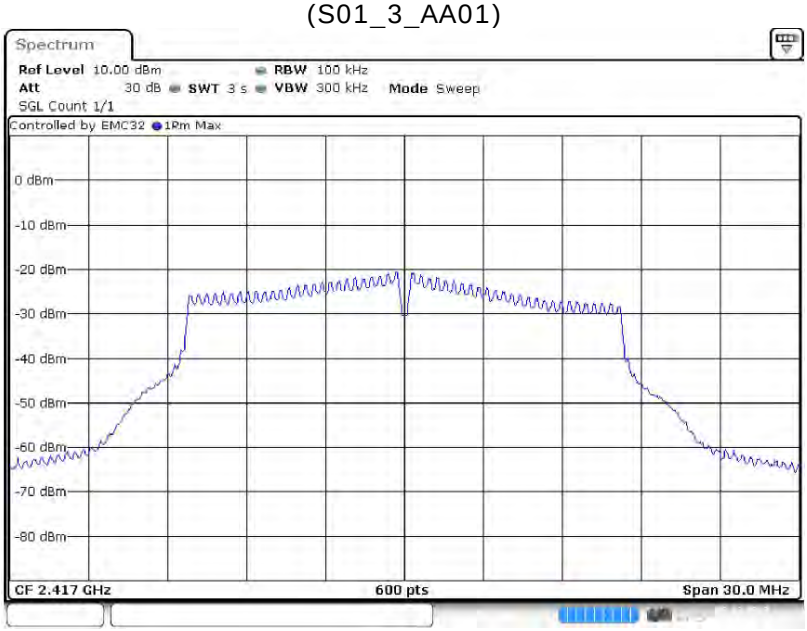
Radio Technology = WLAN b, Operating Frequency = high (S01_3_AA01)



Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)
2462.000000	2461.325000	1.773	8.0

Radio Technology = WLAN g, Operating Frequency = low (S01_3_AA01)

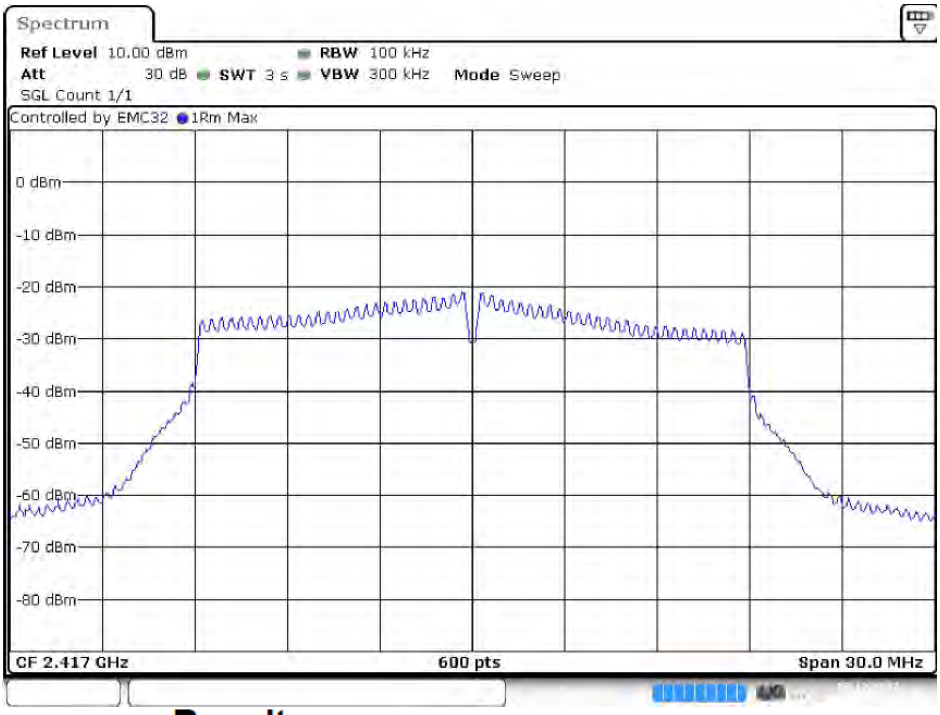


Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)
2417.000000	2416.725000	-2.053	8.0

WLAN g Ch. 2

Radio Technology = WLAN n 20 MHz, Operating Frequency = high (S01_3_AA01)



Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)
2417.000000	2416.675000	-2.309	8.0

WLAN n Ch. 2

4.9.5 TEST EQUIPMENT USED

- Radio Lab
- R&S TS8997
- Regulatory Bluetooth RF Test Solution

5 TEST EQUIPMENT

1 R&S TS8997
EN300328/301893 Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	SMB100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	107695	2017-07	2020-07
1.2	MFS	Rubidium Frequency Standard	Datum-Beverly	5489/001	2017-07	2018-07
1.3	1515 / 93459	Broadband Power Divider SMA (Aux)	Weinschel Associates	LN673		
1.4	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2016-02	2018-02
1.5	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2016-02	2018-02
1.6	VT 4002	Climatic Chamber	Vötsch	58566002150010	2016-03	2018-03
1.7	A8455-4	4 Way Power Divider (SMA)		-		
1.8	Opus10 THI (8152.00)	ThermoHygro Datalogger 03 (Environ)	Lufft Mess- und Regeltechnik GmbH	7482	2017-03	2019-03
1.9	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	259291	2016-10	2019-10
1.10	OSP120	Switching Unit with integrated power meter	Rohde & Schwarz	101158	2016-11	2018-11

2 Radiated Emissions
Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	NRV-Z1	Sensor Head A	Rohde & Schwarz	827753/005	2017-05	2018-05
2.2	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2017-10	2018-10
2.3	Opus10 TPR (8253.00)	ThermoAirpressure Datalogger 13 (Environ)	Lufft Mess- und Regeltechnik GmbH	13936	2017-04	2019-04
2.4	Anechoic Chamber	10.58 x 6.38 x 6.00 m^3	Frankonia	none	2016-05	2019-05
2.5	HL 562	Ultralog new biconicals	Rohde & Schwarz	830547/003	2015-06	2018-06
2.6	5HC2700/12750-1.5-KK	High Pass Filter	Trilithic	9942012		
2.7	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.8	Fully Anechoic Room	8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	2015-06	2018-06
2.9	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2016-02	2018-02
2.10	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
2.11	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2016-12	2018-12
2.12	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronic GmbH	00083069		
2.13	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright	09		
2.14	4HC1600/12750-1.5-KK	High Pass Filter	Trilithic	9942011		
2.15	Chroma 6404	AC Power Source	Chroma ATE INC.	64040001304		
2.16	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
2.17	TT 1.5 WI	Turn Table	Maturo GmbH	-		
2.18	HL 562 Ultralog	Log.-per. Antenna	Rohde & Schwarz	100609	2016-04	2019-04
2.19	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronic GmbH	00086675		
2.20	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008		
2.21	HFH2-Z2	Loop Antenna	Rohde & Schwarz	829324/006	2014-11	2017-11
2.22	Opus10 THI (8152.00)	ThermoHygro Datalogger 12 (Environ)	Lufft Mess- und Regeltechnik GmbH	12482	2017-03	2019-03
2.23	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2016-11	2018-11
2.24	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
2.25	AS 620 P	Antenna mast	HD GmbH	620/37		
2.26	Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	Maturo GmbH	TD1.5-10kg/024/3790709		
2.27	ESIB 26	Spectrum Analyzer	Rohde & Schwarz	830482/004	2015-12	2017-12
2.28	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
2.29	AM 4.0	Antenna mast	Maturo GmbH	AM4.0/180/11920513		
2.30	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2015-05	2018-05

3 Radio Lab

Conducted Radio Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.1	SMB100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	107695	2017-07	2020-07
3.2	MFS	Rubidium Frequency Standard	Datum-Beverly	5489/001	2017-07	2018-07
3.3	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2016-02	2018-02
3.4	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2016-02	2018-02
3.5	SMP03	Signal Generator 2 GHz - 27 GHz	Rohde & Schwarz	833680/003	2017-09	2020-09
3.6	FSIQ26	Signal Analyser	Rohde & Schwarz	840061/005	2017-05	2019-05
3.7	Chroma 6404	AC Power Source	Chroma ATE INC.	64040001304		
3.8	VT 4002	Climatic Chamber	Vötsch	58566002150010	2016-03	2018-03
3.9	WA1515	Broadband Power Divider SMA	Weinschel Associates	A855		
3.10	A8455-4	4 Way Power Divider (SMA)		-		
3.11	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	259291	2016-10	2019-10

4 Regulatory Bluetooth RF Test Solution

Regulatory Bluetooth RF Tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
4.1	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2017-10	2018-10
4.2	EX520	Digital Multimeter 12 (Multimeter)	Extech Instruments Corp	05157876	2016-02	2018-02
4.3	NRV Z1 A	Power Sensor	Rohde & Schwarz	832279/013	2017-09	2018-09
4.4	Opus10 THI (8152.00)	T/H Logger 15	Lufft Mess- und Regeltechnik GmbH	13985	2017-04	2019-04
4.5	TOCT Switching Unit		7layers, Inc.	040107		
4.6	KWP 120/70	Temperature Chamber Weiss 01	Weiss	59226012190010	2016-03	2018-03
4.7	ADU 200 Relay Box 7	used for automated testing (EMMI) only	Ontrak Control Systems Inc	A04380		

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
4.8	CBT	IL BT RF Test Solution	Rohde & Schwarz	100302	2017-02	2018-02
4.9	NRVD	Powermeter	Rohde & Schwarz	832025/059	2017-09	2018-09
4.10	FSIQ26	Signal Analyser	Rohde & Schwarz	832695/007	2016-09	2018-09
4.11	SMP02	Signal Generator SMP	Rohde & Schwarz	833286/0014	2016-05	2019-05
4.12	SMIQ03B	Signal Generator	Rohde & Schwarz	832870/017	2016-06	2019-06
4.13	CBT	Bluetooth Tester	Rohde & Schwarz	100589	2015-01	2018-01
4.14	NGSM 32/10	Power Supply	Rohde & Schwarz	2725	2017-06	2019-06

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

6 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

6.1 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

Frequency		Corr.	LISN insertion loss ESH3-Z5	cable loss (incl. 10 dB atten-uator)
MHz		dB	dB	dB
0.15		10.1	0.1	10.0
5		10.3	0.1	10.2
7		10.5	0.2	10.3
10		10.5	0.2	10.3
12		10.7	0.3	10.4
14		10.7	0.3	10.4
16		10.8	0.4	10.4
18		10.9	0.4	10.5
20		10.9	0.4	10.5
22		11.1	0.5	10.6
24		11.1	0.5	10.6
26		11.2	0.5	10.7
28		11.2	0.5	10.7
30		11.3	0.5	10.8

Sample calculation

U_{LISN} (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

6.2 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

Frequency	AF HFH-Z2)	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-40 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
0.009	20.50	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.01	20.45	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.015	20.37	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.02	20.36	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.025	20.38	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.03	20.32	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.05	20.35	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.08	20.30	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.1	20.20	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.2	20.17	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.3	20.14	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.49	20.12	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.490001	20.12	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.5	20.11	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.8	20.10	-39.6	0.1	0.1	0.1	0.1	-40	30	3
1	20.09	-39.6	0.1	0.1	0.1	0.1	-40	30	3
2	20.08	-39.6	0.1	0.1	0.1	0.1	-40	30	3
3	20.06	-39.6	0.1	0.1	0.1	0.1	-40	30	3
4	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
5	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
6	20.02	-39.5	0.2	0.1	0.1	0.1	-40	30	3
8	19.95	-39.5	0.2	0.1	0.1	0.1	-40	30	3
10	19.83	-39.4	0.2	0.1	0.2	0.1	-40	30	3
12	19.71	-39.4	0.2	0.1	0.2	0.1	-40	30	3
14	19.54	-39.4	0.2	0.1	0.2	0.1	-40	30	3
16	19.53	-39.3	0.3	0.1	0.2	0.1	-40	30	3
18	19.50	-39.3	0.3	0.1	0.2	0.1	-40	30	3
20	19.57	-39.3	0.3	0.1	0.2	0.1	-40	30	3
22	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
24	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
26	19.54	-39.3	0.3	0.1	0.2	0.1	-40	30	3
28	19.46	-39.2	0.3	0.1	0.3	0.1	-40	30	3
30	19.73	-39.1	0.4	0.1	0.3	0.1	-40	30	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

6.3 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

(d_{Limit} = 3 m)

Frequency	AF R&S HL562	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18.6	0.6	0.29	0.04	0.23	0.02	0.0	3	3
50	6.0	0.9	0.39	0.09	0.32	0.08	0.0	3	3
100	9.7	1.2	0.56	0.14	0.47	0.08	0.0	3	3
150	7.9	1.6	0.73	0.20	0.59	0.12	0.0	3	3
200	7.6	1.9	0.84	0.21	0.70	0.11	0.0	3	3
250	9.5	2.1	0.98	0.24	0.80	0.13	0.0	3	3
300	11.0	2.3	1.04	0.26	0.89	0.15	0.0	3	3
350	12.4	2.6	1.18	0.31	0.96	0.13	0.0	3	3
400	13.6	2.9	1.28	0.35	1.03	0.19	0.0	3	3
450	14.7	3.1	1.39	0.38	1.11	0.22	0.0	3	3
500	15.6	3.2	1.44	0.39	1.20	0.19	0.0	3	3
550	16.3	3.5	1.55	0.46	1.24	0.23	0.0	3	3
600	17.2	3.5	1.59	0.43	1.29	0.23	0.0	3	3
650	18.1	3.6	1.67	0.34	1.35	0.22	0.0	3	3
700	18.5	3.6	1.67	0.42	1.41	0.15	0.0	3	3
750	19.1	4.1	1.87	0.54	1.46	0.25	0.0	3	3
800	19.6	4.1	1.90	0.46	1.51	0.25	0.0	3	3
850	20.1	4.4	1.99	0.60	1.56	0.27	0.0	3	3
900	20.8	4.7	2.14	0.60	1.63	0.29	0.0	3	3
950	21.1	4.8	2.22	0.60	1.66	0.33	0.0	3	3
1000	21.6	4.9	2.23	0.61	1.71	0.30	0.0	3	3

(d_{Limit} = 10 m)

30	18.6	-9.9	0.29	0.04	0.23	0.02	-10.5	10	3
50	6.0	-9.6	0.39	0.09	0.32	0.08	-10.5	10	3
100	9.7	-9.2	0.56	0.14	0.47	0.08	-10.5	10	3
150	7.9	-8.8	0.73	0.20	0.59	0.12	-10.5	10	3
200	7.6	-8.6	0.84	0.21	0.70	0.11	-10.5	10	3
250	9.5	-8.3	0.98	0.24	0.80	0.13	-10.5	10	3
300	11.0	-8.1	1.04	0.26	0.89	0.15	-10.5	10	3
350	12.4	-7.9	1.18	0.31	0.96	0.13	-10.5	10	3
400	13.6	-7.6	1.28	0.35	1.03	0.19	-10.5	10	3
450	14.7	-7.4	1.39	0.38	1.11	0.22	-10.5	10	3
500	15.6	-7.2	1.44	0.39	1.20	0.19	-10.5	10	3
550	16.3	-7.0	1.55	0.46	1.24	0.23	-10.5	10	3
600	17.2	-6.9	1.59	0.43	1.29	0.23	-10.5	10	3
650	18.1	-6.9	1.67	0.34	1.35	0.22	-10.5	10	3
700	18.5	-6.8	1.67	0.42	1.41	0.15	-10.5	10	3
750	19.1	-6.3	1.87	0.54	1.46	0.25	-10.5	10	3
800	19.6	-6.3	1.90	0.46	1.51	0.25	-10.5	10	3
850	20.1	-6.0	1.99	0.60	1.56	0.27	-10.5	10	3
900	20.8	-5.8	2.14	0.60	1.63	0.29	-10.5	10	3
950	21.1	-5.6	2.22	0.60	1.66	0.33	-10.5	10	3
1000	21.6	-5.6	2.23	0.61	1.71	0.30	-10.5	10	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

6.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay + cable inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit, atten-uator & pre-amp)	cable loss 4 (to receiver)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24.4	-19.4	0.99	0.31	-21.51	0.79		
2000	28.5	-17.4	1.44	0.44	-20.63	1.38		
3000	31.0	-16.1	1.87	0.53	-19.85	1.33		
4000	33.1	-14.7	2.41	0.67	-19.13	1.31		
5000	34.4	-13.7	2.78	0.86	-18.71	1.40		
6000	34.7	-12.7	2.74	0.90	-17.83	1.47		
7000	35.6	-11.0	2.82	0.86	-16.19	1.46		

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (inside chamber)	cable loss 3 (outside chamber)	cable loss 4 (switch unit, atten-uator & pre-amp)	cable loss 5 (to receiver)	used for FCC 15.247
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31.0	-23.4	0.47	1.87	0.53	-27.58	1.33	
4000	33.1	-23.3	0.56	2.41	0.67	-28.23	1.31	
5000	34.4	-21.7	0.61	2.78	0.86	-27.35	1.40	
6000	34.7	-21.2	0.58	2.74	0.90	-26.89	1.47	
7000	35.6	-19.8	0.66	2.82	0.86	-25.58	1.46	

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (High Pass)	cable loss 3 (pre-amp)	cable loss 4 (inside chamber)	cable loss 5 (outside chamber)	cable loss 6 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35.6	-57.3	0.56	1.28	-62.72	2.66	0.94	1.46
8000	36.3	-56.3	0.69	0.71	-61.49	2.84	1.00	1.53
9000	37.1	-55.3	0.68	0.65	-60.80	3.06	1.09	1.60
10000	37.5	-56.2	0.70	0.54	-61.91	3.28	1.20	1.67
11000	37.5	-55.3	0.80	0.61	-61.40	3.43	1.27	1.70
12000	37.6	-53.7	0.84	0.42	-59.70	3.53	1.26	1.73
13000	38.2	-53.5	0.83	0.44	-59.81	3.75	1.32	1.83
14000	39.9	-56.3	0.91	0.53	-63.03	3.91	1.40	1.77
15000	40.9	-54.1	0.98	0.54	-61.05	4.02	1.44	1.83
16000	41.3	-54.1	1.23	0.49	-61.51	4.17	1.51	1.85
17000	42.8	-54.4	1.36	0.76	-62.36	4.34	1.53	2.00
18000	44.2	-54.7	1.70	0.53	-62.88	4.41	1.55	1.91

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

6.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

Frequency	AF EMCO 3160-09	Corr.
MHz	dB (1/m)	dB
18000	40.2	-23.5
18500	40.2	-23.2
19000	40.2	-22.0
19500	40.3	-21.3
20000	40.3	-20.3
20500	40.3	-19.9
21000	40.3	-19.1
21500	40.3	-19.1
22000	40.3	-18.7
22500	40.4	-19.0
23000	40.4	-19.5
23500	40.4	-19.3
24000	40.4	-19.8
24500	40.4	-19.5
25000	40.4	-19.3
25500	40.5	-20.4
26000	40.5	-21.3
26500	40.5	-21.1

cable loss 1 (inside chamber)	cable loss 2 (pre-amp)	cable loss 3 (inside chamber)	cable loss 4 (switch unit)	cable loss 5 (to receiver)
dB	dB	dB	dB	dB
0.72	-35.85	6.20	2.81	2.65
0.69	-35.71	6.46	2.76	2.59
0.76	-35.44	6.69	3.15	2.79
0.74	-35.07	7.04	3.11	2.91
0.72	-34.49	7.30	3.07	3.05
0.78	-34.46	7.48	3.12	3.15
0.87	-34.07	7.61	3.20	3.33
0.90	-33.96	7.47	3.28	3.19
0.89	-33.57	7.34	3.35	3.28
0.87	-33.66	7.06	3.75	2.94
0.88	-33.75	6.92	3.77	2.70
0.90	-33.35	6.99	3.52	2.66
0.88	-33.99	6.88	3.88	2.58
0.91	-33.89	7.01	3.93	2.51
0.88	-33.00	6.72	3.96	2.14
0.89	-34.07	6.90	3.66	2.22
0.86	-35.11	7.02	3.69	2.28
0.90	-35.20	7.15	3.91	2.36

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

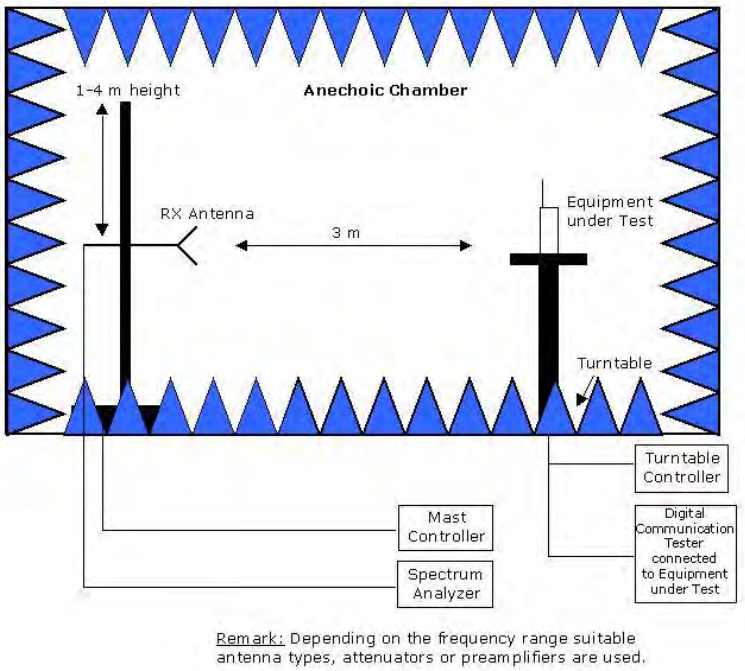
6.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

Frequency	AF EMCO 3160-10	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-15.6	3	0.5
27.0	43.4	-11.2	4.4				-15.6	3	0.5
28.0	43.4	-11.1	4.5				-15.6	3	0.5
29.0	43.5	-11.0	4.6				-15.6	3	0.5
30.0	43.5	-10.9	4.7				-15.6	3	0.5
31.0	43.5	-10.8	4.7				-15.6	3	0.5
32.0	43.5	-10.7	4.8				-15.6	3	0.5
33.0	43.6	-10.7	4.9				-15.6	3	0.5
34.0	43.6	-10.6	5.0				-15.6	3	0.5
35.0	43.6	-10.5	5.1				-15.6	3	0.5
36.0	43.6	-10.4	5.1				-15.6	3	0.5
37.0	43.7	-10.3	5.2				-15.6	3	0.5
38.0	43.7	-10.2	5.3				-15.6	3	0.5
39.0	43.7	-10.2	5.4				-15.6	3	0.5
40.0	43.8	-10.1	5.5				-15.6	3	0.5

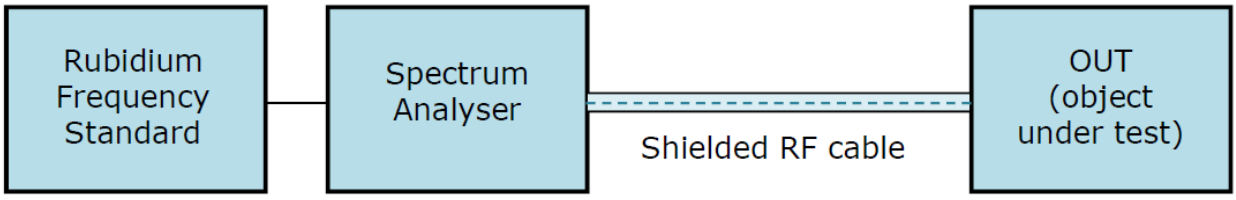
Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

7 SETUP DRAWINGS



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



Drawing 2: Setup for conducted radio tests.

8 MEASUREMENT UNCERTAINTIES

Test Case	Parameter	Uncertainty
AC Power Line	Power	± 3.4 dB
Field Strength of spurious radiation	Power	± 5.5 dB
6 dB / 26 dB / 99% Bandwidth	Power Frequency	± 2.9 dB ± 11.2 kHz
Conducted Output Power	Power	± 2.2 dB
Band Edge Compliance	Power Frequency	± 2.2 dB ± 11.2 kHz
Frequency Stability	Frequency	± 25 Hz
Power Spectral Density	Power	± 2.2 dB

9 PHOTO REPORT

Please see separate photo report.