

FCC Measurement/Technical Report on WLAN and Bluetooth module JODY-W2

FCC ID: XPYJODYW263
IC: 8595A-JODYW263

Test Report Reference: MDE_UBLOX_2008_FCC_02

Test Laboratory:

7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany



Deutsche
Akkreditierungsstelle
D-PL-12140-01-01
D-PL-12140-01-02
D-PL-12140-01-03

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.

7layers GmbH
Borsigstraße 11
40880 Ratingen, Germany
T +49 (0) 2102 749 0
F +49 (0) 2102 749 350

Geschäftsführer/
Managing Directors:
Frank Spiller
Bernhard Retka
Alexandre Norré-Oudard

Registergericht/registered:
Düsseldorf HRB 75554
USt-Id.-Nr./VAT-No. DE203159652
Steuer-Nr./TAX-No. 147/5869/0385

a Bureau Veritas
Group Company
www.7layers.com

Table of Contents

1	Applied Standards and Test Summary	3
1.1	Applied Standards	3
1.2	FCC-IC Correlation Table	4
1.3	Measurement Summary	5
2	Revision History / Signatures	10
3	Administrative Data	11
3.1	Testing Laboratory	11
3.2	Project Data	11
3.3	Applicant Data	11
3.4	Manufacturer Data	12
4	Test object Data	13
4.1	General EUT Description	13
4.2	EUT Main components	14
4.3	Ancillary Equipment	14
4.4	Auxiliary Equipment	15
4.5	EUT Setups	15
4.6	Operating Modes / Test Channels	16
4.7	Duty Cycle	17
4.8	Product labelling	18
5	Test Results	19
5.1	Conducted Emissions at AC Mains	19
5.2	Occupied Bandwidth (6 dB)	22
5.3	Occupied Bandwidth (99%)	27
5.4	Peak Power Output	32
5.5	Spurious RF Conducted Emissions	37
5.6	Transmitter Spurious Radiated Emissions	51
5.7	Band Edge Compliance Conducted	87
5.8	Band Edge Compliance Radiated	99
5.9	Power Density	110
6	Test Equipment	117
7	Antenna Factors, Cable Loss and Sample Calculations	120
7.1	LISN R&S ESH3-Z5 (150 kHz – 30 MHz)	120
7.2	Antenna R&S HFH2-Z2 (9 kHz – 30 MHz)	121
7.3	Antenna R&S HL562 (30 MHz – 1 GHz)	122
7.4	Antenna R&S HF907 (1 GHz – 18 GHz)	123
7.5	Antenna EMCO 3160-09 (18 GHz – 26.5 GHz)	124
7.6	Antenna EMCO 3160-10 (26.5 GHz – 40 GHz)	125
8	Measurement Uncertainties	126
9	Photo Report	127

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 (10-1-19 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:

The tests were selected and performed with reference to the FCC Public Notice "Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules, 558074 D01 15.247 Meas Guidance v05r02, 2019-04-02". ANSI C63.10-2013 is applied.

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 5: 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 5: 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 5: 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 5: 8.3
Receiver spurious emissions	–	–

1.3 MEASUREMENT SUMMARY

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

Conducted Emissions at AC Mains

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode	Setup	Date	FCC	IC
Operating mode, Connection to AC mains worst case, via ancillary/auxiliary equipment	S02_AK01_AC	2020-12-07	Passed	Passed

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

Occupied Bandwidth (6 dB)

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode	Setup	Date	FCC	IC
Radio Technology, Operating Frequency				
Bluetooth LE 1 Mbps, high	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 1 Mbps, low	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 1 Mbps, mid	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, high	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, low	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, mid	S02_AG01	2020-11-19	Passed	Passed
WLAN b, high	S02_AG01	2020-11-17	Passed	Passed
WLAN b, low	S02_AG01	2020-11-17	Passed	Passed
WLAN b, mid	S02_AG01	2020-11-17	Passed	Passed
WLAN g, high	S02_AG01	2020-11-19	Passed	Passed
WLAN g, low	S02_AG01	2020-11-19	Passed	Passed
WLAN g, mid	S02_AG01	2020-12-07	Passed	Passed
WLAN n 20 MHz, high	S02_AG01	2020-11-19	Passed	Passed
WLAN n 20 MHz, low	S02_AG01	2020-11-19	Passed	Passed
WLAN n 20 MHz, mid	S02_AG01	2020-12-07	Passed	Passed
WLAN n 40 MHz, high	S02_AH01	2020-12-17	Passed	Passed
WLAN n 40 MHz, low	S02_AH01	2020-12-17	Passed	Passed
WLAN n 40 MHz, mid	S02_AH01	2020-12-17	Passed	Passed

47 CFR CHAPTER I FCC PART 15 IC RSS-Gen & IC TRC-43; Ch. 6.7 & Ch. 8 Subpart C §15.247

Occupied Bandwidth (99%)

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode	Setup	Date	FCC	IC
Radio Technology, Operating Frequency				
Bluetooth LE 1 Mbps, high	S02_AG01	2020-11-19	N/A	Performed
Bluetooth LE 1 Mbps, low	S02_AG01	2020-11-19	N/A	Performed
Bluetooth LE 1 Mbps, mid	S02_AG01	2020-11-19	N/A	Performed
Bluetooth LE 2 Mbps, high	S02_AG01	2020-11-19	N/A	Performed
Bluetooth LE 2 Mbps, low	S02_AG01	2020-11-19	N/A	Performed
Bluetooth LE 2 Mbps, mid	S02_AG01	2020-11-19	N/A	Performed

47 CFR CHAPTER I FCC PART 15
Subpart C §15.247

IC RSS-Gen & IC TRC-43; Ch. 6.7 & Ch. 8

Occupied Bandwidth (99%)

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode	Setup	Date	FCC	IC
Radio Technology, Operating Frequency				
WLAN b, high	S02_AG01	2020-11-17	N/A	Performed
WLAN b, low	S02_AG01	2020-11-17	N/A	Performed
WLAN b, mid	S02_AG01	2020-11-17	N/A	Performed
WLAN g, high	S02_AG01	2020-11-19	N/A	Performed
WLAN g, low	S02_AG01	2020-11-19	N/A	Performed
WLAN g, mid	S02_AG01	2020-12-07	N/A	Performed
WLAN n 20 MHz, high	S02_AG01	2020-11-19	N/A	Performed
WLAN n 20 MHz, low	S02_AG01	2020-11-19	N/A	Performed
WLAN n 20 MHz, mid	S02_AG01	2020-12-07	N/A	Performed
WLAN n 40 MHz, high	S02_AH01	2020-12-17	N/A	Performed
WLAN n 40 MHz, low	S02_AH01	2020-12-17	N/A	Performed
WLAN n 40 MHz, mid	S02_AH01	2020-12-17	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	Setup	Date	FCC	IC
Radio Technology, Operating Frequency, Measurement method				
Bluetooth LE 1 Mbps, high, conducted	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 1 Mbps, low, conducted	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 1 Mbps, mid, conducted	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, high, conducted	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, low, conducted	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, mid, conducted	S02_AG01	2020-11-19	Passed	Passed
WLAN b, high, conducted	S02_AG01	2020-11-17	Passed	Passed
WLAN b, low, conducted	S02_AG01	2020-11-17	Passed	Passed
WLAN b, mid, conducted	S02_AG01	2020-11-17	Passed	Passed
WLAN g, high, conducted	S02_AG01	2020-11-19	Passed	Passed
WLAN g, low, conducted	S02_AG01	2020-11-19	Passed	Passed
WLAN g, mid, conducted	S02_AG01	2020-12-07	Passed	Passed
WLAN n 20 MHz, high, conducted	S02_AG01	2020-11-19	Passed	Passed
WLAN n 20 MHz, low, conducted	S02_AG01	2020-11-19	Passed	Passed
WLAN n 20 MHz, mid, conducted	S02_AG01	2020-12-07	Passed	Passed
WLAN n 40 MHz, high, conducted	S02_AH01	2020-12-17	Passed	Passed
WLAN n 40 MHz, low, conducted	S02_AH01	2020-12-17	Passed	Passed
WLAN n 40 MHz, mid, conducted	S02_AH01	2020-12-17	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart C §15.247

§ 15.247 (d)

Spurious RF Conducted Emissions

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode	Setup	Date	FCC	IC
Radio Technology, Operating Frequency				
Bluetooth LE 1 Mbps, high	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 1 Mbps, low	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 1 Mbps, mid	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, high	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, low	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, mid	S02_AG01	2020-11-19	Passed	Passed
WLAN b, high	S02_AG01	2020-11-17	Passed	Passed
WLAN b, low	S02_AG01	2020-11-17	Passed	Passed
WLAN b, mid	S02_AG01	2020-11-17	Passed	Passed
WLAN g, high	S02_AG01	2020-11-19	Passed	Passed
WLAN g, low	S02_AG01	2020-11-19	Passed	Passed
WLAN g, mid	S02_AG01	2020-12-07	Passed	Passed
WLAN n 20 MHz, high	S02_AG01	2020-11-19	Passed	Passed
WLAN n 20 MHz, low	S02_AG01	2020-11-19	Passed	Passed
WLAN n 20 MHz, mid	S02_AG01	2020-12-07	Passed	Passed
WLAN n 40 MHz, high	S02_AH01	2020-12-17	Passed	Passed
WLAN n 40 MHz, low	S02_AH01	2020-12-17	Passed	Passed
WLAN n 40 MHz, mid	S02_AH01	2020-12-17	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart C §15.247

§ 15.247 (d)

Transmitter Spurious Radiated Emissions

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode	Setup	Date	FCC	IC
Radio Technology, Operating Frequency, Measurement range				
Bluetooth LE 1 Mbps, high, 1 GHz - 26 GHz Remark: Tested in Bluetooth Classic GFSK mode	S01_AK01	2020-11-23	Passed	Passed
Bluetooth LE 1 Mbps, high, 30 MHz - 1 GHz Remark: Tested in Bluetooth Classic GFSK mode	S01_AK01	2020-11-25	Passed	Passed
Bluetooth LE 1 Mbps, low, 1 GHz - 26 GHz Remark: Tested in Bluetooth Classic GFSK mode	S01_AK01	2020-11-23	Passed	Passed
Bluetooth LE 1 Mbps, low, 30 MHz - 1 GHz Remark: Tested in Bluetooth Classic GFSK mode	S01_AK01	2020-11-25	Passed	Passed
Bluetooth LE 1 Mbps, mid, 1 GHz - 26 GHz Remark: Tested in Bluetooth Classic GFSK mode	S01_AK01	2020-11-23	Passed	Passed
Bluetooth LE 1 Mbps, mid, 30 MHz - 1 GHz Remark: Tested in Bluetooth Classic GFSK mode	S01_AK01	2020-11-25	Passed	Passed
Bluetooth LE 1 Mbps, mid, 9 kHz - 30 MHz Remark: Tested in Bluetooth Classic GFSK mode	S01_AK01	2020-11-25	Passed	Passed
WLAN b, high, 1 GHz - 26 GHz	S01_AK01	2020-11-19	Passed	Passed
WLAN b, high, 30 MHz - 1 GHz	S01_AK01	2020-11-25	Passed	Passed
WLAN b, low, 1 GHz - 26 GHz	S01_AC01	2020-09-25	Passed	Passed
WLAN b, low, 30 MHz - 1 GHz	S01_AK01	2020-11-25	Passed	Passed

47 CFR CHAPTER I FCC PART 15
Subpart C §15.247

§ 15.247 (d)

Transmitter Spurious Radiated Emissions

The measurement was performed according to ANSI C63.10

Final Result

OP-Mode Radio Technology, Operating Frequency, Measurement range	Setup	Date	FCC	IC
WLAN b, mid, 1 GHz - 26 GHz	S01_AK01	2020-11-19	Passed	Passed
WLAN b, mid, 30 MHz - 1 GHz	S01_AK01	2020-11-25	Passed	Passed
WLAN b, mid, 9 kHz - 30 MHz	S01_AK01	2020-11-25	Passed	Passed
WLAN g, high, 1 GHz - 26 GHz Remark: Only higher power channel 10 tested	S01_AK01	2020-12-03	Passed	Passed
WLAN g, low, 1 GHz - 26 GHz Remark: Tested in range 1 - 8 GHz	S01_AK01	2020-12-03	Passed	Passed
WLAN g, mid, 1 GHz - 26 GHz Remark: Tested in range 1 - 8 GHz	S01_AK01	2020-12-07	Passed	Passed
WLAN n 20 MHz, high, 1 GHz - 26 GHz Remark: Only higher power channel 10 tested in range 1 - 8 GHz	S01_AK01	2020-12-03	Passed	Passed
WLAN n 20 MHz, low, 1 GHz - 26 GHz Remark: Tested in range 1 - 8 GHz	S01_AK01	2020-12-03	Passed	Passed
WLAN n 20 MHz, mid, 1 GHz - 26 GHz Remark: Tested in range 1 - 8 GHz	S01_AK01	2020-12-07	Passed	Passed
WLAN n 40 MHz, high, 1 GHz - 26 GHz Remark: Tested in range 1 - 8 GHz	S01_AK01	2020-12-17	Passed	Passed
WLAN n 40 MHz, low, 1 GHz - 26 GHz Remark: Tested in range 1 - 8 GHz	S01_AK01	2020-12-17	Passed	Passed
WLAN n 40 MHz, mid, 1 GHz - 26 GHz Remark: Tested in range 1 - 8 GHz	S01_AK01	2020-12-17	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	Date	FCC	IC
Bluetooth LE 1 Mbps, high, high	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 1 Mbps, low, low	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, high, high	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, low, low	S02_AG01	2020-11-19	Passed	Passed
WLAN b, high, high	S02_AG01	2020-11-17	Passed	Passed
WLAN b, low, low	S02_AG01	2020-11-17	Passed	Passed
WLAN g, high, high	S02_AG01	2020-12-07	Passed	Passed
WLAN g, low, low	S02_AG01	2020-12-07	Passed	Passed
WLAN n 20 MHz, high, high	S02_AG01	2020-12-07	Passed	Passed
WLAN n 20 MHz, low, low	S02_AG01	2020-12-07	Passed	Passed
WLAN n 40 MHz, high, high	S02_AH01	2020-12-17	Passed	Passed
WLAN n 40 MHz, low, low	S02_AH01	2020-12-17	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	Setup	Date	FCC	IC
Radio Technology, Operating Frequency, Band Edge				
Bluetooth LE 1 Mbps, high, high	S01_AK01	2020-11-23	Passed	Passed
Bluetooth LE 2 Mbps, high, high	S01_AK01	2020-11-23	Passed	Passed
WLAN b, high, high	S01_AK01	2020-11-19	Passed	Passed
WLAN g, high, high	S01_AK01	2020-11-19	Passed	Passed
WLAN n 20 MHz, high, high	S01_AK01	2020-12-03	Passed	Passed
WLAN n 40 MHz, high, high	S01_AK01	2020-12-17	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	Setup	Date	FCC	IC
Radio Technology, Operating Frequency				
Bluetooth LE 1 Mbps, high	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 1 Mbps, low	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 1 Mbps, mid	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, high	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, low	S02_AG01	2020-11-19	Passed	Passed
Bluetooth LE 2 Mbps, mid	S02_AG01	2020-11-19	Passed	Passed
WLAN b, high	S02_AG01	2020-11-17	Passed	Passed
WLAN b, low	S02_AG01	2020-11-17	Passed	Passed
WLAN b, mid	S02_AG01	2020-11-17	Passed	Passed
WLAN g, high	S02_AG01	2020-11-19	Passed	Passed
WLAN g, low	S02_AG01	2020-11-19	Passed	Passed
WLAN g, mid	S02_AG01	2020-12-07	Passed	Passed
WLAN n 20 MHz, high	S02_AG01	2020-11-19	Passed	Passed
WLAN n 20 MHz, low	S02_AG01	2020-11-19	Passed	Passed
WLAN n 20 MHz, mid	S02_AG01	2020-12-07	Passed	Passed
WLAN n 40 MHz, high	S02_AH01	2020-12-17	Passed	Passed
WLAN n 40 MHz, low	S02_AH01	2020-12-17	Passed	Passed
WLAN n 40 MHz, mid	S02_AH01	2020-12-17	Passed	Passed

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

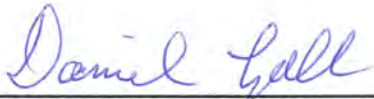
2 REVISION HISTORY / SIGNATURES

Report version control			
Version	Release date	Change Description	Version validity
initial	2020-12-21	--	valid
--	--	--	--

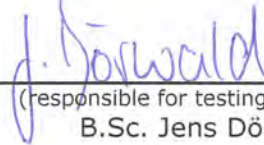
COMMENT: -



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



(responsible for accreditation scope)
Dipl.-Ing. Daniel Gall



(responsible for testing and report)
B.Sc. Jens Dörwald

3 ADMINISTRATIVE DATA

3.1 TESTING LABORATORY

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

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no: DAKKS D-PL-12140-01-01 | -02 | -03
FCC Designation Number: DE0015
FCC Test Firm Registration: 929146
ISED CAB Identifier: DE0007; ISED#: 3699A
Responsible for accreditation scope: Dipl.-Ing. Daniel Gall
Report Template Version: 2020-06-15

3.2 PROJECT DATA

Responsible for testing and report: B.Sc. Jens Dörwald
Employees who performed the tests: documented internally at 7Layers
Date of Report: 2020-12-21
Testing Period: 2020-09-25 to 2020-12-17

3.3 APPLICANT DATA

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

3.4 MANUFACTURER DATA

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

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	Host-based module with Wi-Fi and Bluetooth 5.0
Product name	JODY-W263-01A
Type	JODY-W263-01A
Declared EUT data by the supplier	
Voltage Type	DC
Voltage Level	1.8 and 3.3 V at Module (voltage is generated on the auxiliary carrier board, which is supplied by SDIO from the computer board for conducted tests or external power supply at 5 or 12 V for radiated tests. For AC conducted emissions the module was supplied directly by a laboratory power supply)
Antenna / Gain	External single band antenna with 2.2 dBi max. gain in the relevant 2.4 GHz ISM band for Bluetooth and external dual band antenna with 2.5 dBi max. gain in the relevant 2.4 GHz ISM band for WLAN
Tested Modulation Type	BT LE: GFSK WLAN: WLANb: DSSS, WLANg,n: OFDM
Specific product description for the EUT	The EUT is a Bluetooth and WLAN module. In the 2.4 GHz band it supports SISO Mode only. Supported technologies are Bluetooth Classic, Bluetooth Low Energy and WLAN b, g, n, ac Relevant for this report is Bluetooth Low Energy and WLAN. The Bluetooth Low Energy transmitter supports 1 and 2 Mbps, the WLAN transmitter supports WLAN b, g and n in 20 MHz BW as well as n in 40 MHz BW. 20 MHz channels 12 and 13 as well as 40 MHz channels 10 and 11 are not supported.
EUT ports (connected cables during testing):	Enclosure Data DC Power Antenna
Tested datarates	BT LE: 1 Mbps, 2 Mbps WLAN: WLAN b: 1 Mbps, WLAN g: 6 Mbps, WLAN n: MCS0
Special software used for testing	The test modes were set by the software "labtool" provided by the applicant on an auxiliary computer board.

4.2 EUT MAIN COMPONENTS

Sample Name	Sample Code	Description
EUT ac01	DE1015121ac01	
Sample Parameter	Value	
Serial No.	E98CCF957E012240300	
HW Version	00	
SW Version	16.80.205.p164	
Comment		

Sample Name	Sample Code	Description
EUT ag01	DE1015121ag01	
Sample Parameter	Value	
Serial No.	E98CCF957E012280300	
HW Version	00	
SW Version	16.80.205.p164	
Comment		

Sample Name	Sample Code	Description
EUT ak01	DE1015121ah01	
Sample Parameter	Value	
Serial No.	E98CCF957E012740300	
HW Version	00	
SW Version	16.80.205.p164	
Comment		

Sample Name	Sample Code	Description
EUT ak01	DE1015121ak01	
Sample Parameter	Value	
Serial No.	E98CCF957E011080300	
HW Version	00	
SW Version	16.80.205.p164	
Comment		

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

4.3 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
Antenna 1	Linx, ANT-DB1-RAF-RPS, -, -, -	Dual band antenna used for WLAN
Antenna 2	Linx, ANT-2.4-CW-RCT-RP, -, -, -	Single band antenna for Bluetooth in the 2.4 GHz ISM band

4.4 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, Type Model, HW, SW, S/N)	Description
AUX2	Toradex, Ixora, V 1.2a, Angstrom v2017.12 Apalis-TK1_console-Image 2.8b5 20200801, 10629806	Board Computer
AUX4	UBLOX, JODY-Carrier Board, Rev. C, - , 10000001914323016001	Carrier Board for module providing ports
AUX6	UBLOX, JODY-Carrier Board , Rev. C, - , 10000001898798003001	Carrier Board for module providing ports
AUX7	UBLOX, JODY-Carrier Board , Rev. C, - , 10000001914323007002	Carrier Board for module providing ports
AUX10	Toradex, Ixora, V 1.2a, Angstrom v2017.12 Apalis-TK1_console-Image 2.8b5 20200801, 10629857	Board Computer
AUX7I1	Agilent, E3631A, -, -, MY40018563	120 V 60 Hz AC laboratory power supply

4.5 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
S02_AG01	EUT ag01, AUX6, AUX2,	Conducted Setup
S01_AC01	EUT ac01, AUX4, Antenna 1, Antenna 2	Radiated Setup
S02_AH01	EUT ah01, AUX2, AUX6,	Conducted Setup
S01_AK01	EUT ak01, AUX7, Antenna 1, Antenna 2	Radiated Setup
S02_AK01_AC	EUT ak01, AUX7, AUX7I1, AUX10; Antenna 1, Antenna 2	AC conducted emissions Setup

4.6 OPERATING MODES / TEST CHANNELS

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

WLAN

20 MHz Test Channels:

Channel:

Frequency [MHz]

2.4 GHz ISM 2400 - 2483.5 MHz		
low	mid	high
1 / 2 ¹⁾	6	10 / 11 ¹⁾
2412 / 2417	2437	2457 / 2462

40 MHz Test Channels:

Channel:

Frequency [MHz]

low	mid	high
3 / 4 ²⁾	6	8 / 9 ²⁾
2422 / 2427	2437	2447 / 2452

BT LE Test Channels:

Channel:

Frequency [MHz]

2.4 GHz ISM 2400 - 2483.5 MHz		
low	mid	high
0	19	39
2402	2440	2480

- 1) Since the channels have different power settings, for g and n mode also the second highest and lowest channel was tested.
- 2) Since the channels have different power settings, also the second highest and at least the second lowest channel was tested.

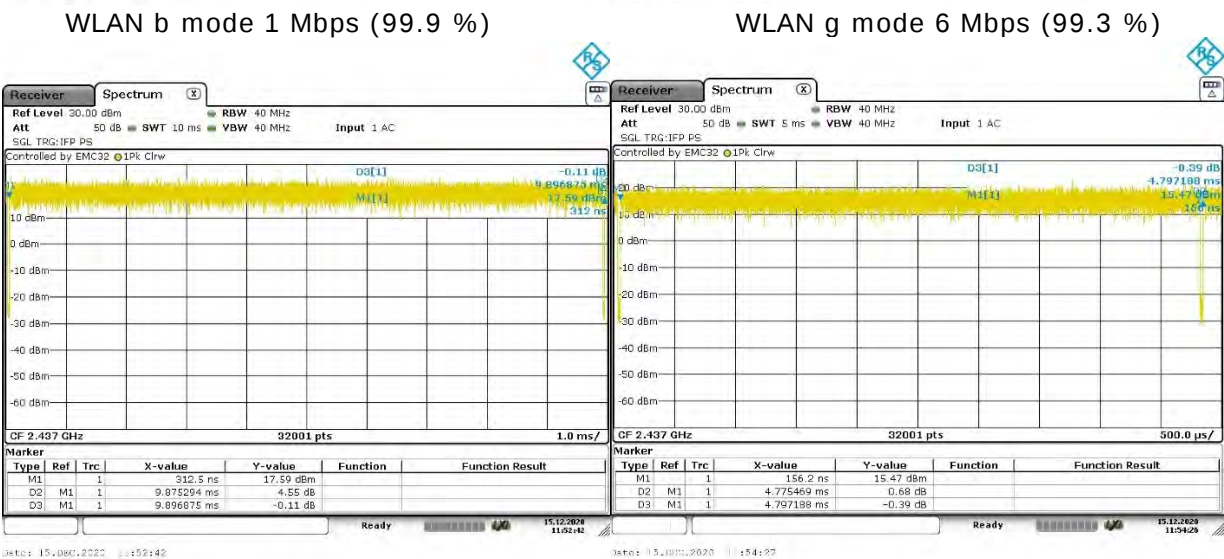
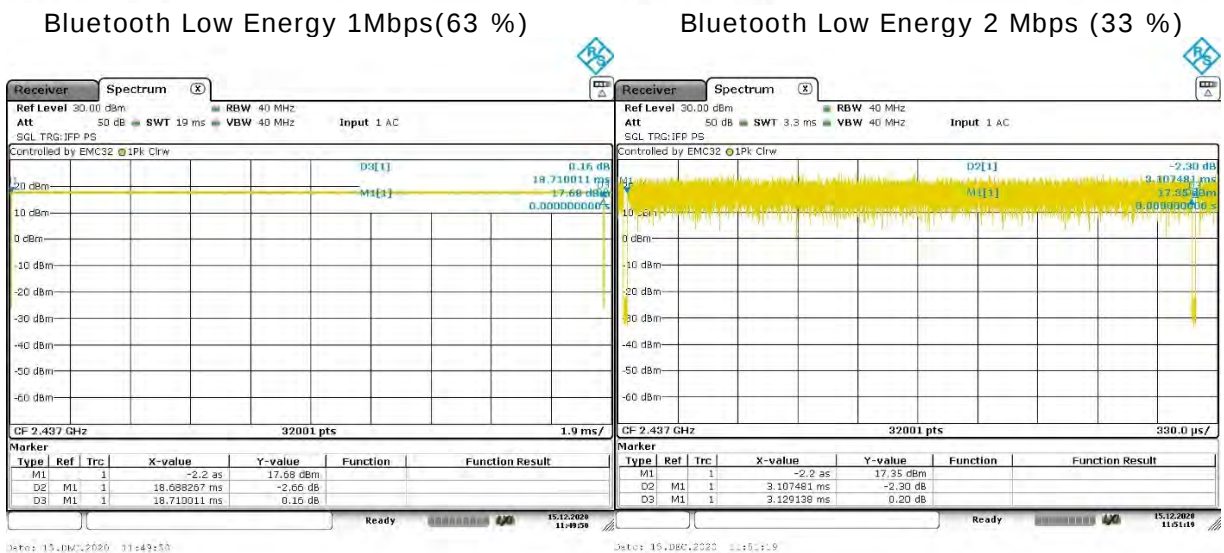
Output Power Settings:

Bluetooth Low Energy: EUT's predefined Output Power used

WLAN:

Channel	1	2	3	4	5	6	7	8	9	10	11
Frequency	2412	2417	2422	2427	2432	2437	2442	2447	2452	2457	2462
WLAN b	12	12	12	12	12	12	12	12	12	12	12
WLAN g	11	16	16	16	16	16	16	16	16	16	11
WLAN n 20	11	16	16	16	16	16	16	16	16	16	11
WLAN n 40	-	-	10	11	12	13	13	13	12	-	-

4.7 DUTY CYCLE



4.8 PRODUCT LABELLING

4.8.1 FCC ID LABEL

Please refer to the documentation of the applicant.

4.8.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

5 TEST RESULTS

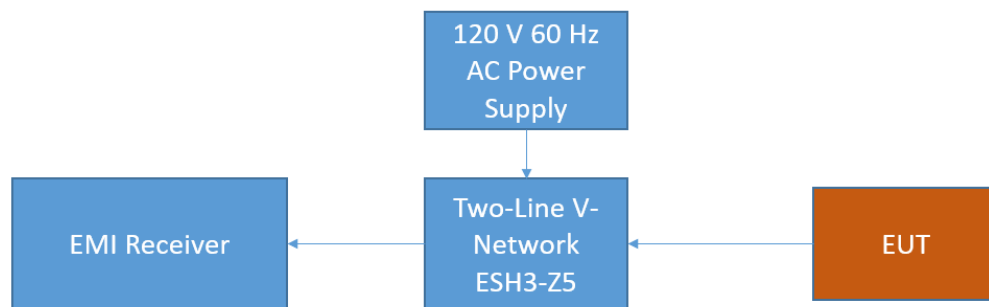
5.1 CONDUCTED EMISSIONS AT AC MAINS

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.1.1 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 50 μ H || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.



FCC Conducted Emissions on AC

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 & (CISPR) Average

- 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.

5.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.207

Frequency (MHz)	QP Limits (dBμV)	AV Limits (dBμV)
0.15 – 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

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

5.1.3 TEST PROTOCOL

Temperature: 22 °C
Air Pressure: 994 hPa
Humidity: 33 %

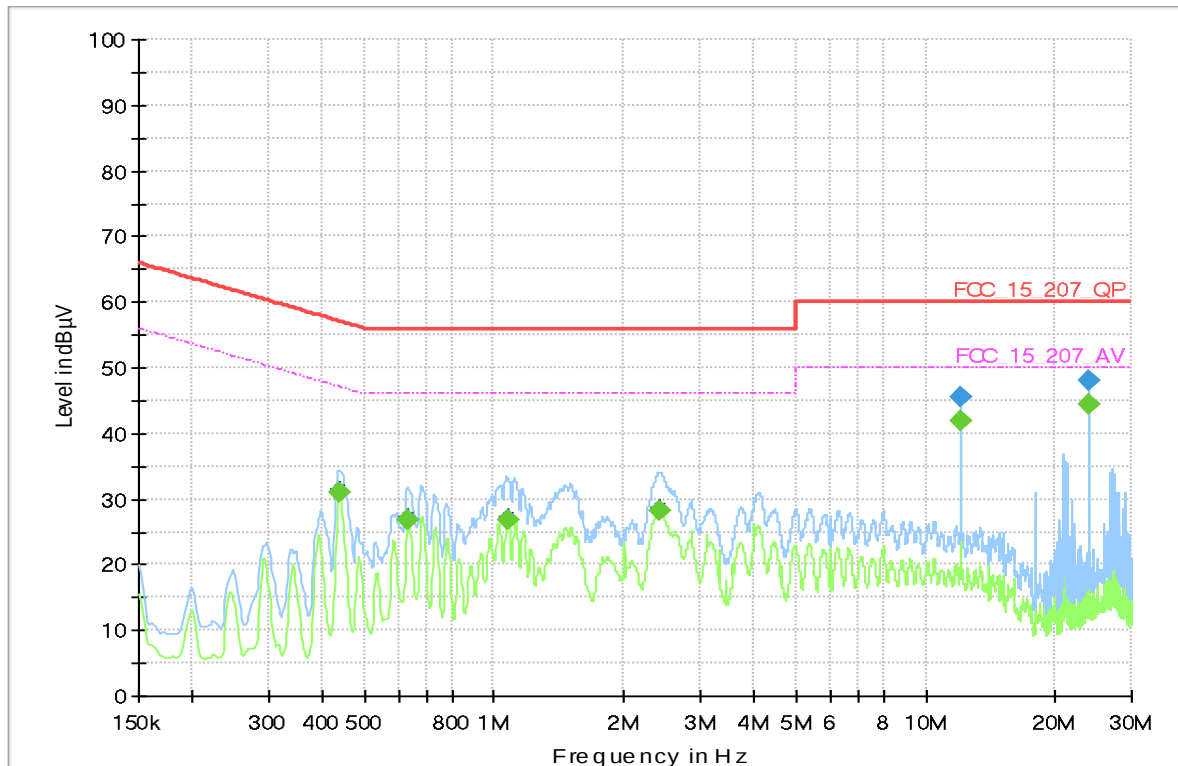
Power line	PE	Frequency [MHz]	Measured value QP [dBμV]	Measured value AV [dBμV]	Limit [dBμV]	Margin [dB]
L1	GND	12.005	-	42.0	50.0	8.0
L1	FLO	24.009	-	44.4	50.0	5.6

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

5.1.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Operating mode = worst case, Connection to AC mains = via ancillary/auxiliary equipment (S02_AK01)

Test Standard: FCC §15.207, ANSI C63.10
 Operating Conditions: 120 V 60 Hz, WLAN n 20 MHz MCS 0 2437 MHz
 Legend: Trace: blue = QP, green = CISPR AV; Star: red or blue = critical frequency; Rhombus: blue = final QP, green = final CISPR AV
 Tested Port / used LISN: AC mains => 1st LISN ESH3-Z5
 Termination of other ports: N/A, AC of AUX => 2nd LISN ESH3-Z5 +50 Ohm



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.438000	---	31.08	47.10	16.02	1000.0	9.000	L1	FLO	10.1
0.633750	---	26.94	46.00	19.06	1000.0	9.000	L1	FLO	10.1
1.072500	---	26.87	46.00	19.13	1000.0	9.000	L1	FLO	10.1
2.418000	---	28.27	46.00	17.73	1000.0	9.000	L1	FLO	10.2
12.005250	---	42.01	50.00	7.99	1000.0	9.000	L1	GND	10.7
12.005250	45.53	---	60.00	14.47	1000.0	9.000	L1	GND	10.7
24.009000	---	44.36	50.00	5.64	1000.0	9.000	L1	FLO	11.2
24.009000	47.97	---	60.00	12.03	1000.0	9.000	L1	FLO	11.2

5.1.5 TEST EQUIPMENT USED

- Conducted Emissions FCC

5.2 OCCUPIED BANDWIDTH (6 DB)

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.2.1 TEST DESCRIPTION

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

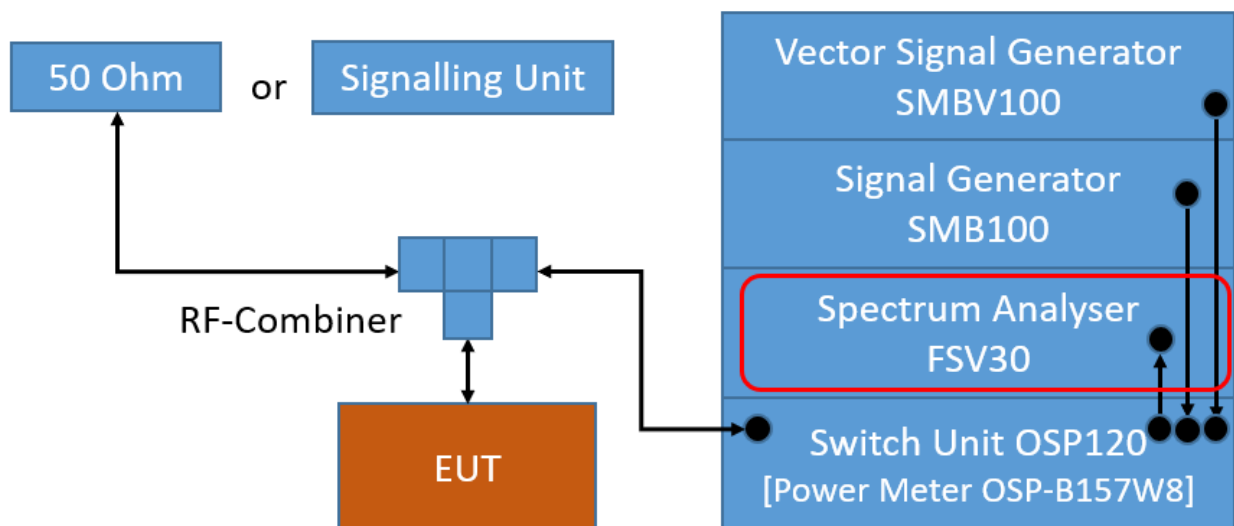
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The results recorded were measured with the modulation which produce the worst-case (smallest) emission bandwidth.

The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

Analyser settings:

- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Span: Two times nominal bandwidth
- Trace: Maxhold
- Sweeps: Till stable (min. 500, max. 15000)
- Sweep time: Auto
- Detector: Peak



TS8997; Channel Bandwidth

5.2.2 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.

5.2.3 TEST PROTOCOL

Ambient temperature: 25 °C
Air Pressure: 1020 hPa
Humidity: 30 %
BT LE 1 Mbit/s

Band / Mode	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	0	2402	0.729	0.5	0.229
	19	2440	0.745	0.5	0.245
	39	2480	0.745	0.5	0.245

BT LE 2 Mbit/s

Band / Mode	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	0	2402	1.184	0.5	0.684
	19	2440	1.184	0.5	0.684
	39	2480	1.184	0.5	0.684

Ambient temperature: 25 °C
Air Pressure: 1017 hPa
Humidity: 35 %
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	10.2	0.5	9.7
	6	2437	10.2	0.5	9.7
	11	2462	10.2	0.5	9.7

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	16.5	0.5	16.0
	2	2417	16.5	0.5	16.0
	6	2437	16.5	0.5	16.0
	10	2457	16.5	0.5	16.0
	11	2462	16.5	0.5	16.0

WLAN n-Mode; 20 MHz; MCS0

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	1	2412	17.7	0.5	17.2
	2	2417	17.7	0.5	17.2
	6	2437	17.7	0.5	17.2
	11	2462	17.7	0.5	17.2
	11	2462	17.7	0.5	17.2

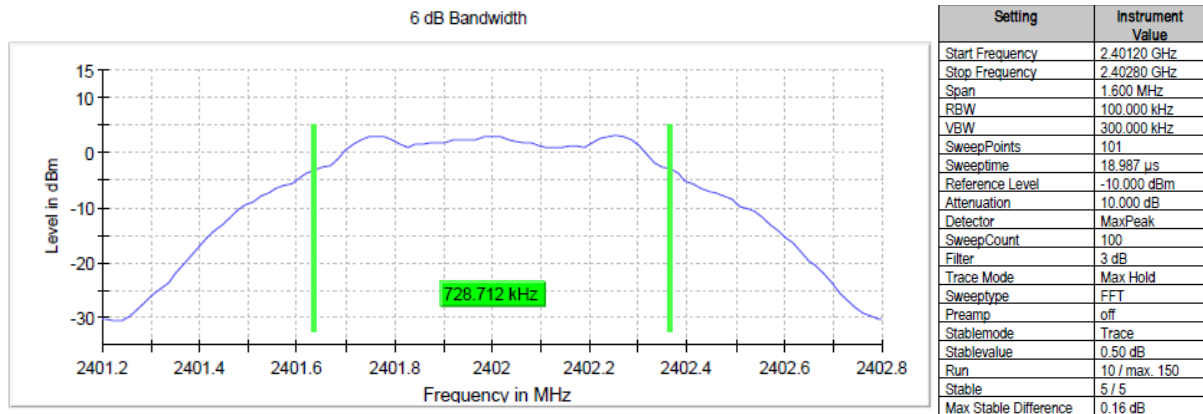
WLAN n-Mode; 40 MHz; MCS0

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [MHz]	Limit [MHz]	Margin to Limit [MHz]
2.4 GHz ISM	3	2422	36.1	0.5	35.6
	4	2427	36.1	0.5	35.6
	6	2437	36.1	0.5	35.6
	8	2447	35.9	0.5	35.4
	9	2452	36.1	0.5	35.6

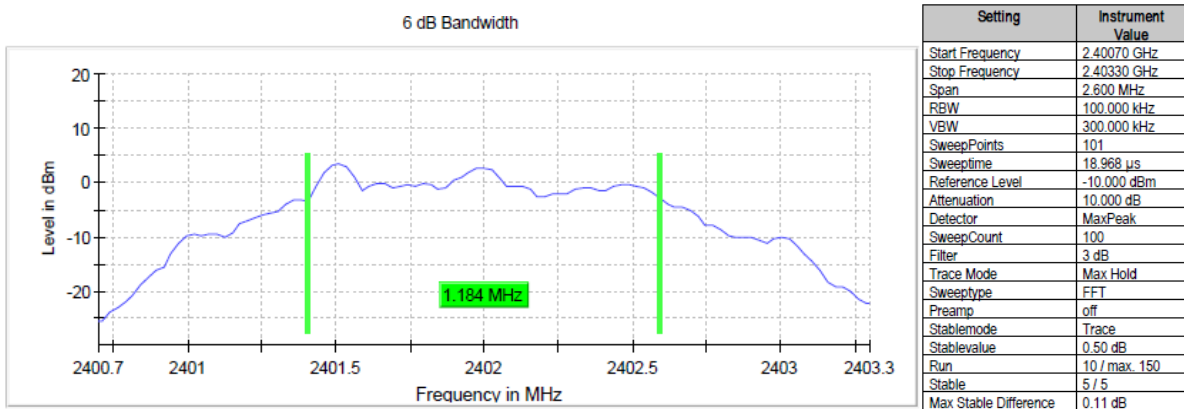
Remark: Please see next sub-clause for the measurement plot.

5.2.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

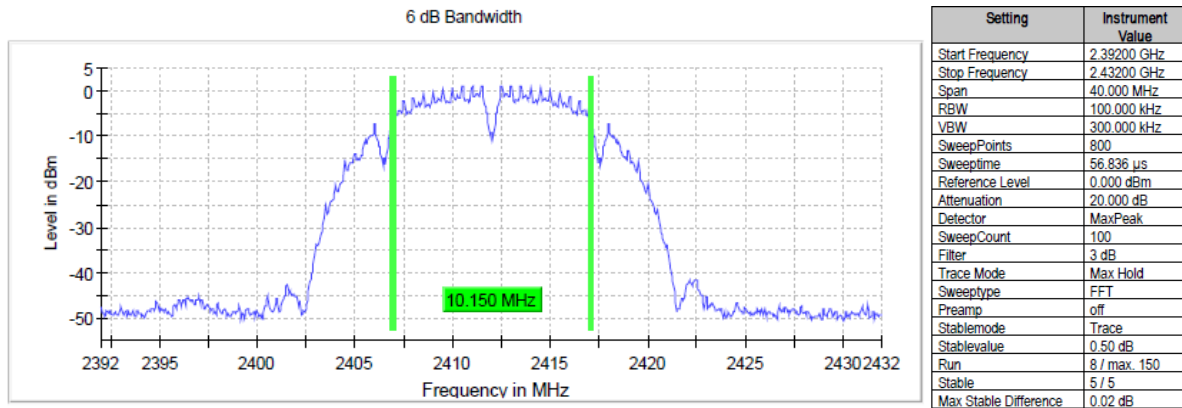
Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = low
(S02_AG01)



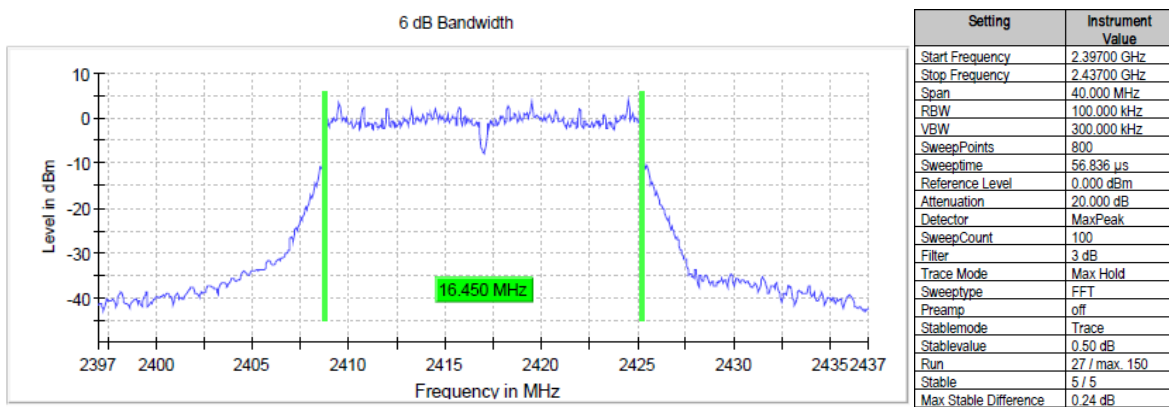
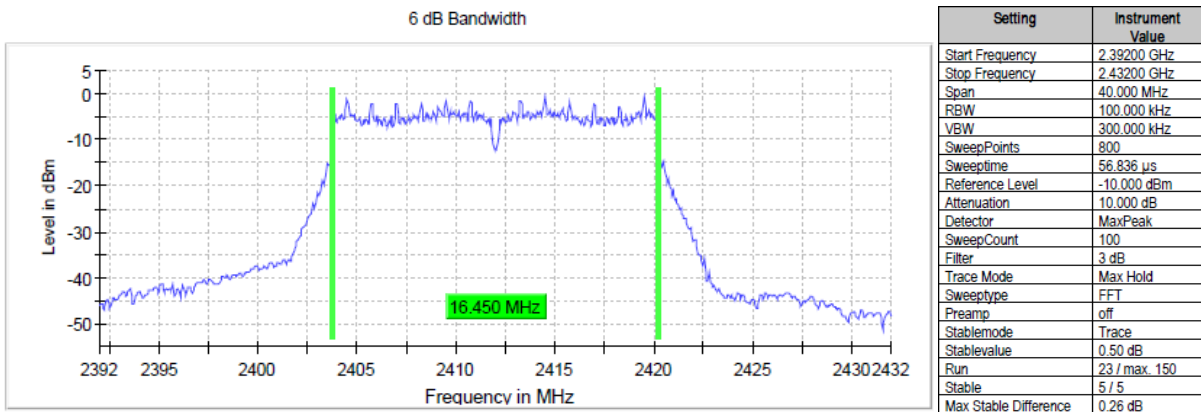
Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = low
(S02_AG01)



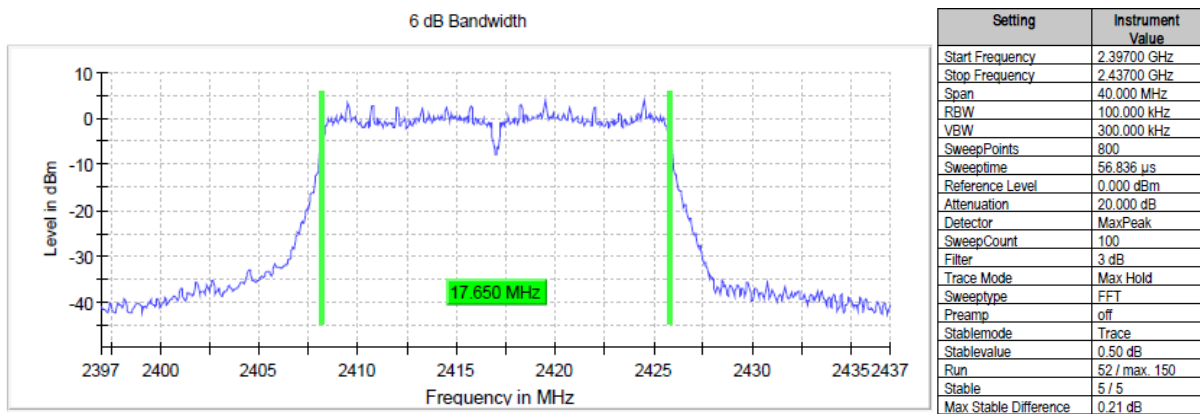
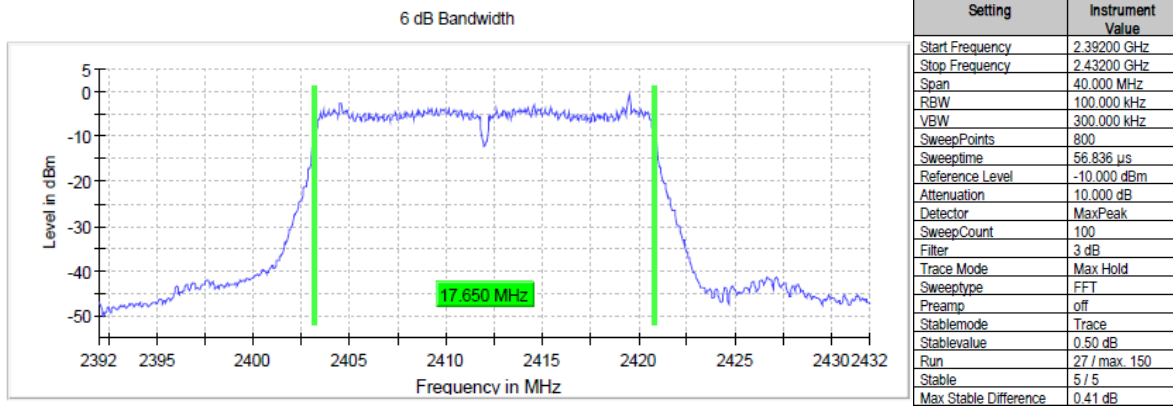
Radio Technology = WLAN b, Operating Frequency = low
(S02_AG01)



Radio Technology = WLAN g, Operating Frequency = low
(S02_AG01)



Radio Technology = WLAN n 20 MHz, Operating Frequency = low
(S02_AG01)



Radio Technology = WLAN n 40 MHz, Operating Frequency = high
(S02_AH01)



5.2.5 TEST EQUIPMENT USED

- R&S TS8997

5.3 OCCUPIED BANDWIDTH (99%)

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.3.1 TEST DESCRIPTION

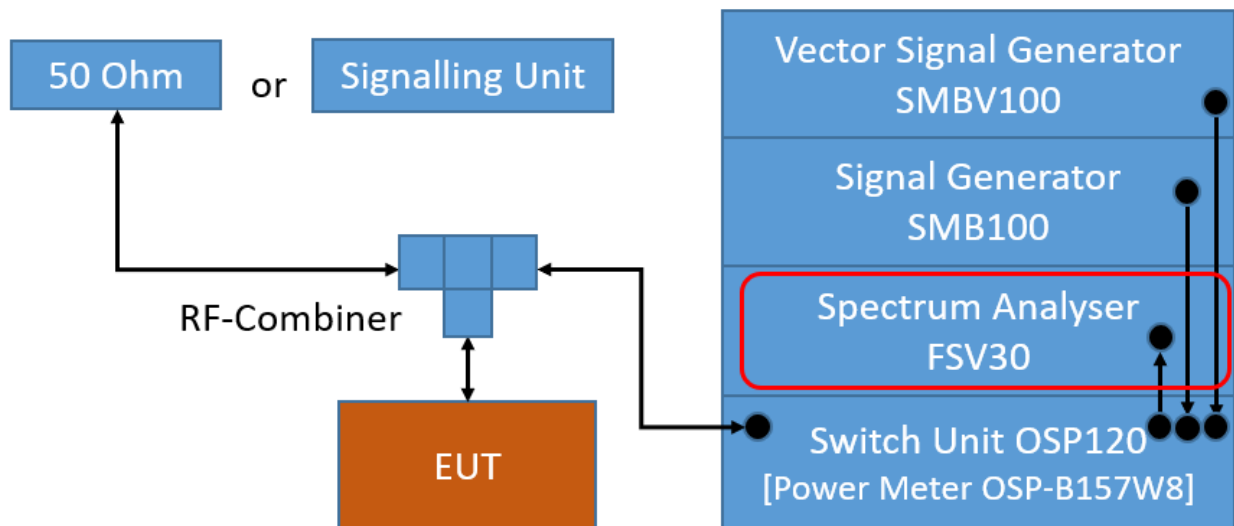
The Equipment Under Test (EUT) was set up to perform the occupied bandwidth measurements.

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 the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

Analyser settings:

- Resolution Bandwidth (RBW): 1 to 5 % of the OBW
- Video Bandwidth (VBW): ≥ 3 times the RBW
- Span: 1.5 to 5 times the OBW
- Trace: Maxhold
- Sweeps: Till stable (min. 500, max. 75000)
- Sweep time: Auto
- Detector: Peak



TS8997; Channel Bandwidth

5.3.2 TEST REQUIREMENTS / LIMITS

No applicable limit.

5.3.3 TEST PROTOCOL

Ambient temperature: 25 °C
 Air Pressure: 1020 hPa
 Humidity: 30 %
 BT LE 1 Mbit/s

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	0	2402	1.020
	19	2440	1.020
	39	2480	1.020

BT LE 2 Mbit/s

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	0	2402	2.040
	19	2440	2.040
	39	2480	2.040

Ambient temperature: 25 °C
 Air Pressure: 1017 hPa
 Humidity: 35 %
 WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	1	2412	13.3
	6	2437	13.4
	11	2462	13.4

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

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	1	2412	16.7
	2	2417	16.7
	6	2437	16.7
	10	2457	16.7
	11	2462	16.7

WLAN n-Mode; 20 MHz; MCS0

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	1	2412	17.7
	2	2417	17.7
	6	2437	17.8
	10	2457	17.7
	11	2462	17.7

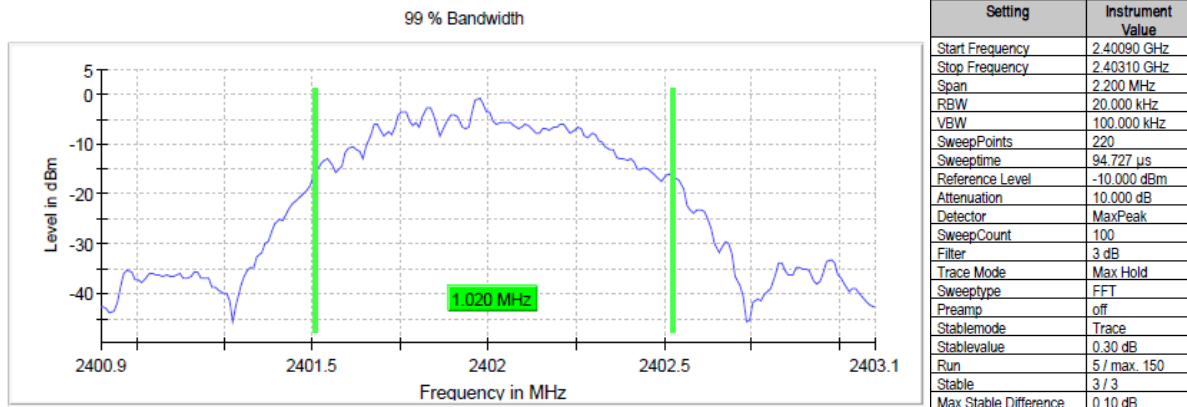
WLAN n-Mode; 40 MHz; MCS0

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [MHz]
2.4 GHz ISM	3	2422	36.3
	4	2427	36.5
	6	2437	36.3
	8	2447	36.3
	9	2452	36.3

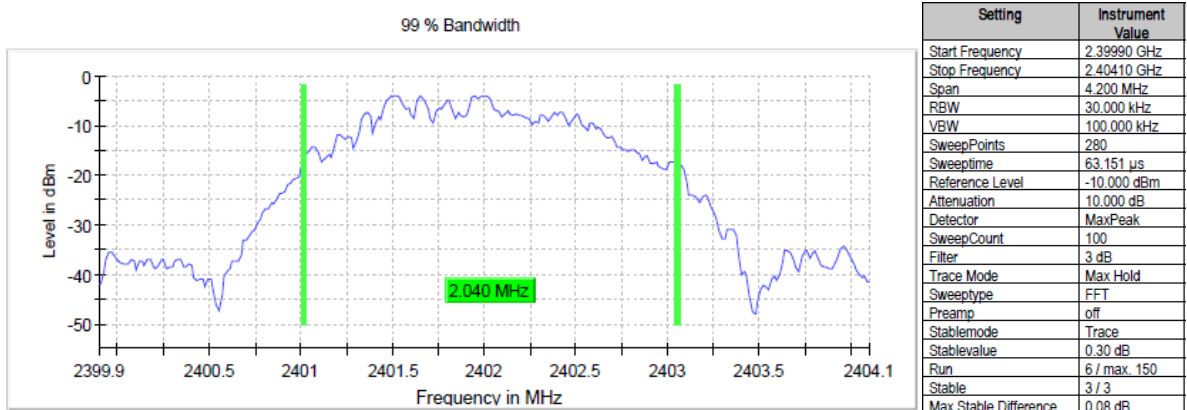
Remark: Please see next sub-clause for the measurement plot.

5.3.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

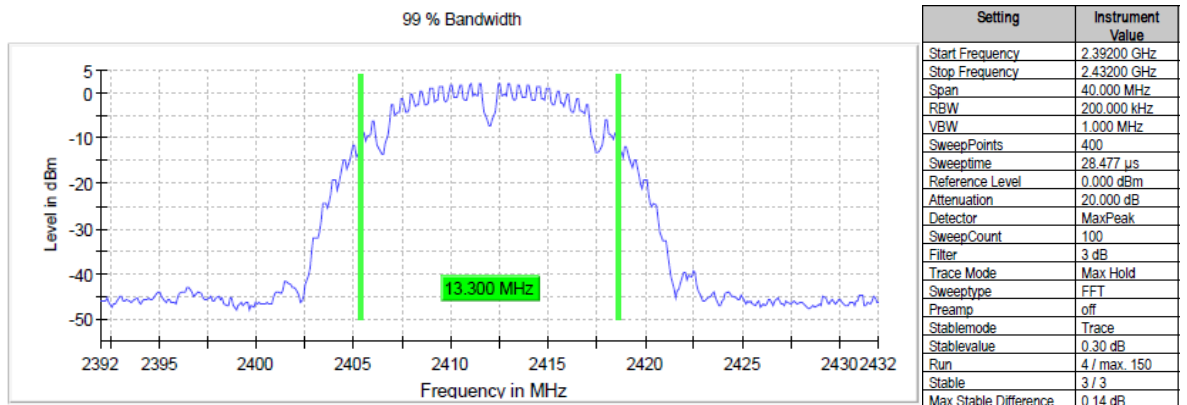
Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = low
(S02_AG01)



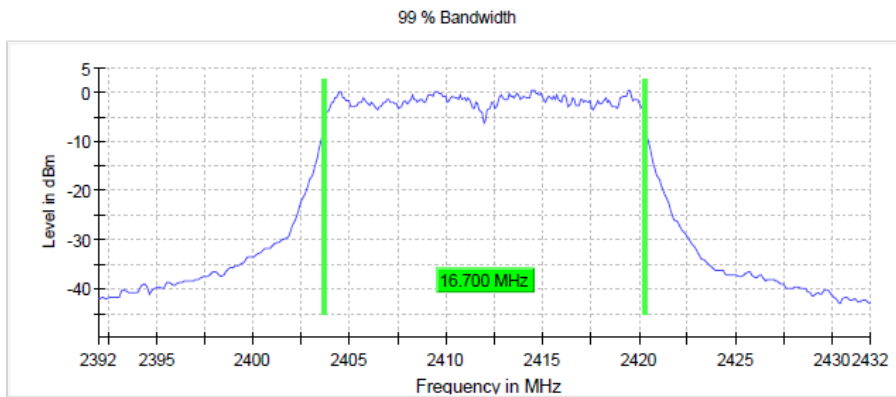
Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = low
(S02_AG01)



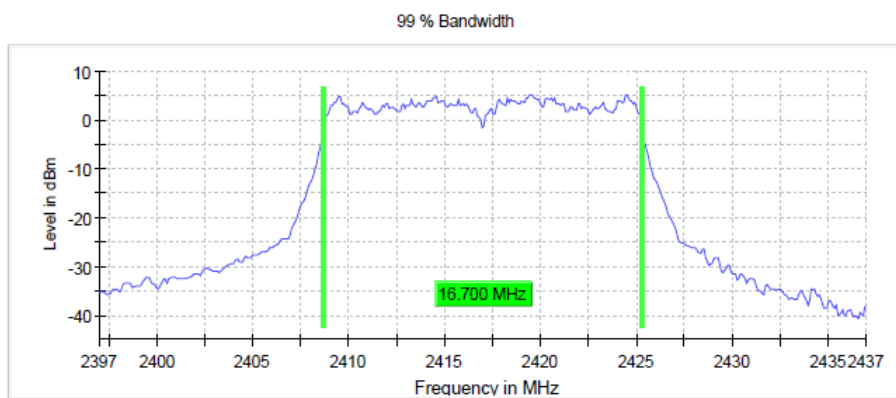
Radio Technology = WLAN b, Operating Frequency = low
(S02_AG01)



Radio Technology = WLAN g, Operating Frequency = low
(S02_AG01)

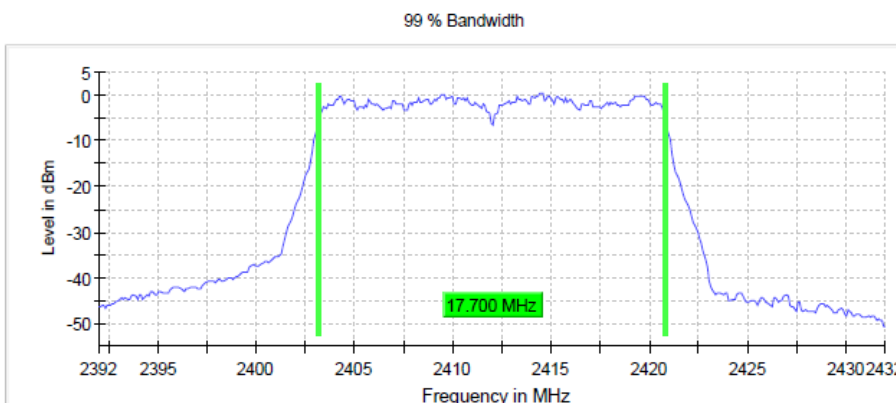


Setting	Instrument Value
Start Frequency	2.39200 GHz
Stop Frequency	2.43200 GHz
Span	40.000 MHz
RBW	200.000 kHz
VBW	1.000 MHz
SweepPoints	400
SweepTime	28.477 μ s
Reference Level	-10.000 dBm
Attenuation	10.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	FFT
Preamplifier	off
Stablemode	Trace
Stablevalue	0.30 dB
Run	33 / max. 150
Stable	3 / 3
Max Stable Difference	0.26 dB

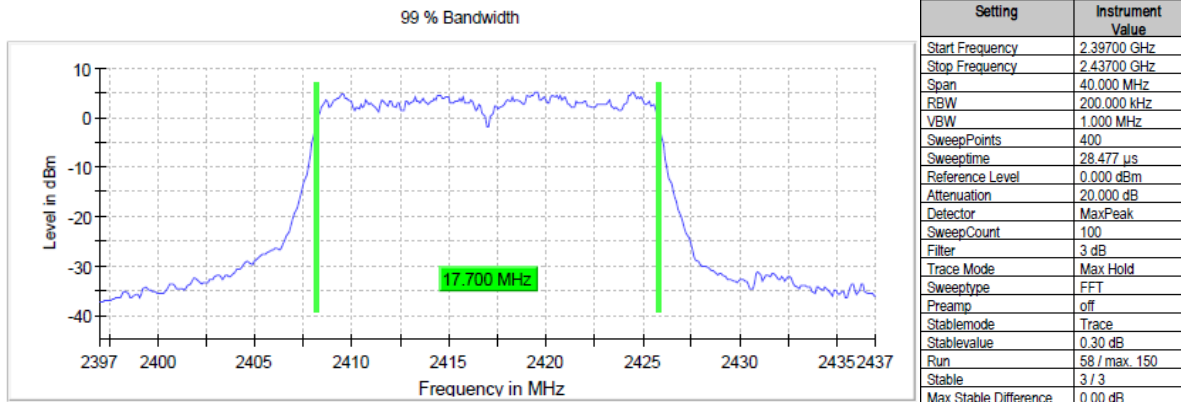


Setting	Instrument Value
Start Frequency	2.39700 GHz
Stop Frequency	2.43700 GHz
Span	40.000 MHz
RBW	200.000 kHz
VBW	1.000 MHz
SweepPoints	400
SweepTime	28.477 μ s
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	FFT
Preamplifier	off
Stablemode	Trace
Stablevalue	0.30 dB
Run	43 / max. 150
Stable	3 / 3
Max Stable Difference	0.00 dB

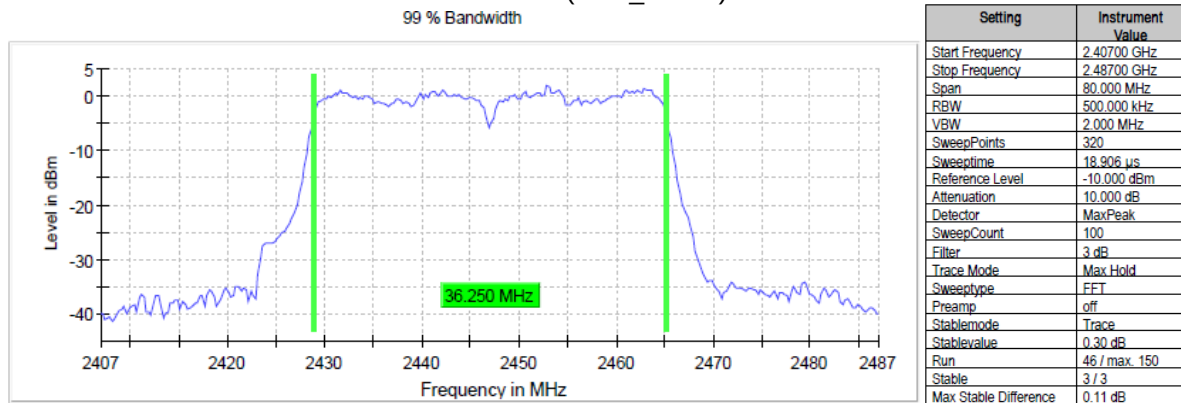
Radio Technology = WLAN n 20 MHz, Operating Frequency = low
(S02_AG01)



Setting	Instrument Value
Start Frequency	2.39200 GHz
Stop Frequency	2.43200 GHz
Span	40.000 MHz
RBW	200.000 kHz
VBW	1.000 MHz
SweepPoints	400
SweepTime	28.477 μ s
Reference Level	-10.000 dBm
Attenuation	10.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	FFT
Preamplifier	off
Stablemode	Trace
Stablevalue	0.30 dB
Run	32 / max. 150
Stable	3 / 3
Max Stable Difference	0.00 dB



Radio Technology = WLAN n 40 MHz, Operating Frequency = high
(S02_AH01)



5.3.5 TEST EQUIPMENT USED

- R&S TS8997

5.4 PEAK POWER OUTPUT

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.4.1 TEST DESCRIPTION

DTS EQUIPMENT:

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.

Maximum peak conducted output power (e.g. Bluetooth Low Energy):

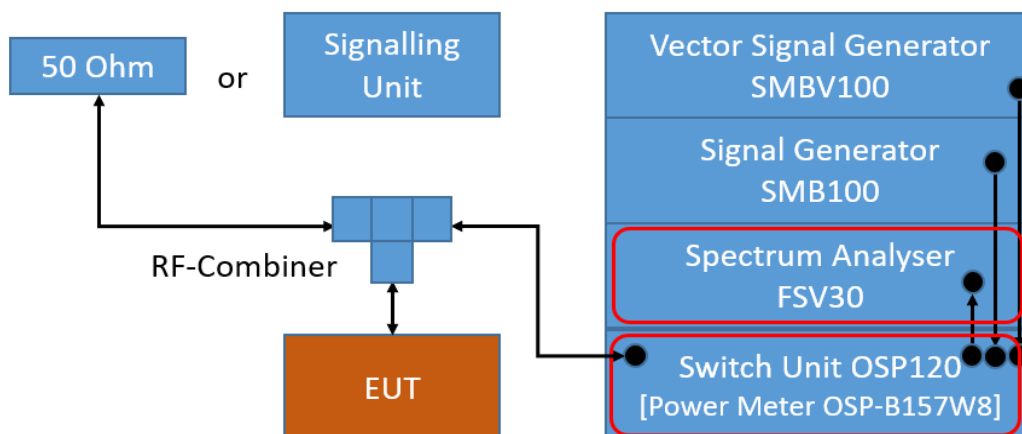
The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered. The reference level of the spectrum analyser was set higher than the output power of the EUT.

Analyser settings:

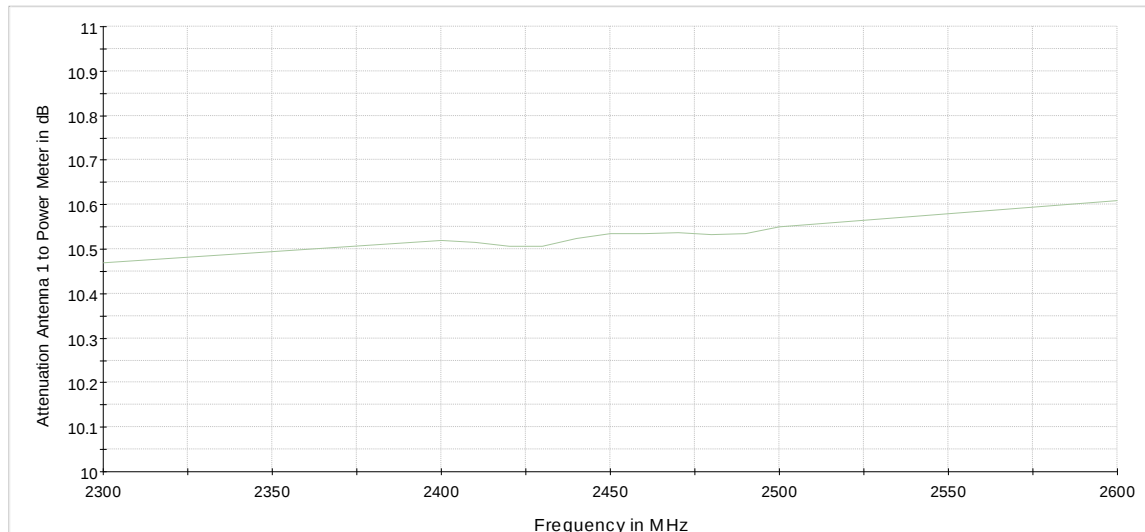
- Resolution Bandwidth (RBW): $\geq$ DTS bandwidth
- Video Bandwidth (VBW): $\geq$ 3 times RBW or maximum of analyzer
- Span: $\geq$ 3 times RBW
- Trace: Maxhold
- Sweeps: Till stable (min. 300, max. 15000)
- Sweep time: Auto
- Detector: Peak

Maximum conducted average output power (e.g. WLAN):

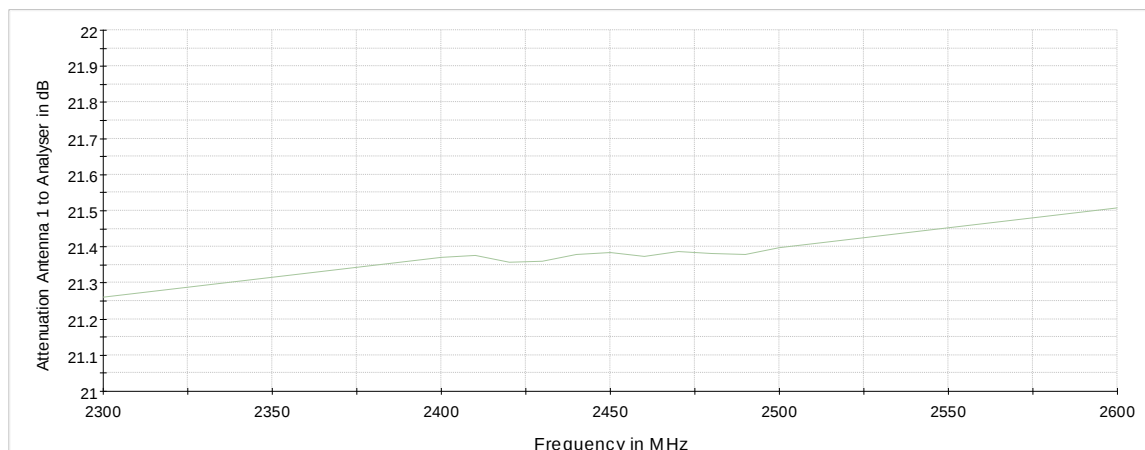
The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered. Measurement is performed using the gated RF average power meter integrated in the OSP 120 module OSP-B157W8 with signal bandwidth > 300 MHz.



TS8997; Output Power



Attenuation of the measurement path to Power Meter



Attenuation of the measurement path to Analyser

5.4.2 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: $\text{Limit (dBm)} = 10 \log (\text{Limit (W)}/1\text{mW})$

5.4.3 TEST PROTOCOL

Ambient temperature: 25 °C
 Air Pressure: 1020 hPa
 Humidity: 30 %
 BT LE 1 Mbit/s

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	3.7	30.0	26.3	5.9
	19	2440	3.7	30.0	26.3	5.9
	39	2480	3.8	30.0	26.2	6.0

BT LE 2 Mbit/s

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	3.7	30.0	26.3	5.9
	19	2440	3.8	30.0	26.2	6.0
	39	2480	3.9	30.0	26.1	6.1

Ambient temperature: 25 °C
 Air Pressure: 1017 hPa
 Humidity: 35 %
 WLAN b-Mode; 20 MHz; 1 Mbit/s

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	1	2412	11.2	30.0	18.8	13.7
	6	2437	11.5	30.0	18.5	14.0
	11	2462	11.7	30.0	18.3	14.2

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

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	1	2412	10.6	30.0	19.4	13.1
	2	2417	15.1	30.0	14.9	17.6
	6	2437	15.3	30.0	14.7	17.8
	10	2457	15.4	30.0	14.6	17.9
	11	2462	10.9	30.0	19.1	13.4

WLAN n-Mode; 20 MHz; MCS0

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	1	2412	10.6	30.0	19.4	13.1
	2	2417	15.3	30.0	14.7	17.8
	6	2437	15.6	30.0	14.4	18.1
	10	2457	15.7	30.0	14.3	18.2
	11	2462	11.1	30.0	18.9	13.6

WLAN n-Mode; 40 MHz; MCS0

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	3	2422	7.2	30.0	22.8	9.7
	4	2427	8.3	30.0	21.7	10.8
	5	2432	9.5	30.0	20.5	12.0
	6	2437	10.7	30.0	19.3	13.2
	8	2447	10.7	30.0	19.3	13.2
	9	2452	9.7	30.0	20.3	12.2

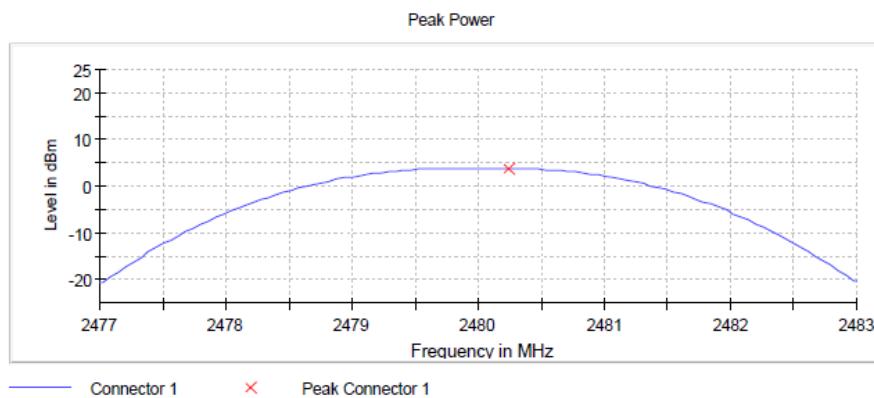
Remark: Please see next sub-clause for the measurement plot.
 No plots are provided for WLAN (power meter measurement).

5.4.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = high, Measurement method = conducted (S02_AG01)

Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	3.8	30.0	PASS

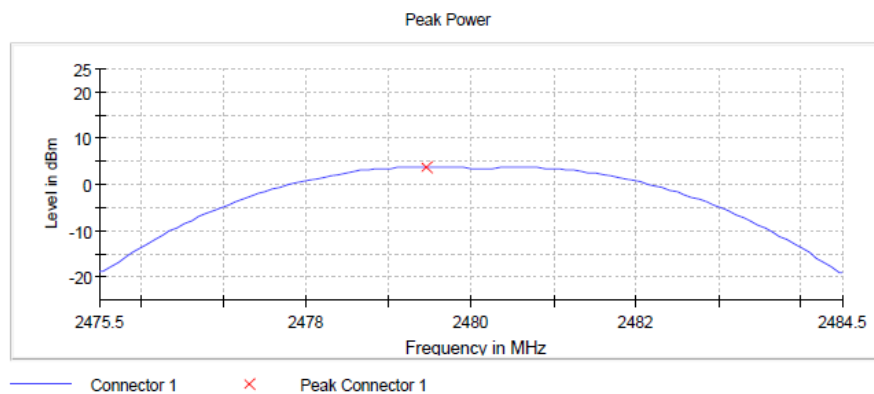


Setting	Instrument Value
Start Frequency	2.47700 GHz
Stop Frequency	2.48300 GHz
Span	6.000 MHz
RBW	2.000 MHz
VBW	10.000 MHz
SweepPoints	101
SweepTime	953.450 ns
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	FFT
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	4 / max. 150
Stable	3 / 3
Max Stable Difference	0.02 dB

Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = high, Measurement method = conducted (S02_AG01)

Result

DUT Frequency (MHz)	Peak Power (dBm)	Limit Max (dBm)	Result
2480.000000	3.9	30.0	PASS



Setting	Instrument Value
Start Frequency	2.47550 GHz
Stop Frequency	2.48450 GHz
Span	9.000 MHz
RBW	3.000 MHz
VBW	10.000 MHz
SweepPoints	101
SweepTime	1.271 us
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	FFT
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	5 / max. 150
Stable	3 / 3
Max Stable Difference	0.03 dB

5.4.5 TEST EQUIPMENT USED

- R&S TS8997

5.5 SPURIOUS RF CONDUCTED EMISSIONS

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.5.1 TEST DESCRIPTION

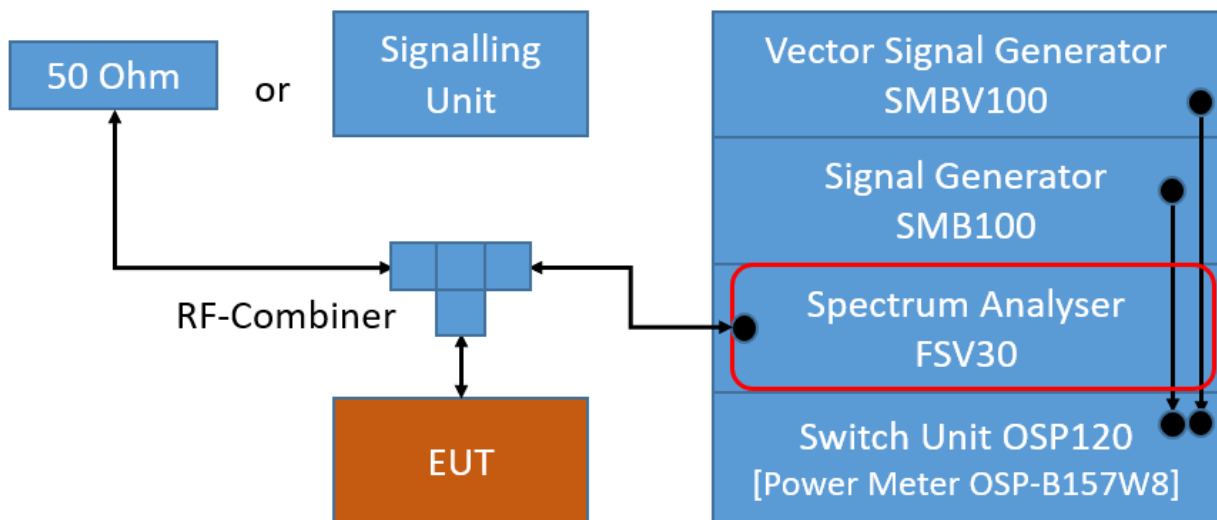
The Equipment Under Test (EUT) was set up to perform the spurious emissions measurements.

The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

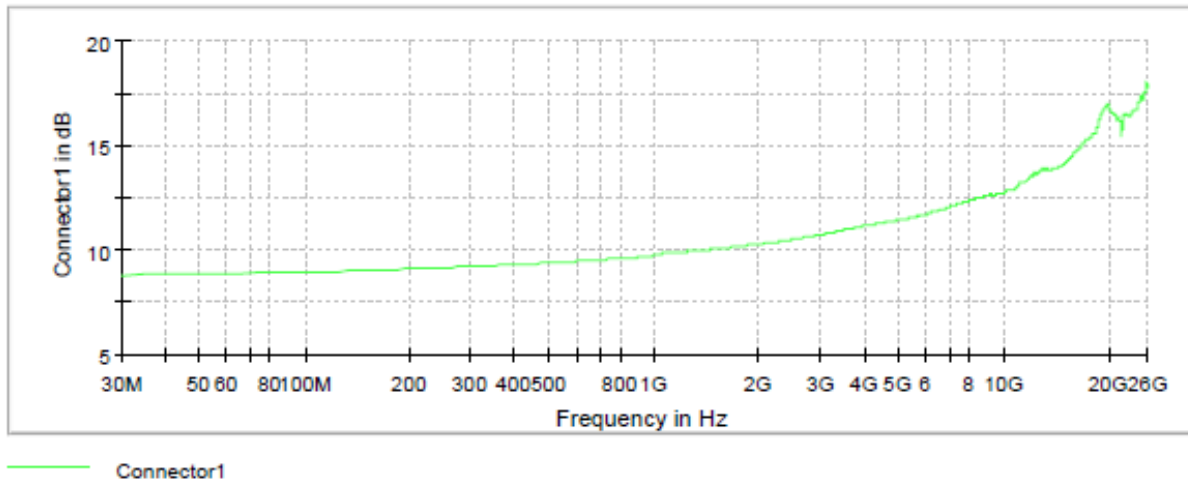
Analyser settings:

- Frequency range: 30 – 26000 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Trace: Maxhold
- Sweeps: Till Stable (max. 120)
- Sweep Time: Auto
- 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 or 30 dBc limit.



TS8997; Spurious RF Conducted Emissions



Attenuation of the measurement part

5.5.2 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.

5.5.3 TEST PROTOCOL

Ambient temperature: 25 °C
 Air Pressure: 1020 hPa
 Humidity: 30 %
 BT LE 1 Mbit/s

Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	2335.3	-47.8	PEAK	100	-7.5	-27.5	20.3
19	2440	2508.5	-46.9	PEAK	100	-7.3	-27.3	19.6
39	2480	2558.5	-50.6	PEAK	100	-7.4	-27.4	23.2

BT LE 2 Mbit/s

Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402	2395.0	-30.0	PEAK	100	-7.0	-27.0	3.0
19	2440	2375.1	-53.7	PEAK	100	-6.4	-26.4	27.3
39	2480	2518.5	-49.8	PEAK	100	-6.4	-26.4	23.4

Ambient temperature: 25 °C
 Air Pressure: 1017 hPa
 Humidity: 35 %
 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 [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	4827.2	-40.0	PEAK	100	1.1	-28.9	11.1
6	2437	25255.4	-41.9	PEAK	100	0.3	-29.7	12.2
11	2462	25925.0	-42.4	PEAK	100	2.4	-27.6	14.8

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 [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	2395.0	-39.2	PEAK	100	-3.4	-33.4	5.8
2	2417	2395.0	-40.1	PEAK	100	1.0	-29.0	11.1
6	2437	1220.0	-40.7	PEAK	100	1.2	-28.8	11.9
10	2457	1229.9	-40.8	PEAK	100	1.5	-28.5	12.3
11	2462	25995.0	-42.4	PEAK	100	-3.4	-33.4	9.0

WLAN n-Mode; 20 MHz; MCS0

Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
1	2412	25825.1	-41.1	PEAK	100	-3.6	-33.6	7.5
2	2417	2395.0	-39.5	PEAK	100	1.0	-29.0	10.5
6	2437	1220.0	-40.7	PEAK	100	1.4	-28.6	12.1
10	2457	1229.9	-40.2	PEAK	100	2.1	-27.9	12.3
11	2462	25905.1	-41.7	PEAK	100	-3.1	-33.1	8.6

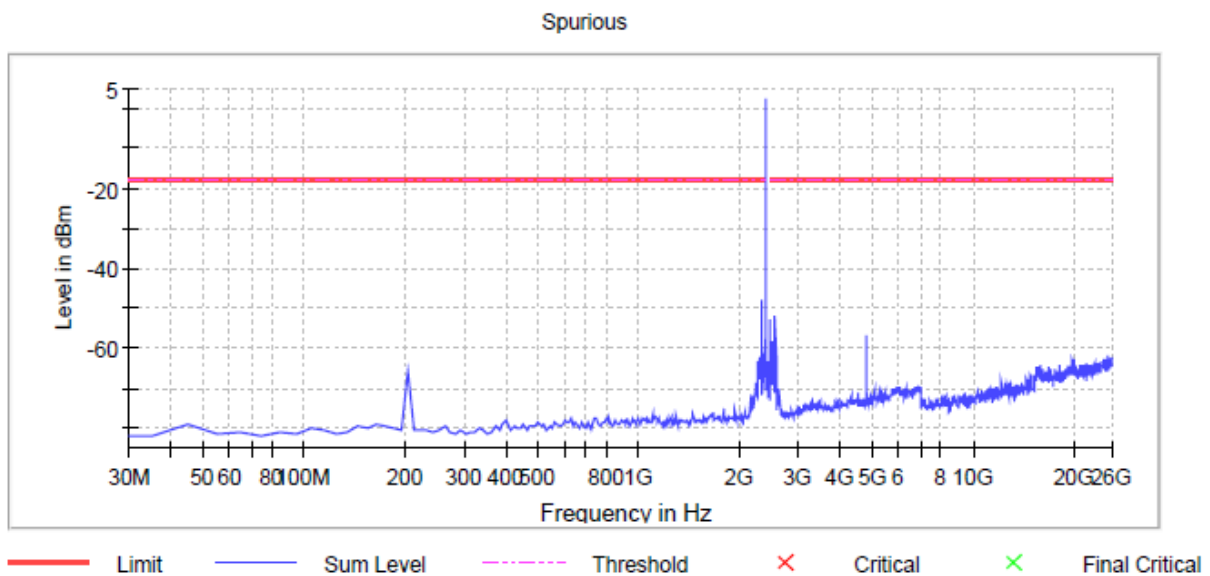
WLAN n-Mode; 40 MHz; MCS0

Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
3	2422	25935.0	-42.1	PEAK	100	-9.5	-39.5	2.6
4	2427	25855.1	-42.3	PEAK	100	-8.2	-38.2	4.1
5	2432	25855.1	-41.1	PEAK	100	-4.2	-34.2	6.9
6	2437	25295.4	-41.8	PEAK	100	-5.9	-35.9	5.9
8	2447	25305.4	-42.1	PEAK	100	-6.3	-36.3	5.8
9	2452	25905.1	-41.4	PEAK	100	-7.7	-37.7	3.6

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

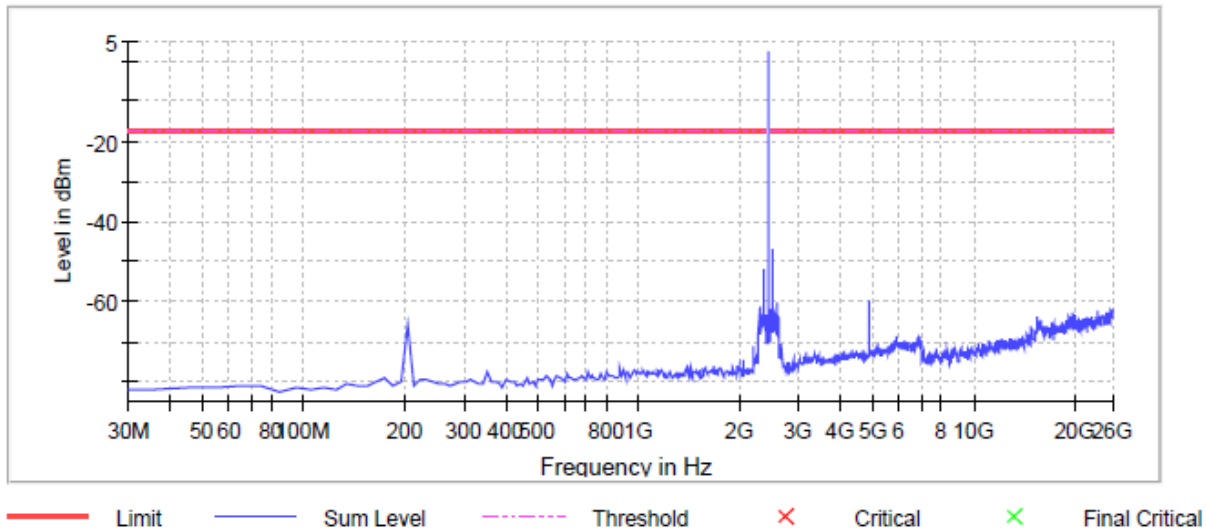
5.5.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = low (S02_AG01)



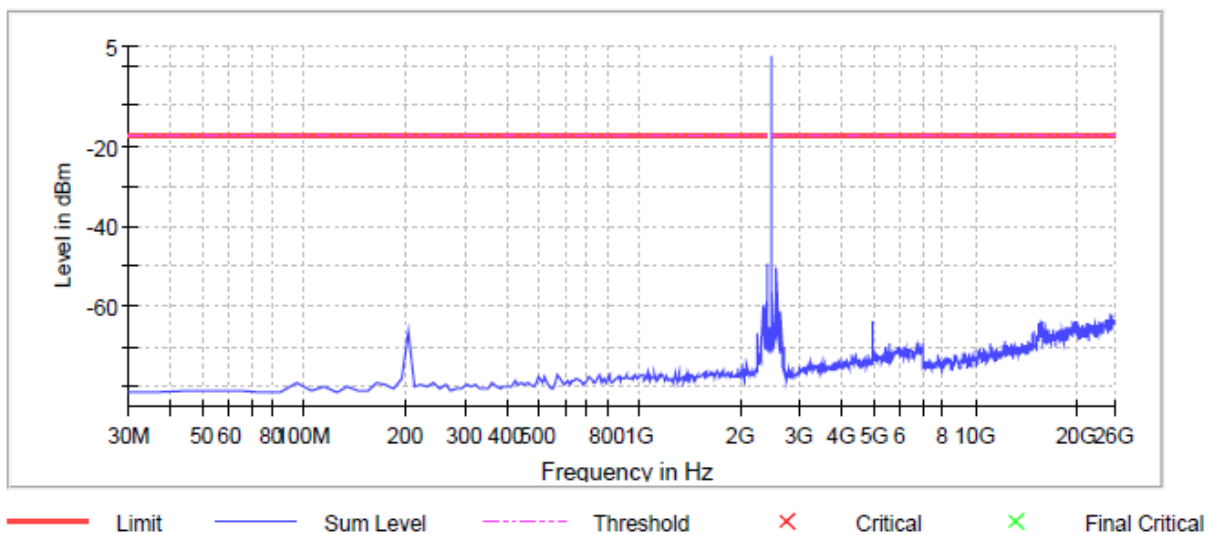
Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = mid
(S02_AG01)

Spurious

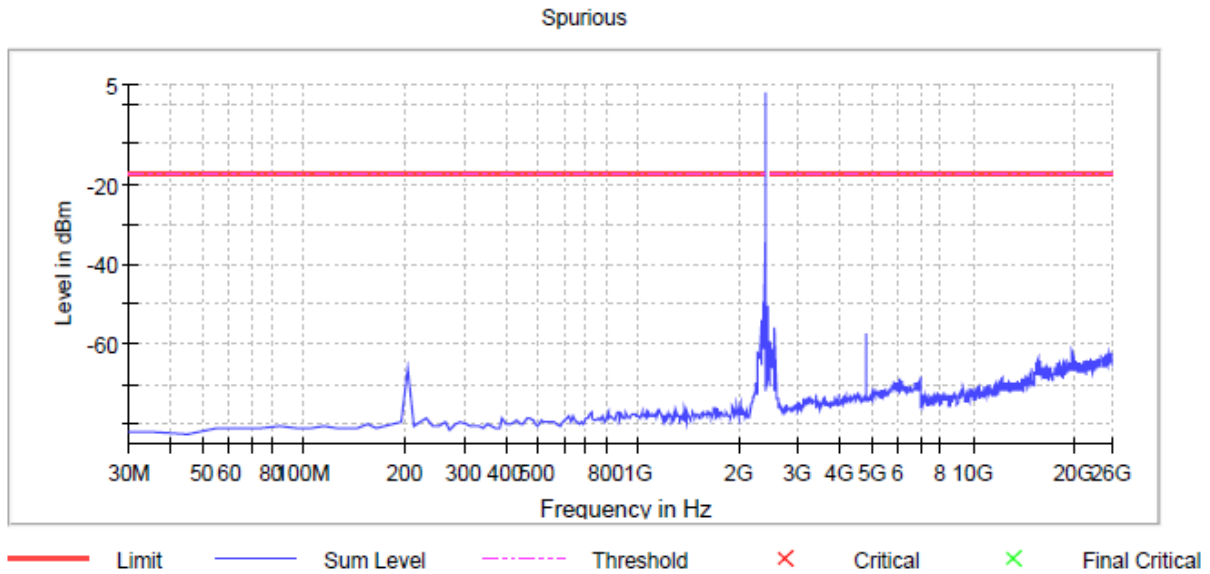


Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = high
(S02_AG01)

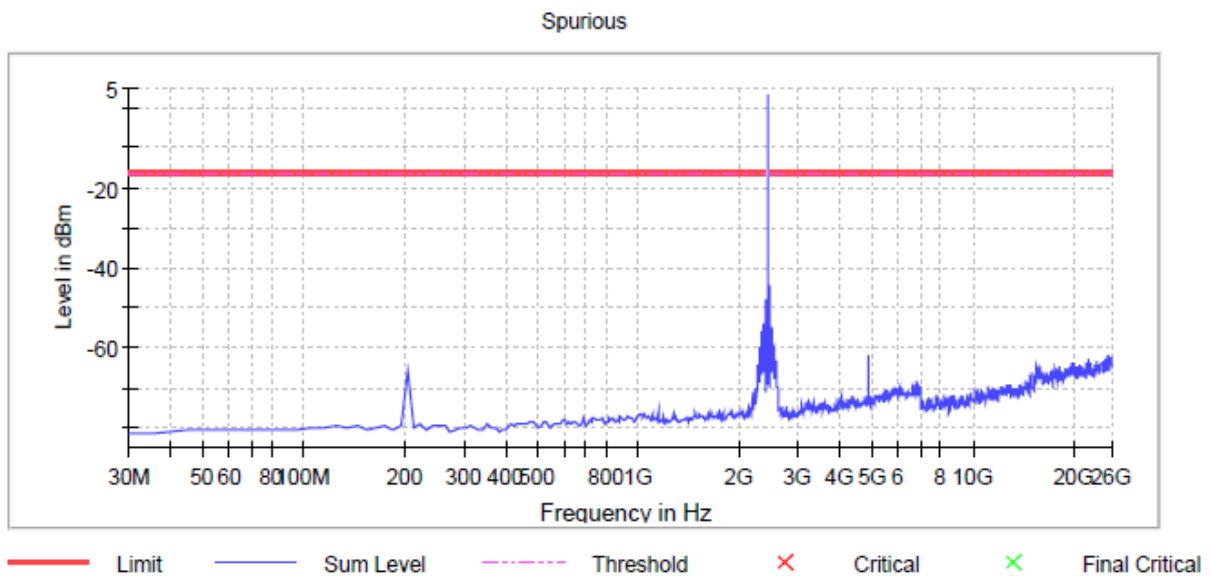
Spurious



Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = low
(S02_AG01)

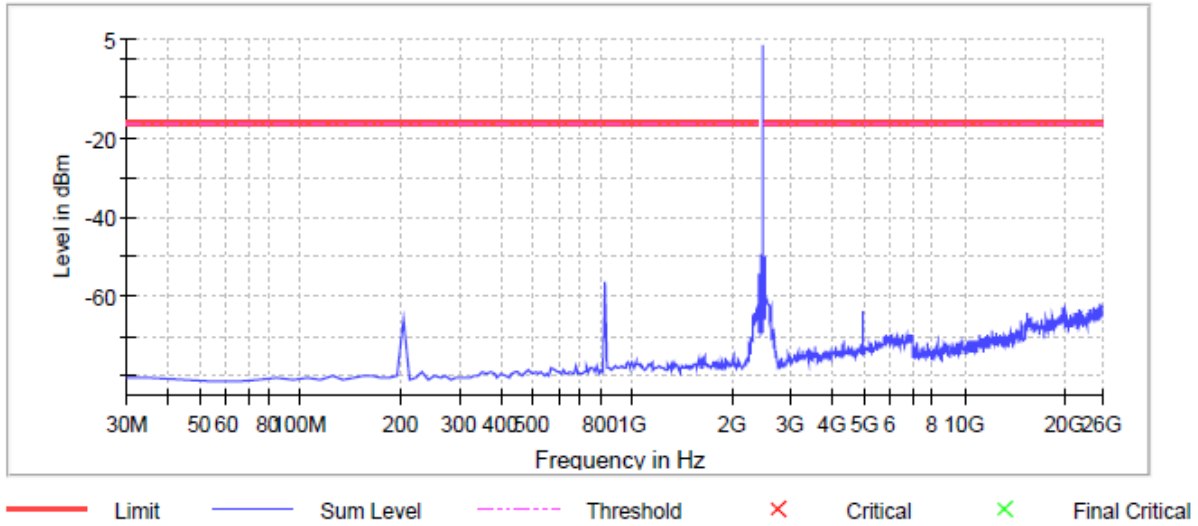


Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = mid
(S02_AG01)



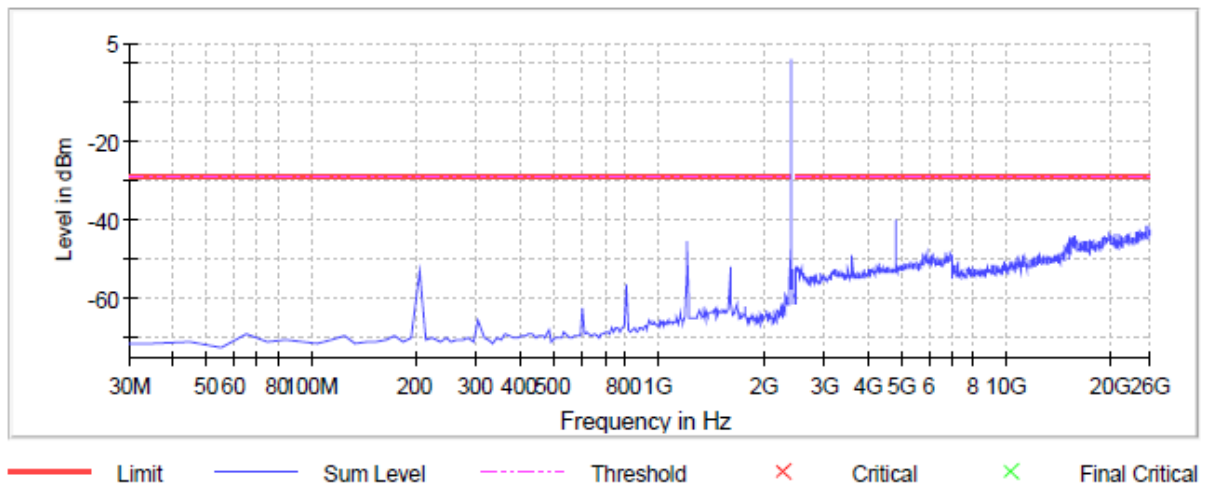
Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = high
(S02_AG01)

Spurious



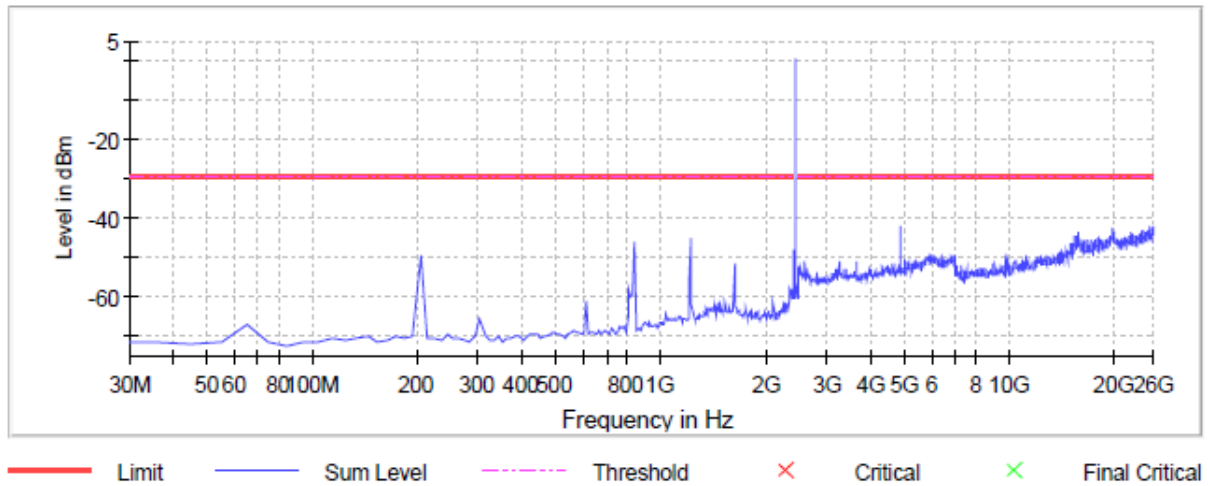
Radio Technology = WLAN b, Operating Frequency = low
(S02_AG01)

Spurious



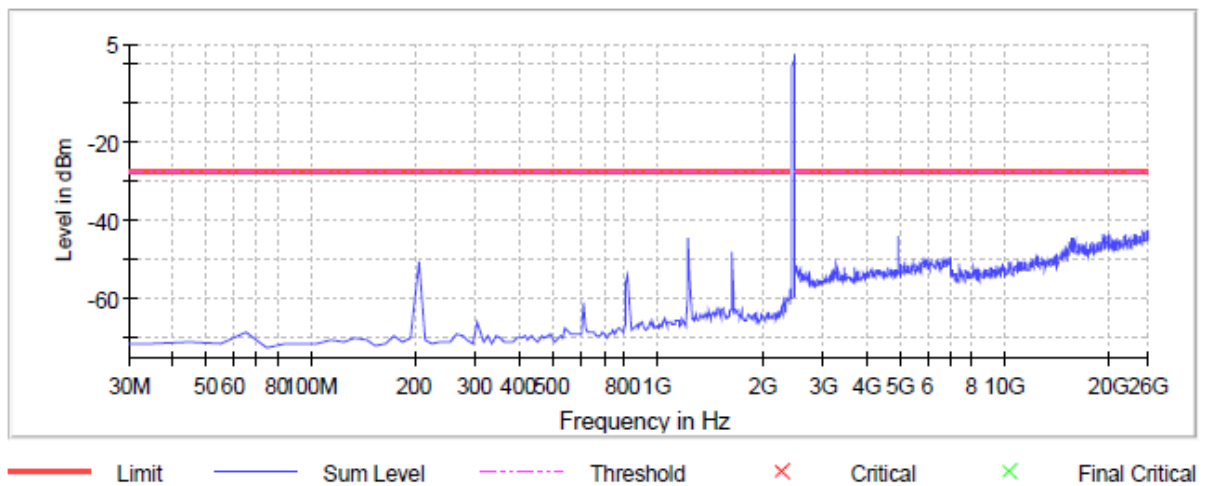
Radio Technology = WLAN b, Operating Frequency = mid
(S02_AG01)

Spurious



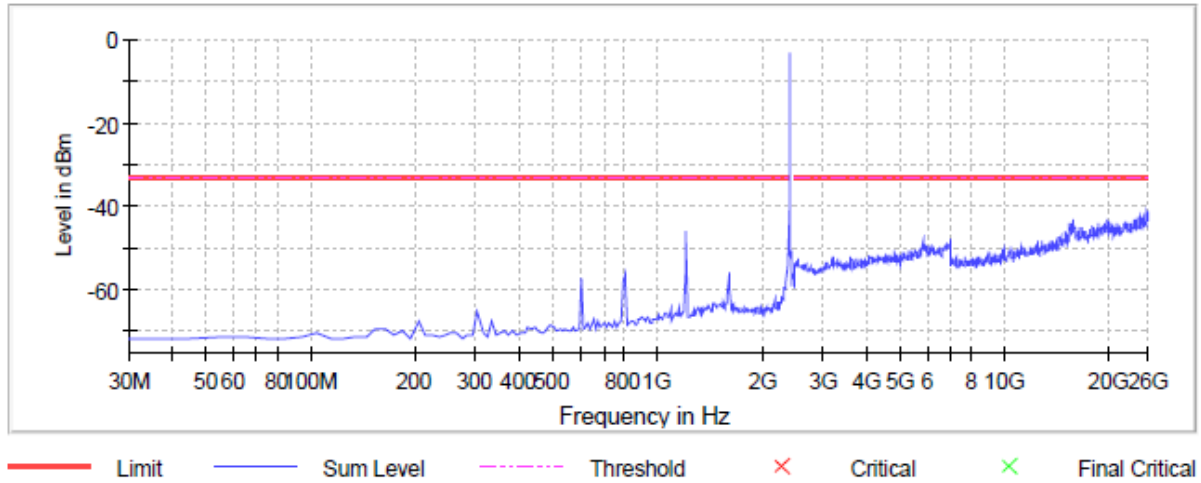
Radio Technology = WLAN b, Operating Frequency = high
(S02_AG01)

Spurious

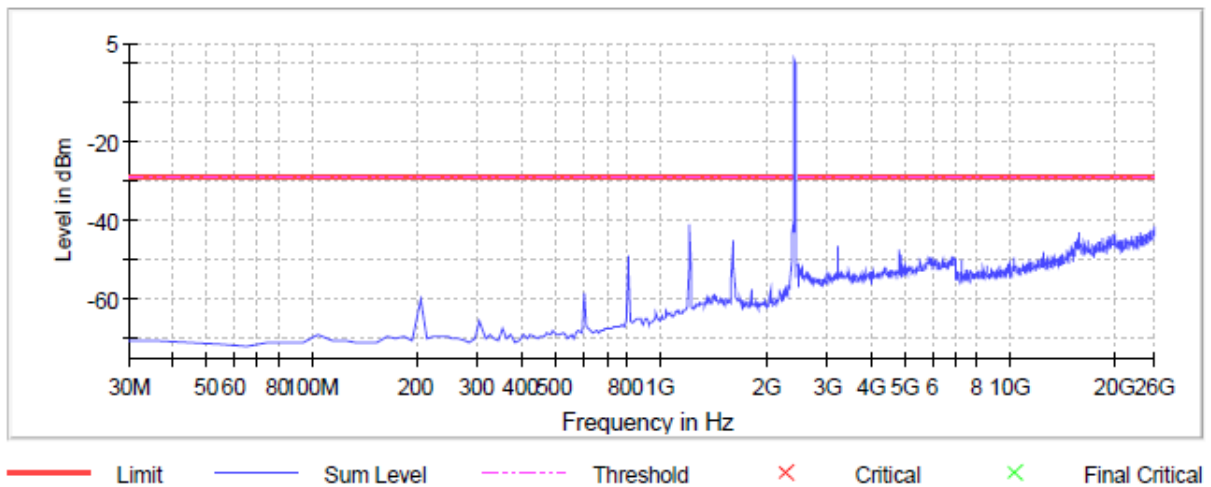


Radio Technology = WLAN g, Operating Frequency = low
(S02_AG01)

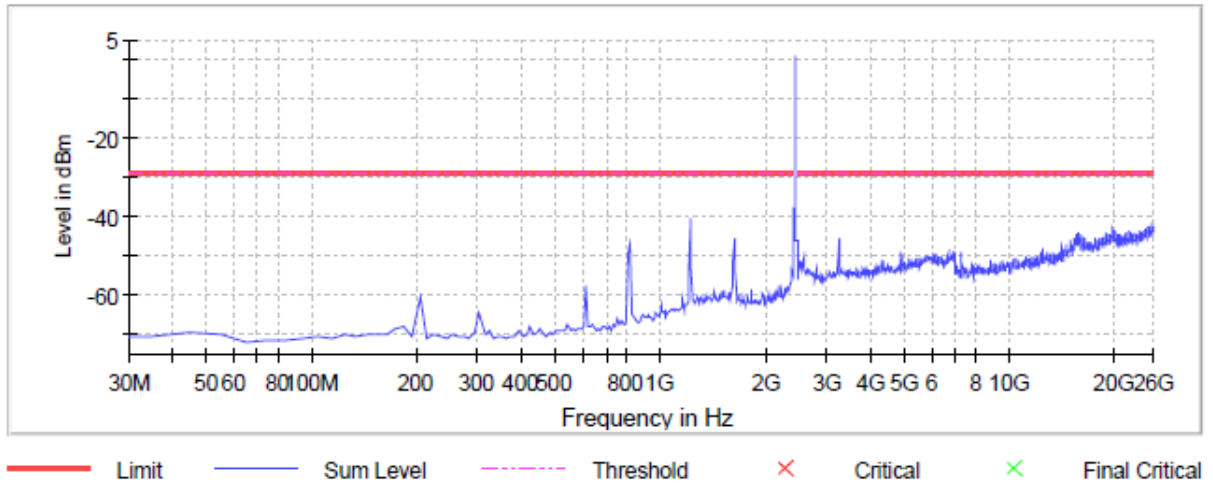
Spurious



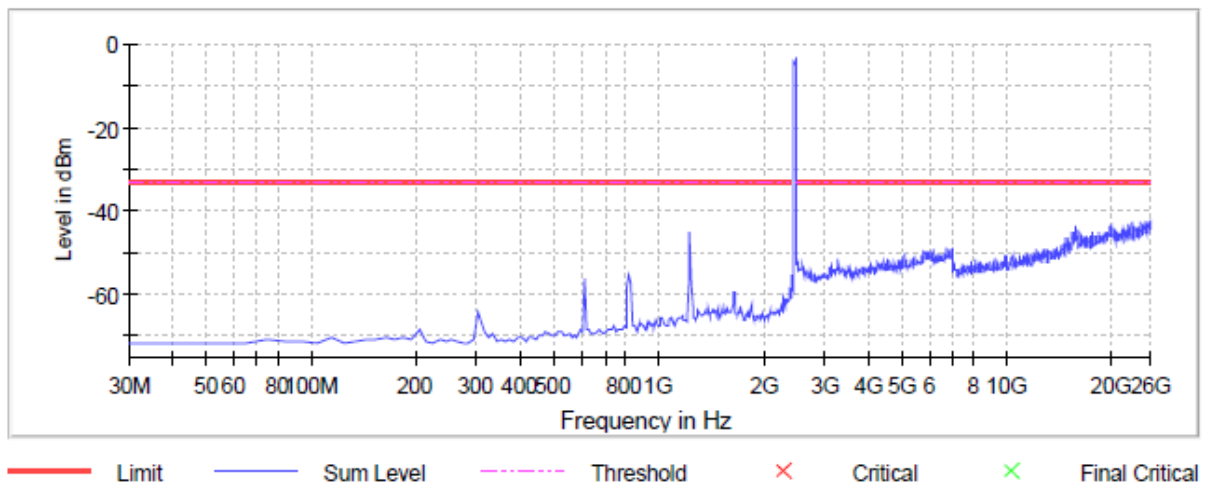
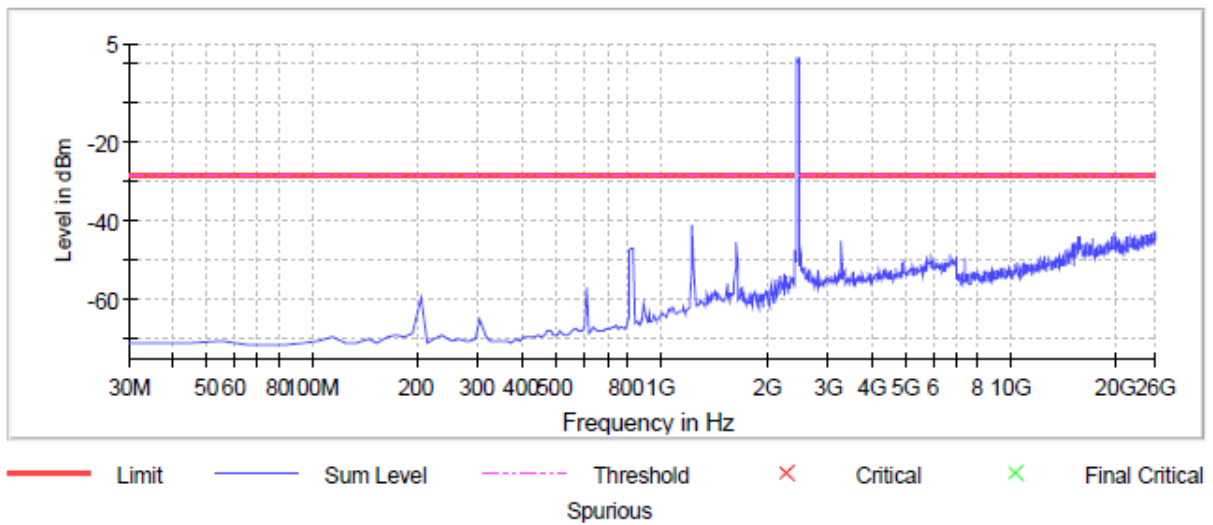
Spurious



Radio Technology = WLAN g, Operating Frequency = mid
(S02_AH01)
Spurious

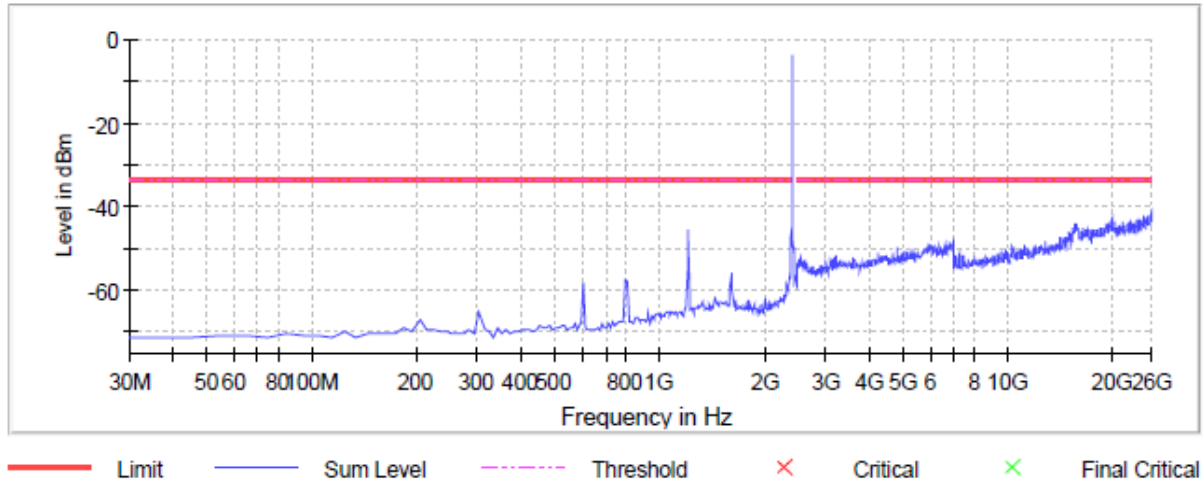


Radio Technology = WLAN g, Operating Frequency = high
(S02_AG01)
Spurious

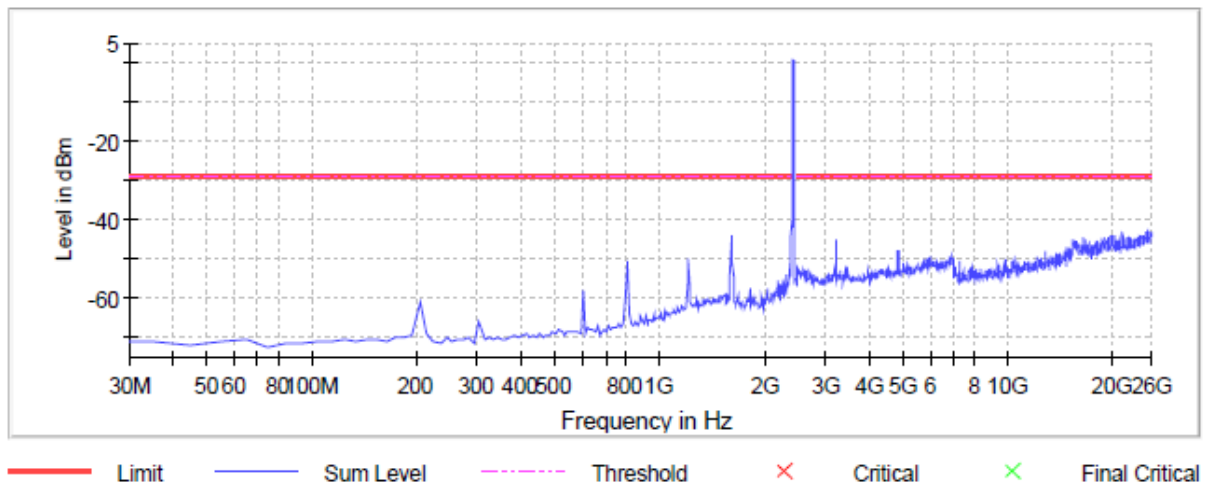


Radio Technology = WLAN n 20 MHz, Operating Frequency = low
(S02_AG01)

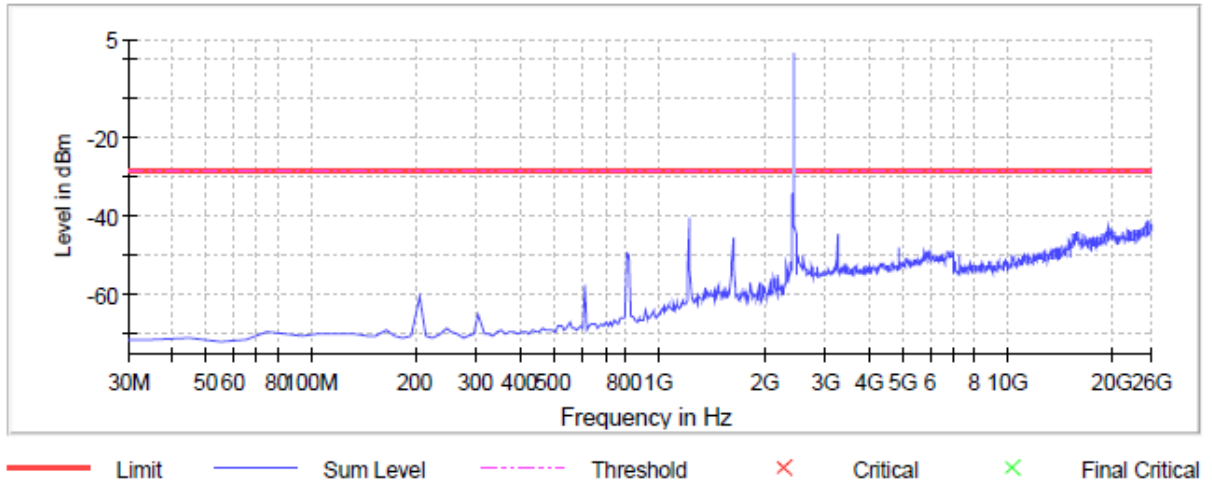
Spurious



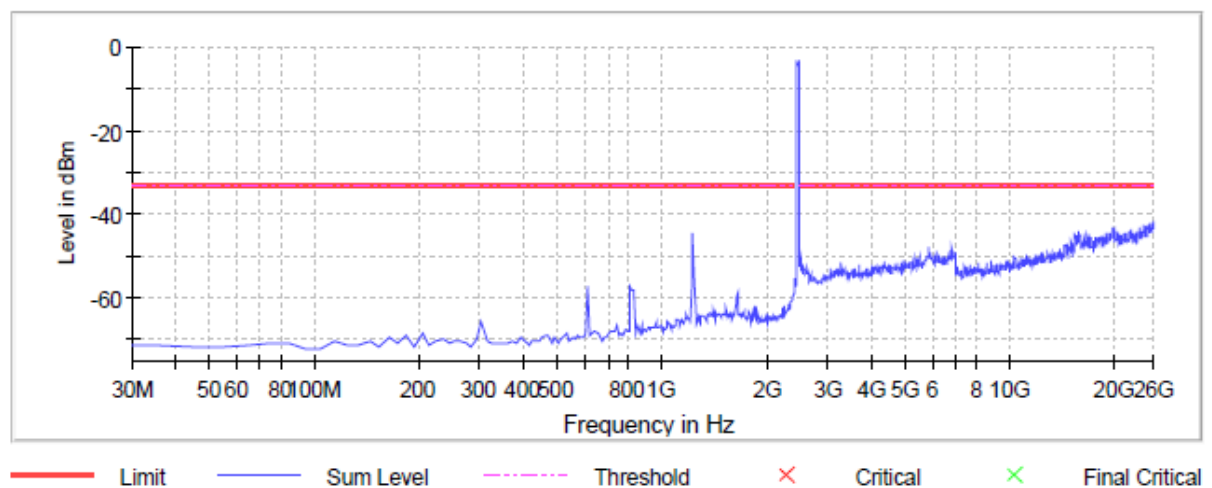
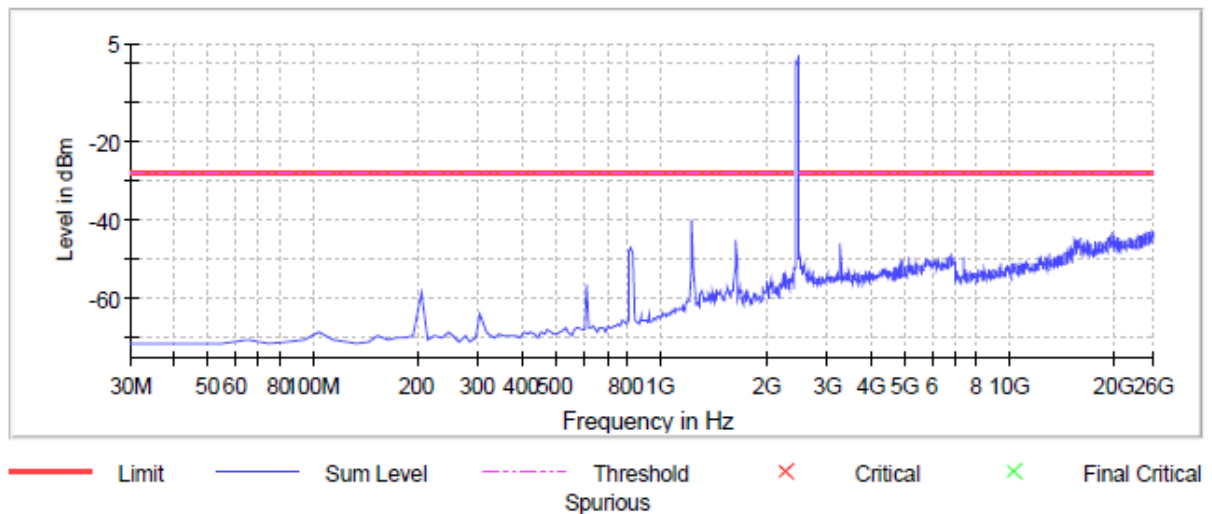
Spurious



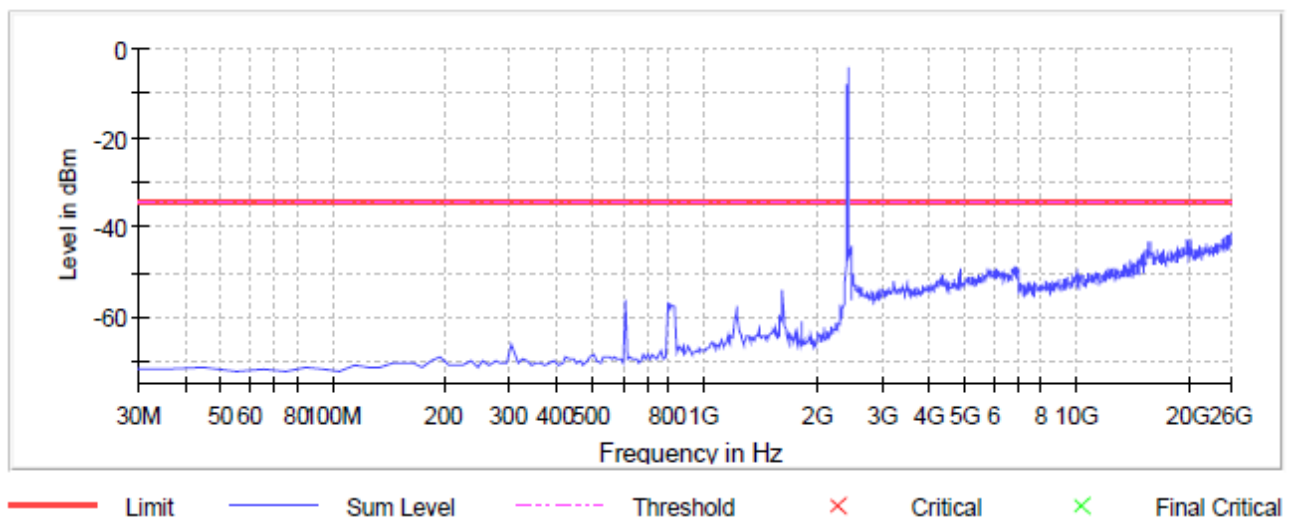
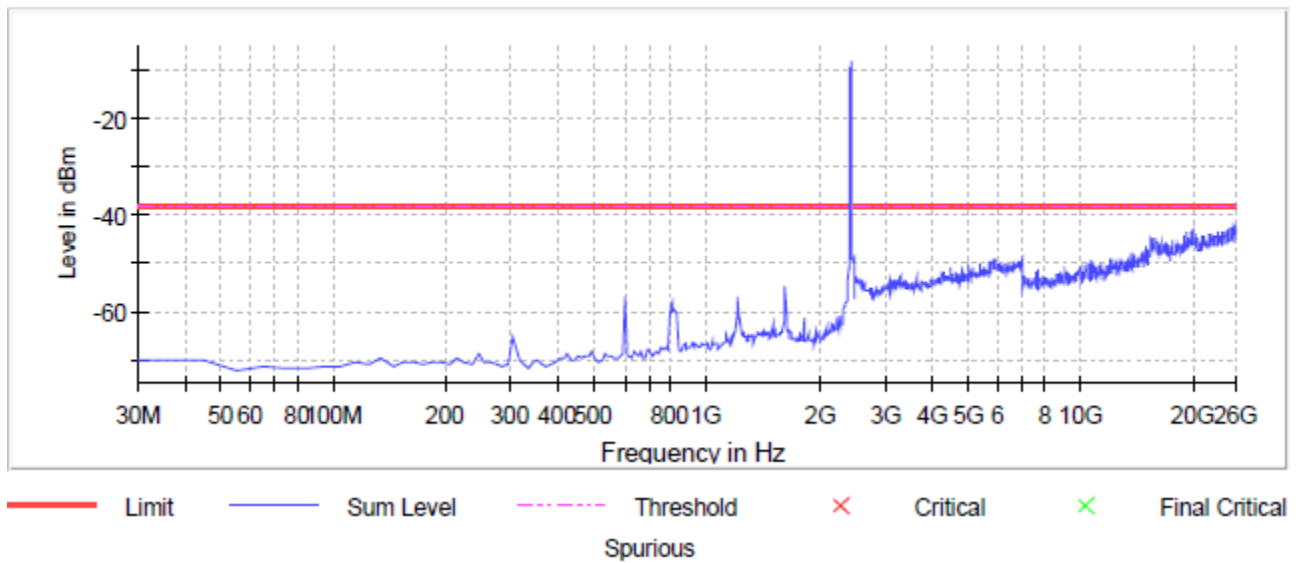
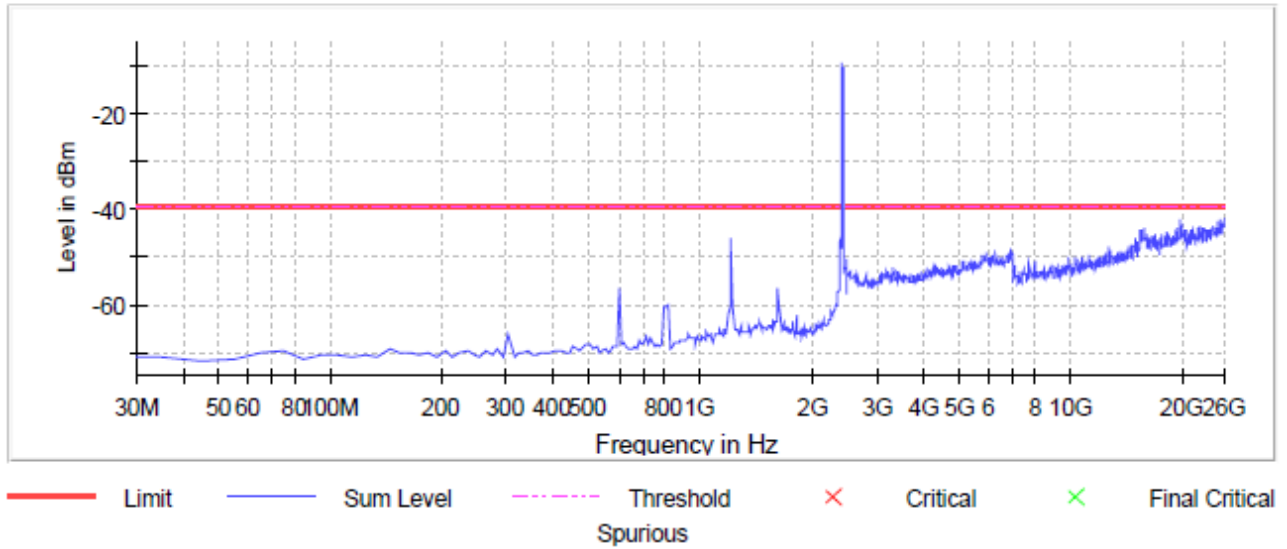
Radio Technology = WLAN n 20 MHz, Operating Frequency = mid
(S02_AH01)
Spurious



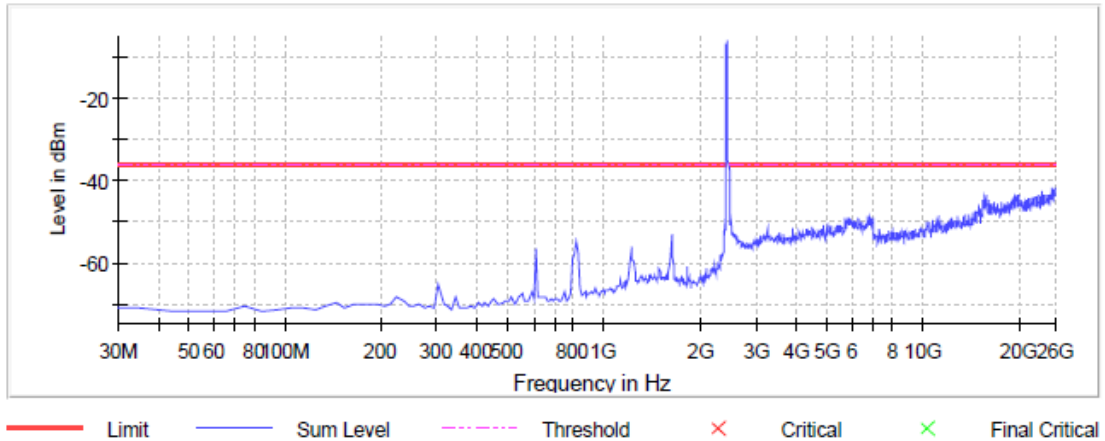
Radio Technology = WLAN n 20 MHz, Operating Frequency = high
(S02_AG01)
Spurious



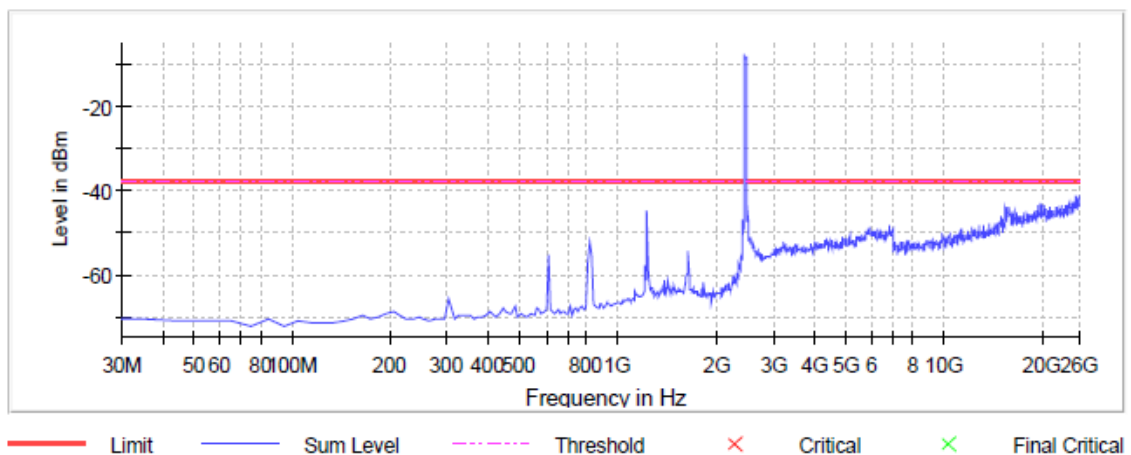
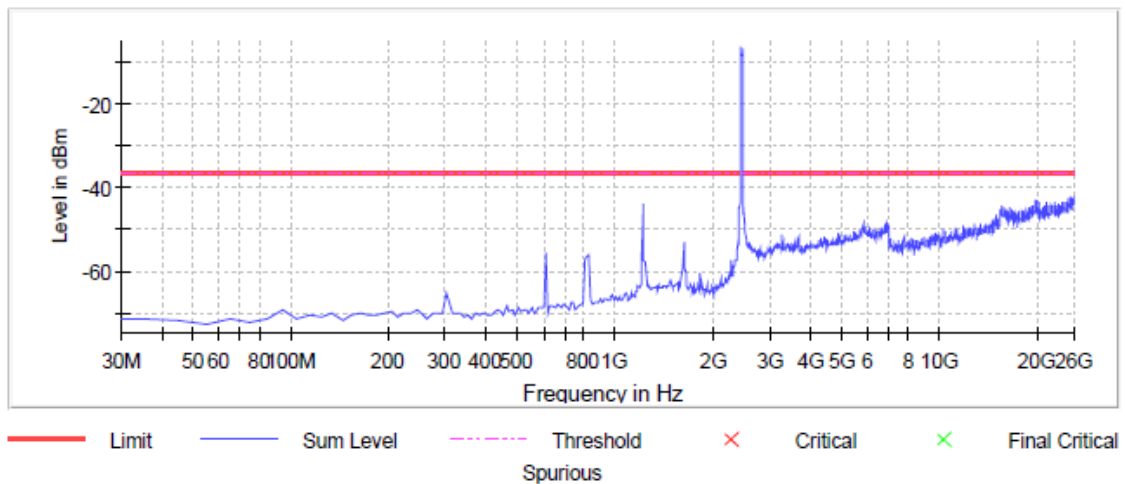
Radio Technology = WLAN n 40 MHz, Operating Frequency = low
(S02_AH01)
Spurious



Radio Technology = WLAN n 40 MHz, Operating Frequency = mid
(S02_AH01)
Spurious



Radio Technology = WLAN n 40 MHz, Operating Frequency = high
(S02_AH01)
Spurious



5.5.5 TEST EQUIPMENT USED

- R&S TS8997

5.6 TRANSMITTER SPURIOUS RADIATED EMISSIONS

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.6.1 TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The measurements were performed according the following sub-chapters of ANSI C63.10:

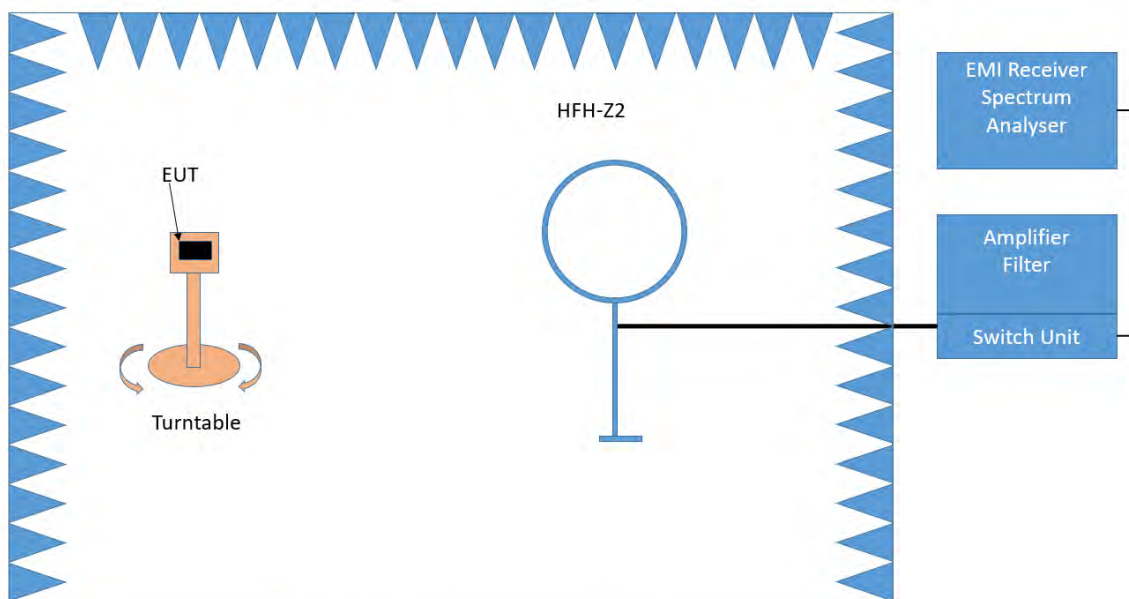
- < 30 MHz: Chapter 6.4
- 30 MHz – 1 GHz: Chapter 6.5
- > 1 GHz: Chapter 6.6 (procedure according 6.6.5 used)

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.

Below 1 GHz:

The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

1. Measurement up to 30 MHz



Test Setup; Spurious Emission Radiated (SAC), 9 kHz – 30 MHz

The Loop antenna HFH2-Z2 is used.

Step 1: pre measurement

- Anechoic chamber
- Antenna distance: 3 m
- Antenna height: 1 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)

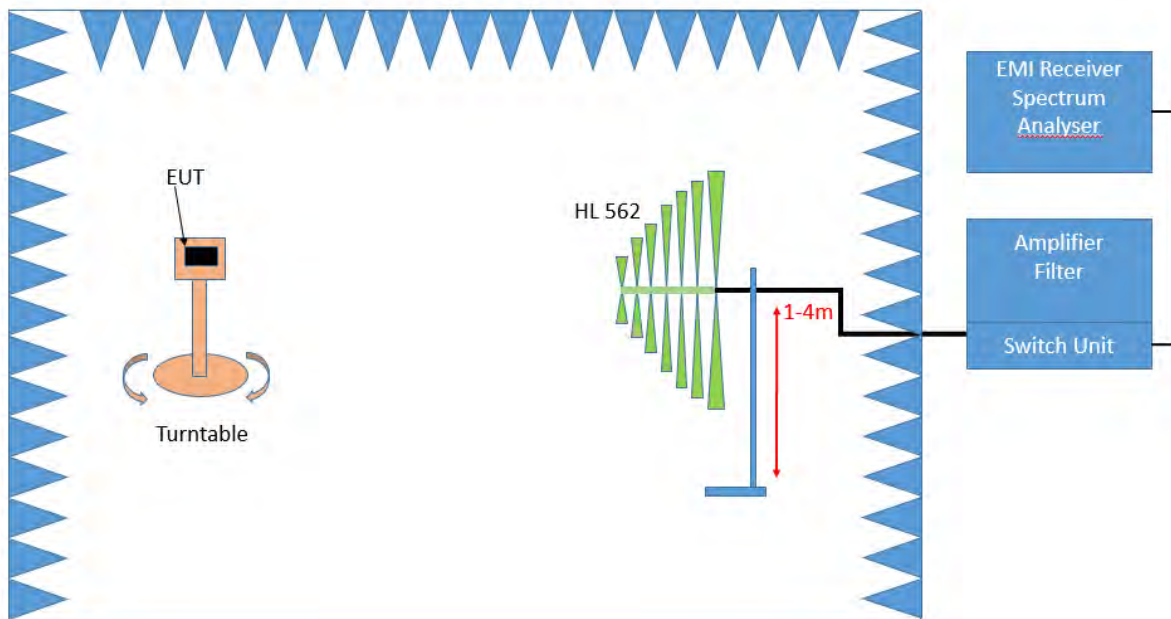
Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

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.

- Detector: Quasi-Peak (9 kHz - 150 kHz, Peak / Average 150 kHz- 30 MHz)
- 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



Test Setup; Spurious Emission Radiated (SAC), 30 MHz- 1GHz

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 – 4 m
- Height variation step size: 1.5 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 360°. 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 between 1 and 4m. 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: 360 °
- Height variation range: 1 – 4 m
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector

With the settings determined in step 2, the final measurement will be performed:

EMI receiver settings for step 3:

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

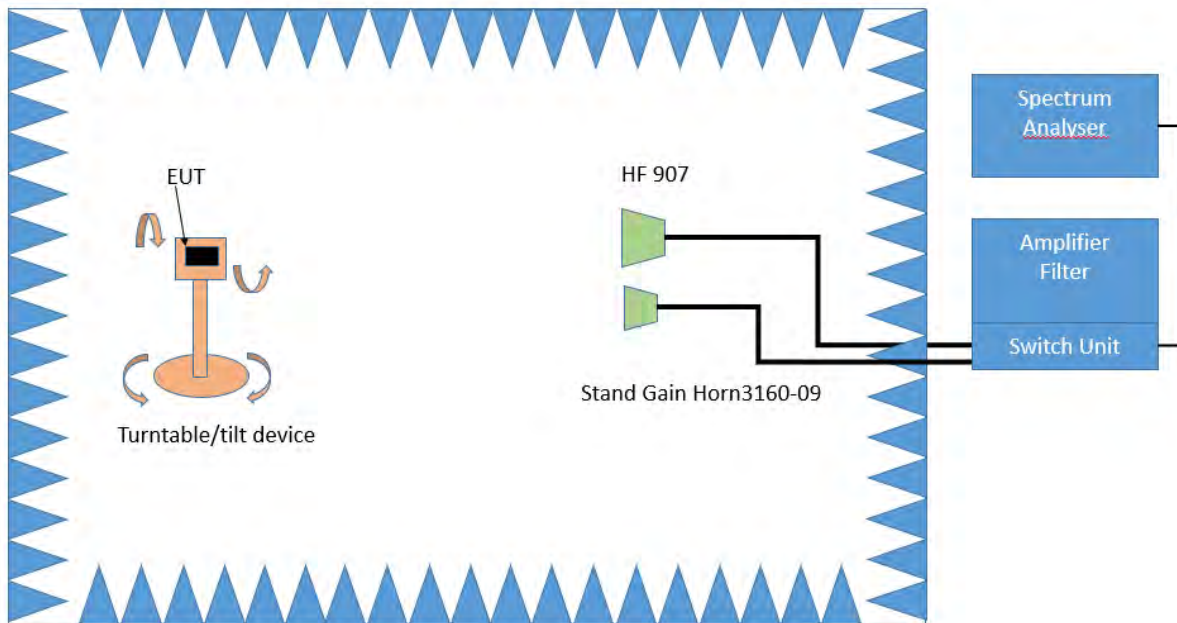
After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

Above 1 GHz:

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.

3. Measurement above 1 GHz



Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz

Step 1:

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 °.

Spectrum analyser settings:

- Detector: Peak, Average
- RBW = 1 MHz
- VBW = 3 MHz

Step 2:

The turn table azimuth will slowly vary by $\pm 22.5^\circ$.

The elevation angle will slowly vary by $\pm 45^\circ$

Spectrum analyser settings:

- Detector: Peak

Step 3:

Spectrum analyser settings for step 3:

- Detector: Peak / CISPR Average
- Measured frequencies: in step 1 determined frequencies
- RBW = 1 MHz
- VBW = 3 MHz
- Measuring time: 1 s

5.6.2 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: $\text{Limit (dBµV/m)} = 20 \log (\text{Limit (µV/m)}/1\mu\text{V/m})$

5.6.3 TEST PROTOCOL

Ambient temperature: 22-26 °C
 Air Pressure: 1010-1015 hPa
 Humidity: 34-38 %
 BT GFSK (1-DH5)
 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	2493.5	55.8	PEAK	1000	74.0	18.2	RB
0	2402	2493.5	38.6	AV	1000	54.0	15.4	RB
0	2402	15610.0	56.2	PEAK	1000	74.0	17.8	RB
0	2402	15610.0	42.1	AV	1000	54.0	11.9	RB
39	2441	14477.4	54.4	PEAK	1000	74.0	19.6	RB
39	2441	14477.4	40.1	AV	1000	54.0	13.9	RB
78	2480	2382.2	56.5	PEAK	1000	74.0	17.5	RB
78	2480	2382.2	37.2	AV	1000	54.0	16.8	RB

Ambient temperature: 22-24 °C
 Air Pressure: 1010-1015 hPa
 Humidity: 34-38 %
 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	2386.5	56.2	PEAK	1000	74.0	17.8	RB
1	2412	2387.4	49.4	AV	1000	54.0	4.6	RB
1	2412	4823.9	56.0	PEAK	1000	74.0	18.0	RB
1	2412	4824.0	52.8	AV	1000	54.0	1.2	RB
6	2437	3652.8	48.0	PEAK	1000	74.0	26.0	RB
6	2437	3655.4	42.4	AV	120	54.0	11.6	RB
6	2437	4873.9	53.7	AV	120	54.0	0.3	RB
6	2437	4873.9	57.2	PEAK	1000	74.0	16.8	RB
11	2462	1231.1	48.3	AV	1000	54.0	5.7	RB
11	2462	1231.5	61.3	PEAK	1000	74.0	12.7	RB
11	2462	2487.4	43.9	AV	1000	54.0	10.1	RB
11	2462	2489.3	51.3	PEAK	1000	74.0	22.7	RB
11	2462	3692.8	41.5	AV	1000	54.0	12.5	RB
11	2462	3693.2	55.0	PEAK	1000	74.0	19.0	RB
11	2462	4924.0	51.6	AV	1000	54.0	2.4	RB
11	2462	4924.0	56.4	PEAK	1000	74.0	17.6	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	1206.0	46.9	AV	1000	54.0	7.1	RB
1	2412	1206.2	53.8	PEAK	1000	74.0	20.2	RB
1	2412	2388.7	72.2	PEAK	1000	74.0	1.8	RB
1	2412	2389.8	53.3	AV	1000	54.0	0.7	RB
2	2417	1208.4	46.5	AV	1000	54.0	7.5	RB
2	2417	1208.7	52.9	PEAK	1000	74.0	21.1	RB
2	2417	1611.4	50.4	AV	1000	54.0	3.6	RB
2	2417	1611.8	57.4	PEAK	1000	74.0	16.6	RB
2	2417	2386.6	70.1	PEAK	1000	74.0	3.9	RB
2	2417	2390.0	69.8	PEAK	1000	74.0	4.2	RB
2	2417	2390.0	50.7	AV	1000	54.0	3.3	RB
2	2417	4833.9	43.5	AV	1000	54.0	10.5	RB
2	2417	4839.1	56.6	PEAK	1000	74.0	17.4	RB
2	2417	7250.0	56.9	PEAK	1000	74.0	17.1	RB
2	2417	7250.0	42.2	AV	1000	54.0	11.8	RB
6	2437	1218.5	56.2	PEAK	1000	74.0	17.8	RB

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
6	2437	1218.6	48.8	AV	1000	54.0	5.2	RB
6	2437	1624.8	49.6	AV	1000	54.0	4.4	RB
6	2437	1624.8	59.3	PEAK	1000	74.0	14.7	RB
6	2437	3657.8	41.5	AV	1000	54.0	12.5	RB
6	2437	3658.4	55.3	PEAK	1000	74.0	18.7	RB
6	2437	4873.4	42.1	AV	1000	54.0	11.9	RB
6	2437	4874.2	56.2	PEAK	1000	74.0	17.8	RB
6	2437	7307.5	57.2	PEAK	1000	74.0	16.8	RB
6	2437	7313.5	41.0	AV	1000	54.0	13.0	RB
10	2457	1228.2	57.3	PEAK	1000	74.0	16.7	RB
10	2457	1228.6	47.2	AV	1000	54.0	6.8	RB
10	2457	2389.5	38.7	AV	1000	54.0	15.3	RB
10	2457	2389.5	56.7	PEAK	1000	74.0	17.3	RB
10	2457	2484.0	48.5	AV	1000	54.0	5.5	RB
10	2457	2484.8	72.1	PEAK	1000	74.0	1.9	RB
10	2457	2726.5	55.5	PEAK	1000	74.0	18.5	RB
10	2457	2727.2	37.7	AV	1000	54.0	16.3	RB
10	2457	3682.4	54.8	PEAK	1000	74.0	19.2	RB
10	2457	3682.4	41.7	AV	1000	54.0	12.3	RB
10	2457	4910.8	56.0	PEAK	1000	74.0	18.0	RB
10	2457	4913.4	41.6	AV	1000	54.0	12.4	RB

WLAN n-Mode; 20 MHz; MCS0

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	1206.0	46.9	AV	1000	54.0	7.1	RB
1	2412	1206.2	52.6	PEAK	1000	74.0	21.4	RB
1	2412	2389.4	73.0	PEAK	1000	74.0	1.0	RB
1	2412	2389.6	52.7	AV	1000	54.0	1.3	RB
2	2417	1208.3	54.3	PEAK	1000	74.0	19.7	RB
2	2417	1208.4	46.4	AV	1000	54.0	7.6	RB
2	2417	1611.4	58.7	PEAK	1000	74.0	15.3	RB
2	2417	1611.4	50.4	AV	1000	54.0	3.6	RB
2	2417	2386.6	73.9	PEAK	1000	74.0	0.1	RB
2	2417	2389.3	53.7	AV	1000	54.0	0.3	RB
2	2417	4828.9	58.0	PEAK	1000	74.0	16.0	RB
2	2417	4833.3	43.0	AV	1000	54.0	11.0	RB
2	2417	7250.6	42.3	AV	1000	54.0	11.7	RB
2	2417	7253.3	58.6	PEAK	1000	74.0	15.4	RB
6	2437	1218.5	49.7	AV	1000	54.0	4.3	RB
6	2437	1218.6	56.6	PEAK	1000	74.0	17.4	RB
6	2437	1522.1	34.9	AV	1000	54.0	19.1	RB
6	2437	1522.3	54.4	PEAK	1000	74.0	19.6	RB
6	2437	1624.6	50.0	AV	1000	54.0	4.0	RB
6	2437	1624.6	59.6	PEAK	1000	74.0	14.4	RB
6	2437	2389.6	64.9	PEAK	1000	74.0	9.1	RB
6	2437	2390.0	41.5	AV	1000	54.0	12.5	RB
6	2437	2484.3	62.7	PEAK	1000	74.0	11.3	RB
6	2437	2485.0	40.7	AV	1000	54.0	13.3	RB
6	2437	4874.6	41.1	AV	1000	54.0	12.9	RB
6	2437	4875.4	56.2	PEAK	1000	74.0	17.8	RB
6	2437	7313.4	41.0	AV	1000	54.0	13.0	RB
6	2437	7314.5	56.5	PEAK	1000	74.0	17.5	RB
10	2457	1228.5	47.9	AV	1000	54.0	6.1	RB
10	2457	1228.6	56.9	PEAK	1000	74.0	17.1	RB
10	2457	1554.1	55.4	PEAK	1000	74.0	18.6	RB
10	2457	1566.8	34.8	AV	1000	54.0	19.2	RB
10	2457	2483.5	71.1	PEAK	1000	74.0	2.9	RB
10	2457	2483.7	50.1	AV	1000	54.0	3.9	RB

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
10	2457	3688.0	40.3	AV	1000	54.0	13.7	RB
10	2457	3688.2	54.8	PEAK	1000	74.0	19.2	RB
10	2457	4912.9	56.5	PEAK	1000	74.0	17.5	RB
10	2457	4914.1	41.6	AV	1000	54.0	12.4	RB

WLAN n-Mode; 40 MHz; MCS0

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
3	2422	2388.4	70.9	PEAK	1000	74.0	3.1	RB
3	2422	2390.0	53.9	AV	1000	54.0	0.1	RB
4	2427	2388.9	70.9	PEAK	1000	74.0	3.1	RB
4	2427	2389.7	53.4	AV	1000	54.0	0.6	RB
5	2432	2389.3	69.1	PEAK	1000	74.0	4.9	RB
5	2432	2390.0	53.2	AV	1000	54.0	0.8	RB
6	2437	2390.0	71.9	PEAK	1000	74.0	2.1	RB
6	2437	2390.0	52.1	AV	1000	54.0	1.9	RB
6	2437	4873.3	48.8	PEAK	1000	74.0	25.2	RB
6	2437	4874.2	34.6	AV	1000	54.0	19.4	RB
8	2447	3262.5	53.0	PEAK	1000	74.0	21.0	RB
8	2447	3262.7	45.3	AV	1000	54.0	8.7	RB
9	2452	-	-	-	-	-	>6	RB

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

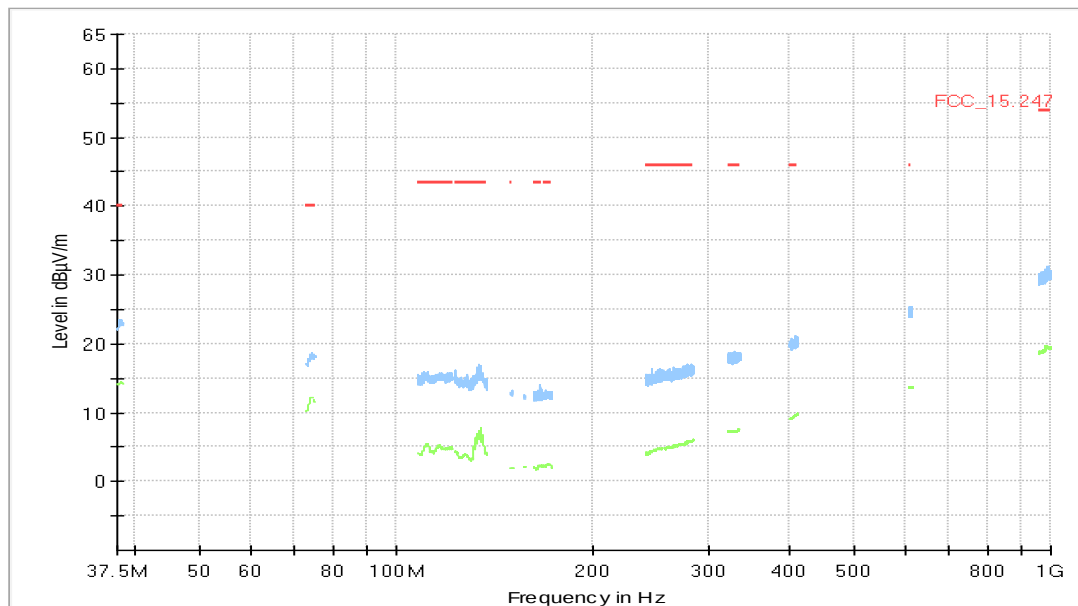
Bluetooth Classic GFSK mode was tested instead of Bluetooth Low Energy GFSK mode, since it is worst case in regard to output power.

The WLAN g and n 20 MHz BW mode tests were performed at 17 dBm setting. The power was lowered to 16 afterwards, however since 17 is worst case, the spurious radiated emission measurements were not repeated at the new power setting.

For Band Edge Results at the upper band edge see test case Band Edge.

5.6.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

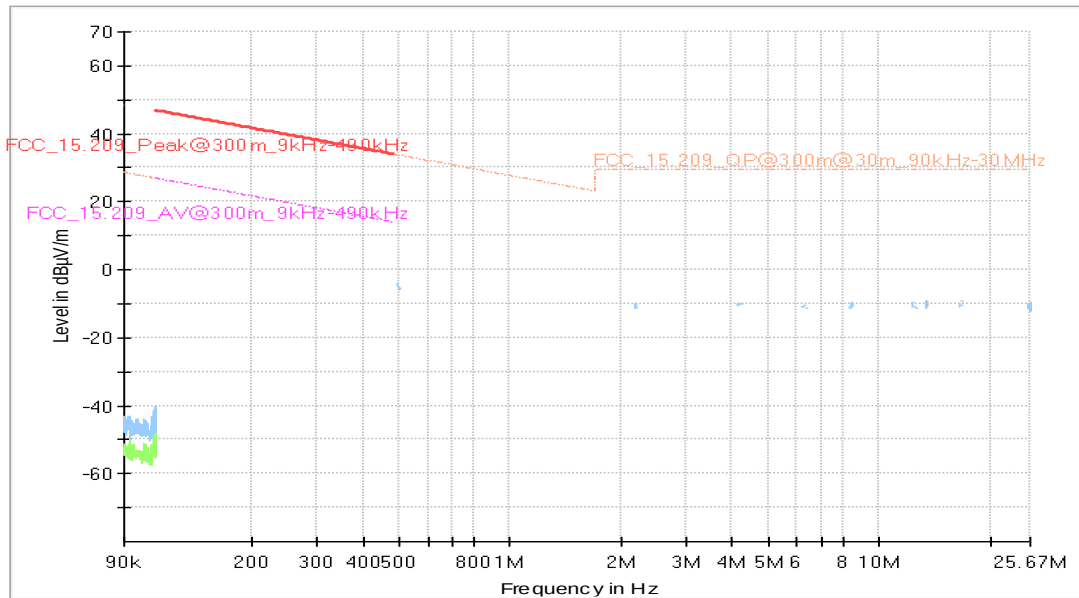
Radio Technology = Bluetooth BDR, Operating Frequency = high, Measurement range = 30 MHz - 1 GHz
(S01_AK01)



Final Result

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

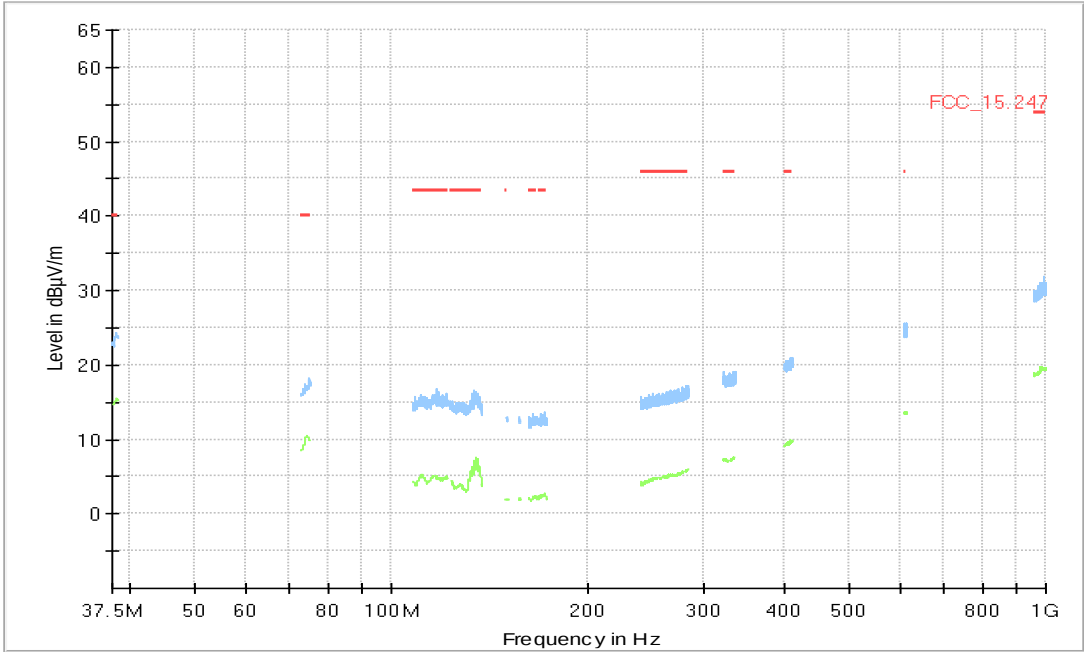
Radio Technology = Bluetooth BDR, Operating Frequency = mid, Measurement range = 9 kHz
- 30 MHz
(S01_AK01)



Final Result

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

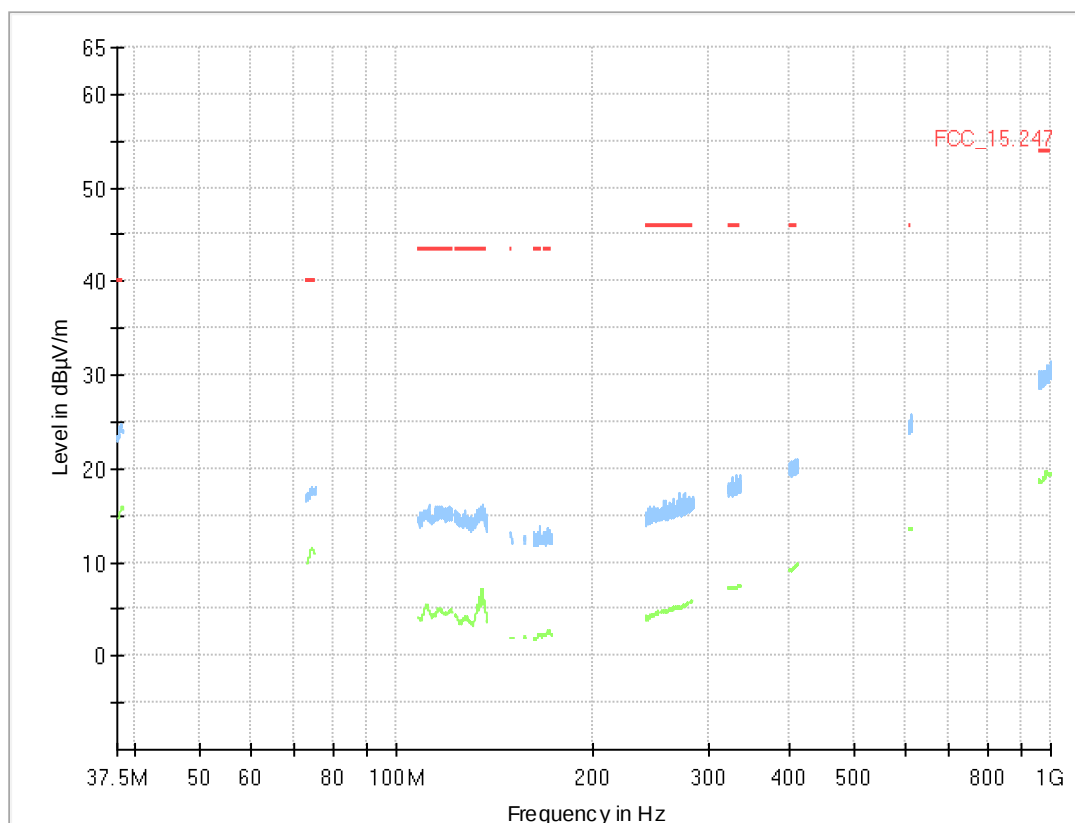
Radio Technology = Bluetooth BDR, Operating Frequency = mid, Measurement range = 30 MHz - 1 GHz
(S01_AK01)



Final_Result

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

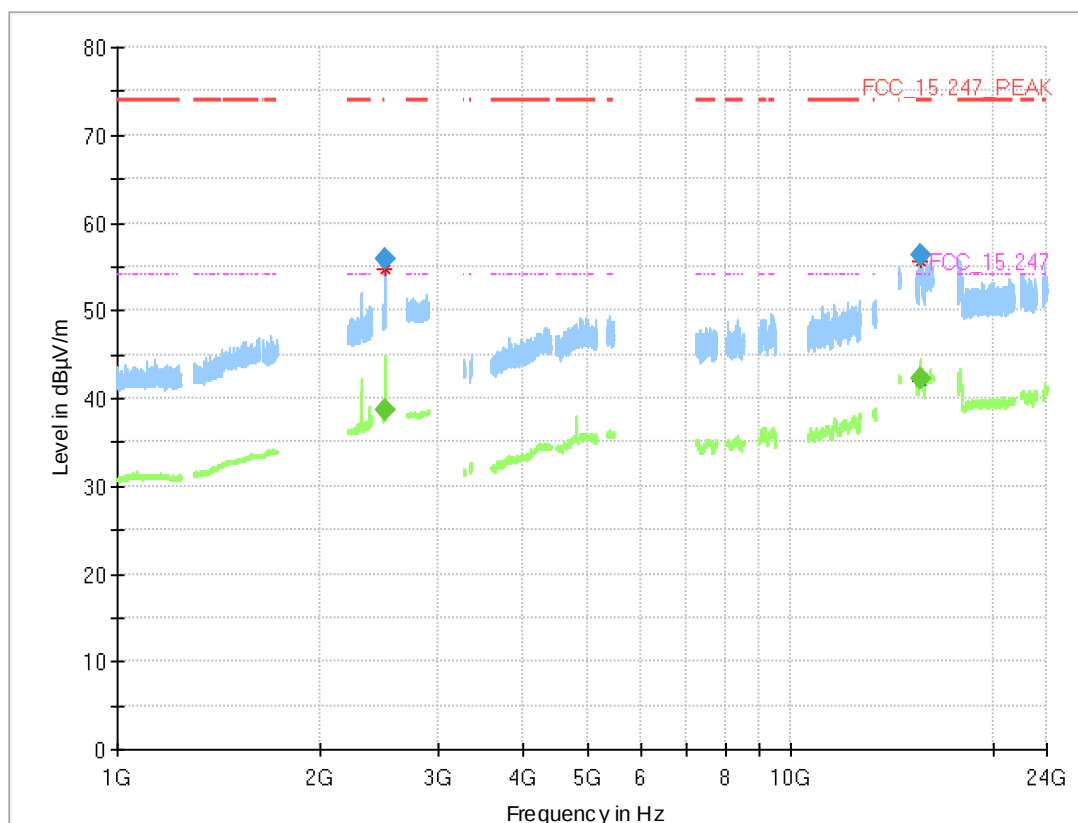
Radio Technology = Bluetooth BDR, Operating Frequency = low, Measurement range = 30 MHz
 - 1 GHz
 (S01_AK01)



Final Result

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

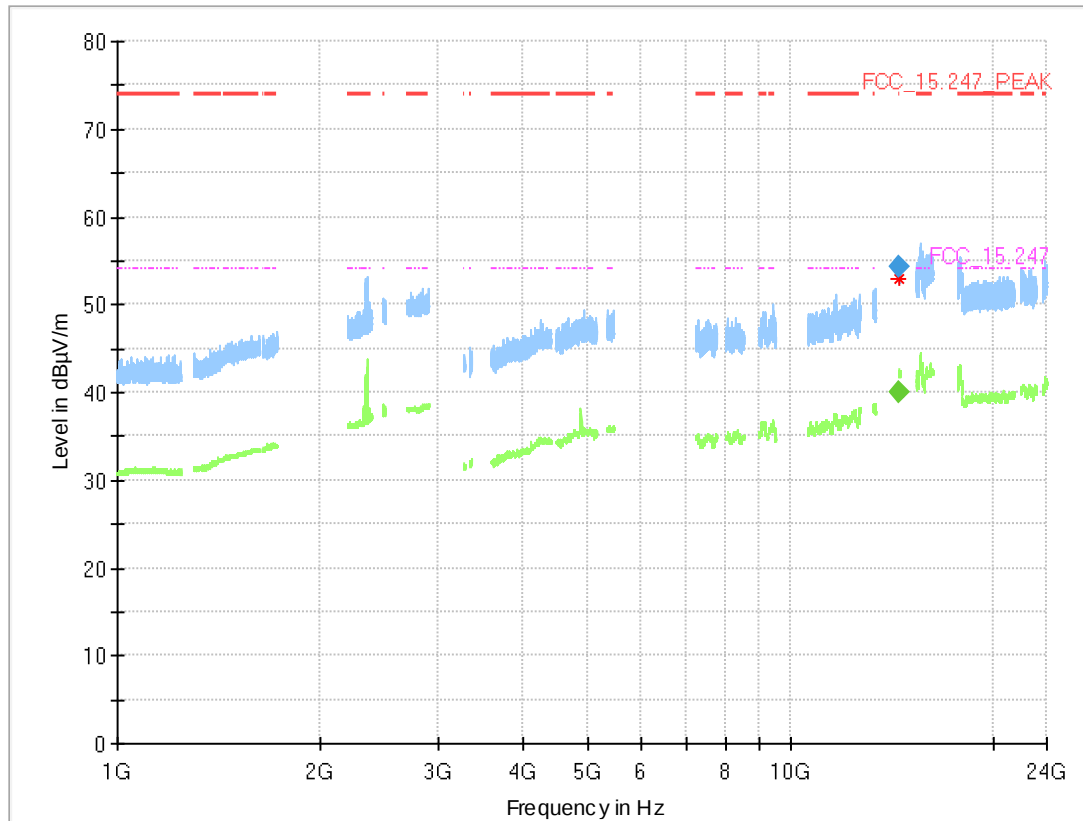
Radio Technology = Bluetooth BDR, Operating Frequency = low, Measurement range = 1 GHz
- 26 GHz
(S01_AK01)



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)	Corr. (dB/m)
2493.483	---	38.6	54.00	15.40	1000.0	1000.000	150.0	H	-60.0	75.0	5.5
2493.483	55.8	---	74.00	18.21	1000.0	1000.000	150.0	V	158.0	-15.0	5.5
15609.958	---	42.1	54.00	11.88	1000.0	1000.000	150.0	V	-182.0	105.0	-1.8
15609.958	56.2	---	74.00	17.78	1000.0	1000.000	150.0	V	-96.0	88.0	-1.8

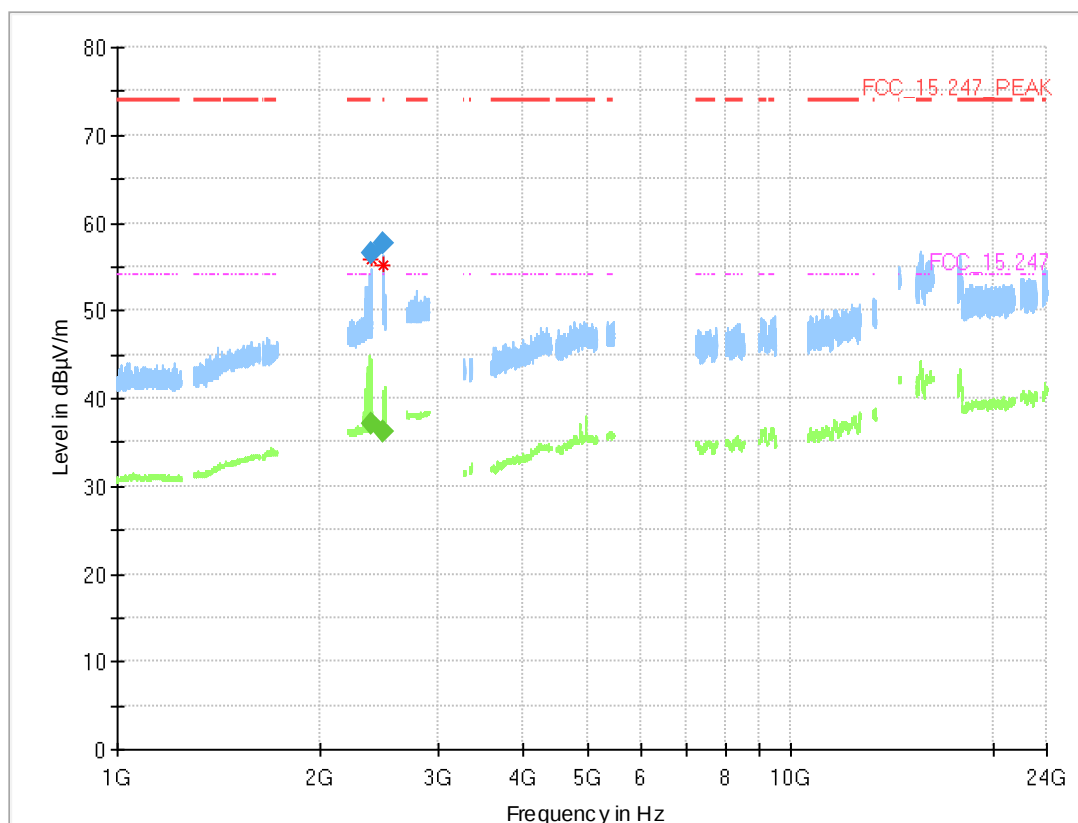
Radio Technology = Bluetooth BDR, Operating Frequency = mid, Measurement range = 1 GHz
 - 26 GHz
 (S01_AK01)



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)	Corr. (dB/m)
14477.350	---	40.1	54.00	13.95	1000.0	1000.000	150.0	H	131.0	15.0	-3.3
14477.350	54.4	---	74.00	19.65	1000.0	1000.000	150.0	H	99.0	84.0	-3.3

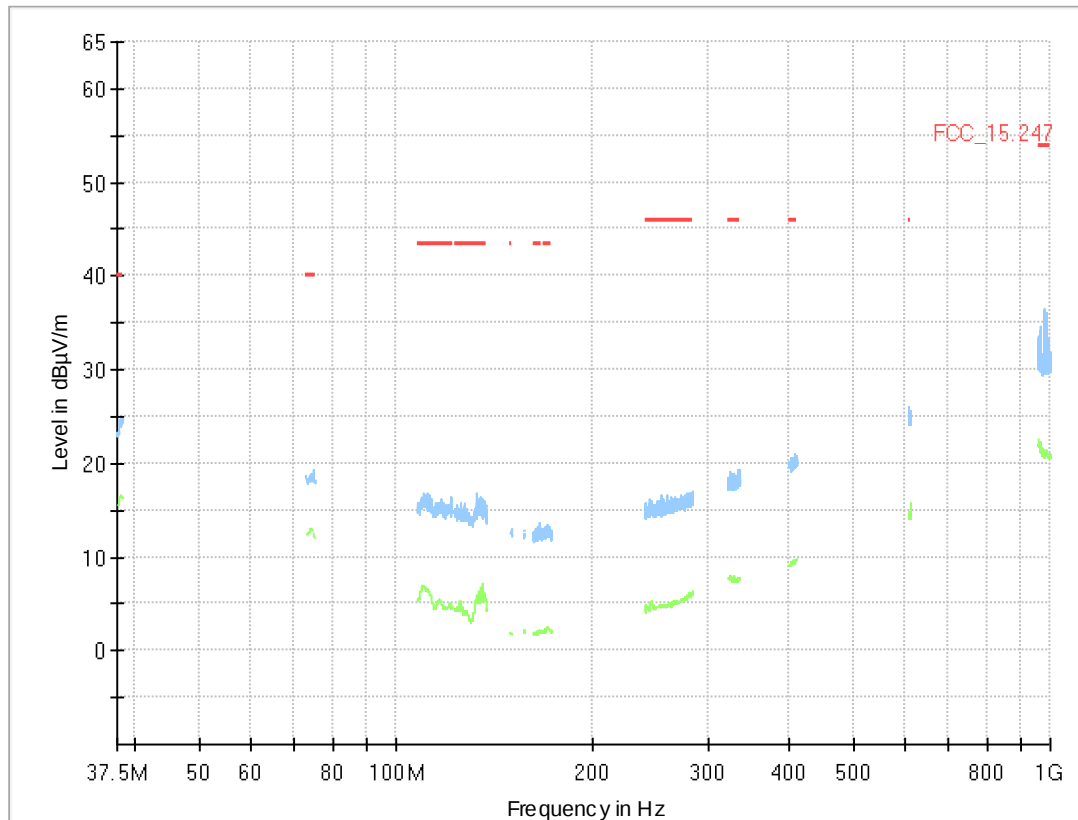
Radio Technology = Bluetooth BDR, Operating Frequency = high, Measurement range = 1 GHz
 - 26 GHz
 (S01_AK01)



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)	Corr. (dB/m)
2382.240	---	37.2	54.00	16.82	1000.0	1000.000	150.0	H	86.0	78.0	4.9
2382.240	56.5	---	74.00	17.53	1000.0	1000.000	150.0	V	161.0	15.0	4.9
2483.665	---	36.3	54.00	17.73	1000.0	1000.000	150.0	V	139.0	-12.0	5.4
2483.665	57.8	---	74.00	16.24	1000.0	1000.000	150.0	V	139.0	4.0	5.4

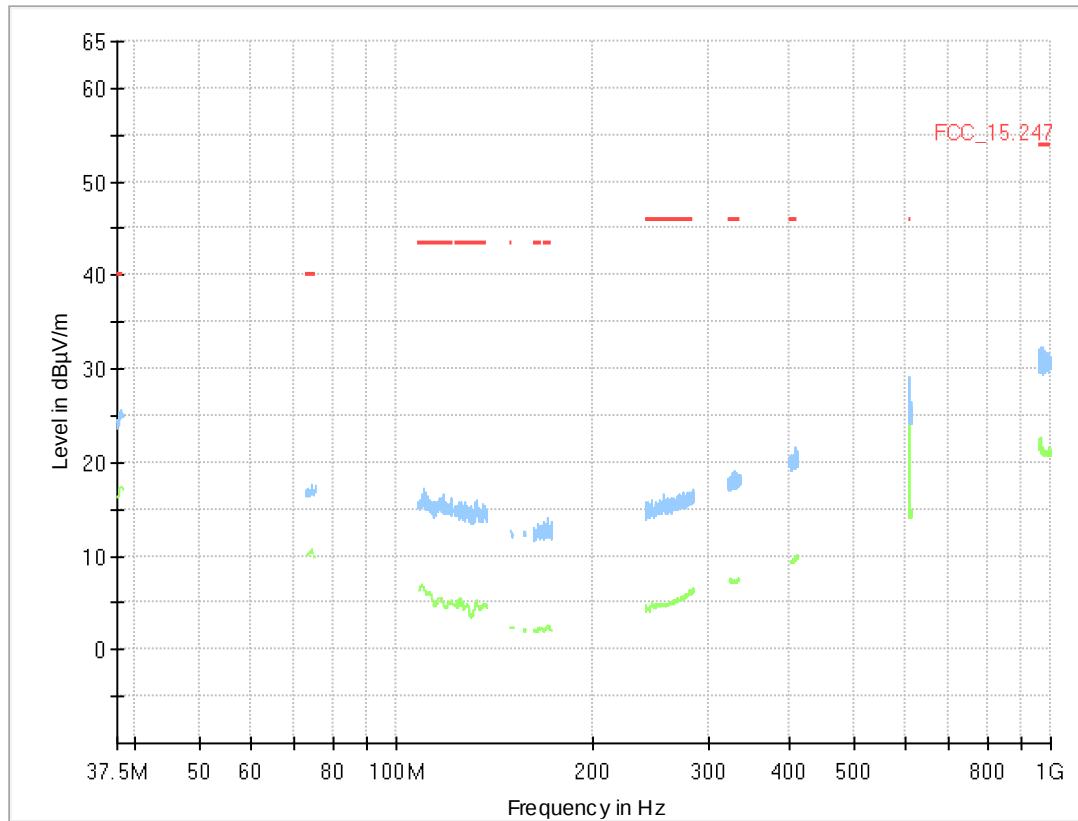
Radio Technology = WLAN b, Operating Frequency = high, Measurement range = 30 MHz - 1 GHz
(S01_AK01)



Final Result

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

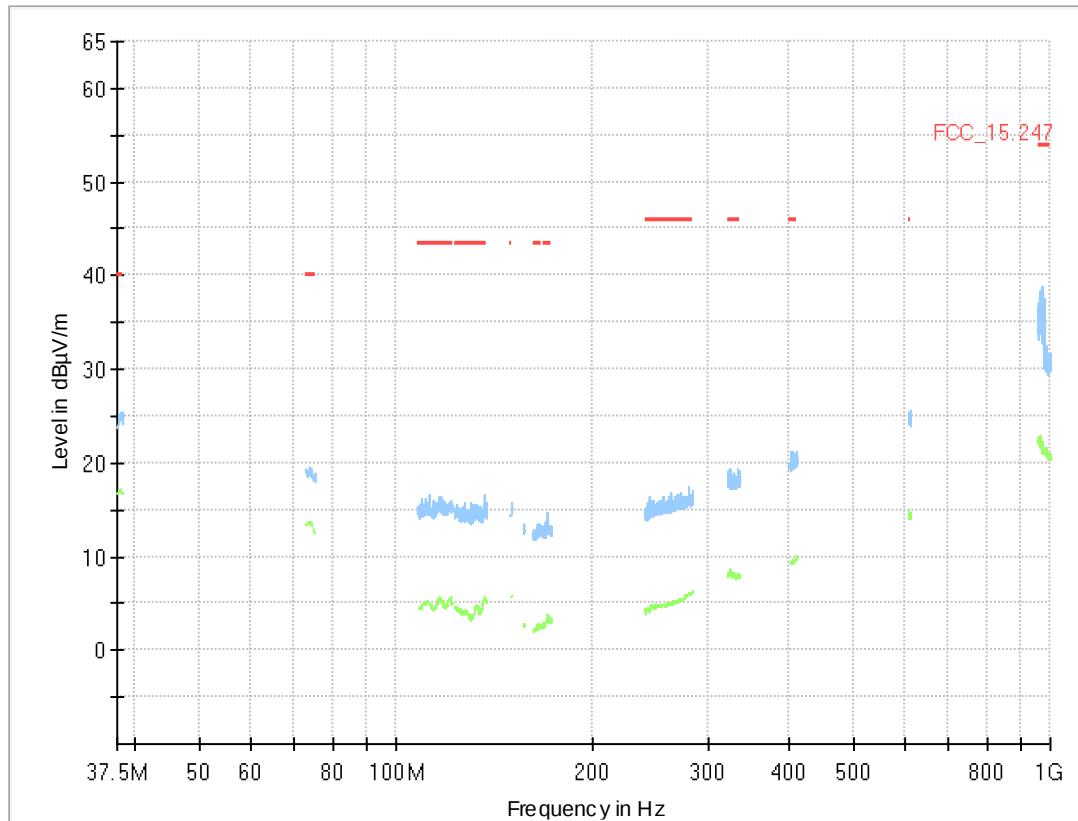
Radio Technology = WLAN b, Operating Frequency = mid, Measurement range = 30 MHz - 1 GHz
(S01_AK01)



Final_Result

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

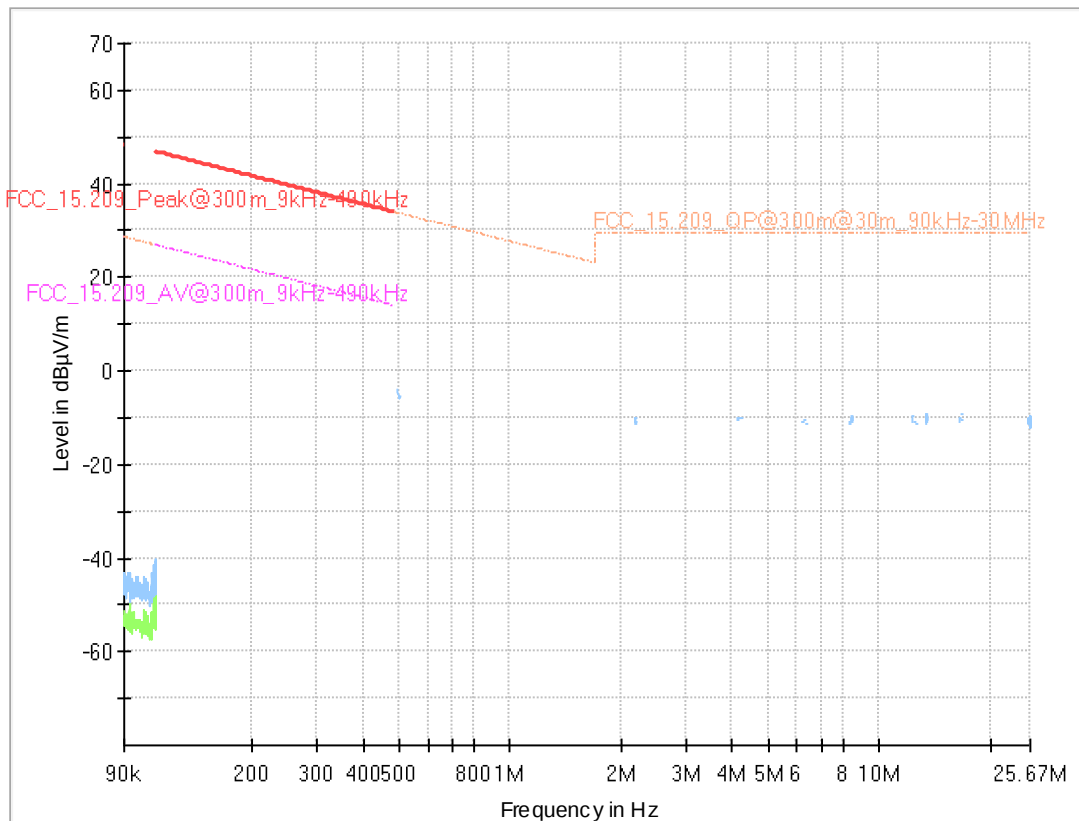
Radio Technology = WLAN b, Operating Frequency = low, Measurement range = 30 MHz - 1 GHz
(S01_AK01)



Final_Result

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

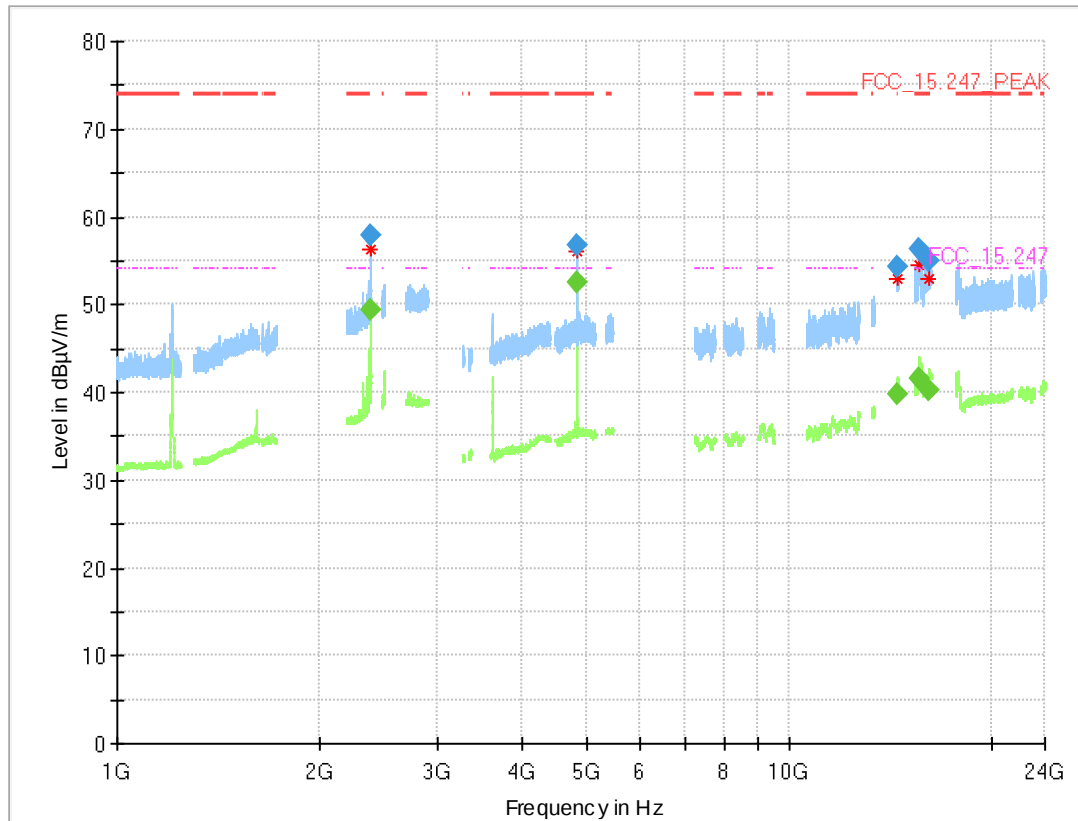
Radio Technology = WLAN b, Operating Frequency = mid, Measurement range = 9 kHz - 30 MHz
(S01_AK01)



Final_Result

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

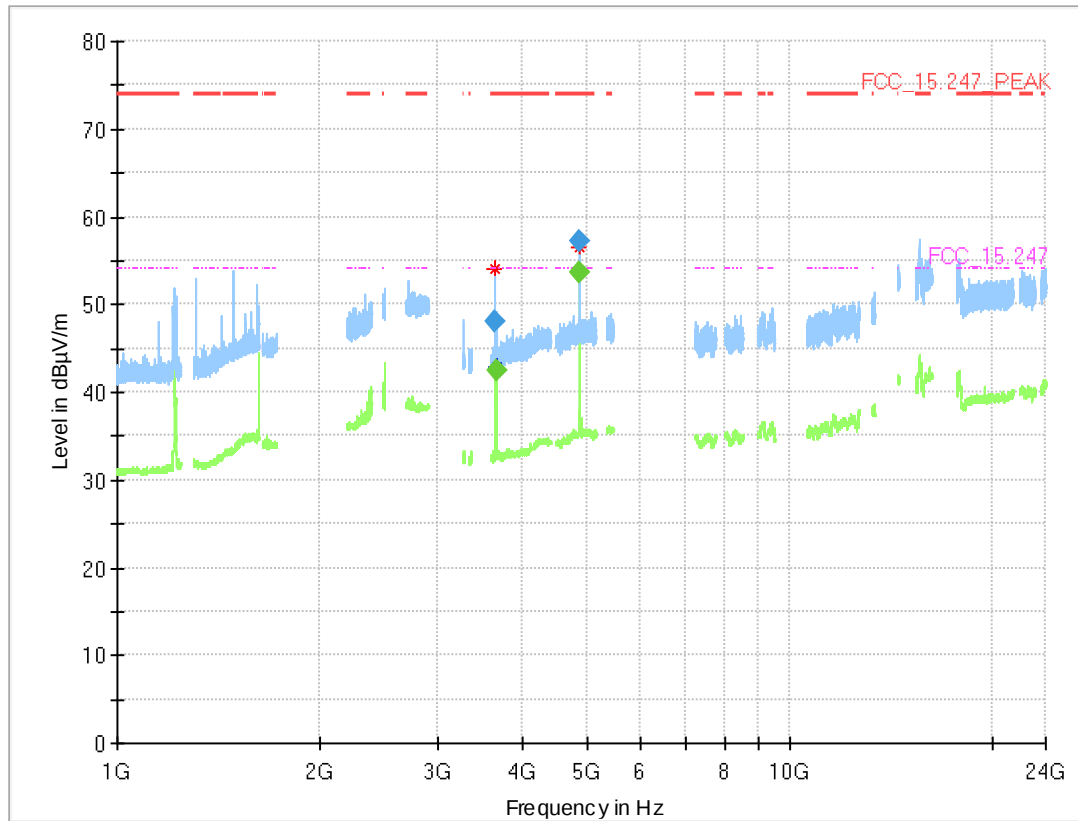
Radio Technology = WLAN b, Operating Frequency = low, Measurement range = 1 GHz - 26 GHz
(S01_AC01)



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)	Corr. (dB/m)
2386.480	58.0	---	74.00	16.02	1000.0	1000.000	150.0	V	-1.0	-11.0	4.9
2387.360	---	49.4	54.00	4.60	1000.0	1000.000	150.0	V	-8.0	-15.0	4.9
4823.863	56.7	---	74.00	17.25	1000.0	1000.000	150.0	V	-90.0	-15.0	3.7
4824.025	---	52.6	54.00	1.40	1000.0	1000.000	150.0	V	-92.0	-11.0	3.7
14488.150	54.4	---	74.00	19.63	1000.0	1000.000	150.0	H	-116.0	102.0	-3.3
14498.950	---	39.8	54.00	14.22	1000.0	1000.000	150.0	V	-190.0	-15.0	-3.5
15625.825	56.4	---	74.00	17.62	1000.0	1000.000	150.0	V	1.0	11.0	-2.0
15625.825	---	41.7	54.00	12.35	1000.0	1000.000	150.0	V	-60.0	13.0	-2.0
16149.567	54.9	---	74.00	19.07	1000.0	1000.000	150.0	V	4.0	105.0	-1.9
16160.050	---	40.2	54.00	13.76	1000.0	1000.000	150.0	V	-49.0	-15.0	-1.4

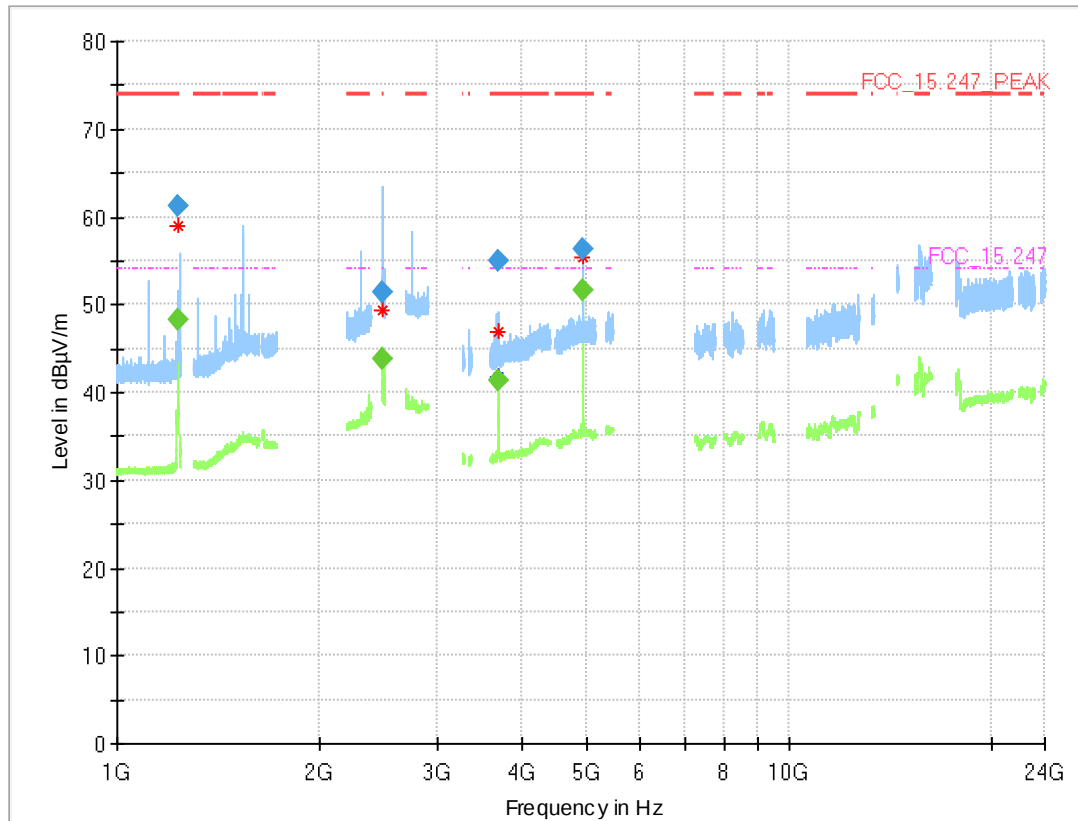
Radio Technology = WLAN b, Operating Frequency = mid, Measurement range = 1 GHz - 26 GHz
(S01_AK01)



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)	Corr. (dB/m)
3652.800	48.0	---	74.00	26.04	1000.0	1000.000	150.0	V	80.0	-2.0	0.6
3655.400	---	42.4	54.00	11.64	1000.0	1000.000	150.0	H	-116.0	78.0	0.7
4873.913	---	53.7	54.00	0.28	1000.0	1000.000	150.0	H	-95.0	98.0	4.6
4873.913	57.2	---	74.00	16.82	1000.0	1000.000	150.0	H	-91.0	98.0	4.6

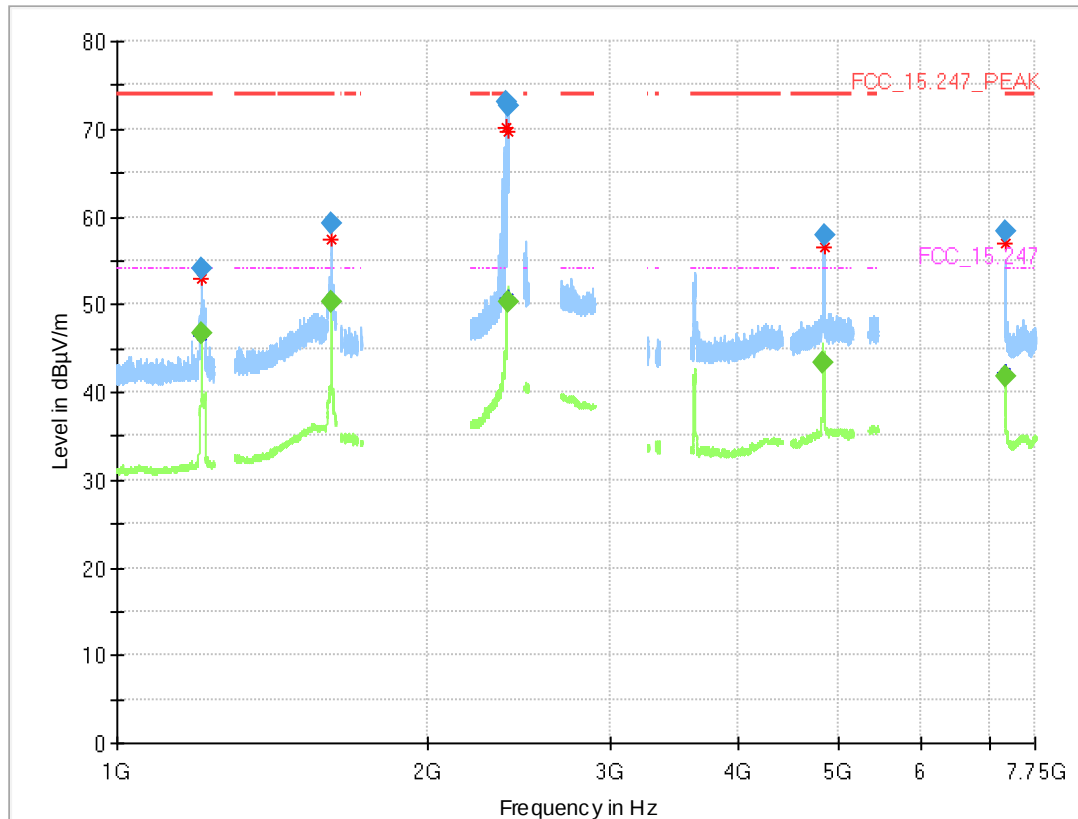
Radio Technology = WLAN b, Operating Frequency = high, Measurement range = 1 GHz - 26 GHz
(S01_AK01)



Final Result

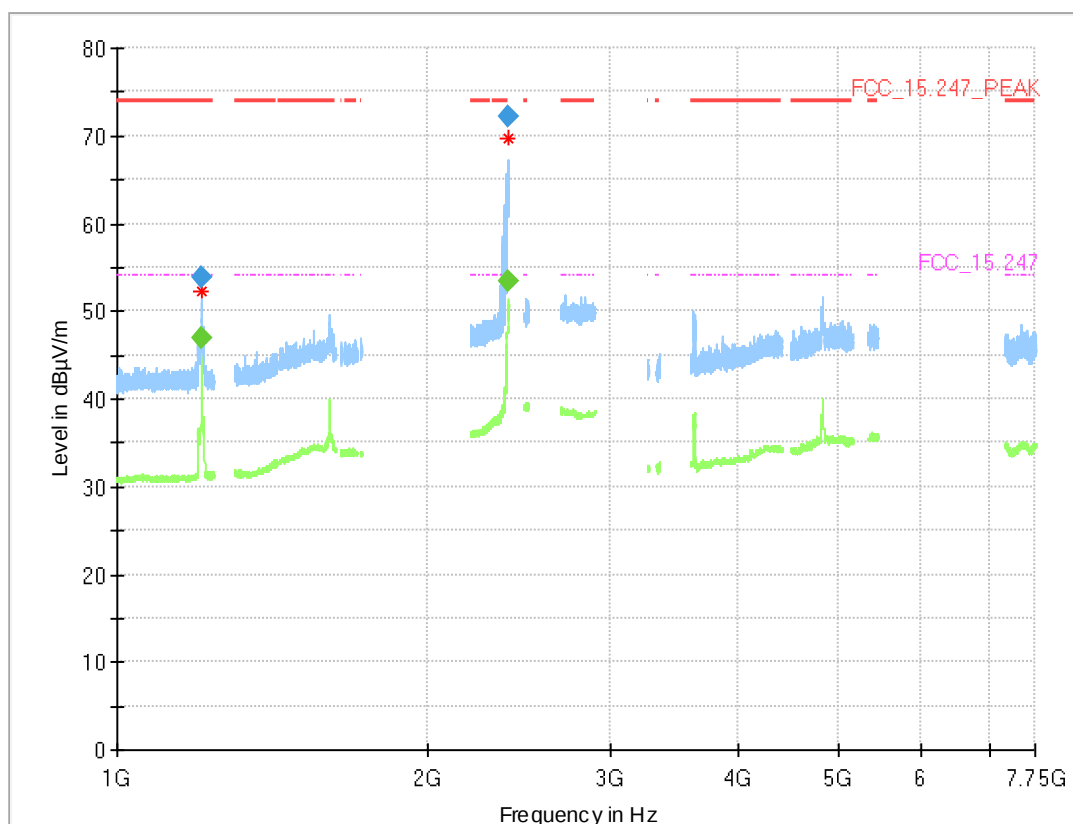
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
1231.120	---	48.3	54.00	5.75	1000.0	1000.000	150.0	H	-79.0	-12.0	-1.5
1231.480	61.3	---	74.00	12.67	1000.0	1000.000	150.0	H	-91.0	10.0	-1.5
2487.378	---	43.9	54.00	10.13	1000.0	1000.000	150.0	H	110.0	78.0	5.4
2489.275	51.3	---	74.00	22.71	1000.0	1000.000	150.0	H	-124.0	82.0	5.4
3692.800	---	41.5	54.00	12.55	1000.0	1000.000	150.0	V	-158.0	5.0	1.3
3693.200	55.0	---	74.00	18.99	1000.0	1000.000	150.0	H	127.0	105.0	1.3
4923.963	---	51.6	54.00	2.40	1000.0	1000.000	150.0	H	-92.0	105.0	4.9
4923.963	56.4	---	74.00	17.63	1000.0	1000.000	150.0	H	-90.0	96.0	4.9

Radio Technology = WLAN g, Operating Frequency = low, Measurement range = 1 GHz - 26 GHz
(S01_AK01)



Final Result

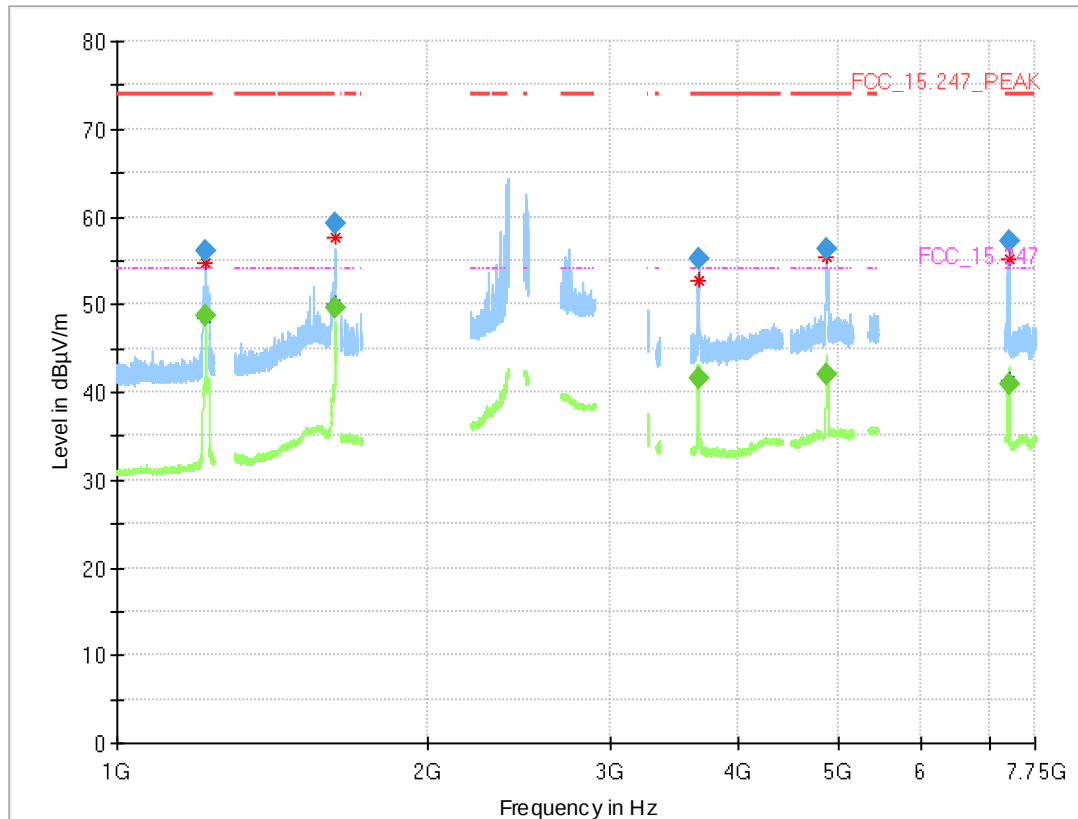
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
1208.440	---	46.7	54.00	7.28	1000.0	1000.000	150.0	V	-88.0	-4.0	-1.5
1208.680	54.0	---	74.00	20.00	1000.0	1000.000	150.0	V	-85.0	-10.0	-1.5
1611.372	---	50.2	54.00	3.76	1000.0	1000.000	150.0	H	-172.0	-4.0	1.4
1611.755	59.2	---	74.00	14.76	1000.0	1000.000	150.0	H	-169.0	-1.0	1.4
2386.560	73.1	---	74.00	0.94	1000.0	1000.000	150.0	V	-149.0	15.0	4.9
2390.000	---	50.3	54.00	3.71	1000.0	1000.000	150.0	V	152.0	4.0	5.0
2390.000	72.7	---	74.00	1.29	1000.0	1000.000	150.0	V	127.0	10.0	5.0
4833.938	---	43.4	54.00	10.59	1000.0	1000.000	150.0	H	-92.0	94.0	3.7
4839.138	57.9	---	74.00	16.10	1000.0	1000.000	150.0	H	-90.0	98.0	3.8
7250.000	---	41.8	54.00	12.22	1000.0	1000.000	150.0	H	56.0	94.0	-13.4
7250.000	58.3	---	74.00	15.73	1000.0	1000.000	150.0	H	57.0	100.0	-13.4



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)	Corr. (dB/m)
1206.040	---	46.9	54.00	7.07	1000.0	1000.000	150.0	H	-79.0	-4.0	-1.5
1206.160	53.8	---	74.00	20.20	1000.0	1000.000	150.0	H	-79.0	15.0	-1.5
2388.720	72.2	---	74.00	1.83	1000.0	1000.000	150.0	V	-97.0	-5.0	4.9
2389.760	---	53.3	54.00	0.67	1000.0	1000.000	150.0	V	-96.0	-15.0	5.0

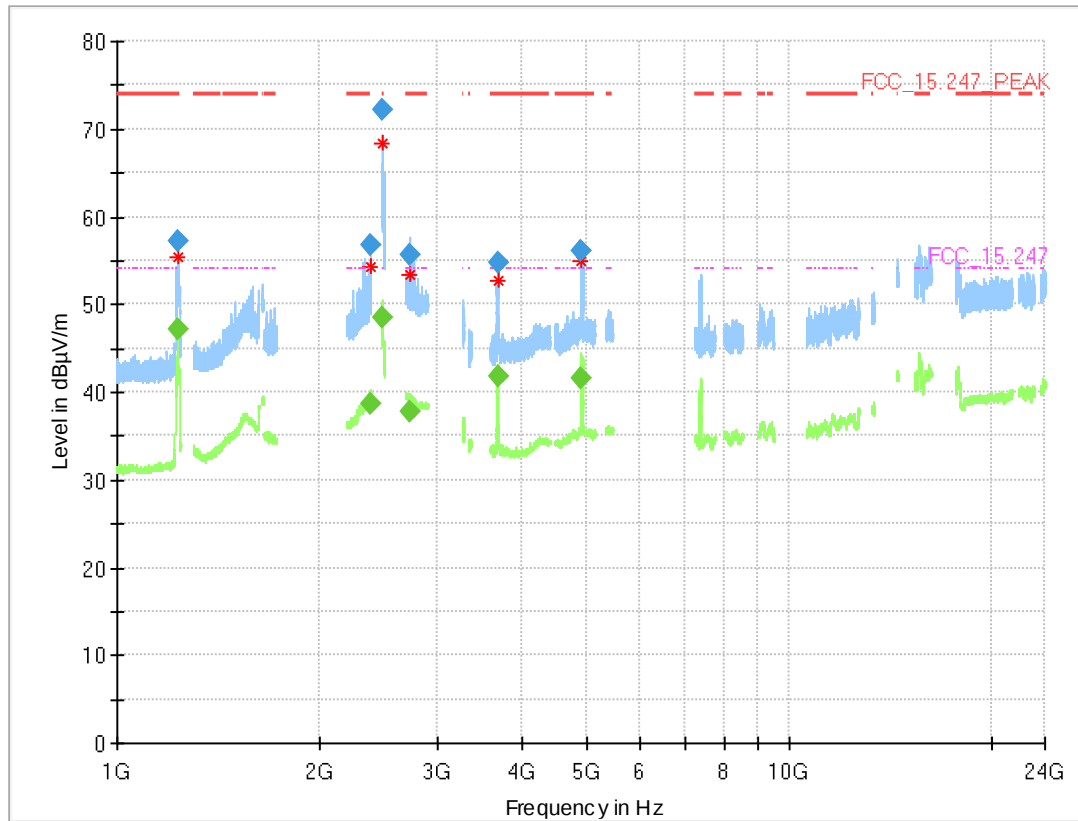
Radio Technology = WLAN g, Operating Frequency = mid, Measurement range = 1 GHz - 26 GHz
(S01_AK01)



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)	Corr. (dB/m)
1218.520	56.2	---	74.00	17.80	1000.0	1000.000	150.0	H	-1.0	-6.0	-1.5
1218.640	---	48.8	54.00	5.19	1000.0	1000.000	150.0	H	-28.0	-15.0	-1.5
1624.777	---	49.6	54.00	4.39	1000.0	1000.000	150.0	H	-158.0	-4.0	1.3
1624.777	59.3	---	74.00	14.72	1000.0	1000.000	150.0	H	-156.0	-1.0	1.3
3657.800	---	41.5	54.00	12.50	1000.0	1000.000	150.0	V	-122.0	15.0	0.7
3658.400	55.3	---	74.00	18.70	1000.0	1000.000	150.0	V	-120.0	3.0	0.7
4873.425	---	42.1	54.00	11.91	1000.0	1000.000	150.0	H	-90.0	78.0	4.6
4874.238	56.2	---	74.00	17.75	1000.0	1000.000	150.0	H	-90.0	91.0	4.6
7307.500	57.2	---	74.00	16.78	1000.0	1000.000	150.0	H	62.0	95.0	-13.2
7313.500	---	41.0	54.00	13.01	1000.0	1000.000	150.0	H	60.0	93.0	-13.3

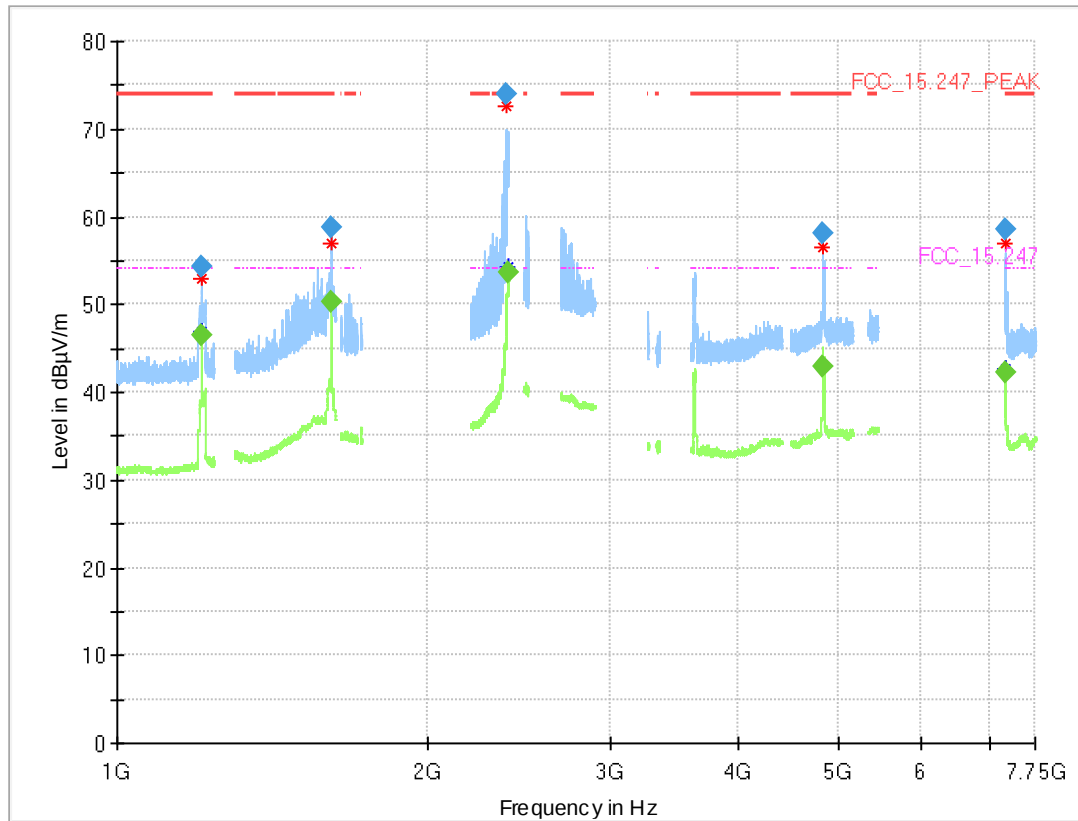
Radio Technology = WLAN g, Operating Frequency = high, Measurement range = 1 GHz - 26 GHz
(S01_AK01)



Final Result

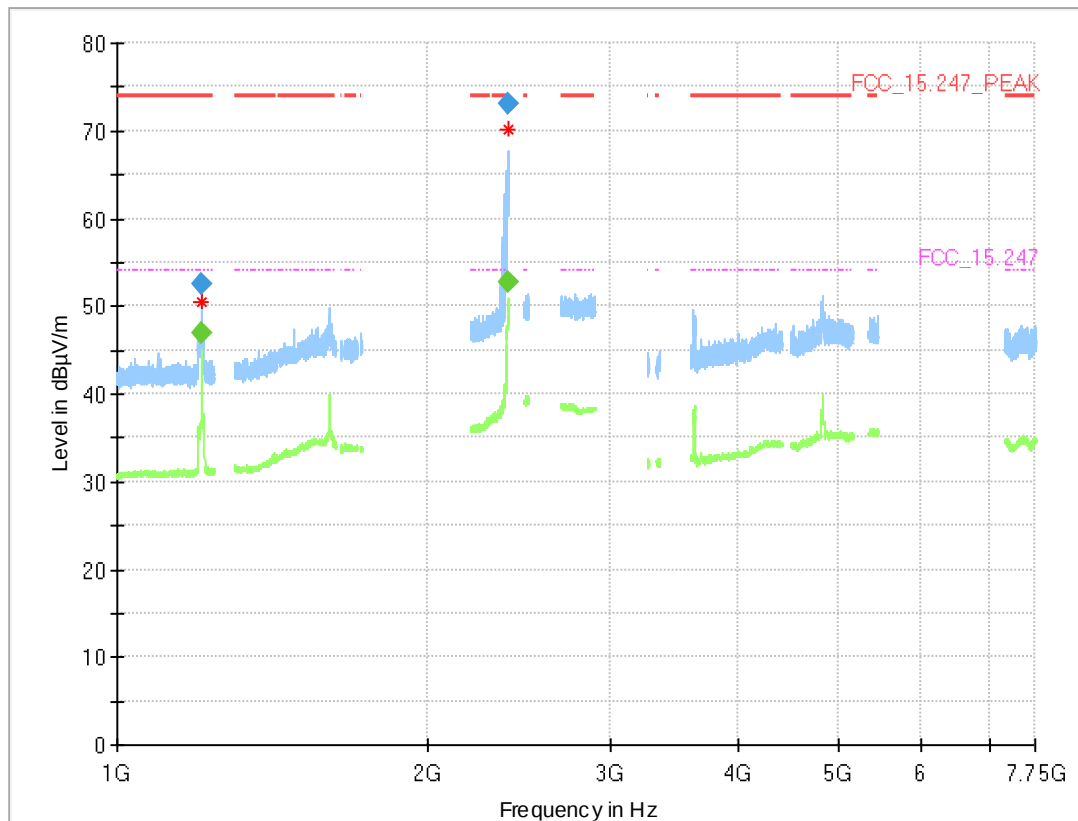
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
1228.240	57.3	---	74.00	16.74	1000.0	1000.000	150.0	H	-95.0	-8.0	-1.5
1228.600	---	47.2	54.00	6.83	1000.0	1000.000	150.0	H	-30.0	-15.0	-1.5
2389.520	---	38.7	54.00	15.28	1000.0	1000.000	150.0	V	-191.0	5.0	4.9
2389.520	56.7	---	74.00	17.28	1000.0	1000.000	150.0	V	-154.0	15.0	4.9
2483.995	---	48.5	54.00	5.53	1000.0	1000.000	150.0	V	-25.0	-15.0	5.4
2484.820	72.1	---	74.00	1.92	1000.0	1000.000	150.0	V	-191.0	14.0	5.4
2726.540	55.5	---	74.00	18.46	1000.0	1000.000	150.0	V	-93.0	-15.0	6.2
2727.170	---	37.7	54.00	16.33	1000.0	1000.000	150.0	V	-180.0	1.0	6.2
3682.400	54.8	---	74.00	19.22	1000.0	1000.000	150.0	V	-111.0	15.0	1.5
3682.400	---	41.7	54.00	12.27	1000.0	1000.000	150.0	V	-122.0	15.0	1.5
4910.800	56.0	---	74.00	17.99	1000.0	1000.000	150.0	H	-91.0	96.0	4.4
4913.400	---	41.6	54.00	12.36	1000.0	1000.000	150.0	H	-92.0	88.0	4.5

Radio Technology = WLAN n 20 MHz, Operating Frequency = low, Measurement range = 1 GHz
- 26 GHz
(S01_AK01)



Final Result

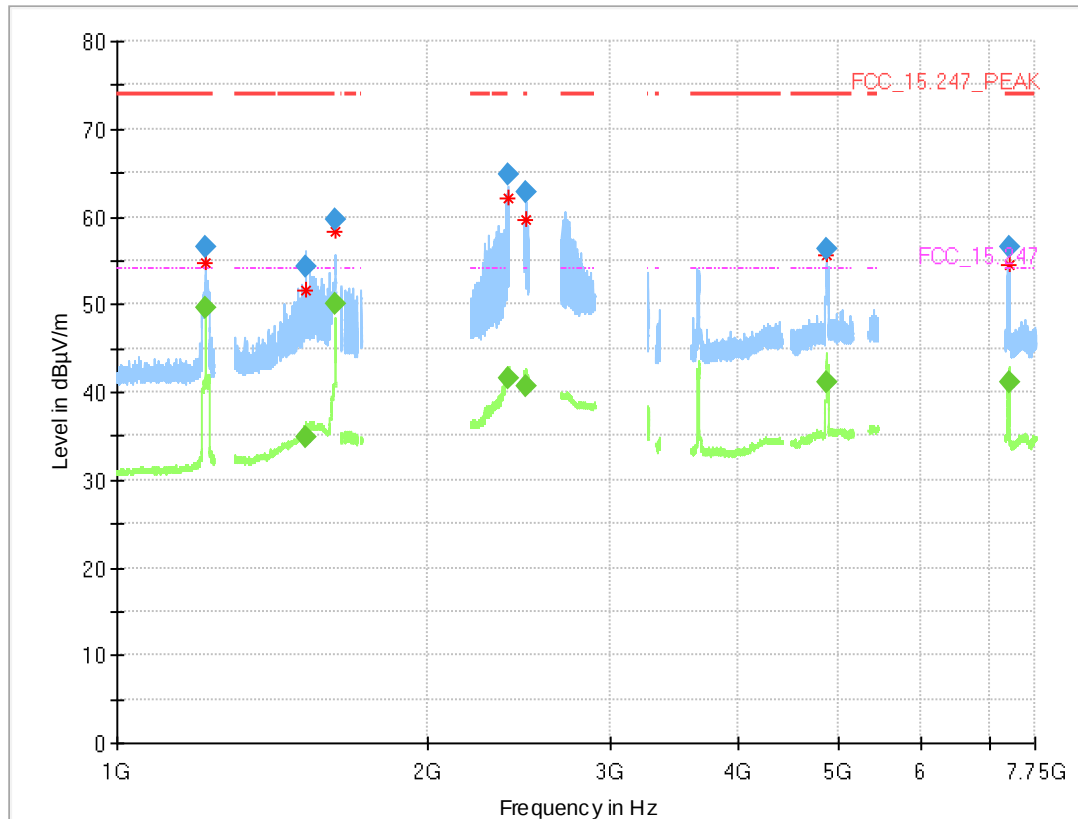
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
1208.320	54.3	---	74.00	19.66	1000.0	1000.000	150.0	V	-90.0	4.0	-1.5
1208.440	---	46.4	54.00	7.58	1000.0	1000.000	150.0	V	-88.0	-5.0	-1.5
1611.372	58.7	---	74.00	15.25	1000.0	1000.000	150.0	V	-119.0	102.0	1.4
1611.372	---	50.4	54.00	3.65	1000.0	1000.000	150.0	V	-90.0	102.0	1.4
2386.640	73.9	---	74.00	0.11	1000.0	1000.000	150.0	V	-190.0	15.0	4.9
2389.280	---	53.7	54.00	0.33	1000.0	1000.000	150.0	V	169.0	7.0	4.9
4828.900	58.0	---	74.00	16.00	1000.0	1000.000	150.0	H	-92.0	92.0	3.6
4833.288	---	43.0	54.00	11.01	1000.0	1000.000	150.0	H	-92.0	94.0	3.7
7250.625	---	42.3	54.00	11.74	1000.0	1000.000	150.0	H	56.0	94.0	-13.4
7253.250	58.6	---	74.00	15.36	1000.0	1000.000	150.0	H	57.0	104.0	-13.4



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)	Corr. (dB/m)
1206.040	---	46.9	54.00	7.06	1000.0	1000.000	150.0	H	-83.0	4.0	-1.5
1206.160	52.6	---	74.00	21.39	1000.0	1000.000	150.0	V	-5.0	78.0	-1.5
2389.440	73.0	---	74.00	0.95	1000.0	1000.000	150.0	V	-114.0	-3.0	4.9
2389.600	---	52.7	54.00	1.34	1000.0	1000.000	150.0	V	-98.0	-12.0	5.0

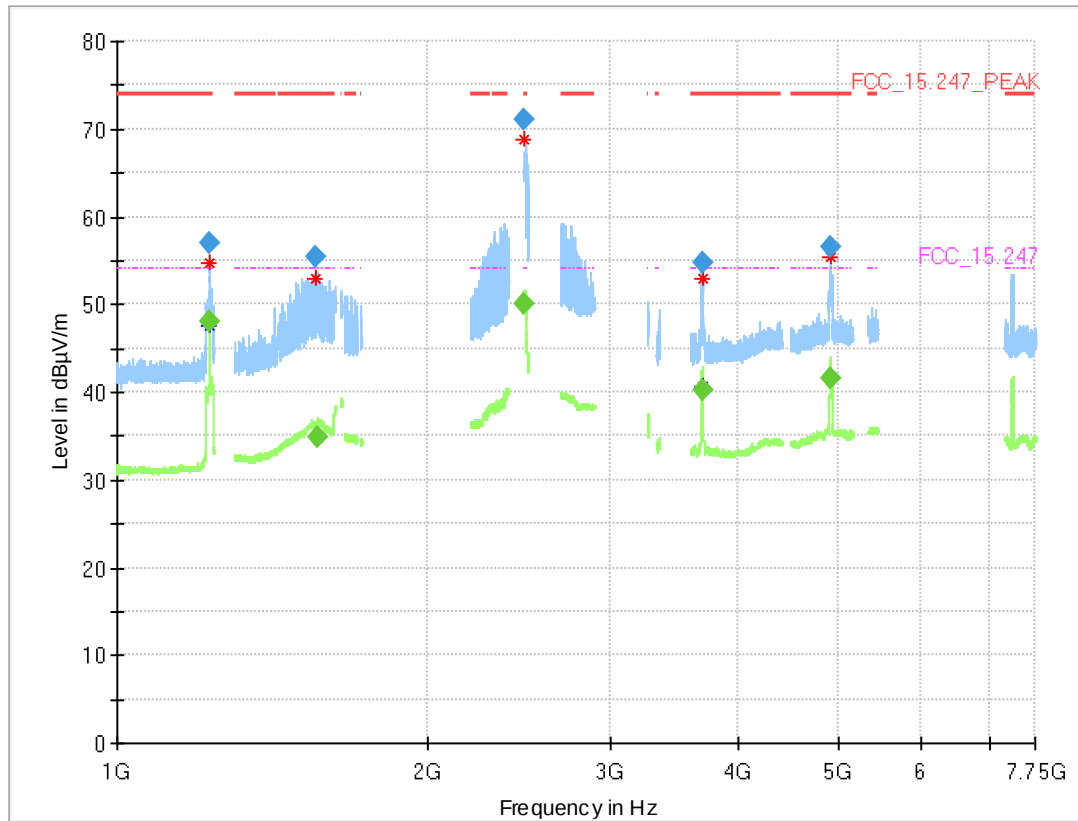
Radio Technology = WLAN n 20 MHz, Operating Frequency = mid, Measurement range = 1
GHz - 26 GHz
(S01_AK01)



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)	Corr. (dB/m)
1218.520	---	49.7	54.00	4.33	1000.0	1000.000	150.0	H	-26.0	-15.0	-1.5
1218.640	56.6	---	74.00	17.38	1000.0	1000.000	150.0	H	0.0	-6.0	-1.5
1522.133	---	34.9	54.00	19.09	1000.0	1000.000	150.0	H	-86.0	4.0	0.9
1522.324	54.4	---	74.00	19.61	1000.0	1000.000	150.0	H	-169.0	15.0	0.9
1624.585	---	50.0	54.00	3.95	1000.0	1000.000	150.0	H	-158.0	4.0	1.3
1624.585	59.6	---	74.00	14.43	1000.0	1000.000	150.0	H	-157.0	15.0	1.3
2389.600	64.9	---	74.00	9.09	1000.0	1000.000	150.0	V	-154.0	15.0	5.0
2390.000	---	41.5	54.00	12.54	1000.0	1000.000	150.0	V	-191.0	4.0	5.0
2484.325	62.7	---	74.00	11.32	1000.0	1000.000	150.0	V	-156.0	6.0	5.4
2484.985	---	40.7	54.00	13.30	1000.0	1000.000	150.0	V	-152.0	3.0	5.4
4874.563	---	41.1	54.00	12.87	1000.0	1000.000	150.0	H	-91.0	78.0	4.6
4875.375	56.2	---	74.00	17.76	1000.0	1000.000	150.0	H	-88.0	94.0	4.5
7313.375	---	41.0	54.00	12.98	1000.0	1000.000	150.0	H	62.0	93.0	-13.2
7314.500	56.5	---	74.00	17.49	1000.0	1000.000	150.0	H	62.0	96.0	-13.3

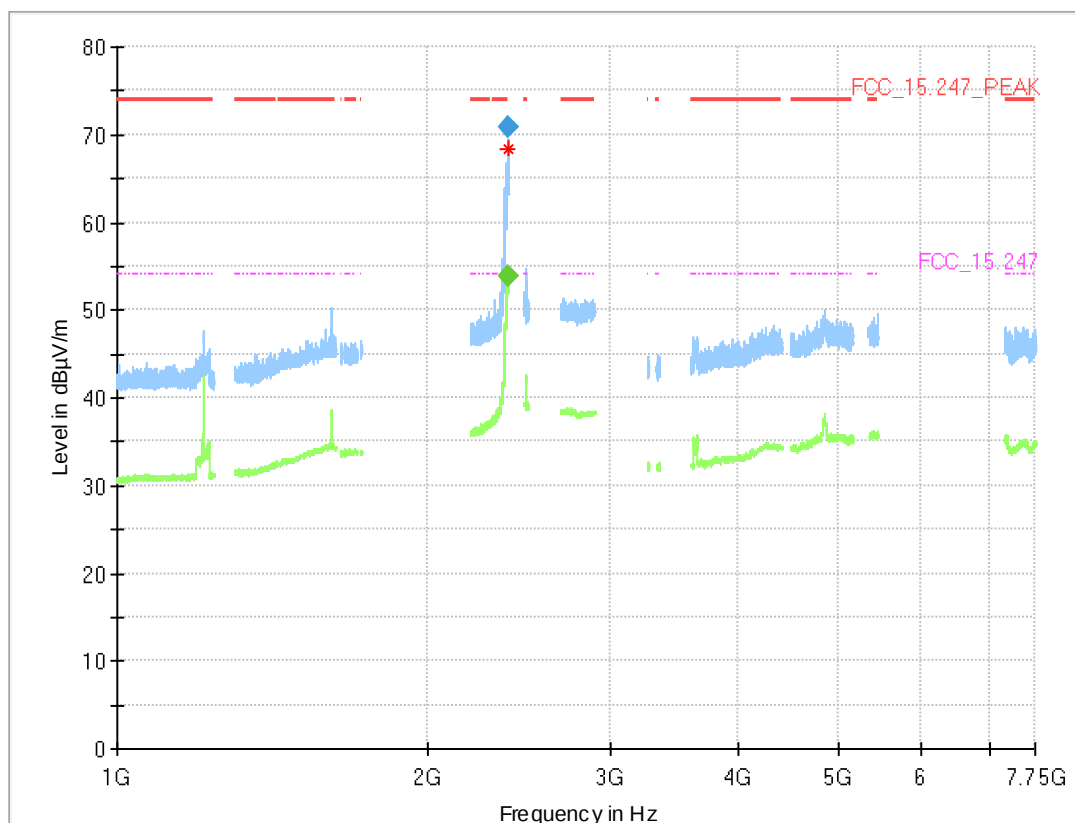
Radio Technology = WLAN n 20 MHz, Operating Frequency = high, Measurement range = 1
GHz - 26 GHz
(S01_AK01)



Final Result

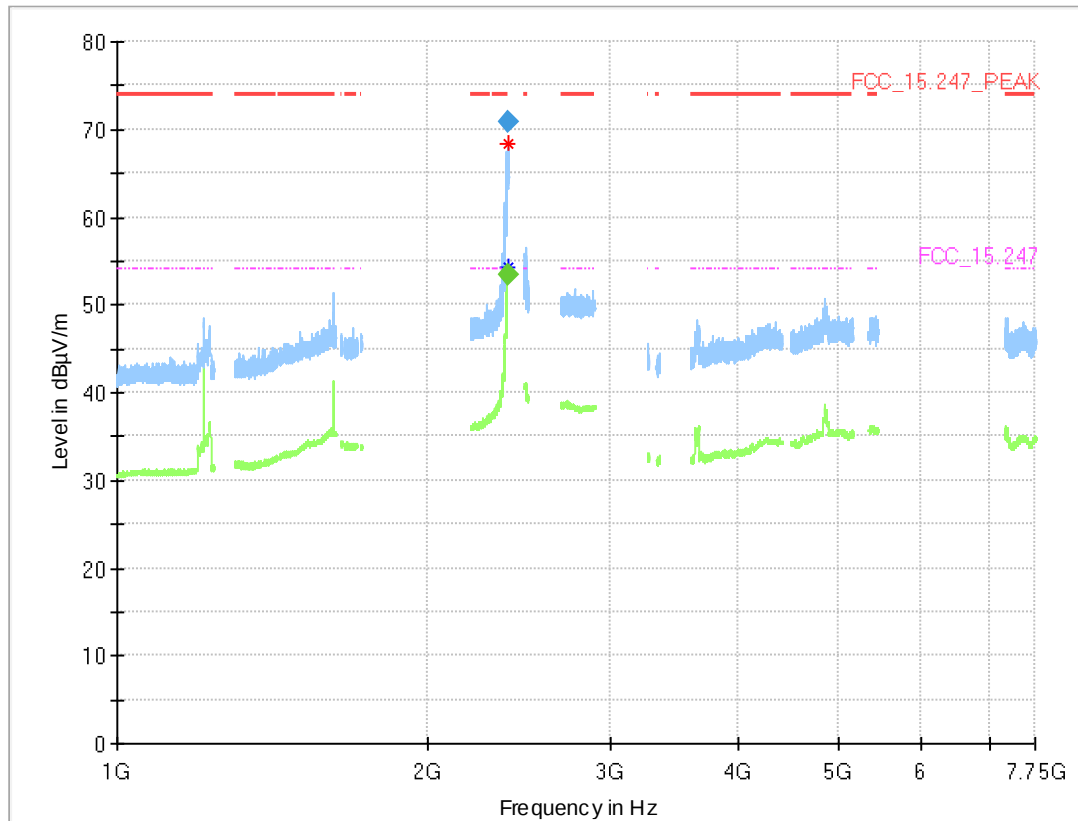
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
1228.480	---	47.9	54.00	6.06	1000.0	1000.000	150.0	H	-30.0	-12.0	-1.5
1228.600	56.9	---	74.00	17.08	1000.0	1000.000	150.0	H	-93.0	-15.0	-1.5
1554.113	55.4	---	74.00	18.65	1000.0	1000.000	150.0	H	-83.0	12.0	1.1
1566.752	---	34.8	54.00	19.16	1000.0	1000.000	150.0	V	-120.0	86.0	1.2
2483.500	71.1	---	74.00	2.92	1000.0	1000.000	150.0	V	-41.0	-15.0	5.4
2483.748	---	50.1	54.00	3.91	1000.0	1000.000	150.0	V	-11.0	-12.0	5.4
3688.000	---	40.3	54.00	13.71	1000.0	1000.000	150.0	H	-96.0	79.0	1.4
3688.200	54.8	---	74.00	19.15	1000.0	1000.000	150.0	H	-92.0	102.0	1.4
4912.913	56.5	---	74.00	17.48	1000.0	1000.000	150.0	H	-91.0	91.0	4.5
4914.050	---	41.6	54.00	12.38	1000.0	1000.000	150.0	H	-92.0	86.0	4.6

Radio Technology = WLAN n 40 MHz, Operating Frequency = low, Measurement range = 1 GHz
- 26 GHz
(S01_AK01)



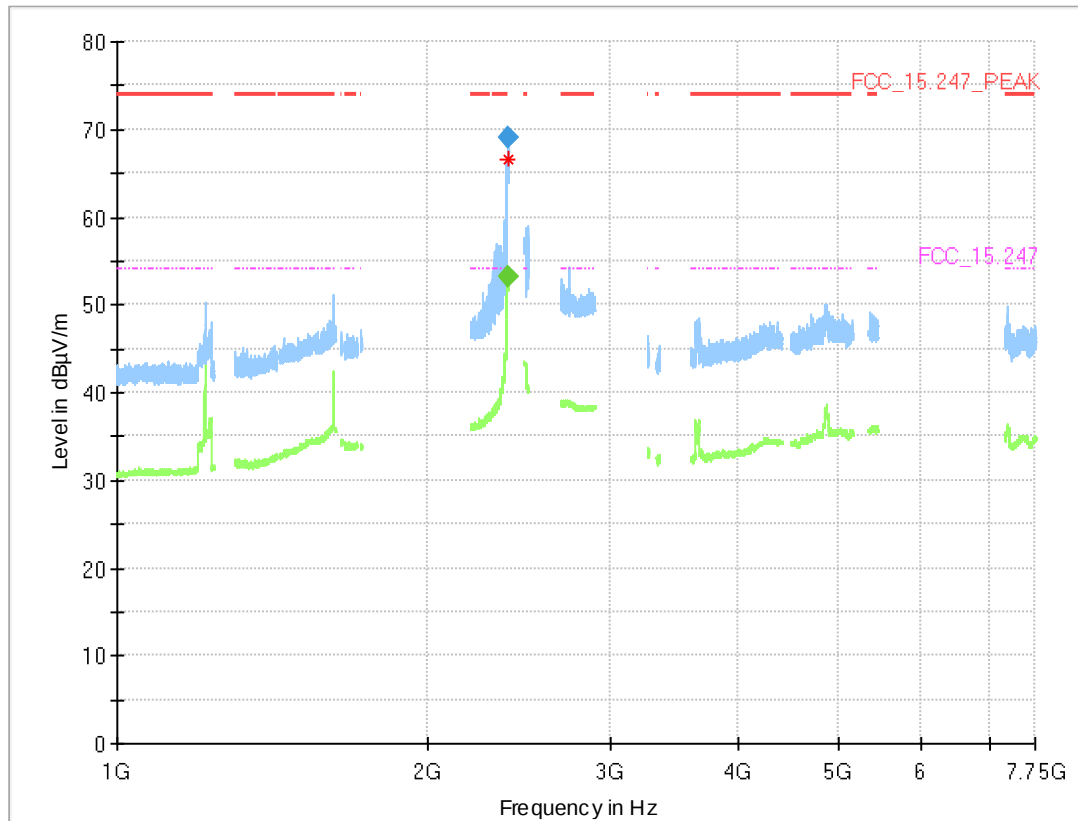
Final_Result

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)	Corr. (dB/m)
2388.400	70.9	---	74.00	3.09	1000.0	1000.000	150.0	V	-160.0	9.0	4.9
2390.000	---	53.9	54.00	0.05	1000.0	1000.000	150.0	V	165.0	6.0	5.0



Final_Result

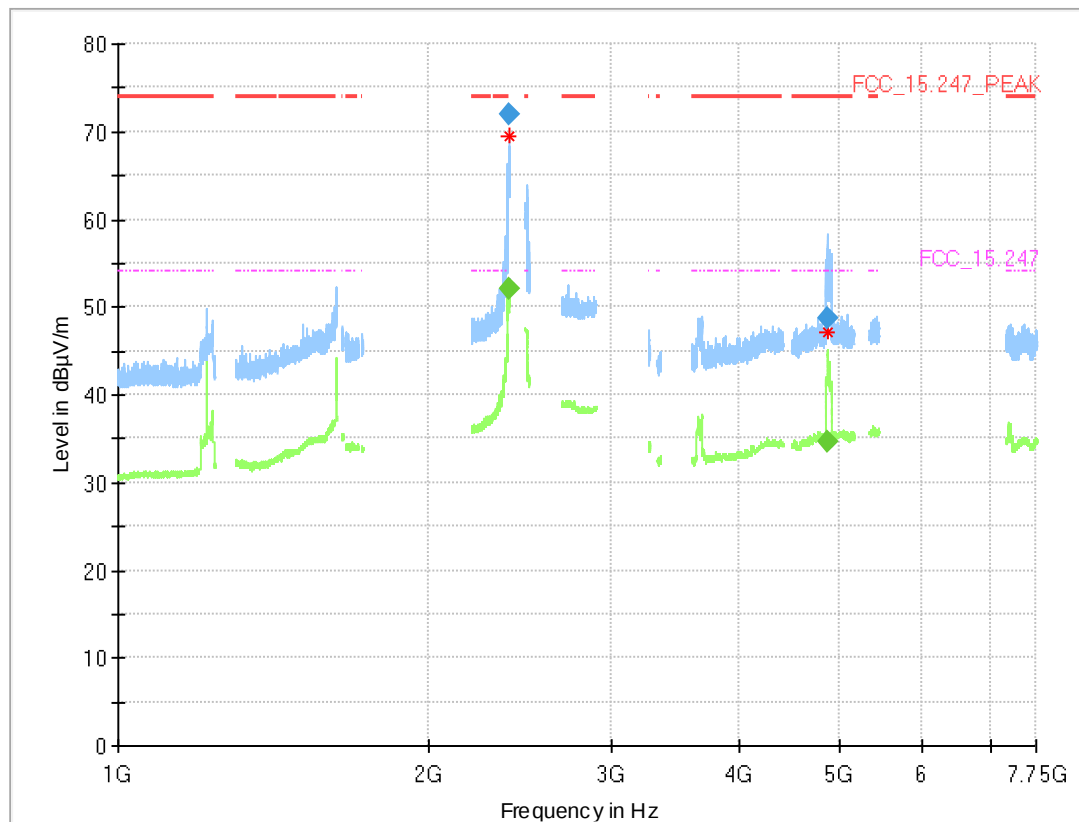
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
2388.880	70.9	---	74.00	3.12	1000.0	1000.000	150.0	V	-192.0	5.0	4.9
2389.680	---	53.4	54.00	0.63	1000.0	1000.000	150.0	V	165.0	1.0	5.0



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)	Corr. (dB/m)
2389.280	69.1	---	74.00	4.91	1000.0	1000.000	150.0	V	135.0	18.0	4.9
2390.000	---	53.2	54.00	0.84	1000.0	1000.000	150.0	V	-194.0	4.0	5.0

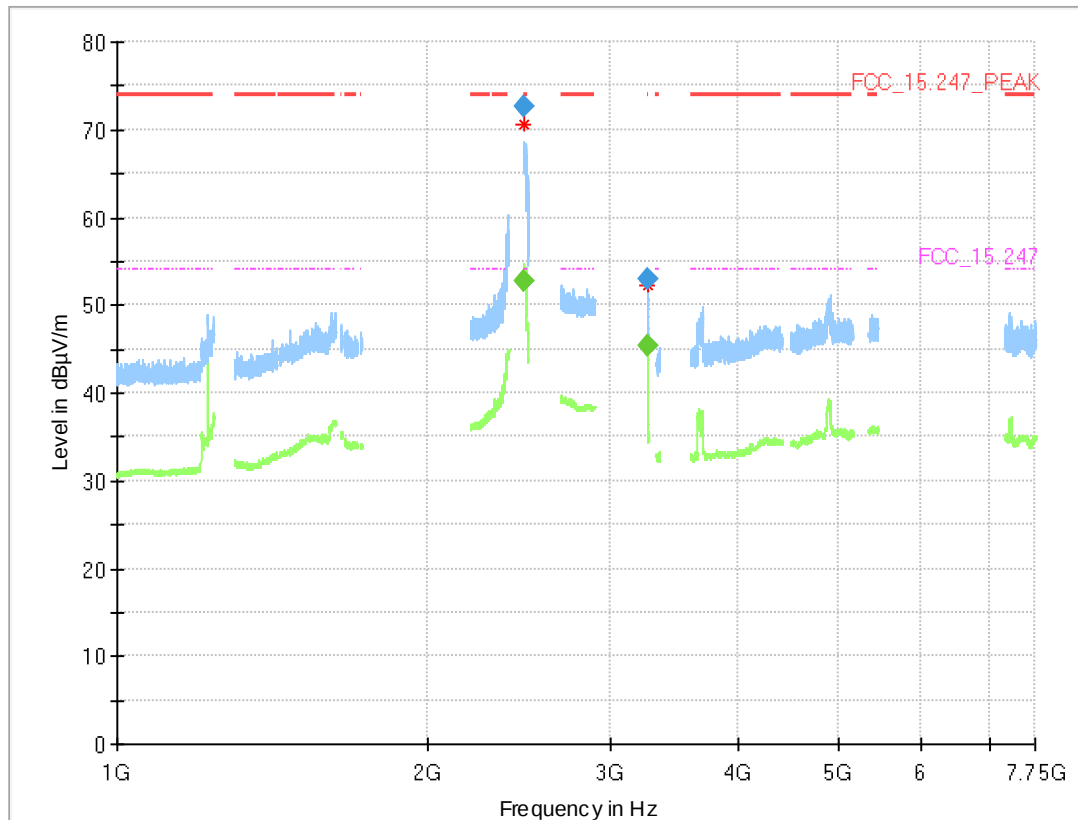
Radio Technology = WLAN n 40 MHz, Operating Frequency = mid, Measurement range = 1
GHz - 26 GHz
(S01_AK01)



Final_Result

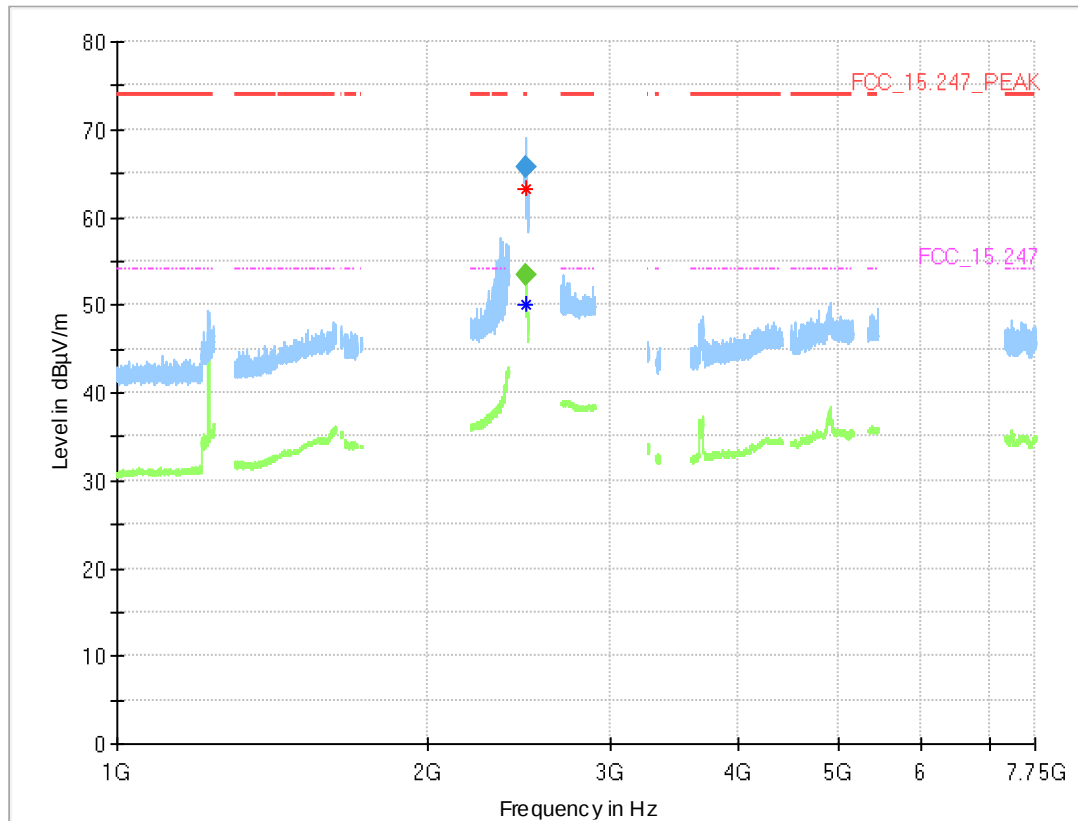
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
2390.000	---	52.1	54.00	1.90	1000.0	1000.000	150.0	V	165.0	5.0	5.0
2390.000	71.9	---	74.00	2.06	1000.0	1000.000	150.0	V	165.0	12.0	5.0
4873.263	48.8	---	74.00	25.21	1000.0	1000.000	150.0	H	142.0	-35.0	4.6
4874.238	---	34.6	54.00	19.40	1000.0	1000.000	150.0	H	135.0	107.0	4.6

Radio Technology = WLAN n 40 MHz, Operating Frequency = high, Measurement range = 1 GHz - 26 GHz
(S01_AK01)



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)
2483.583	72.7	---	74.00	1.35	1000.0	1000.000	150.0	H	98.0	87.0
2483.665	---	52.6	54.00	1.36	1000.0	1000.000	150.0	V	90.0	-4.0
3262.520	53.0	---	74.00	21.01	1000.0	1000.000	150.0	H	122.0	91.0
3262.660	---	45.3	54.00	8.66	1000.0	1000.000	150.0	H	123.0	85.0



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)	Corr. (dB/m)
2484.160	---	53.5	54.00	0.50	1000.0	1000.000	150.0	H	79.0	78.0	5.4
2485.398	65.7	---	74.00	8.26	1000.0	1000.000	150.0	H	79.0	88.0	5.4

5.6.5 TEST EQUIPMENT USED

- Radiated Emissions

5.7 BAND EDGE COMPLIANCE CONDUCTED

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

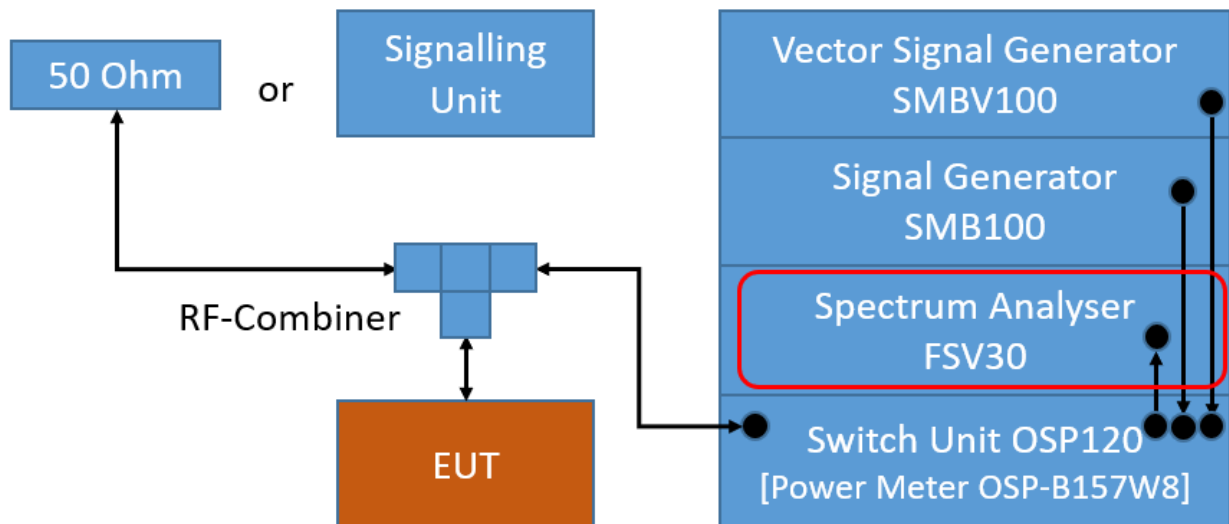
5.7.1 TEST DESCRIPTION

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".

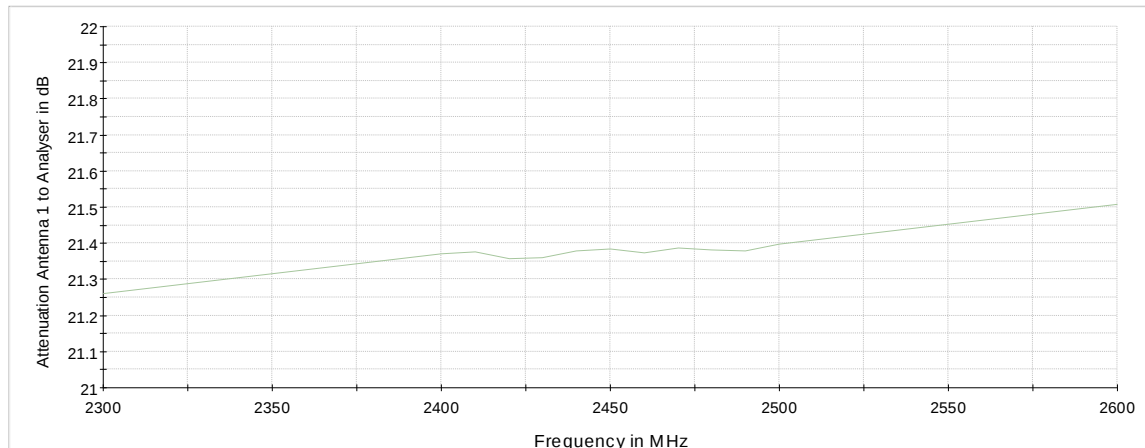
The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

Analyser settings:

- Lower Band Edge:
Measured range: 2310.0 MHz to 2483.5 MHz
- Upper Band Edge
Measured range: 2400.0 MHz to 2500 MHz
- Detector: Peak
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweptime: Auto
- Sweeps: Till stable (min. 300, max. 15000)
- Trace: Maxhold



TS8997; Band Edge Conducted



Attenuation of the measurement path

5.7.2 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..."

5.7.3 TEST PROTOCOL

Ambient temperature: 25 °C
 Air Pressure: 1020 hPa
 Humidity: 30 %
 BT LE 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]
0	2402	2400.0	-47.3	PEAK	100	3.0	-17.0	30.3
39	2480	2483.5	-51.3	PEAK	100	3.0	-17.0	34.3

BT LE 2 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]
0	2402	2400.0	-26.9	PEAK	100	3.3	-16.7	10.2
39	2480	2483.5	-52.8	PEAK	100	3.4	-16.6	36.2

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	-43.6	PEAK	100	1.3	-28.7	14.9
11	2462	2483.5	-43.5	PEAK	100	1.4	-28.6	14.9

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	-38.6	PEAK	100	-0.6	-30.6	8.0
2	2417	2400.0	-39.9	PEAK	100	4.1	-25.9	14.0
11	2462	2483.5	-43.5	PEAK	100	-0.1	-30.1	13.4
10	2457	2483.5	-43.1	PEAK	100	4.3	-25.7	17.4

WLAN n-Mode; 20 MHz; 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	-39.6	PEAK	100	-0.7	-30.7	8.9
2	2417	2400.0	-37.9	PEAK	100	3.9	-26.1	11.8
11	2462	2483.5	-43.7	PEAK	100	0.0	-30.0	13.7
10	2457	2483.5	-42.0	PEAK	100	3.3	-26.7	15.3

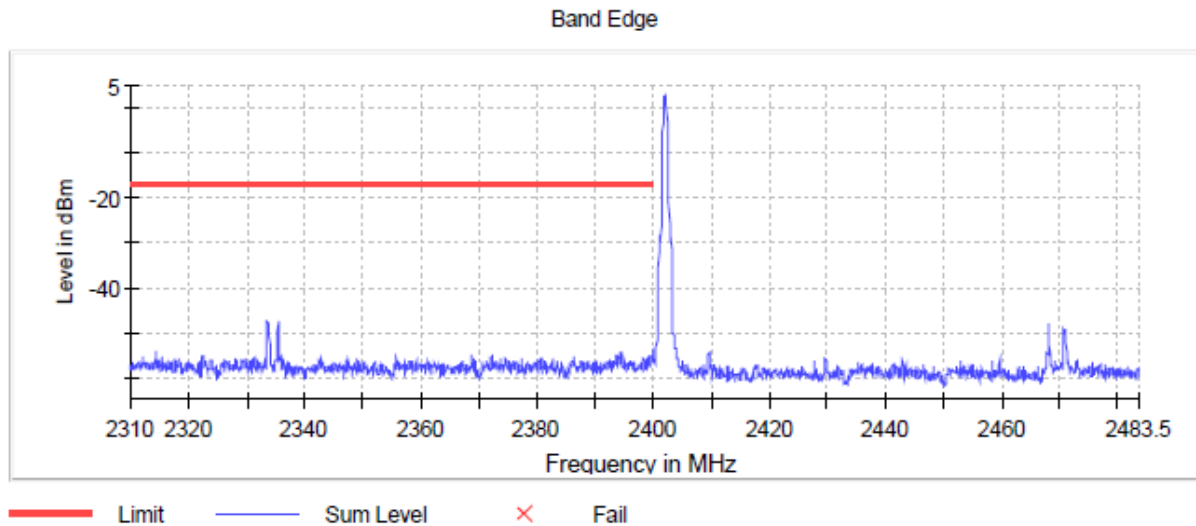
WLAN n-Mode; 40 MHz; MCS0

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]
3	2422	2400.0	-46.8	PEAK	100	-6.5	-36.5	10.2
4	2427	2400.0	-44.6	PEAK	100	-5.7	-35.7	8.9
5	2432	2400.0	-42.7	PEAK	100	-4.3	-34.3	8.4
8	2447	2483.5	-43.4	PEAK	100	-3.2	-33.2	10.2
9	2452	2483.5	-43.6	PEAK	100	-4.4	-34.4	9.2

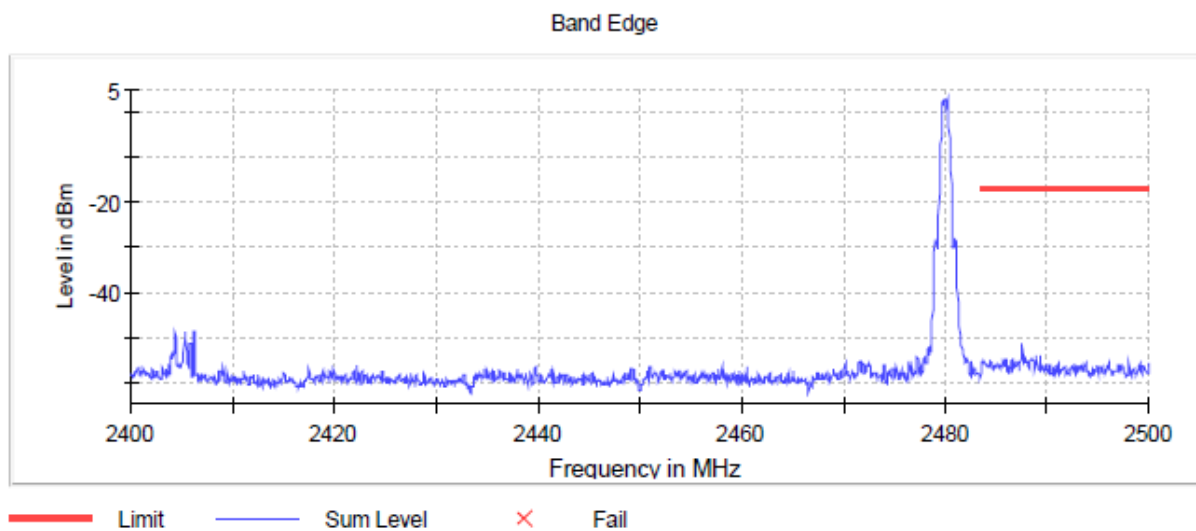
Remark: Please see next sub-clause for the measurement plot.

5.7.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

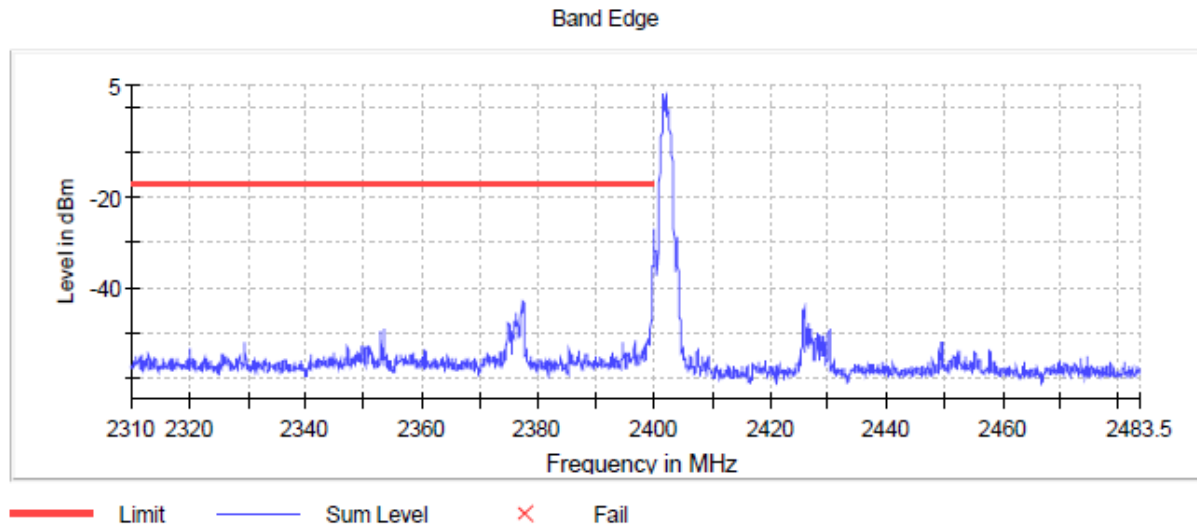
Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = low, Band Edge = low (S02_AG01)



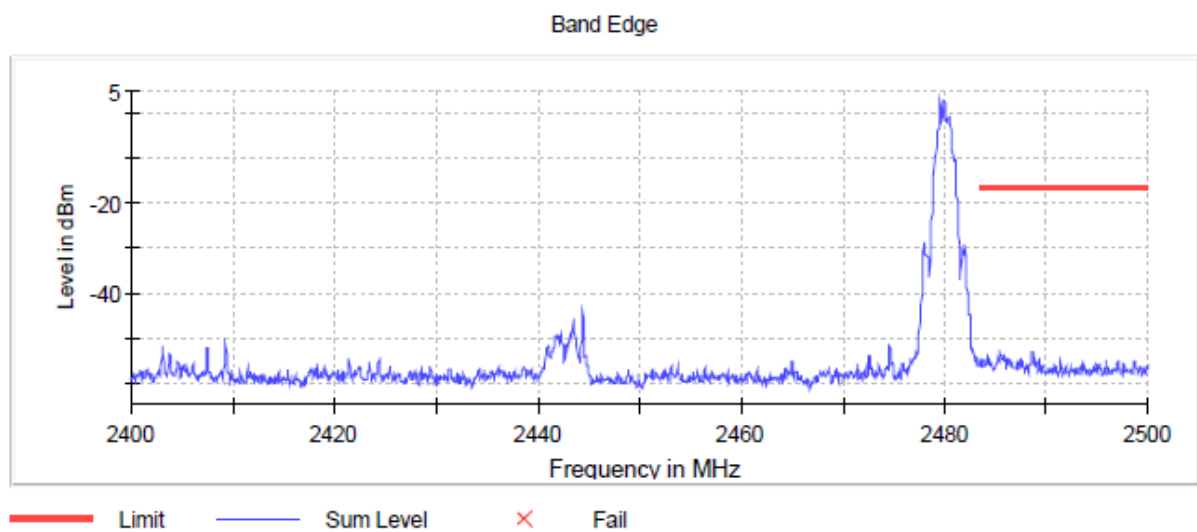
Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = high, Band Edge = high (S02_AG01)



Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = low, Band Edge = low
(S02_AG01)

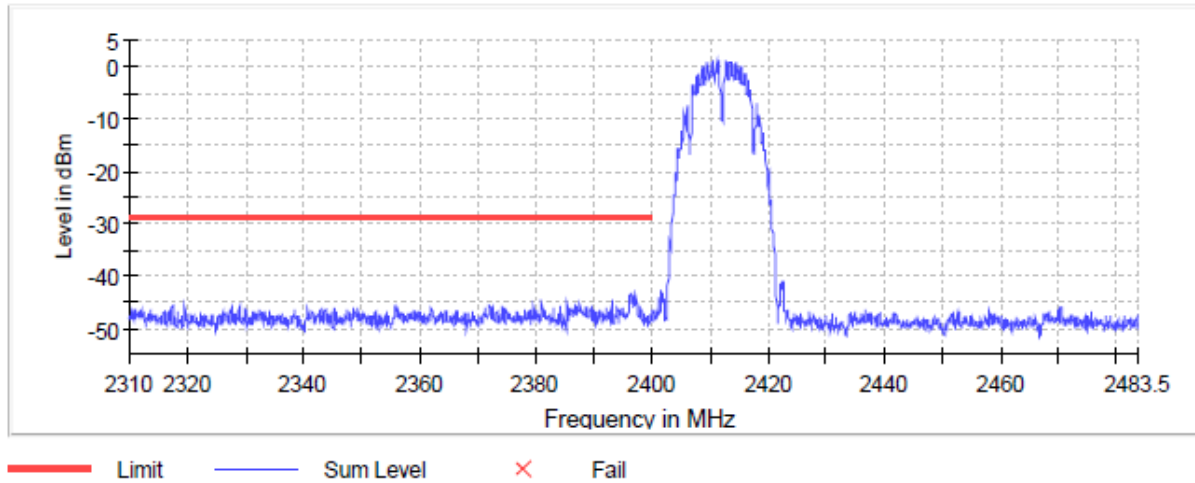


Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = high, Band Edge = high
(S02_AG01)



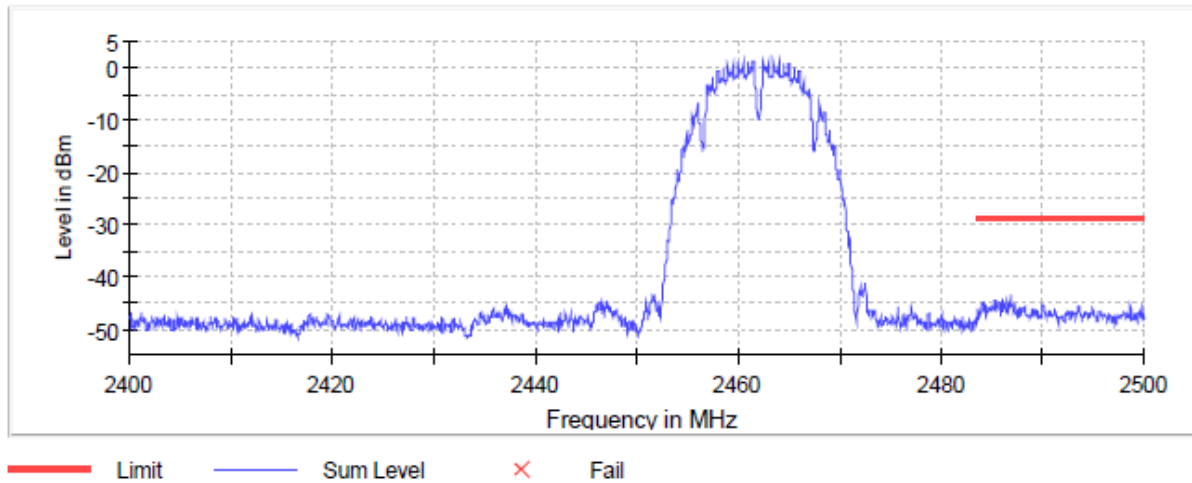
Radio Technology = WLAN b, Operating Frequency = low, Band Edge = low
(S02_AG01)

Band Edge



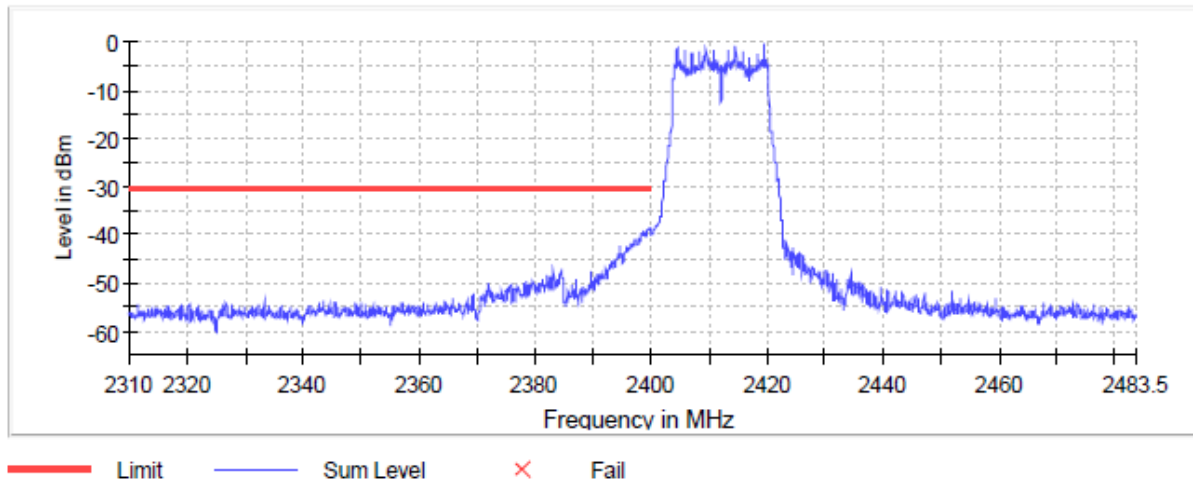
Radio Technology = WLAN b, Operating Frequency = high, Band Edge = high
(S02_AG01)

Band Edge

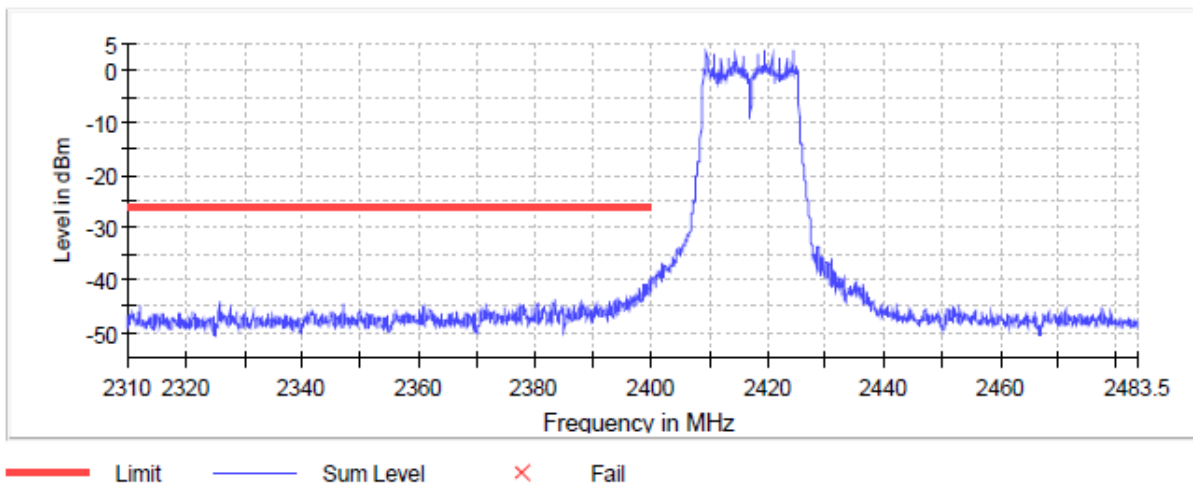


Radio Technology = WLAN g, Operating Frequency = low, Band Edge = low
(S02_AG01)

Band Edge

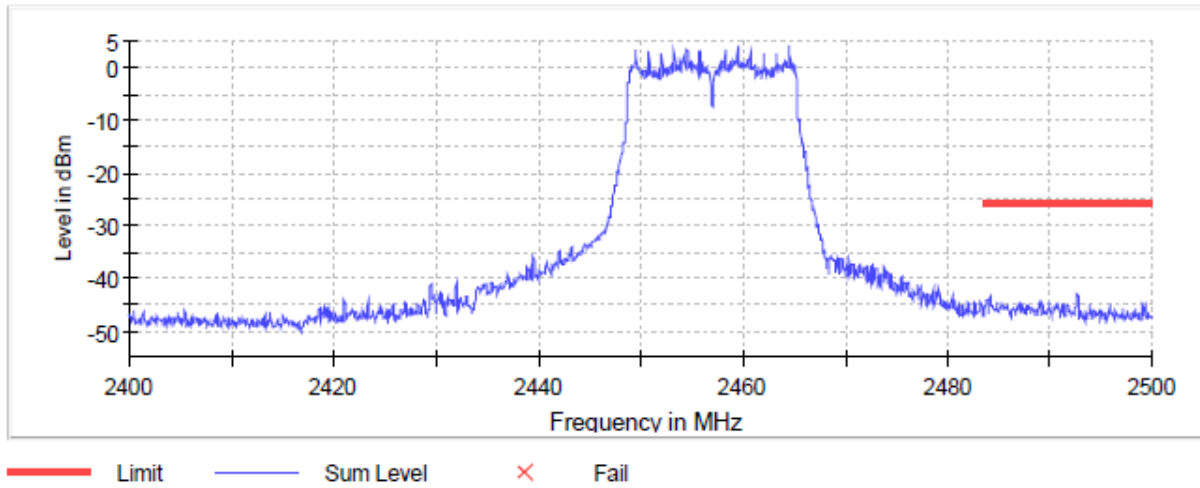


Band Edge

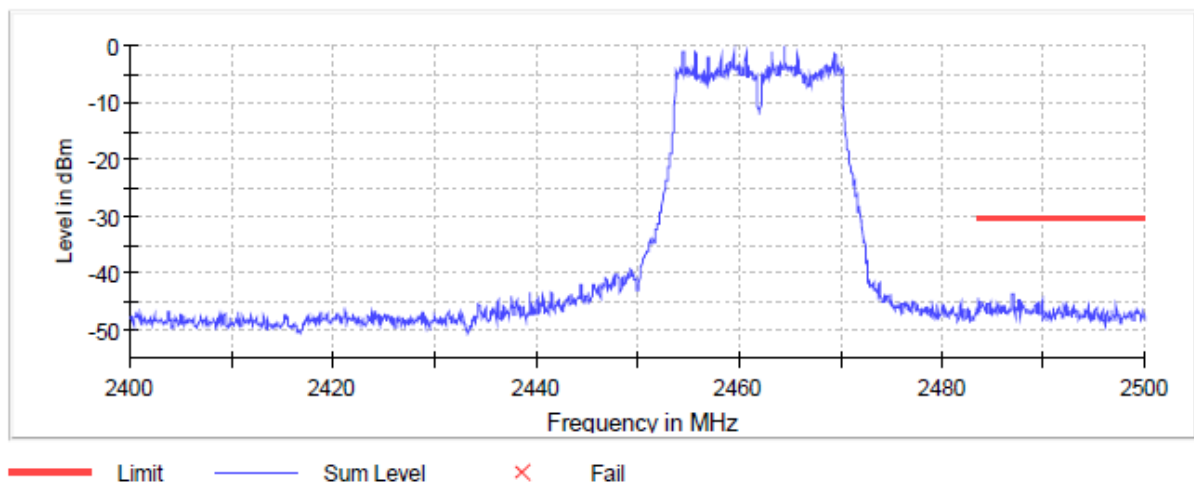


Radio Technology = WLAN g, Operating Frequency = high, Band Edge = high
(S02_AG01)

Band Edge

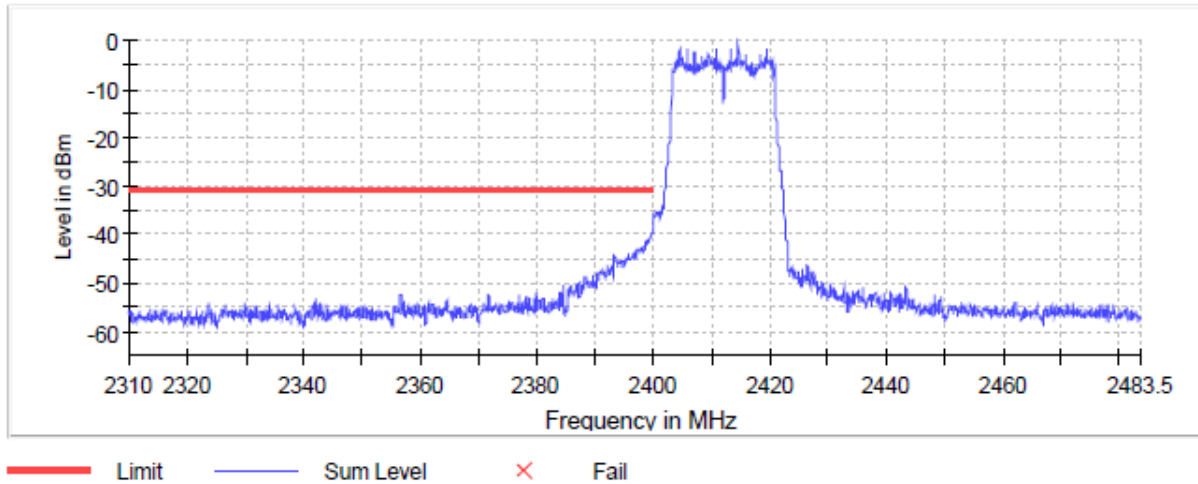


Band Edge

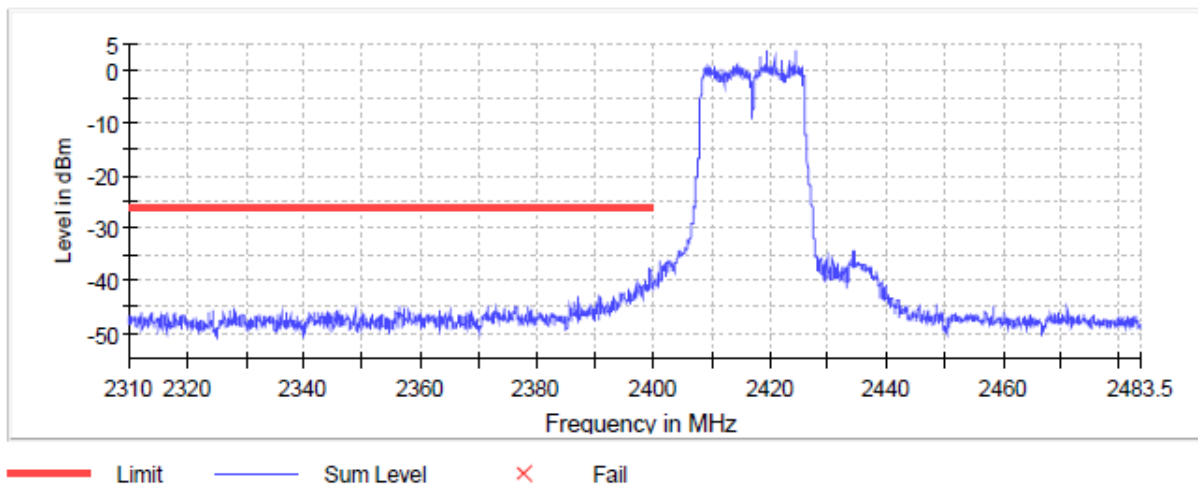


Radio Technology = WLAN n 20 MHz, Operating Frequency = low, Band Edge = low
(S02_AG01)

Band Edge

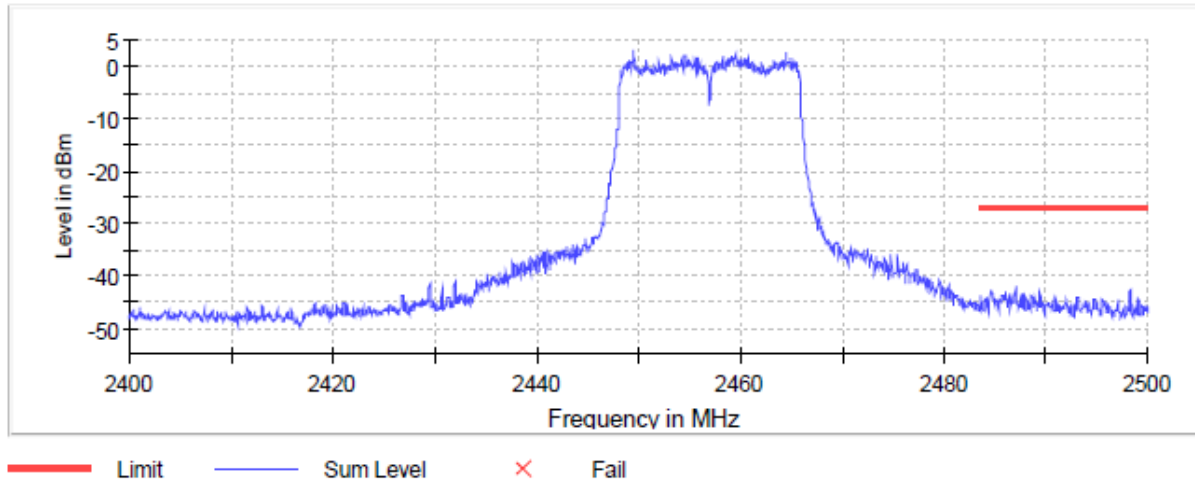


Band Edge

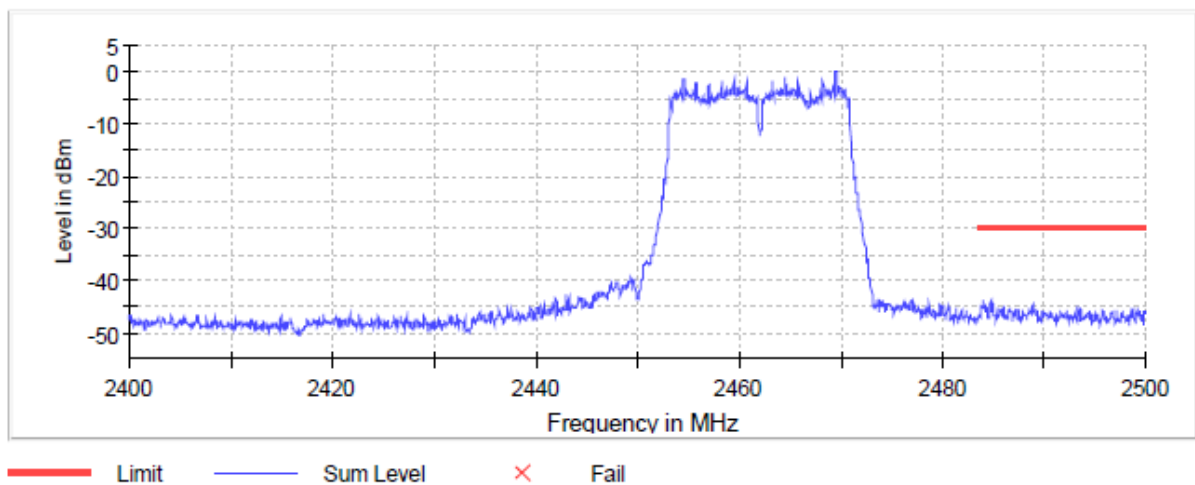


Radio Technology = WLAN n 20 MHz, Operating Frequency = high, Band Edge = high
(S02_AG01)

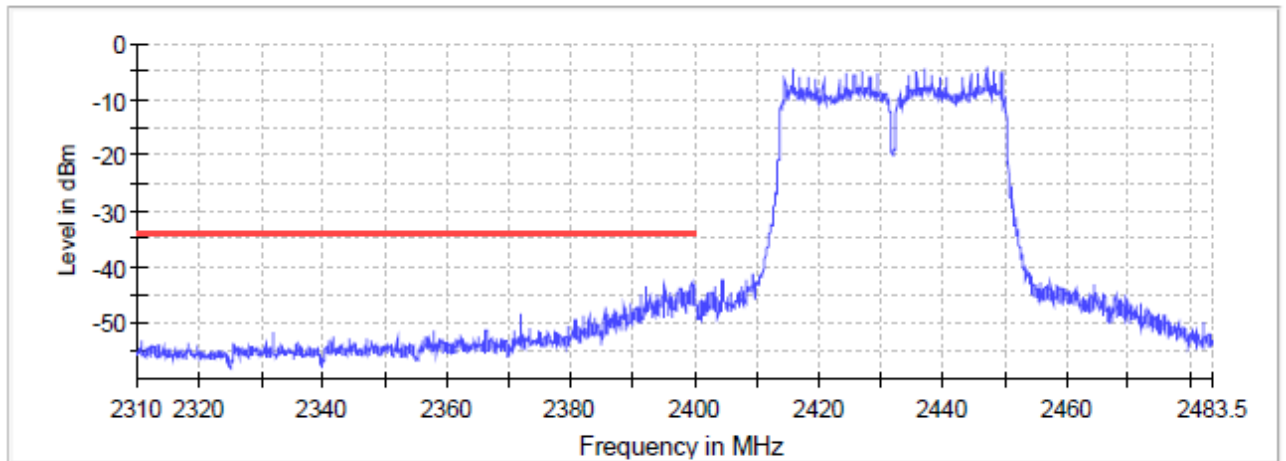
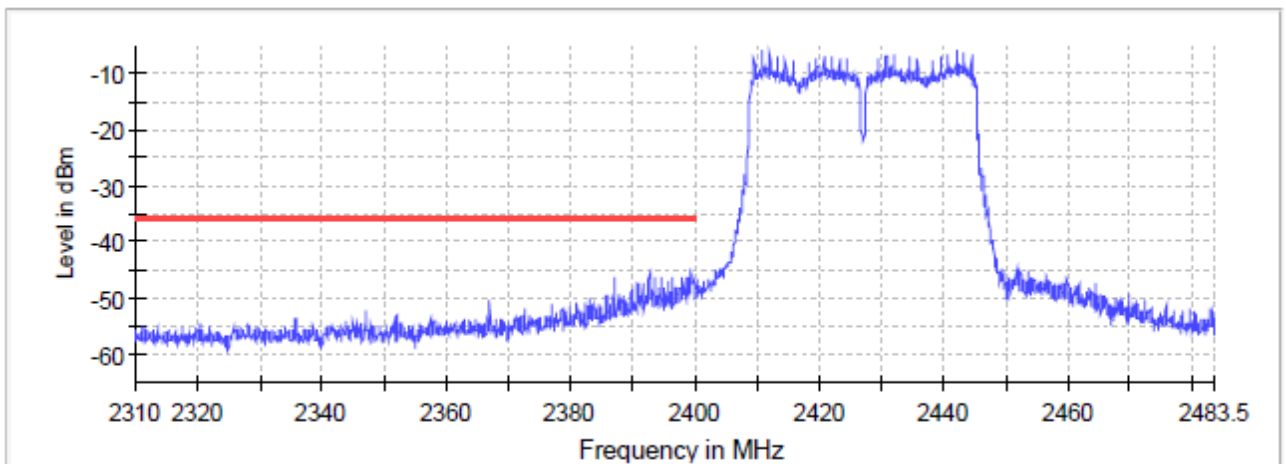
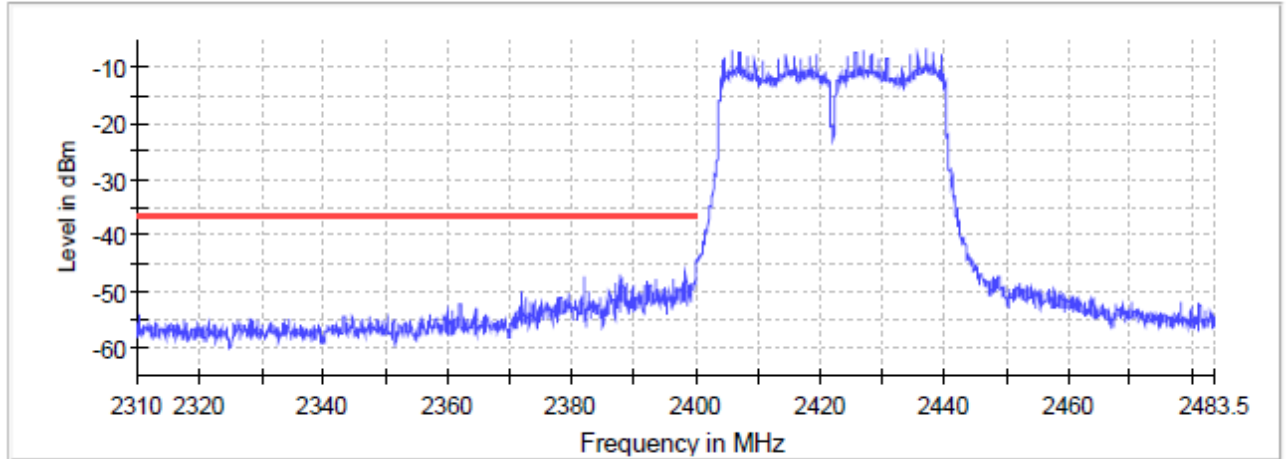
Band Edge



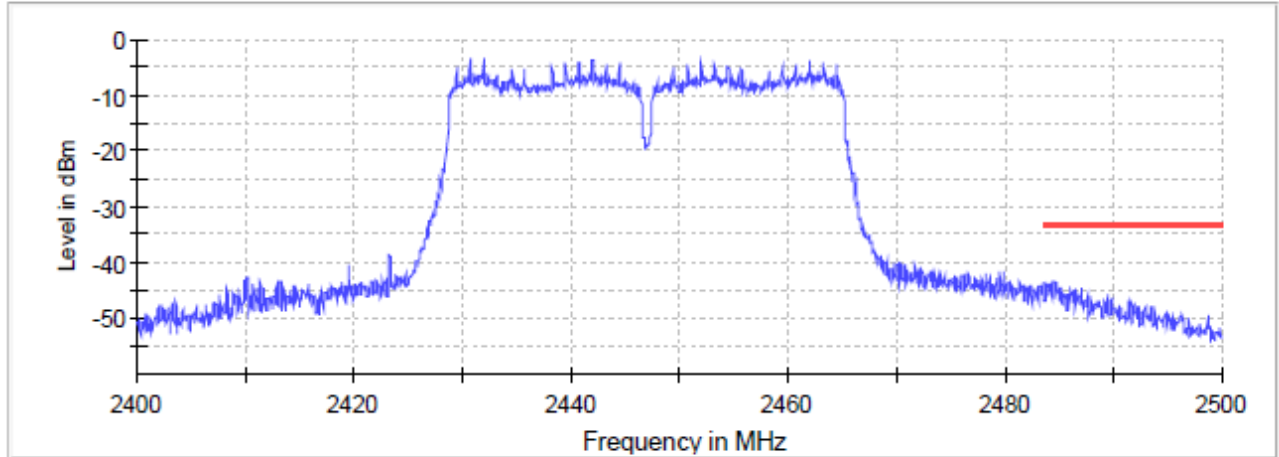
Band Edge



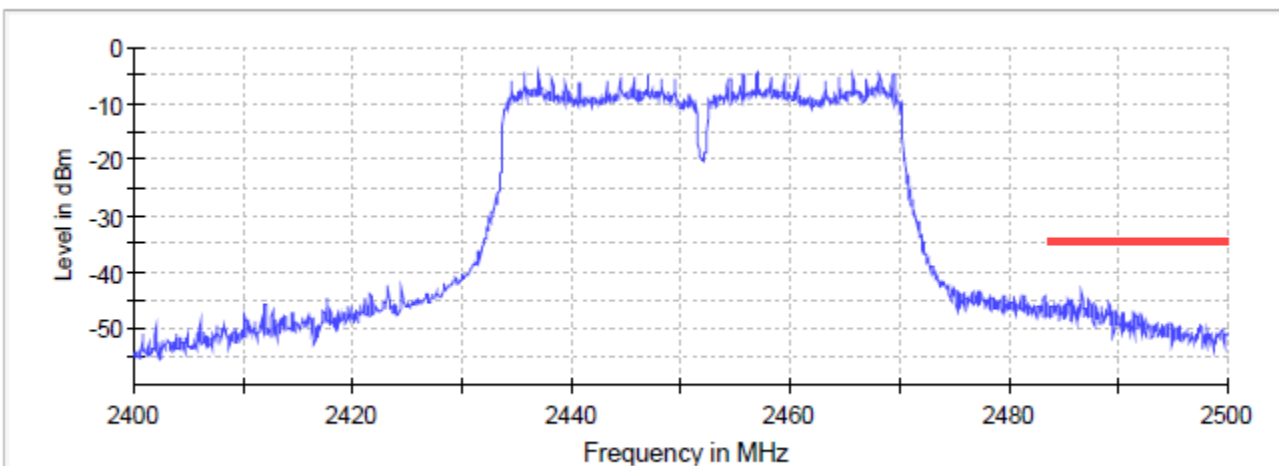
Radio Technology = WLAN n 40 MHz, Operating Frequency = low, Band Edge = low
(S02_AH01)
Band Edge



Radio Technology = WLAN n 40 MHz, Operating Frequency = high, Band Edge = high
(S02_AH01)
Band Edge



— Limit — Sum Level × Fail
Band Edge



— Limit — Sum Level × Fail

5.7.5 TEST EQUIPMENT USED

- R&S TS8997

5.8 BAND EDGE COMPLIANCE RADIATED

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.8.1 TEST DESCRIPTION

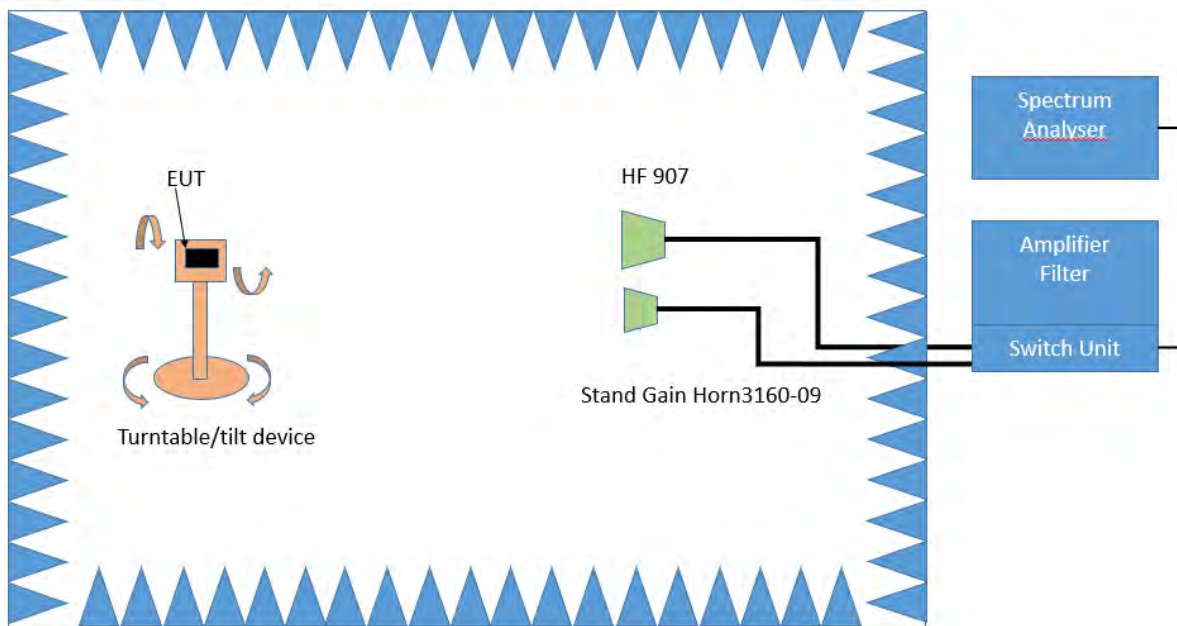
The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The measurements were performed according the following sub-chapter of ANSI C63.10:

- Chapter 6.10.5

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 (procedure according ANSI C63.10, chapter 6.6.5).

3. Measurement above 1 GHz



Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz

Step 1:

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 °.

Spectrum analyser settings:

- Detector: Peak, Average
- RBW = 1 MHz
- VBW = 3 MHz

Step 2:

The turn table azimuth will slowly vary by $\pm 22.5^\circ$.

The elevation angle will slowly vary by $\pm 45^\circ$

Spectrum analyser settings:

- Detector: Peak

Step 3:

Spectrum analyser settings for step 3:

- Detector: Peak / CISPR Average
- Measured frequencies: in step 1 determined frequencies
- RBW = 1 MHz
- VBW = 3 MHz
- Measuring time: 1 s

5.8.2 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: $\text{Limit (dBµV/m)} = 20 \log (\text{Limit (µV/m)}/1\mu\text{V/m})$

5.8.3 TEST PROTOCOL

Ambient temperature: 22-26 °C
 Air Pressure: 1010-1015 hPa
 Humidity: 34-38 %
 BT LE 1 Mbit/s
 Applied duty cycle correction (AV): 4.1 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dB μ V/m]	Detector	RBW [kHz]	Limit [dB μ V/m]	Margin to Limit [dB]	Limit Type
39	2480	2483.5	59.7	PEAK	1000	74.0	14.3	BE
39	2480	2483.5	40.0	AV	1000	54.0	14.0	BE

BT LE 2 Mbit/s
 Applied duty cycle correction (AV): 9.5 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dB μ V/m]	Detector	RBW [kHz]	Limit [dB μ V/m]	Margin to Limit [dB]	Limit Type
39	2480	2483.5	55.2	PEAK	1000	74.0	18.8	BE
39	2480	2483.5	45.7	AV	1000	54.0	8.3	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 [dB μ V/m]	Detector	RBW [kHz]	Limit [dB μ V/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	49.9	PEAK	1000	74.0	24.1	BE
11	2462	2483.5	44.1	AV	1000	54.0	9.9	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 [dB μ V/m]	Detector	RBW [kHz]	Limit [dB μ V/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	69.6	PEAK	1000	74.0	4.4	BE
11	2462	2483.5	48.0	AV	1000	54.0	6.0	BE
10	2457	2483.5	72.1	PEAK	1000	74.0	1.9	BE
10	2457	2483.5	48.5	AV	1000	54.0	5.5	BE

WLAN n-Mode; 20 MHz; MCS0
 Applied duty cycle correction (AV): 0 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dB μ V/m]	Detector	RBW [kHz]	Limit [dB μ V/m]	Margin to Limit [dB]	Limit Type
11	2462	2483.5	69.1	PEAK	1000	74.0	4.9	BE
11	2462	2483.5	47.8	AV	1000	54.0	6.2	BE
10	2457	2483.5	71.1	PEAK	1000	74.0	2.9	BE
10	2457	2483.5	50.1	AV	1000	54.0	3.9	BE

WLAN n-Mode; 40 MHz; MCS0
 Applied duty cycle correction (AV): 0 dB

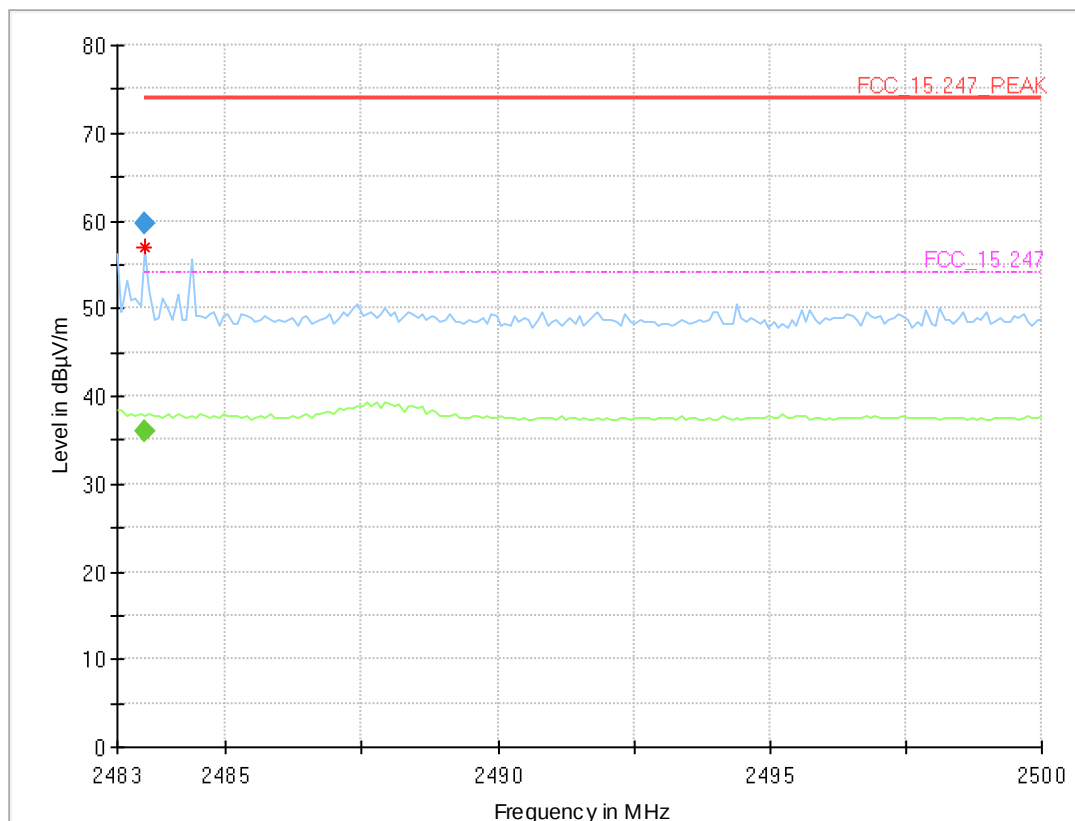
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dB μ V/m]	Detector	RBW [kHz]	Limit [dB μ V/m]	Margin to Limit [dB]	Limit Type
8	2447	2483.5	72.7	PEAK	1000	74.0	1.3	BE
8	2447	2483.5	52.6	AV	1000	54.0	1.4	BE
9	2452	2483.5	65.7	PEAK	1000	74.0	8.3	BE
9	2452	2483.5	53.5	AV	1000	54.0	0.5	BE

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

For Band Edge Results at the lower band edge see test case Transmitter Radiated Spurious Emissions.

5.8.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

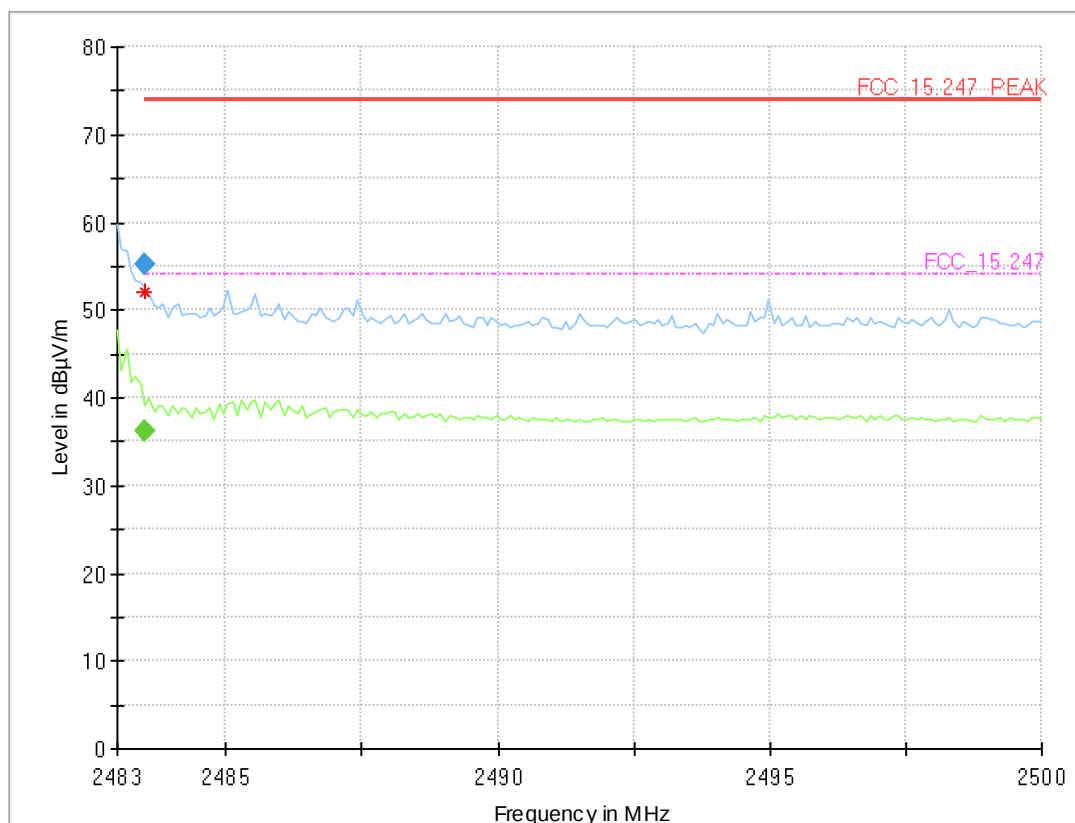
Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = high, Band Edge = high (S01_AK01)



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)	Corr. (dB/m)
2483.510	---	35.9	54.00	18.08	1000.0	1000.000	150.0	H	-58.0	93.0	5.4
2483.510	59.7	---	74.00	14.33	1000.0	1000.000	150.0	V	-34.0	-4.0	5.4

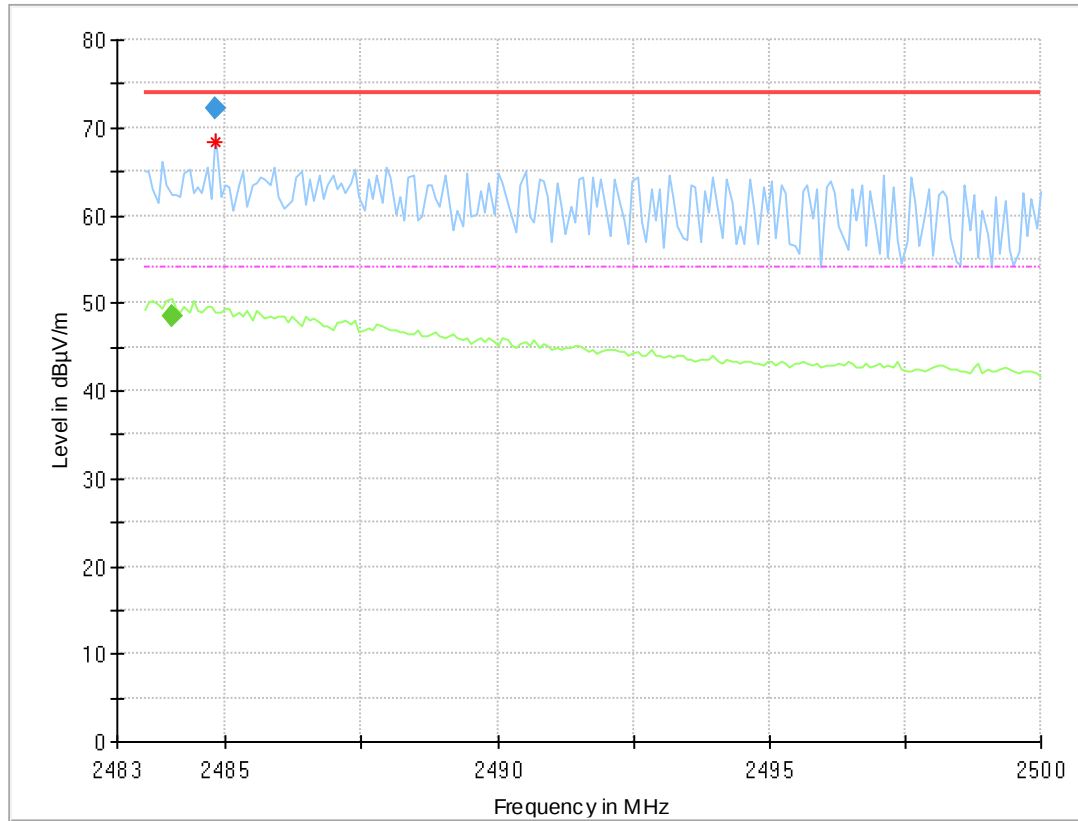
Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = high, Band Edge = high
(S01_AK01)



Final_Result

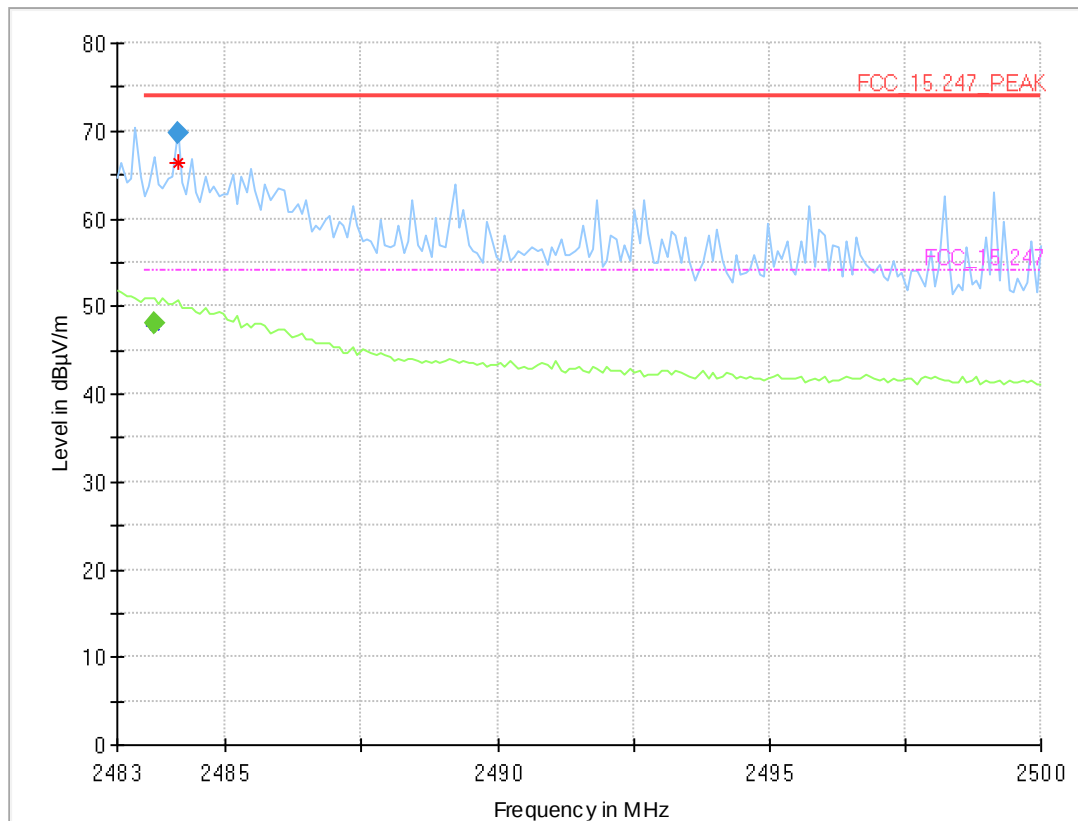
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
2483.510	---	36.2	54.00	17.78	1000.0	1000.000	150.0	H	-59.0	86.0	5.4
2483.510	55.2	---	74.00	18.80	1000.0	1000.000	150.0	H	-92.0	79.0	5.4

Radio Technology = WLAN g, Operating Frequency = high, Band Edge = high
(S01_AK01)



Final Result

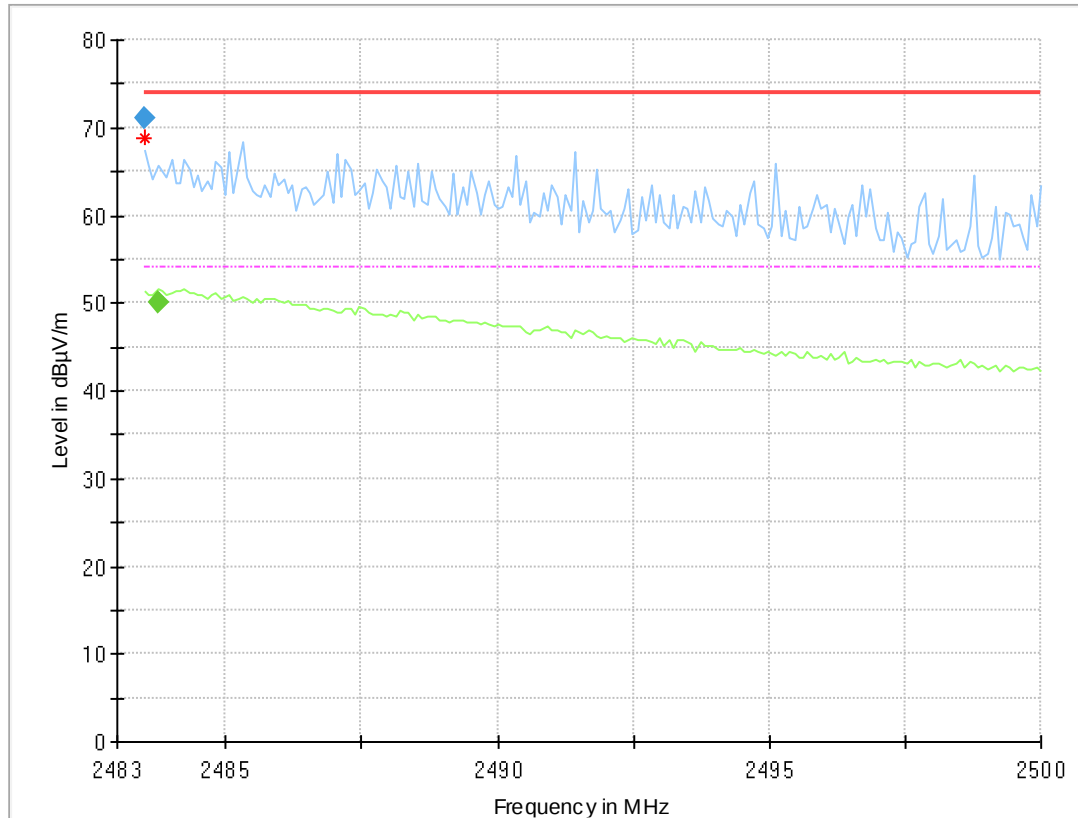
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
2483.995	---	48.5	54.0	5.53	1000.0	1000.00	150.	V	-25.0	-15.0	5.4
2484.820	72.1	---	74.0	1.92	1000.0	1000.00	150.	V	-191.0	14.0	5.4



Final Result

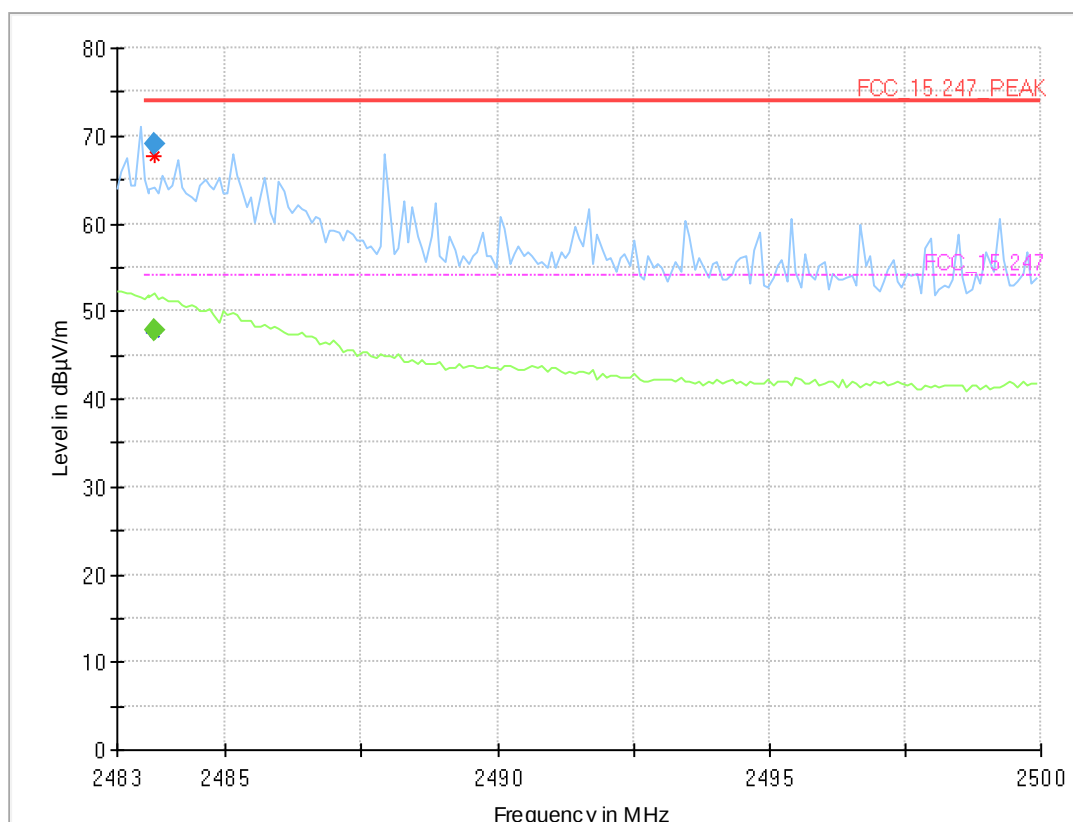
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
2483.680	---	48.0	54.00	6.03	1000.0	1000.000	150.0	H	-101.0	75.0	5.4
2484.105	69.6	---	74.00	4.37	1000.0	1000.000	150.0	H	-101.0	96.0	5.4

Radio Technology = WLAN n 20 MHz, Operating Frequency = high, Band Edge = high
(S01_AK01)



Final_Result

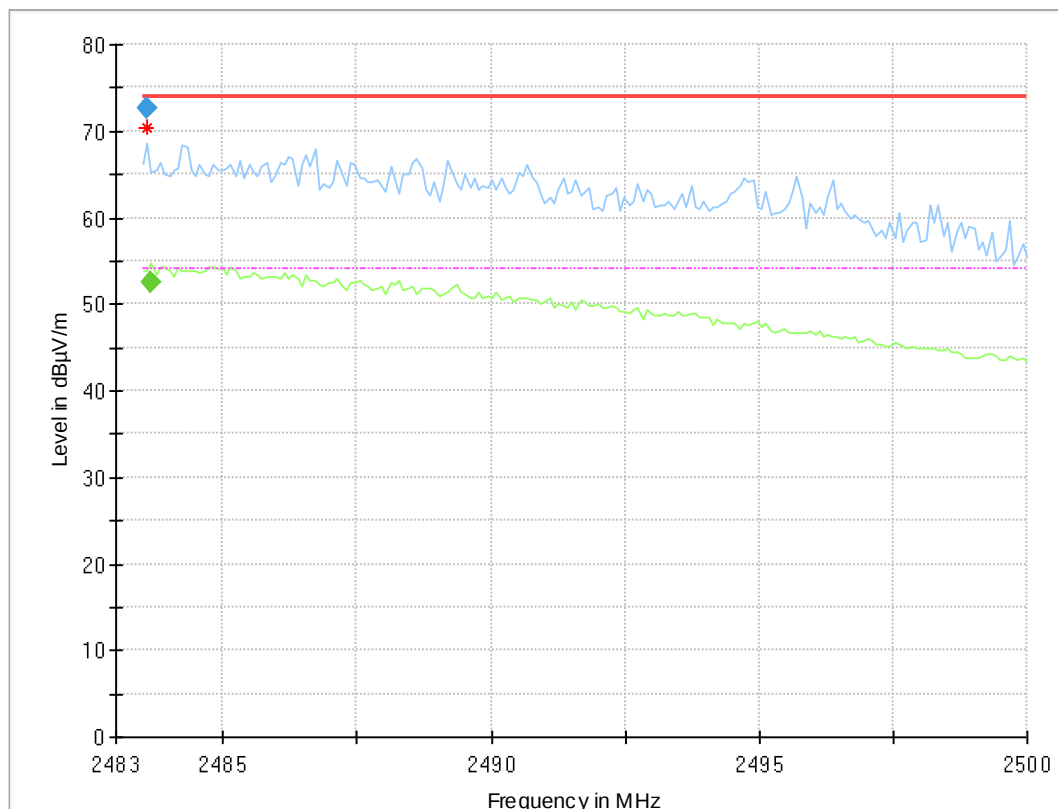
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
2483.500	71.1	---	74.0	2.92	1000.0	1000.00	150.	V	-41.0	-15.0	5.4
2483.748	---	50.1	54.0	3.91	1000.0	1000.00	150.	V	-11.0	-12.0	5.4



Final Result

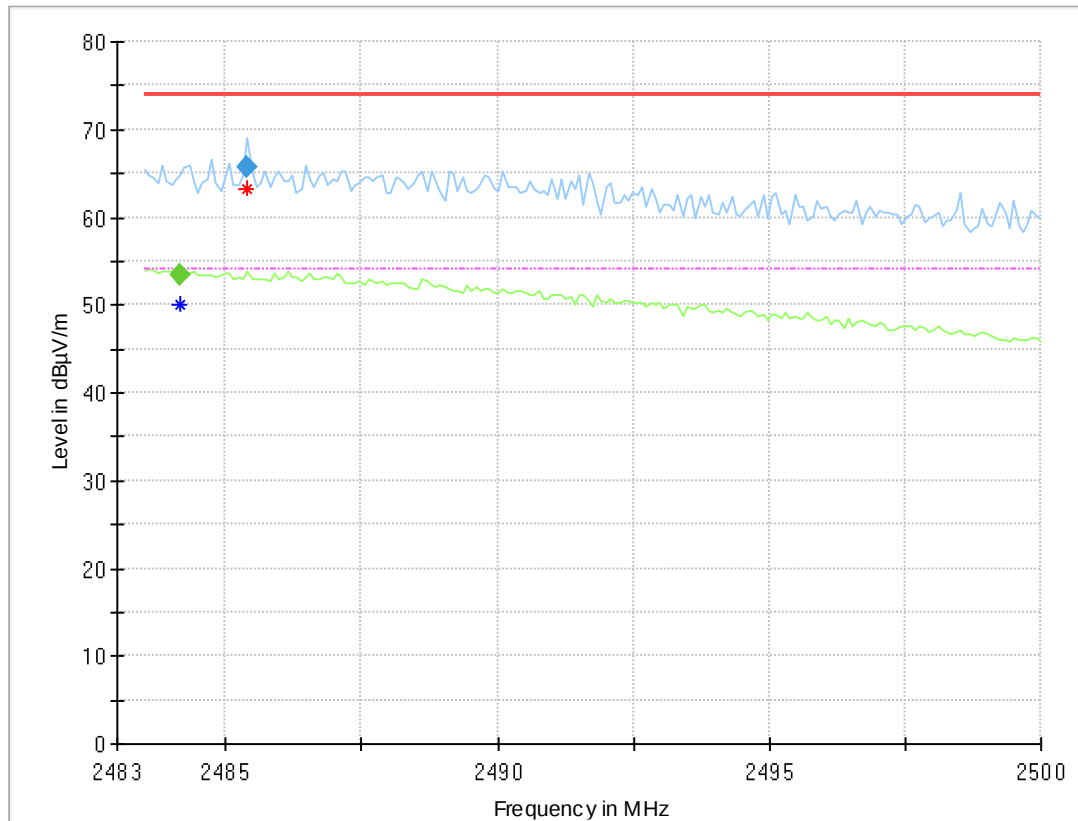
Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
2483.680	---	47.8	54.00	6.23	1000.0	1000.000	150.0	H	-101.0	75.0	5.4
2483.680	69.1	---	74.00	4.88	1000.0	1000.000	150.0	H	-101.0	88.0	5.4

Radio Technology = WLAN n 40 MHz, Operating Frequency = high, Band Edge = high
(S01_AK01)



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)
2483.583	72.7	---	74.0	1.35	1000.0	1000.00	150.	H	98.0	87.0
2483.665	---	52.6	54.0	1.36	1000.0	1000.00	150.	V	90.0	-4.0



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)	Corr. (dB/m)
2484.160	---	53.5	54.00	0.50	1000.0	1000.000	150.0	H	79.0	78.0	5.4
2485.398	65.7	---	74.00	8.26	1000.0	1000.000	150.0	H	79.0	88.0	5.4

5.8.5 TEST EQUIPMENT USED

- Radiated Emissions

5.9 POWER DENSITY

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.9.1 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 test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

Maximum Peak Power Spectral Density (e.g. Bluetooth low energy):

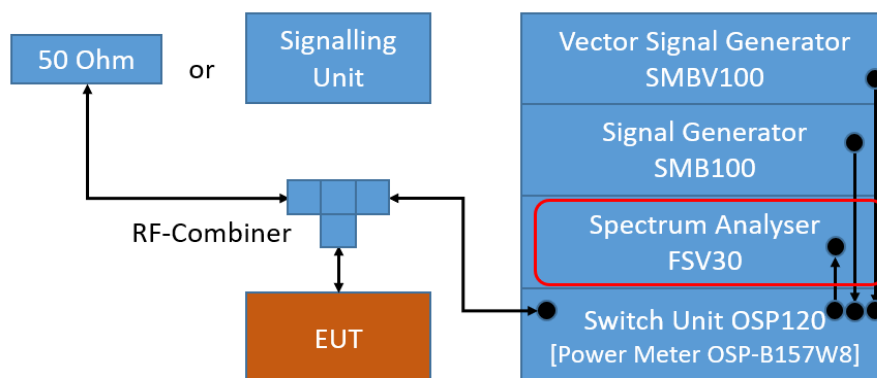
Analyser settings:

- Resolution Bandwidth (RBW): 100 kHz, 10 kHz or 3 kHz
- Video Bandwidth (VBW): ≥ 3 times RBW
- Trace: Maxhold
- Sweeps: Till stable (min. 200, max. 15000)
- Sweeptime: Auto
- Detector: Peak

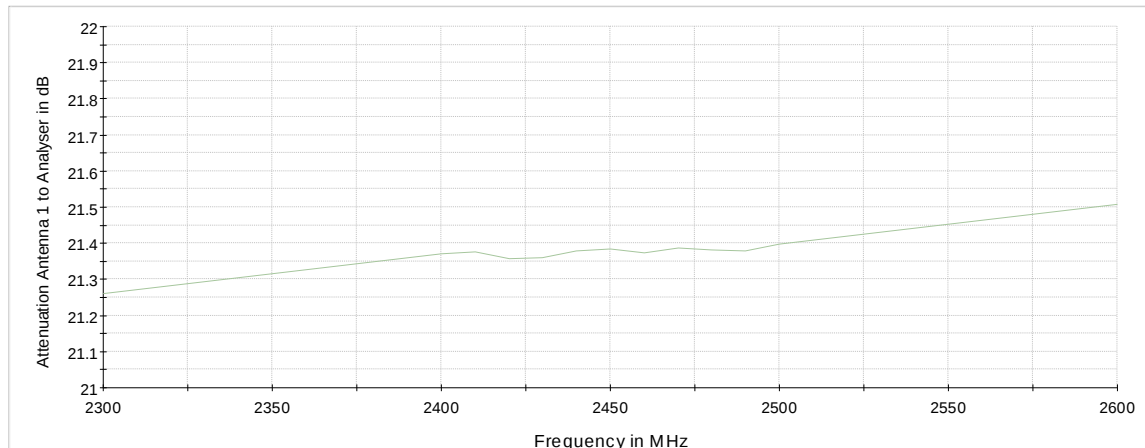
Maximum Average Power Spectral Density (e.g. WLAN):

Analyser settings:

- Resolution Bandwidth (RBW): 100 kHz, 10 kHz or 3 kHz
- Video Bandwidth (VBW): ≥ 3 times RBW
- Sweep Points: ≥ 2 times span / RBW
- Trace: Maxhold
- Sweeps: Till stable (max. 150)
- Sweeptime: $\leq$ Number of Sweep Points x minimum transmission duration
- Detector: RMS



TS8997; Power Spectral Density



Attenuation of the measurement path

5.9.2 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.

FCC Part 15, Subpart C, §15.247 (f)

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques.

...

The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

5.9.3 TEST PROTOCOL

Ambient temperature: 25 °C
 Air Pressure: 1020 hPa
 Humidity: 30 %
 BT LE 1 Mbit/s

Band	Channel No.	Frequency [MHz]	Power Density [dBm / 10kHz]	Limit [dBm / 3kHz]	Margin to Limit [dB]
2.4 GHz ISM	0	2402	-5.2	8.0	13.2
	19	2440	-5.2	8.0	13.2
	39	2480	-5.2	8.0	13.2

BT LE 2 Mbit/s

Band	Channel No.	Frequency [MHz]	Power Density [dBm / 10kHz]	Limit [dBm / 3kHz]	Margin to Limit [dB]
2.4 GHz ISM	0	2402	-9.5	8.0	17.5
	19	2440	-9.4	8.0	17.4
	39	2480	-9.4	8.0	17.4

Ambient temperature: 25 °C
 Air Pressure: 1017 hPa
 Humidity: 35 %
 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	-6.5	8.0	14.5
	6	2437	-6.1	8.0	14.1
	11	2462	-5.9	8.0	13.9

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	-9.2	8.0	17.2
	2	2417	-4.8	8.0	12.8
	6	2437	-4.5	8.0	12.5
	10	2457	-4.3	8.0	12.3
	11	2462	-8.8	8.0	16.8

WLAN n-Mode; 20 MHz; MCS0

Band	Channel No.	Frequency [MHz]	Power Density [dBm / 100kHz]	Limit [dBm / 3kHz]	Margin to Limit [dB]
2.4 GHz ISM	1	2412	-9.3	8.0	17.3
	2	2417	-4.6	8.0	12.6
	6	2437	-4.5	8.0	12.5
	10	2457	-4.2	8.0	12.2
	11	2462	-8.8	8.0	16.8

WLAN n-Mode; 40 MHz; MCS0

Band	Channel No.	Frequency [MHz]	Power Density [dBm / 100kHz]	Limit [dBm / 3kHz]	Margin to Limit [dB]
2.4 GHz ISM	3	2422	-15.4	8.0	23.4
	4	2427	-14.3	8.0	22.3
	6	2437	-12.1	8.0	20.1
	8	2447	-12.0	8.0	20.0
	9	2452	-12.9	8.0	20.9

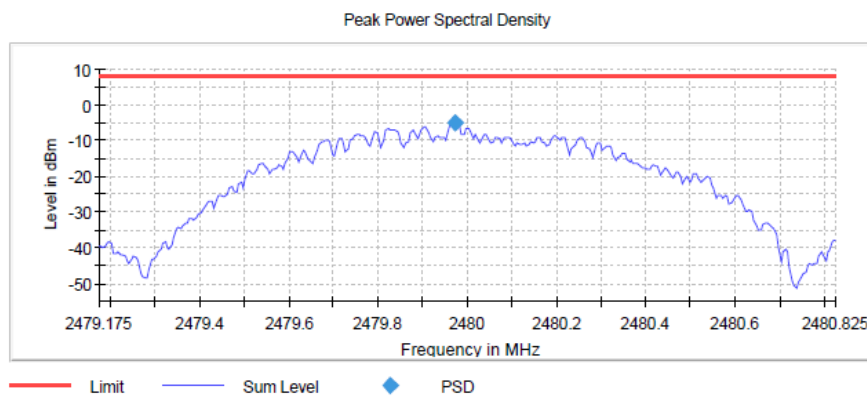
Remark: Please see next sub-clause for the measurement plot.

5.9.4 MEASUREMENT PLOT (EXAMPLE PLOT, SHOWING WORST CASE, IF APPLICABLE)

Radio Technology = Bluetooth LE 1 Mbps, Operating Frequency = high
(S02_AG01)

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2480.000000	2479.972500	-5.169	8.0	PASS

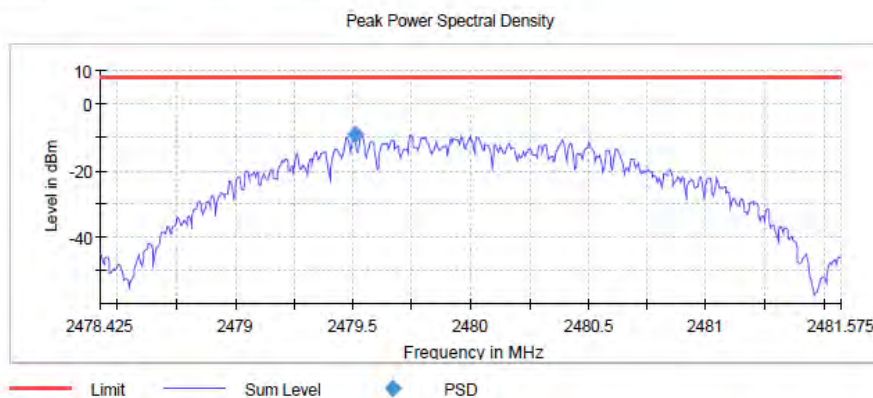


Setting	Instrument Value
Start Frequency	2.47918 GHz
Stop Frequency	2.48083 GHz
Span	1.650 MHz
RBW	10.000 kHz
VBW	30.000 kHz
SweepPoints	330
SweepTime	1.650 ms
Reference Level	-10.000 dBm
Attenuation	10.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	4 / max. 150
Stable	2 / 2
Max Stable Difference	0.09 dB

Radio Technology = Bluetooth LE 2 Mbps, Operating Frequency = high
(S02_AG01)

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2480.000000	2479.507500	-9.383	8.0	PASS

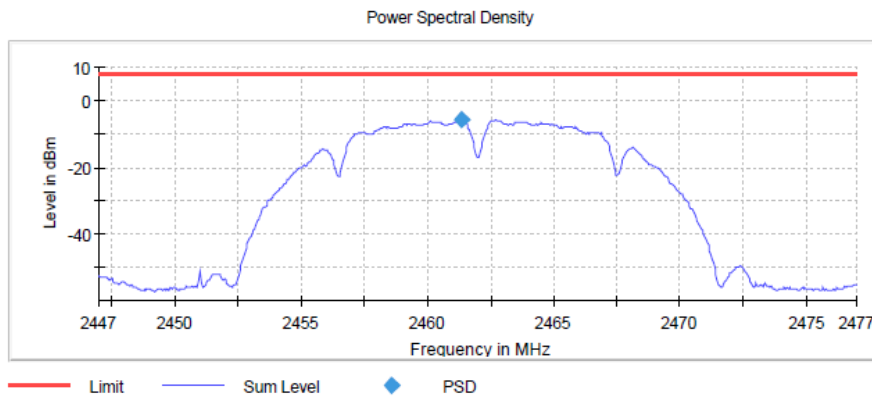


Setting	Instrument Value
Start Frequency	2.47843 GHz
Stop Frequency	2.48158 GHz
Span	3.150 MHz
RBW	10.000 kHz
VBW	30.000 kHz
SweepPoints	630
SweepTime	3.150 ms
Reference Level	-10.000 dBm
Attenuation	10.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	4 / max. 150
Stable	2 / 2
Max Stable Difference	0.18 dB

Radio Technology = WLAN b, Operating Frequency = high
(S02_AG01)

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2462.000000	2461.325000	-5.880	8.0	PASS

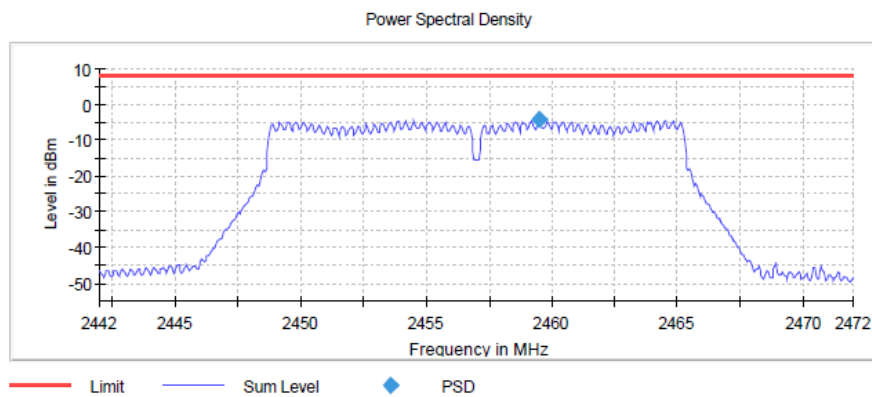


Setting	Instrument Value
Start Frequency	2.44700 GHz
Stop Frequency	2.47700 GHz
Span	30.000 MHz
RBW	100.000 kHz
VBW	300.000 kHz
SweepPoints	600
SweepTime	600.000 ms
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	RMS
SweepCount	1
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	14 / max. 150
Stable	3 / 3
Max Stable Difference	0.21 dB

Radio Technology = WLAN g, Operating Frequency = high
(S02_AG01)

Result

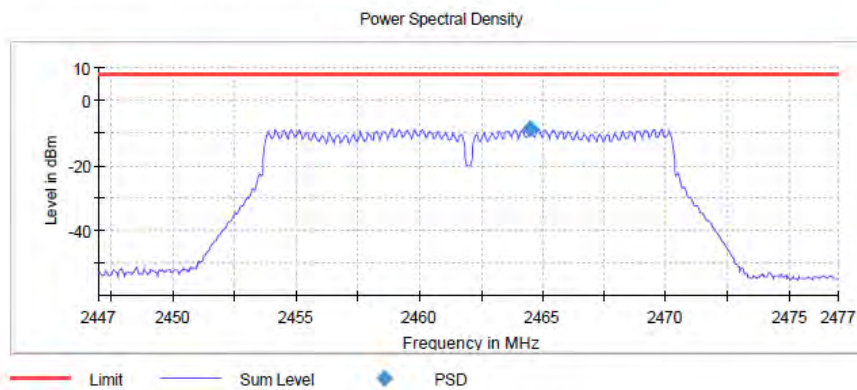
DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2457.000000	2459.475000	-4.292	8.0	PASS



Setting	Instrument Value
Start Frequency	2.44200 GHz
Stop Frequency	2.47200 GHz
Span	30.000 MHz
RBW	100.000 kHz
VBW	300.000 kHz
SweepPoints	600
SweepTime	600.000 ms
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	RMS
SweepCount	1
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	6 / max. 150
Stable	3 / 3
Max Stable Difference	0.16 dB

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2462.000000	2464.525000	-8.818	8.0	PASS



Setting	Instrument Value
Start Frequency	2.44700 GHz
Stop Frequency	2.47700 GHz
Span	30.000 MHz
RBW	100.000 kHz
VBW	300.000 kHz
SweepPoints	600
SweepTime	600.000 ms
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	RMS
SweepCount	1
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	6 / max. 150
Stable	3 / 3
Max Stable Difference	0.32 dB

Radio Technology = WLAN n 20 MHz, Operating Frequency = high (S02_AG01)

Result

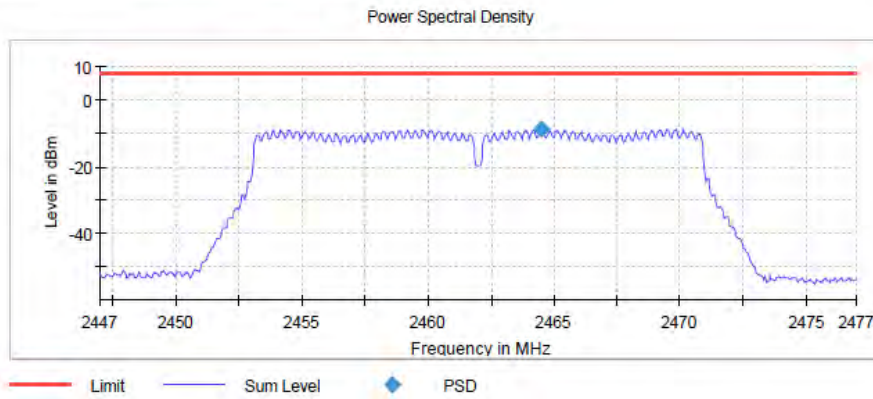
DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2457.000000	2459.475000	-4.240	8.0	PASS



Setting	Instrument Value
Start Frequency	2.44200 GHz
Stop Frequency	2.47200 GHz
Span	30.000 MHz
RBW	100.000 kHz
VBW	300.000 kHz
SweepPoints	600
SweepTime	600.000 ms
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	RMS
SweepCount	1
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	11 / max. 150
Stable	3 / 3
Max Stable Difference	0.47 dB

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2462.000000	2464.475000	-8.800	8.0	PASS

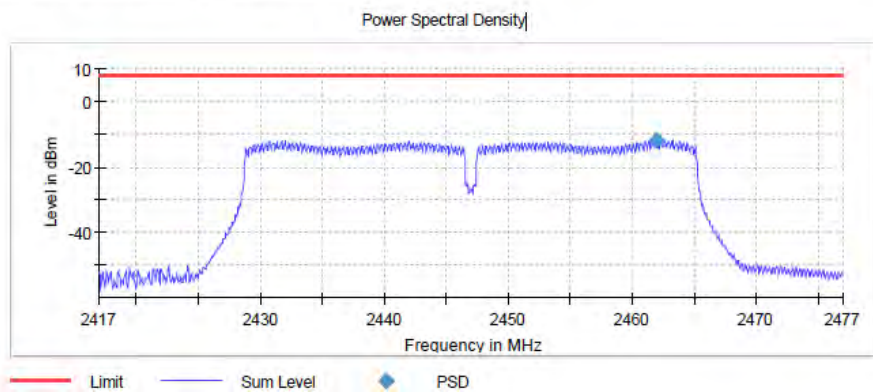


Setting	Instrument Value
Start Frequency	2.44700 GHz
Stop Frequency	2.47700 GHz
Span	30.000 MHz
RBW	100.000 kHz
VBW	300.000 kHz
SweepPoints	600
SweepTime	600.000 ms
Reference Level	0.000 dBm
Attenuation	20.000 dB
Detector	RMS
SweepCount	1
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	11 / max. 150
Stable	3 / 3
Max Stable Difference	0.23 dB

Radio Technology = WLAN n 40 MHz, Operating Frequency = high (S02_AH01)

Result

DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2447.000000	2462.025000	-12.014	8.0	PASS



Setting	Instrument Value
Start Frequency	2.41700 GHz
Stop Frequency	2.47700 GHz
Span	60.000 MHz
RBW	100.000 kHz
VBW	300.000 kHz
SweepPoints	1200
SweepTime	1.200 s
Reference Level	-10.000 dBm
Attenuation	10.000 dB
Detector	RMS
SweepCount	1
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamplifier	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	14 / max. 150
Stable	3 / 3
Max Stable Difference	0.30 dB

5.9.5 TEST EQUIPMENT USED

- R&S TS8997

6 TEST EQUIPMENT

- 1 Conducted Emissions FCC
Conducted Emissions AC Mains for FCC standards

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2020-11	2021-11
1.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufth Mess- und Regeltechnik GmbH	13936	2019-05	2021-05
1.3	Chroma 6404	AC Source	Chroma ATE INC.	64040001304		
1.4	Shielded Room 02	Shielded Room 4m x 3m	Frankonia Germany EMC Solution GmbH	-		
1.5	ESH3-Z5	Two-Line V-Network (EUT)	Rohde & Schwarz GmbH & Co. KG	829996/002	2019-06	2021-06
1.6	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2019-01	2021-01
1.7	Opus10 THI (8152.00)	T/H Logger 02	Lufth Mess- und Regeltechnik GmbH	7489	2019-05	2021-05

- 2 R&S TS8997
2.4 and 5 GHz Bands Conducted Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2020-05	2022-05
2.2	Opus10 THI (8152.00)	T/H Logger 15	Lufth Mess- und Regeltechnik GmbH	13985	2019-06	2021-06
2.3	Opus10 THI (8152.00)	T/H Logger 14	Lufth Mess- und Regeltechnik GmbH	13993	2019-06	2021-06
2.4	Opus10 THI (8152.00)	T/H Logger 03	Lufth Mess- und Regeltechnik GmbH	7482	2019-06	2021-06
2.5	OSP120	Contains Power Meter and Switching Unit OSP-B157W8	Rohde & Schwarz	101158	2018-05	2021-05

- 3 Radiated Emissions
Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.1	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2020-11	2021-11
3.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufth Mess- und Regeltechnik GmbH	13936	2019-05	2021-05
3.3	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2019-12	2021-12

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.4	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia	none	2018-06	2021-06
3.5	HL 562 ULTRALOG	Biconical-log-per antenna (30 MHz - 3 GHz) with HL 562E biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2018-07	2021-07
3.6	AMF-7D00101800-30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq			
3.7	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		
3.8	Anechoic Chamber 03	FAR, 8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB		
3.9	Opus10 THI (8152.00)	T/H Logger 10	Lufth Mess- und Regeltechnik GmbH	12488	2019-06	2021-06
3.10	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
3.11	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2019-02	2021-02
3.12	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronik GmbH	00083069		
3.13	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright Instruments GmbH	09		
3.14	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99		
3.15	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
3.16	TT 1.5 WI	Turn Table	Maturo GmbH	-		
3.17	HL 562 ULTRALOG	Biconical-log-per Antenna (30 MHz - 3 GHz)	Rohde & Schwarz GmbH & Co. KG	100609	2019-05	2022-05
3.18	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronik GmbH	00086675		
3.19	MA4985-XP-ET	Bore Sight Antenna Mast	innco systems GmbH	none		
3.20	JUN-AIR Mod. 6-15	Air Compressor	JUN-AIR Deutschland GmbH	612582		
3.21	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008		
3.22	HFH2-Z2	Loop Antenna	Rohde & Schwarz	829324/006	2018-01	2021-01
3.23	SB4-100.OLD20-3T/10 Airwin 2 x 1.5 kW	Air compressor (oil-free)	airWin Kompressoren UG	901/00503		

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.24	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
3.25	AS 620 P	Antenna Mast (pneumatic polarisation)	HD GmbH	620/37		
3.26	TD1.5-10kg	EUT Tilt Device (Rohacell)	Maturo GmbH	TD1.5-10kg/024/3790709		
3.27	HF 907-2	Double-ridged horn	Rohde & Schwarz	102817	2019-04	2022-04
3.28	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
3.29	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324		
3.30	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/11920513		
3.31	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2018-07	2021-07

The calibration interval is the time interval between "Last Calibration" and "Calibration Due"

7 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.

7.1 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

$$U_{\text{LISN}} (\text{dB } \mu\text{V}) = U (\text{dB } \mu\text{V}) + \text{Corr. (dB)}$$

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.

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

Frequency	AF	Corr.	cable loss 1	cable loss 2	cable loss 3	cable loss 4	distance corr.	d _{Limit}	d _{used}
MHz	dB (1/m)	dB	(inside chamber)	(outside chamber)	(switch unit)	(to receiver)	(-40 dB/decade)	(meas. distance (limit))	(meas. distance (used))
			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

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)

distance correction = $-40 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values

7.3 ANTENNA R&S HL562 (30 MHz – 1 GHz)

($d_{\text{Limit}} = 3 \text{ m}$)

Frequency	AF R&S HL562	Corr.
MHz	dB (1/m)	dB
30	18.6	0.6
50	6.0	0.9
100	9.7	1.2
150	7.9	1.6
200	7.6	1.9
250	9.5	2.1
300	11.0	2.3
350	12.4	2.6
400	13.6	2.9
450	14.7	3.1
500	15.6	3.2
550	16.3	3.5
600	17.2	3.5
650	18.1	3.6
700	18.5	3.6
750	19.1	4.1
800	19.6	4.1
850	20.1	4.4
900	20.8	4.7
950	21.1	4.8
1000	21.6	4.9

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))
dB	dB	dB	dB	dB	m	m
0.29	0.04	0.23	0.02	0.0	3	3
0.39	0.09	0.32	0.08	0.0	3	3
0.56	0.14	0.47	0.08	0.0	3	3
0.73	0.20	0.59	0.12	0.0	3	3
0.84	0.21	0.70	0.11	0.0	3	3
0.98	0.24	0.80	0.13	0.0	3	3
1.04	0.26	0.89	0.15	0.0	3	3
1.18	0.31	0.96	0.13	0.0	3	3
1.28	0.35	1.03	0.19	0.0	3	3
1.39	0.38	1.11	0.22	0.0	3	3
1.44	0.39	1.20	0.19	0.0	3	3
1.55	0.46	1.24	0.23	0.0	3	3
1.59	0.43	1.29	0.23	0.0	3	3
1.67	0.34	1.35	0.22	0.0	3	3
1.67	0.42	1.41	0.15	0.0	3	3
1.87	0.54	1.46	0.25	0.0	3	3
1.90	0.46	1.51	0.25	0.0	3	3
1.99	0.60	1.56	0.27	0.0	3	3
2.14	0.60	1.63	0.29	0.0	3	3
2.22	0.60	1.66	0.33	0.0	3	3
2.23	0.61	1.71	0.30	0.0	3	3

($d_{\text{Limit}} = 10 \text{ m}$)

30	18.6	-9.9
50	6.0	-9.6
100	9.7	-9.2
150	7.9	-8.8
200	7.6	-8.6
250	9.5	-8.3
300	11.0	-8.1
350	12.4	-7.9
400	13.6	-7.6
450	14.7	-7.4
500	15.6	-7.2
550	16.3	-7.0
600	17.2	-6.9
650	18.1	-6.9
700	18.5	-6.8
750	19.1	-6.3
800	19.6	-6.3
850	20.1	-6.0
900	20.8	-5.8
950	21.1	-5.6
1000	21.6	-5.6

0.29	0.04	0.23	0.02	-10.5	10	3
0.39	0.09	0.32	0.08	-10.5	10	3
0.56	0.14	0.47	0.08	-10.5	10	3
0.73	0.20	0.59	0.12	-10.5	10	3
0.84	0.21	0.70	0.11	-10.5	10	3
0.98	0.24	0.80	0.13	-10.5	10	3
1.04	0.26	0.89	0.15	-10.5	10	3
1.18	0.31	0.96	0.13	-10.5	10	3
1.28	0.35	1.03	0.19	-10.5	10	3
1.39	0.38	1.11	0.22	-10.5	10	3
1.44	0.39	1.20	0.19	-10.5	10	3
1.55	0.46	1.24	0.23	-10.5	10	3
1.59	0.43	1.29	0.23	-10.5	10	3
1.67	0.34	1.35	0.22	-10.5	10	3
1.67	0.42	1.41	0.15	-10.5	10	3
1.87	0.54	1.46	0.25	-10.5	10	3
1.90	0.46	1.51	0.25	-10.5	10	3
1.99	0.60	1.56	0.27	-10.5	10	3
2.14	0.60	1.63	0.29	-10.5	10	3
2.22	0.60	1.66	0.33	-10.5	10	3
2.23	0.61	1.71	0.30	-10.5	10	3

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + \text{Corr. (dB)}$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)

distance correction = $-20 \cdot \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

Linear interpolation will be used for frequencies in between the values in the table.

Tables show an extract of values.

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

Frequency	AF R&S HF907	Corr.
MHz	dB (1/m)	dB
1000	24.4	-19.4
2000	28.5	-17.4
3000	31.0	-16.1
4000	33.1	-14.7
5000	34.4	-13.7
6000	34.7	-12.7
7000	35.6	-11.0

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)		
dB	dB	dB	dB		
0.99	0.31	-21.51	0.79		
1.44	0.44	-20.63	1.38		
1.87	0.53	-19.85	1.33		
2.41	0.67	-19.13	1.31		
2.78	0.86	-18.71	1.40		
2.74	0.90	-17.83	1.47		
2.82	0.86	-16.19	1.46		

Frequency	AF R&S HF907	Corr.
MHz	dB (1/m)	dB
3000	31.0	-23.4
4000	33.1	-23.3
5000	34.4	-21.7
6000	34.7	-21.2
7000	35.6	-19.8

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
dB	dB	dB	dB	dB	
0.47	1.87	0.53	-27.58	1.33	
0.56	2.41	0.67	-28.23	1.31	
0.61	2.78	0.86	-27.35	1.40	
0.58	2.74	0.90	-26.89	1.47	
0.66	2.82	0.86	-25.58	1.46	

Frequency	AF R&S HF907	Corr.
MHz	dB (1/m)	dB
7000	35.6	-57.3
8000	36.3	-56.3
9000	37.1	-55.3
10000	37.5	-56.2
11000	37.5	-55.3
12000	37.6	-53.7
13000	38.2	-53.5
14000	39.9	-56.3
15000	40.9	-54.1
16000	41.3	-54.1
17000	42.8	-54.4
18000	44.2	-54.7

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)
dB	dB	dB	dB	dB	dB
0.56	1.28	-62.72	2.66	0.94	1.46
0.69	0.71	-61.49	2.84	1.00	1.53
0.68	0.65	-60.80	3.06	1.09	1.60
0.70	0.54	-61.91	3.28	1.20	1.67
0.80	0.61	-61.40	3.43	1.27	1.70
0.84	0.42	-59.70	3.53	1.26	1.73
0.83	0.44	-59.81	3.75	1.32	1.83
0.91	0.53	-63.03	3.91	1.40	1.77
0.98	0.54	-61.05	4.02	1.44	1.83
1.23	0.49	-61.51	4.17	1.51	1.85
1.36	0.76	-62.36	4.34	1.53	2.00
1.70	0.53	-62.88	4.41	1.55	1.91

Sample calculation

$$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$$

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.

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

Frequency	AF EMCO 3160-09	Corr.	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)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB
18000	40.2	-23.5	0.72	-35.85	6.20	2.81	2.65
18500	40.2	-23.2	0.69	-35.71	6.46	2.76	2.59
19000	40.2	-22.0	0.76	-35.44	6.69	3.15	2.79
19500	40.3	-21.3	0.74	-35.07	7.04	3.11	2.91
20000	40.3	-20.3	0.72	-34.49	7.30	3.07	3.05
20500	40.3	-19.9	0.78	-34.46	7.48	3.12	3.15
21000	40.3	-19.1	0.87	-34.07	7.61	3.20	3.33
21500	40.3	-19.1	0.90	-33.96	7.47	3.28	3.19
22000	40.3	-18.7	0.89	-33.57	7.34	3.35	3.28
22500	40.4	-19.0	0.87	-33.66	7.06	3.75	2.94
23000	40.4	-19.5	0.88	-33.75	6.92	3.77	2.70
23500	40.4	-19.3	0.90	-33.35	6.99	3.52	2.66
24000	40.4	-19.8	0.88	-33.99	6.88	3.88	2.58
24500	40.4	-19.5	0.91	-33.89	7.01	3.93	2.51
25000	40.4	-19.3	0.88	-33.00	6.72	3.96	2.14
25500	40.5	-20.4	0.89	-34.07	6.90	3.66	2.22
26000	40.5	-21.3	0.86	-35.11	7.02	3.69	2.28
26500	40.5	-21.1	0.90	-35.20	7.15	3.91	2.36

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$
 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.

7.6 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				-9.5	3	1.0
27.0	43.4	-11.2	4.4				-9.5	3	1.0
28.0	43.4	-11.1	4.5				-9.5	3	1.0
29.0	43.5	-11.0	4.6				-9.5	3	1.0
30.0	43.5	-10.9	4.7				-9.5	3	1.0
31.0	43.5	-10.8	4.7				-9.5	3	1.0
32.0	43.5	-10.7	4.8				-9.5	3	1.0
33.0	43.6	-10.7	4.9				-9.5	3	1.0
34.0	43.6	-10.6	5.0				-9.5	3	1.0
35.0	43.6	-10.5	5.1				-9.5	3	1.0
36.0	43.6	-10.4	5.1				-9.5	3	1.0
37.0	43.7	-10.3	5.2				-9.5	3	1.0
38.0	43.7	-10.2	5.3				-9.5	3	1.0
39.0	43.7	-10.2	5.4				-9.5	3	1.0
40.0	43.8	-10.1	5.5				-9.5	3	1.0

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

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 = $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

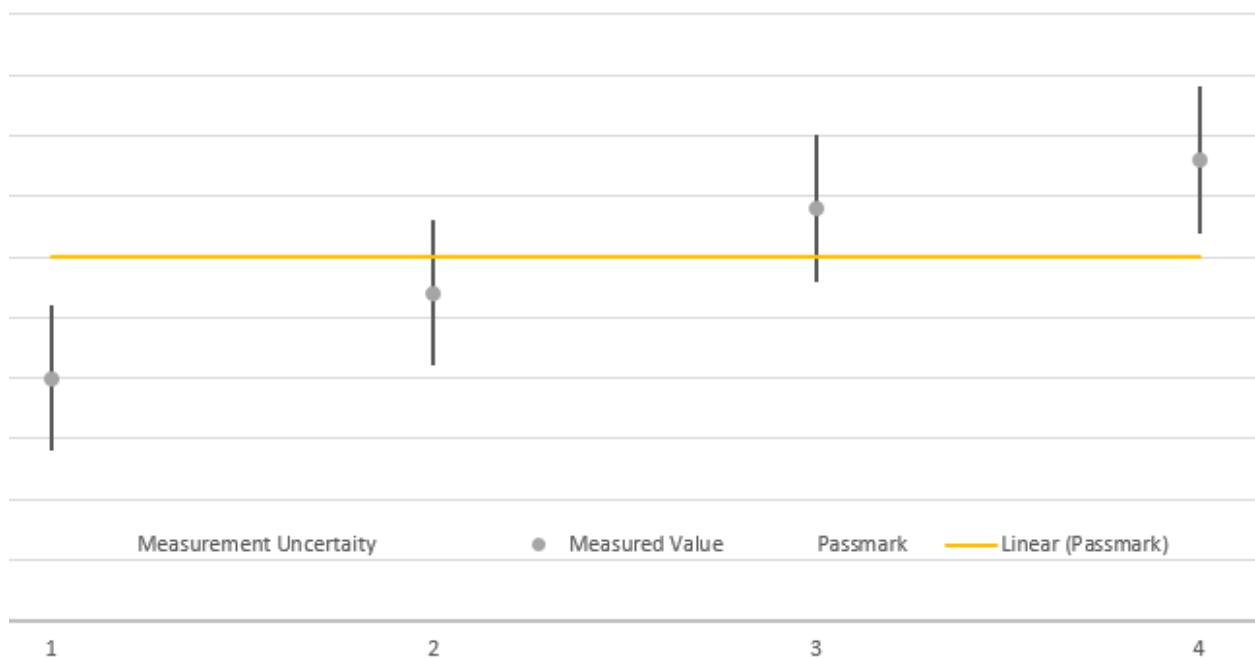
Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values.

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

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) $k = 1.96$. This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

Case	Measured Value	Uncertainty Range	Verdict
1	below pass mark	below pass mark	Passed
2	below pass mark	within pass mark	Passed
3	above pass mark	within pass mark	Failed
4	above pass mark	above pass mark	Failed

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so called shared risk principle.

9 PHOTO REPORT

Please see separate photo report.