

FCC Measurement/Technical Report on

Multimedia Equipment with WLAN and Bluetooth

BCI3L4PTN1(Star 3.5 / Star 3.0)

FCC ID: 2AUXS- BCI3L4PTN1
IC: 25847-BCI3L4PTN1

Test Report Reference: MDE_BOSCH_2511_FCC_05

Test Laboratory:

7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany



Deutsche
Akkreditierungsstelle
D-PL-12140-01-00

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:
Jörg-Timm Kilisch
Bernhard Retka

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

Commerzbank AG Account No. 303 016 000 Bank Code 300 400 00 IBAN DE81 3004 0000 0303 0160 00 Swift Code COBADEFF

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1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization

Certification for an Intentional Radiator.

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15 (10-1-24 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 (only in case of direct or indirect connection to AC main)

§ 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 C63.10-2020 + Cor. 1-2023 + C63.10a-2024 + Errata to C63.10a-2024 are applied.

1.2 FCC-IC CORRELATION TABLE

Correlation of measurement requirements for FHSS (e.g. Bluetooth®) equipment from FCC and IC

FHSS equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 5 & AMD 1 & AMD 2: 8.8
Occupied bandwidth	§ 15.247 (a) (1)	RSS-247 Issue 3: 5.1 (b)
Peak conducted output power	§ 15.247 (b) (1), (4)	RSS-247 Issue 3: 5.4 (b)
Transmitter spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen Issue 5 & AMD 1 & AMD 2: 6.13/8.9/8.10; RSS-247 Issue 3: 5.5
Transmitter spurious radiated emissions	§ 15.247 (d); § 15.209 (a)	RSS-Gen Issue 5 & AMD 1 & AMD 2: 6.13 / 8.9/8.10; RSS-247 Issue 3: 5.5
Band edge compliance	§ 15.247 (d)	RSS-247 Issue 3: 5.5
Dwell time	§ 15.247 (a) (1) (iii)	RSS-247 Issue 3: 5.1 (d)
Channel separation	§ 15.247 (a) (1)	RSS-247 Issue 3: 5.1 (b)
No. of hopping frequencies	§ 15.247 (a) (1) (iii)	RSS-247 Issue 3: 5.1 (d)
Hybrid systems (only)	§ 15.247 (f); § 15.247 (e)	RSS-247 Issue 3: 5.3
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 5 & AMD 1 & AMD 2: 8.3
Receiver spurious emissions	-	-

1.3 MEASUREMENT SUMMARY

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247

§ 15.247 (b) (1) (2)

Peak Power Output

The measurement was performed according to ANSI C63.10, chapter 7.8.5

Final Result

OP-Mode Chip, Radio Technology, Operating Frequency, Measurement method	Setup	Date	FCC	IC
Chip01, Bluetooth BR, high, conducted	S02_BC03#S3.5	2025-04-09	Passed	Passed
Chip01, Bluetooth BR, low, conducted	S02_BC03#S3.5	2025-04-09	Passed	Passed
Chip01, Bluetooth BR, mid, conducted	S02_BC03#S3.5	2025-04-09	Passed	Passed
Chip01, Bluetooth EDR 2, high, conducted	S02_BC03#S3.5	2025-04-09	Passed	Passed
Chip01, Bluetooth EDR 2, low, conducted	S02_BC03#S3.5	2025-04-09	Passed	Passed
Chip01, Bluetooth EDR 2, mid, conducted	S02_BC03#S3.5	2025-04-09	Passed	Passed
Chip01, Bluetooth EDR 3, high, conducted	S02_BC03#S3.5	2025-04-09	Passed	Passed
Chip01, Bluetooth EDR 3, low, conducted	S02_BC03#S3.5	2025-04-09	Passed	Passed
Chip01, Bluetooth EDR 3, mid, conducted	S02_BC03#S3.5	2025-04-09	Passed	Passed
Chip02, Bluetooth BR, high, conducted	S02_BD03#S3.5	2025-07-10	Passed	Passed
Chip02, Bluetooth BR, low, conducted	S02_BD03#S3.5	2025-07-10	Passed	Passed
Chip02, Bluetooth BR, mid, conducted	S02_BD03#S3.5	2025-07-10	Passed	Passed
Chip02, Bluetooth EDR 2, high, conducted	S02_BD03#S3.5	2025-07-10	Passed	Passed
Chip02, Bluetooth EDR 2, low, conducted	S02_BD03#S3.5	2025-07-10	Passed	Passed
Chip02, Bluetooth EDR 2, mid, conducted	S02_BD03#S3.5	2025-07-10	Passed	Passed
Chip02, Bluetooth EDR 3, high, conducted	S02_BD03#S3.5	2025-07-10	Passed	Passed
Chip02, Bluetooth EDR 3, low, conducted	S02_BD03#S3.5	2025-07-10	Passed	Passed
Chip02, Bluetooth EDR 3, mid, conducted	S02_BD03#S3.5	2025-07-10	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.247

§ 15.247 (d)

Transmitter Spurious Emissions in Restricted Bands

The measurement was performed according to ANSI C63.10, chapter 6.4, 6.5, 6.6.5

Final Result

OP-Mode Chip, Radio Technology, Operating Frequency, Measurement range	Setup	Date	FCC	IC
Chip01, Bluetooth EDR 2, high, 1 GHz - 8 GHz	S01_BC03#S3.5	2025-04-20	Passed	Passed
Chip01, Bluetooth EDR 3, high, 30 MHz - 1 GHz	S01_BC03#S3.5	2025-04-28	Passed	Passed
Chip01, Bluetooth EDR 3, low, 1 GHz - 26 GHz	S01_BC03#S3.5	2025-04-21	Passed	Passed
Chip01, Bluetooth EDR 3, low, 30 MHz - 1 GHz	S01_BC03#S3.5	2025-04-28	Passed	Passed
Chip01, Bluetooth EDR 3, mid, 1 GHz - 26 GHz	S01_BC03#S3.5	2025-04-10	Passed	Passed
Chip01, Bluetooth EDR 3, mid, 30 MHz - 1 GHz	S01_BC03#S3.5	2025-04-28	Passed	Passed
Chip02, Bluetooth EDR 2, high, 1 GHz - 8 GHz	S01_BC03#S3.5	2025-07-28	Passed	Passed
Chip02, Bluetooth EDR 2, low, 1 GHz - 8 GHz	S01_BC03#S3.5	2025-07-28	Passed	Passed
Chip02, Bluetooth EDR 3, high, 30 MHz - 1 GHz	S01_BC03#S3.5	2025-04-30	Passed	Passed
Chip02, Bluetooth EDR 3, low, 30 MHz - 1 GHz	S01_BC03#S3.5	2025-04-30	Passed	Passed
Chip02, Bluetooth EDR 3, mid, 1 GHz - 26 GHz	S01_BC03#S3.5	2025-04-10	Passed	Passed
Chip02, Bluetooth EDR 3, mid, 30 MHz - 1 GHz	S01_BC03#S3.5	2025-07-30	Passed	Passed
Chip01, Bluetooth EDR 3, high, 1 GHz - 26 GHz	S01_BB03#S3.0	2025-08-04	Passed	Passed
Chip02, Bluetooth EDR 3, high, 1 GHz - 26 GHz	S01_BB03#S3.0	2025-08-04	Passed	Passed

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

Transmitter Spurious Emissions in Restricted Bands

The measurement was performed according to ANSI C63.10, chapter 6.4, 6.5, 6.6.5

Final Result
OP-Mode

Chip, Radio Technology, Operating Frequency, Measurement range

Setup
Date
FCC
IC

Chip02, Bluetooth EDR 3, low, 30 MHz - 1 GHz

S01_BB03#S3.0

2025-07-30

Passed

Passed

Chip02, Bluetooth EDR 3, mid, 9 kHz - 30 MHz

S01_BB03#S3.0

2025-07-30

Passed

Passed

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

Band Edge Compliance Restricted Bands

The measurement was performed according to ANSI C63.10, chapter 6.6.5

Final Result
OP-Mode

Chip, Radio Technology, Operating Frequency, Band Edge

Setup
Date
FCC
IC

Chip01, Bluetooth EDR 3, low, low

S01_BC03#S3.5

2025-07-21

Passed

Passed

Chip01, Bluetooth EDR 2, high, high

S01_BC03#S3.5

2025-04-20

Passed

Passed

Chip01, Bluetooth EDR 3, high, high

S01_BC03#S3.5

2025-04-10

Passed

Passed

Chip02, Bluetooth EDR 2, low, low

S01_BC03#S3.5

2025-07-28

Passed

Passed

Chip02, Bluetooth EDR 2, high, high

S01_BC03#S3.5

2025-07-28

Passed

Passed

Chip02, Bluetooth EDR 3, high, high

S01_BC03#S3.5

2025-04-10

Passed

Passed

Chip01, Bluetooth BR, high, high

S01_BB03#S3.0

2025-08-18

Passed

Passed

Chip01, Bluetooth EDR 3, high, high

S01_BB03#S3.0

2025-08-04

Passed

Passed

Chip02, Bluetooth BR, high, high

S01_BB03#S3.0

2025-08-18

Passed

Passed

Chip02, Bluetooth EDR 3, high, high

S01_BB03#S3.0

2025-08-04

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	2025-09-24	--	valid
--	--	--	--

COMMENT:

The hardware version of the equipment under test (EUT) has been updated from "**D05**" to "**D10**". The detailed differences between these two hardware versions can be found in document "BCI3L4PTN1--D10-HW-Changes--Release-Version-1.0".

Not all applicable tests were performed on the updated hardware version. The EUT with hardware version "D05" has been fully tested, as documented in Reference Test Report: "MDE_BOSCH_2411_FCC_05_rev01".

The focus of this test report is to demonstrate that the EUT with hardware version "D10" also fulfills the requirements of FCC 15.247. Therefore, only spot-checks have been performed on the updated hardware.



(responsible for accreditation scope)
Dipl.-Ing. Robert Machulec



(responsible for testing and report)
BSc. Mhd Mouaz Saad



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

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-12140-01-00
FCC Designation Number: DE0015
FCC Test Firm Registration: 929146
ISED CAB Identifier DE0007; ISED#: 3699A

Responsible for accreditation scope: Dipl.-Ing. Robert Machulec
Report Template Version: 2025-02-28

3.2 PROJECT DATA

Responsible for testing and report: BSc. Mhd Mouaz Saad
Employees who performed the tests: documented internally at 7Layers
Date of Report: 2025-09-24
Testing Period: 2025-04-09 to 2025-08-18

3.3 APPLICANT DATA

Company Name: Robert Bosch GmbH
Address: Robert-Bosch-Platz 1, 70839 Gerlingen
Germany
Contact Person: Karin Silberhorn

3.4 MANUFACTURER DATA

Manufacturer 1

Company Name: Bosch Car Multimedia Portugal

Address: S.A. Rua Max Grundig
35-Lomar,
4705-820 Braga

Manufacturer 2

Company Name: Bosch Automotive Products (Suzhou) Co., Ltd.

Address: Changzhou Branch
No. 17, Long Men Road,
Wujin Hi-tech Industrial Zone
Changzhou, Jiangsu, P.R. China

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	Central In-Vehicle Infotainment Computer	
Product name	Multimedia Device with WLAN and Bluetooth	
Model name	BCI3L4PTN1(Star 3.5 / Star 3.0)	
Declared EUT data by the supplier		
Voltage Type	DC	
Voltage Level	12 VDC	
Antenna / Gain	External	
	Antenna 3 (Chip01, BT)	Antenna 2 (Chip02, BT)
	0.1 dB	0.1 dB
Tested Modulation Type and Tested datarates	GFSK Modulation, 1-DHx packets, 1 Mbit n/4 DQPSK Modulation, 2-DHx packets, 2 Mbit 8-DPSK Modulation, 3-DHx packets, 3 Mbit	
General product description	Central In-Vehicle Infotainment Computer Gen20x.i3 infotainment system is the main unit in the vehicle, which combines the instrument cluster and infotainment functionality. It supports Bluetooth classic (BT), Bluetooth Low Energy (BTLE) and Wi-Fi (2.4GHz and 5GHz).	
Specific product description for the EUT	The EUT has the following modules for Bluetooth and WLAN:	
	ATC6QPL002(Chip02): Only BT and BTLE	ATC6QPL004(Chip01): BT, BTLE, Wi-Fi (2.4GHz and 5GHz).
EUT ports (connected cables during testing):	Main Connector A (incl. DC Power) (unshielded, 1m)	GNSS antenna (shielded, 1.5m)
	Main Connector B (unshielded, 1m)	BT/WLAN Antenna (shielded, 1.5m)
	Ethernet (shielded, 1.5m)	HD-BaseT (shielded, 1.5m)
	FM/AM/SDARS/Ref.-Antennas	USB 2.0 – TGS (shielded, 1.5m)
	Video-Out Displays (shielded, 1.5m)	USB 2.0 - MM-Box (shielded, 1.5m)
	CamsControl(shielded, 1.5m)	Video-in Cameras (shielded, 1.5m)
	USB 3.0 High Speed Flashing/CAM Logging (shielded, 1.5m)	
Special software used for testing	ADB shell.exe	
Connection to AC main is supported	No (no direct or indirect connection)	

4.2 EUT MAIN COMPONENTS

Sample Name	Sample Code	Description
EUT A	DE1050025bd03	Conducted Sample
Sample Parameter	Value	
Serial No.	0020722	
HW Version	D10	
SW Version	E077.0	
Comment	BCI3L4PTN1 - Star 3.5	

Sample Name	Sample Code	Description
EUT B	DE1050025bc03	Radiated Sample
Sample Parameter	Value	
Serial No.	00207223	
HW Version	D10	
SW Version	E077.0	
Comment	BCI3L4PTN1 - Star 3.5	

Sample Name	Sample Code	Description
EUT C	DE1050026bb03	Radiated Sample
Sample Parameter	Value	
Serial No.	0028787	
HW Version	D10	
SW Version	E230.1	
Comment	BCI3L4PTN1 - Star 3.0	

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
ANC 1	Continental, RKE223E1GNS, DE1050025/026AUX01	GNSS Antenna + Antenna Cable (1.5m)
ANC 2	Mercedes-Benz, A1779052902, DE1050025/026AUX45	4x WIFI/BT Antenna + 4x Antenna Cable (1.5m)

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
AUX A	Bosch, -, -, -, -	2x Cable Harness

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_BD03#S3.5	EUT A, AUX A	Conducted Setup
S02_BC03#S3.5	EUT B, AUX A	Conducted Setup
S01_BC03#S3.5	EUT B, ANC 1, ANC 2, AUX A	Radiated Setup
S01_BB03#S3.0	EUT C, ANC 1, ANC 2, AUX A	Radiated Setup

4.6 OPERATING MODES / TEST CHANNELS

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

BT Test Channels:
Channel:
Frequency [MHz]

2.4 GHz ISM 2400 - 2483.5 MHz		
low	mid	high
0	39	78
2402	2441	2480

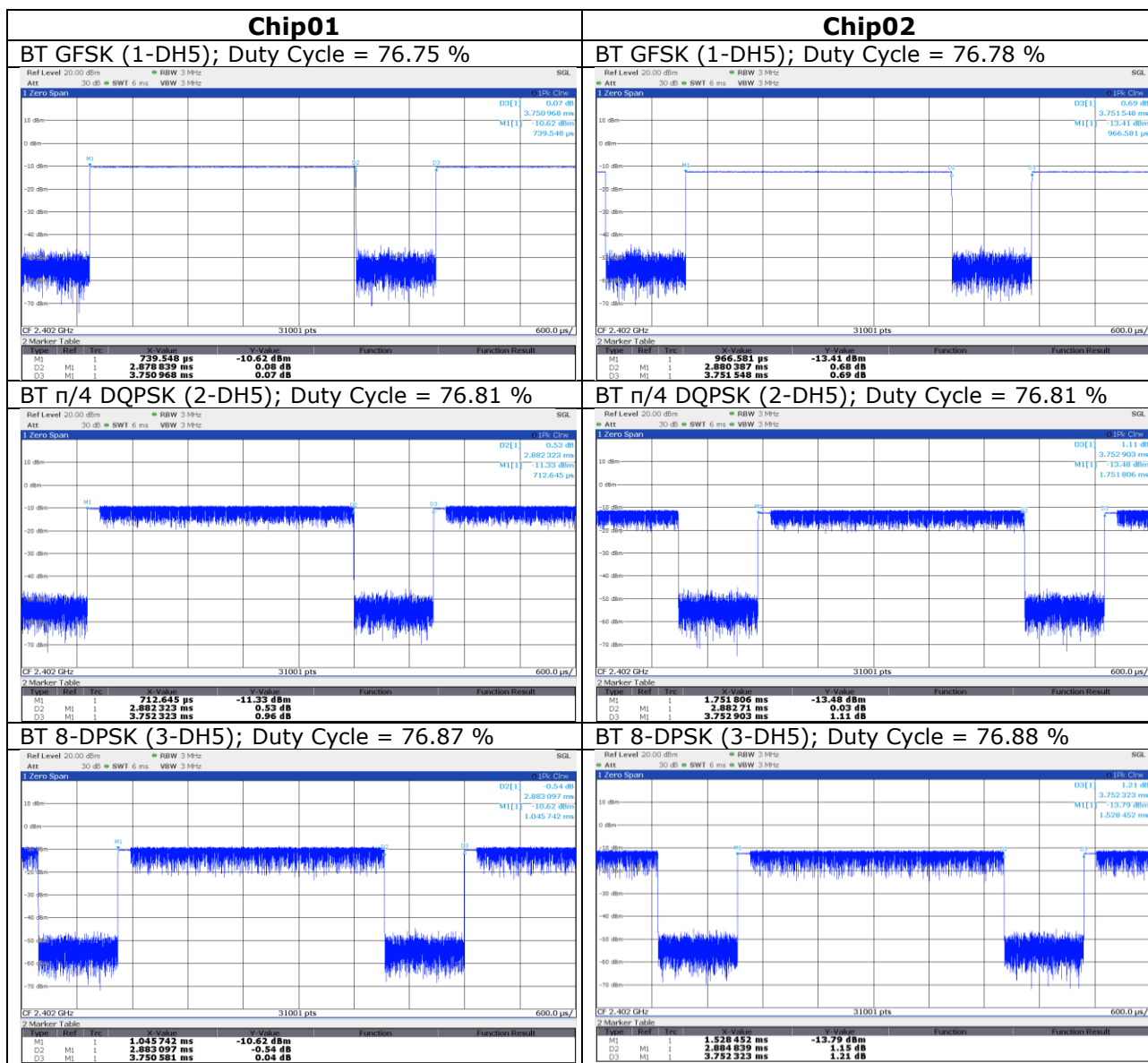
Operating Modes:

- Bluetooth BR: GFSK Modulation, 1-DHx packets, 1 Mbit
- Bluetooth EDR 2: $\pi/4$ DQPSK Modulation, 2-DHx packets, 2 Mbit
- Bluetooth EDR 3: 8-DPSK Modulation, 3-DHx packets, 3 Mbit

The testing was conducted at the maximum output power setting specified by the manufacturer.

4.7 DUTY CYCLE

The test was performed according to:
ANSI C63.10, chapter 7.5



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 PEAK POWER OUTPUT

Standard **FCC Part 15 Subpart C**

The test was performed according to:
 ANSI C63.10, chapter 7.8.5

5.1.1 TEST DESCRIPTION

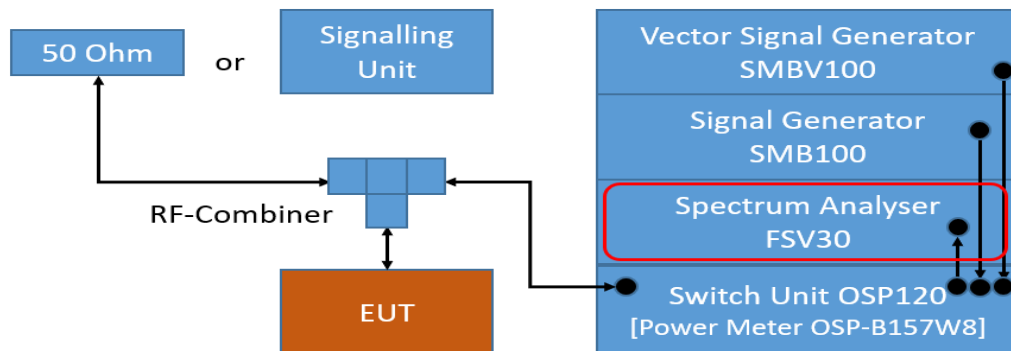
FHSS EQUIPMENT:

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. The reference level of the spectrum analyser was set higher than the output power of the EUT.

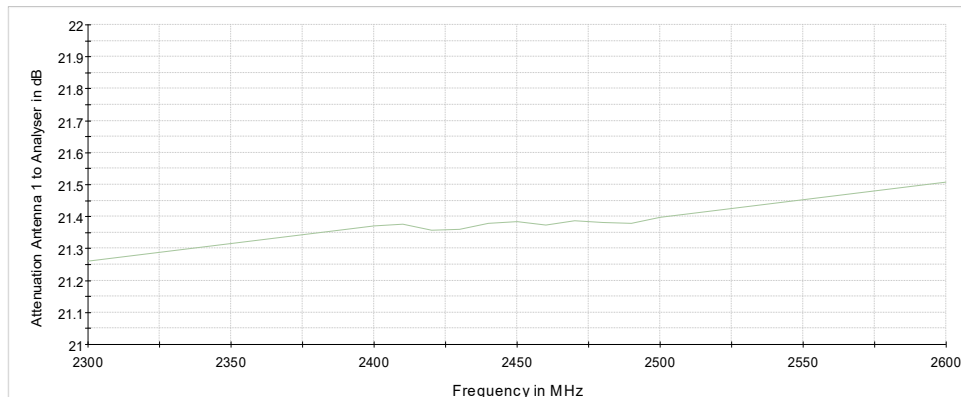
The EUT was connected to the test system as described in the block diagram below. The complete attenuation of the measurement path is known and considered.

Analyser settings:

- Resolution Bandwidth (RBW): ≥ 20 dB BW
- Video Bandwidth (VBW): $\geq$ RBW
- Trace: Maxhold
- Sweeps: Till stable (min. 300, max. 15000)
- Sweptime: Auto
- Detector: Peak



TS8997; Output Power



Attenuation Output power

5.1.2 TEST REQUIREMENTS / LIMITS

Frequency Hopping Systems:

FCC Part 15, Subpart C, §15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

FCC Part 15, Subpart C, §15.247 (b) (2)

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW)

5.1.3 TEST PROTOCOL

Ambient temperature: 23 °C
 Air Pressure: 998 hPa
 Humidity: 38 %

Chip01

BT GFSK (1-DH5)

Band	Channel No.	Frequency [MHz]	Peak Power@ EUT[dBm]	Cable + Insertion Loss[dB]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	-0.3	-1.1	-1.4	21.0	22.4	-1.3
	39	2441	-0.6	-1.1	-1.7	21.0	22.7	-1.6
	78	2480	-0.8	-1.1	-1.9	21.0	22.9	-1.8

BT π/4 DQPSK (2-DH5)

Band	Channel No.	Frequency [MHz]	Peak Power@ EUT[dBm]	Cable + Insertion Loss[dB]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	1.1	-1.1	0.0	21.0	21.0	0.1
	39	2441	0.9	-1.1	-0.2	21.0	21.2	-0.1
	78	2480	0.6	-1.1	-0.5	21.0	21.5	-0.4

BT 8-DPSK (3-DH5)

Band	Channel No.	Frequency [MHz]	Peak Power@ EUT[dBm]	Cable + Insertion Loss[dB]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	1.2	-1.1	0.1	21.0	20.9	0.2
	39	2441	1.2	-1.1	0.1	21.0	20.9	0.2
	78	2480	0.9	-1.1	-0.2	21.0	21.2	-0.1

Chip02

BT GFSK (1-DH5)

Band	Channel No.	Frequency [MHz]	Peak Power@ EUT[dBm]	Cable + Insertion Loss[dB]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	-2.5	-1.2	-3.7	21.0	24.7	-3.6
	39	2441	-3.2	-1.2	-4.4	21.0	25.4	-4.3
	78	2480	-3.3	-1.2	-4.5	21.0	25.5	-4.4

BT $\pi/4$ DQPSK (2-DH5)

Band	Channel No.	Frequency [MHz]	Peak Power@ EUT[dBm]	Cable + Insertion Loss[dB]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	-1.1	-1.2	-2.3	21.0	23.3	-2.2
	39	2441	-1.9	-1.2	-3.1	21.0	24.1	-3.0
	78	2480	-2.1	-1.2	-3.3	21.0	24.3	-3.2

BT 8-DPSK (3-DH5)

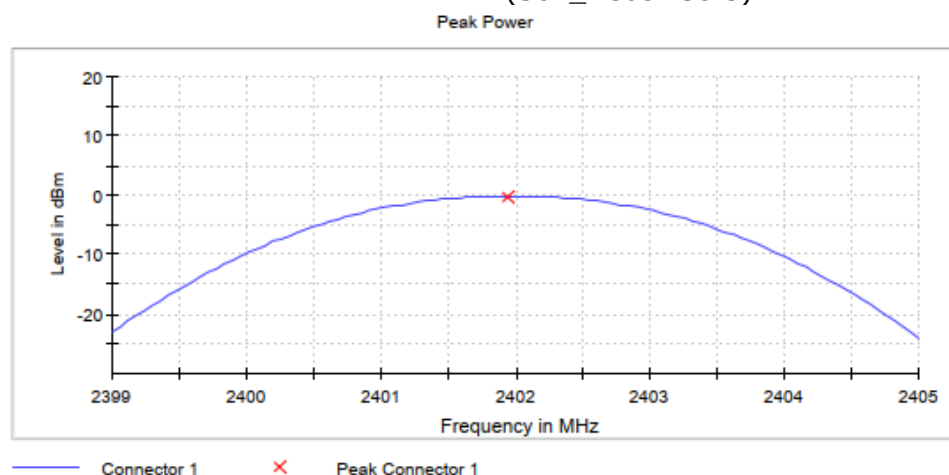
Band	Channel No.	Frequency [MHz]	Peak Power@ EUT[dBm]	Cable + Insertion Loss[dB]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]	E.I.R.P [dBm]
2.4 GHz ISM	0	2402	-0.9	-1.2	-2.1	21.0	23.1	-2.0
	39	2441	-1.6	-1.2	-2.8	21.0	23.8	-2.7
	78	2480	-1.9	-1.2	-3.1	21.0	24.1	-3.0

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

- The Results in the following plots are before implementing the cable attenuation correction, the corrected Results are defined in the previous tables.

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

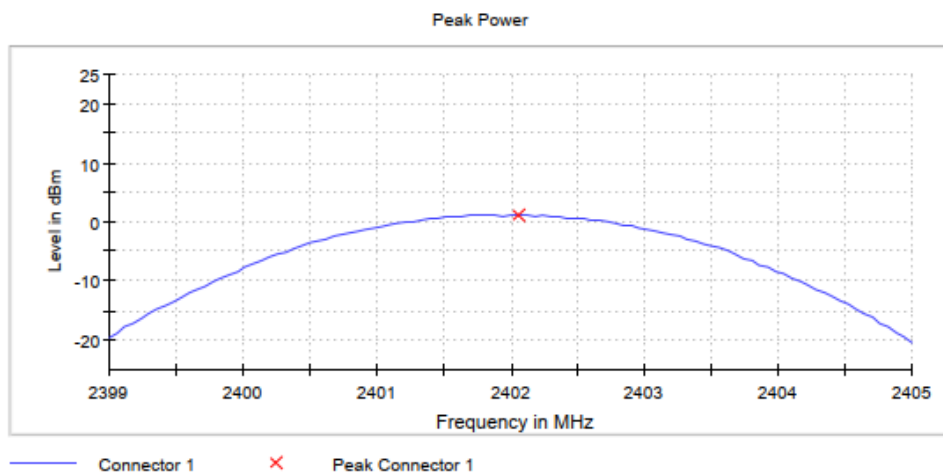
Chip01, Modulation= Bluetooth BR, Operating Channel = 0
(S02_BC03#S3.5)



Measurement

Setting	Instrument Value
Start Frequency	2.39900 GHz
Stop Frequency	2.40500 GHz
Span	6.000 MHz
RBW	2.000 MHz
VBW	10.000 MHz
SweepPoints	101
SweepTime	1.000 ms
Reference Level	0.000 dBm
Attenuation	10.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamp	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	4 / max. 150
Stable	3 / 3
Max Stable Difference	0.06 dB

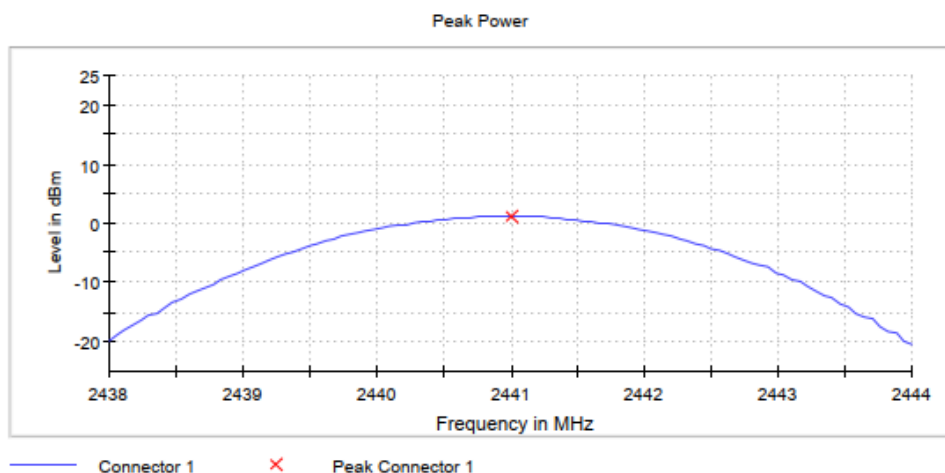
Chip01, Modulation= Bluetooth EDR 2, Operating Channel = 0
(S02_BC03#S3.5)



Measurement

Setting	Instrument Value
Start Frequency	2.39900 GHz
Stop Frequency	2.40500 GHz
Span	6.000 MHz
RBW	2.000 MHz
VBW	10.000 MHz
SweepPoints	101
SweepTime	1.000 ms
Reference Level	0.000 dBm
Attenuation	10.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamp	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	4 / max. 150
Stable	3 / 3
Max Stable Difference	0.12 dB

Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 39
(S02_BC03#S3.5)



Measurement

Setting	Instrument Value
Start Frequency	2.43800 GHz
Stop Frequency	2.44400 GHz
Span	6.000 MHz
RBW	2.000 MHz
VBW	10.000 MHz
SweepPoints	101
SweepTime	1.000 ms
Reference Level	0.000 dBm
Attenuation	10.000 dB
Detector	MaxPeak
SweepCount	100
Filter	3 dB
Trace Mode	Max Hold
SweepType	Sweep
Preamp	off
Stablemode	Trace
Stablevalue	0.50 dB
Run	4 / max. 150
Stable	3 / 3
Max Stable Difference	0.15 dB

5.1.5 TEST EQUIPMENT USED

- R&S TS8997

5.2 TRANSMITTER SPURIOUS EMISSIONS IN RESTRICTED BANDS

Standard **FCC Part 15 Subpart C**

The test was performed according to:

ANSI C63.10, chapter 6.4, 6.5, 6.6.5

5.2.1 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:

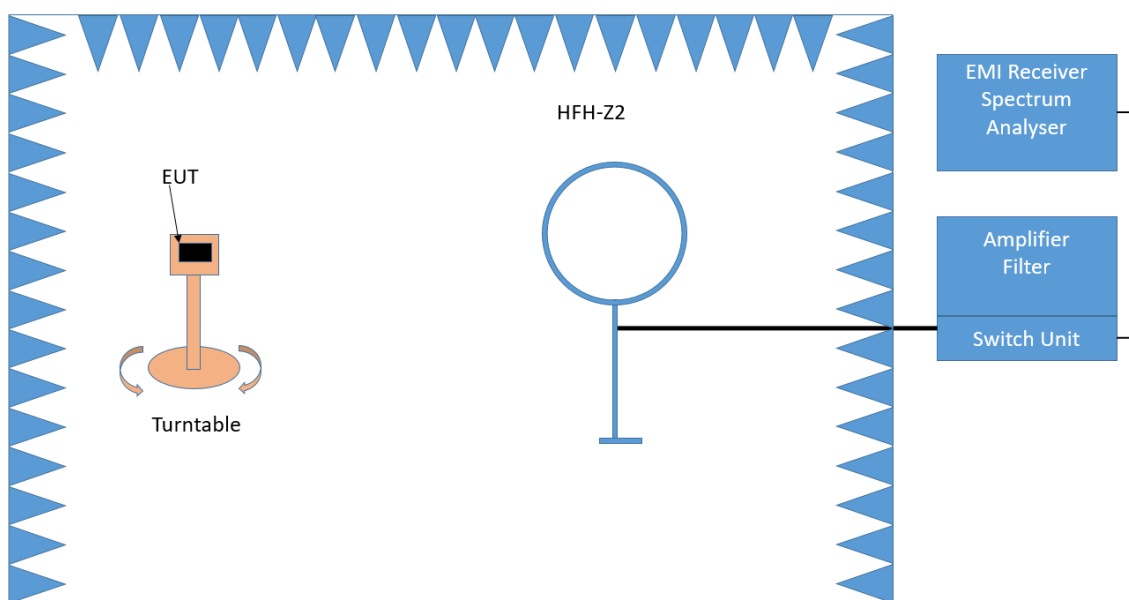
- < 30 MHz: Chapter 6.4
- 30 MHz – 1 GHz: Chapter 6.5
- > 1 GHz: Chapter 6.6 (procedure according 6.6.5 used)

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)

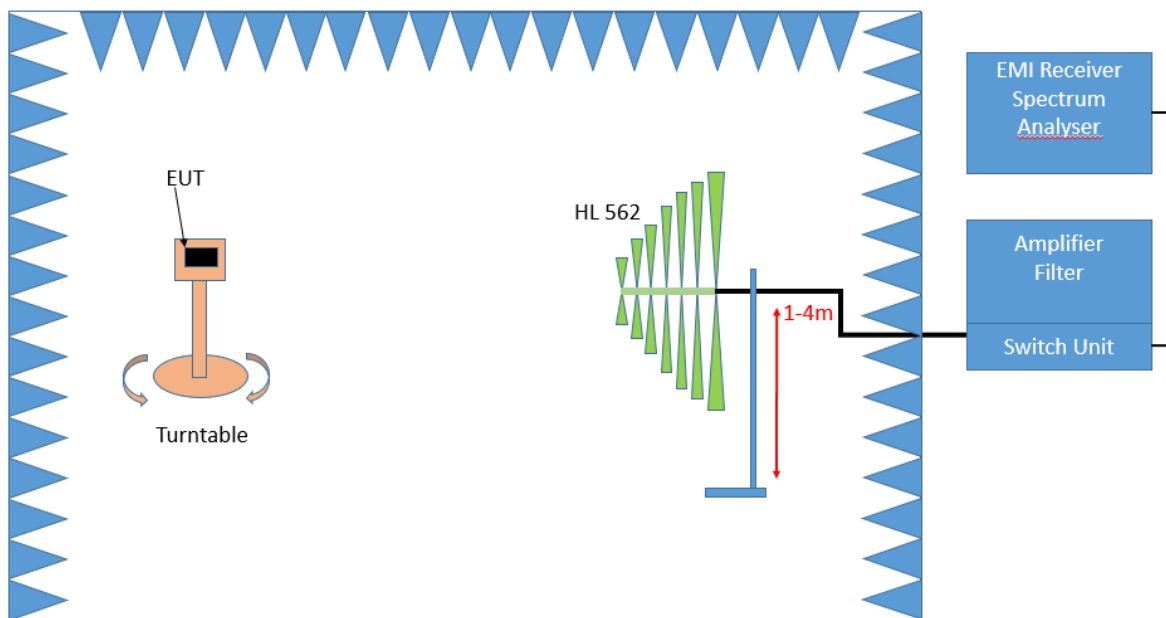
Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

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 – 4 meter. 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

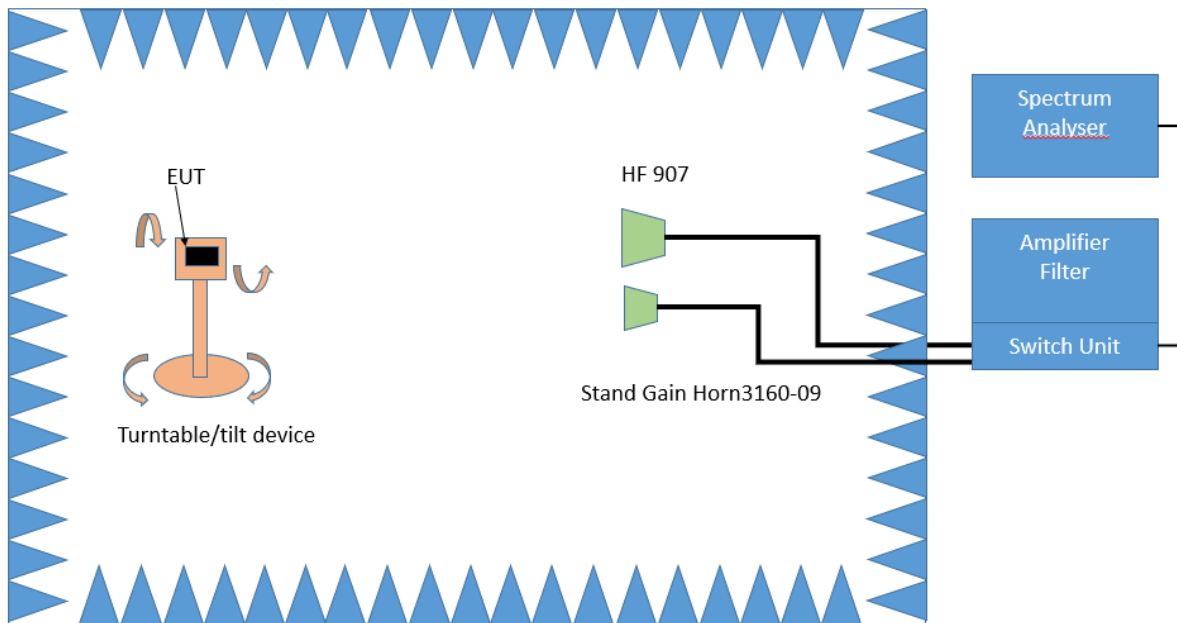
After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

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

5.2.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.247 (d)

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

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

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

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

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

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

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

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

5.2.3 TEST PROTOCOL

Ambient temperature: 20–22 °C
 Air Pressure: 999–1010 hPa
 Humidity: 38–45 %

Chip01(S01_BC03#S3.5)

BT π/4 DQPSK (2-DH5)

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detector	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480*	---	---	---	---	---	---	RB

Chip01(S01_BC03#S3.5)

BT 8-DPSK (3-DH5)

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]	Limit Type
0	2402	132.1	33.3	QP	120	43.5	10.2	RB
0	2402	243.6	21.5	QP	120	46.0	24.5	RB
0	2402	262.3	28.9	QP	120	46.0	17.1	RB
0	2402	327.4	34.7	QP	120	46.0	11.4	RB
0	2402	334.6	33.3	QP	120	46.0	12.7	RB
0	2402	407.1	26.5	QP	120	46.0	19.5	RB
39	2441	129.8	26.3	QP	120	43.5	17.2	RB
39	2441	150.0	33.8	QP	120	43.5	9.7	RB
39	2441	327.3	27.4	QP	120	46.0	18.6	RB
39	2441	409.6	32.1	QP	120	46.0	13.9	RB
78	2480	129.8	24.7	QP	120	43.5	18.8	RB
78	2480	150.0	30.7	QP	120	43.5	12.8	RB
78	2480	323.6	28.9	QP	120	46.0	17.1	RB
78	2480	335.0	29.8	QP	120	46.0	16.2	RB
78	2480	409.6	33.4	QP	120	46.0	12.6	RB

Chip02(S01_BC03#S3.5)

BT π/4 DQPSK (2-DH5)

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]	Limit Type
0	2402*	---	---	---	---	---	---	RB
78	2480*	---	---	---	---	---	---	RB

Chip02 (S01_BC03#S3.5)

BT 8-DPSK (3-DH5)

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]	Limit Type
0	2402	119.9	22.8	QP	120	43.5	20.7	RB
0	2402	150.0	30.0	QP	120	43.5	13.5	RB
0	2402	323.6	30.8	QP	120	46.0	15.2	RB
0	2402	406.5	31.3	QP	120	46.0	14.7	RB
39	2441	165.2	10.8	QP	120	43.5	32.7	RB
39	2441	259.6	16.2	QP	120	46.0	29.8	RB
39	2441	327.4	25.5	QP	120	46.0	20.5	RB
78	2480	165.2	38.7	QP	120	43.5	4.8	RB

=====

Chip01(S01_BB03#S3.0)

BT 8-DPSK (3-DH5)

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]	Limit Type
78	2480*	- - -	- - -	- - -	- - -	- - -	- - -	RB

Chip02(S01_BB03#S3.0)

BT 8-DPSK (3-DH5)

Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]	Limit Type
0	2402	162.3	34.6	QP	120	43.5	8.9	RB
0	2402	325.1	33.6	QP	120	46.0	12.4	RB
0	2402	410.0	33.1	QP	120	46.0	12.9	RB
39	2441*	- - -	- - -	- - -	- - -	- - -	- - -	RB
78	2480*	- - -	- - -	- - -	- - -	- - -	- - -	RB

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

- The measurements have been performed only on worst-case modes" BT 8-DPSK (3-DH5) and BT n/4 DQPSK (2-DH5)", which they had the highest spurious Emission in the Reference Report: "MDE_BOSCH_2411_FCC_05_rev01".

***) no peaks have been found for these operating channels /operating modes**

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

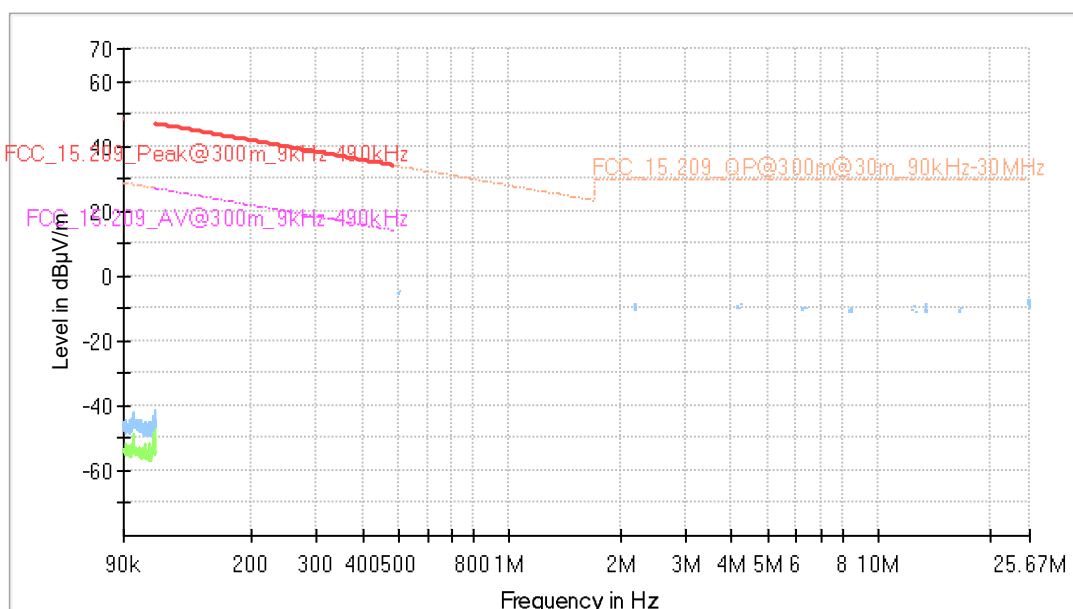
Trace:

blue = Peak (9 kHz - 40 GHz)
green = AV (9 kHz - 30 MHz and 1 - 26 GHz), QP (30 MHz - 1 GHz)

Marker:

Star = critical frequency, Rhombus = final Results

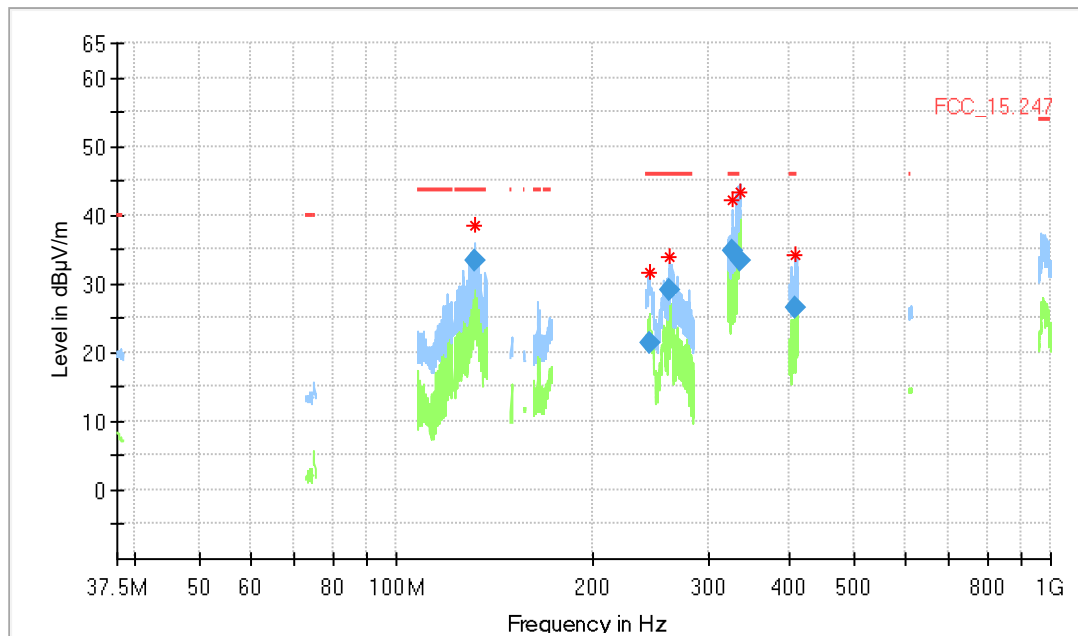
Chip02, Modulation= Bluetooth EDR 3, Operating Channel = 39
Measurements range = 9 kHz - 30 MHz
(S01_BB03#S3.0)



Final Result

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

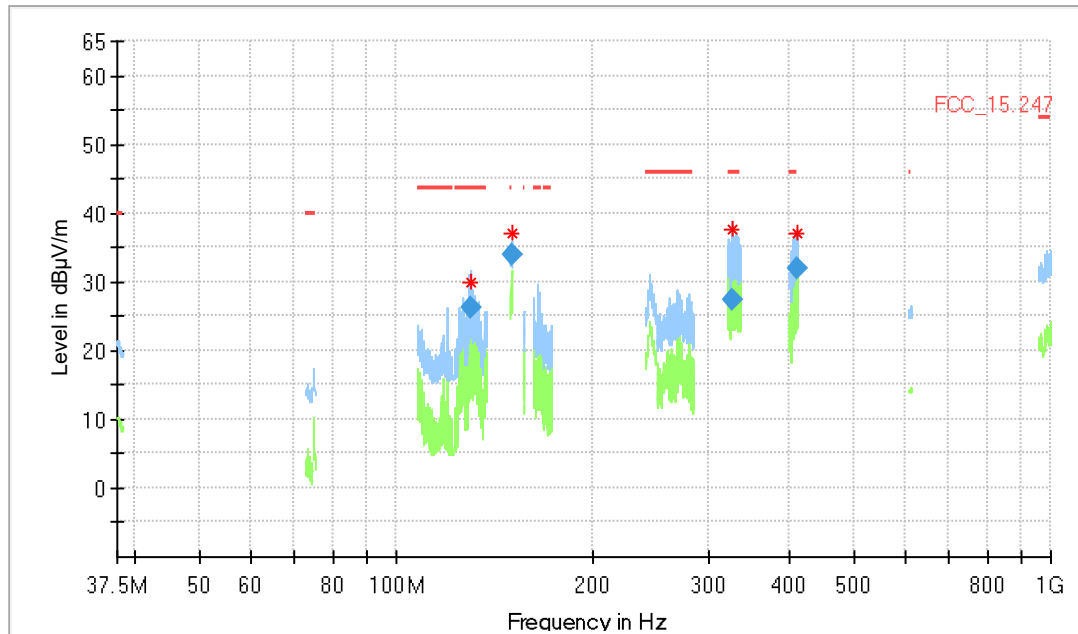
Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 0
Measurements range = 30 MHz – 1 GHz
(S01_BC03#S3.5)



Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
132.090000	33.29	43.50	10.21	1000.0	120.000	194.0	H	284.0	10.9
243.600000	21.47	46.00	24.53	1000.0	120.000	114.0	V	9.0	11.7
262.260000	28.93	46.00	17.07	1000.0	120.000	136.0	H	160.0	12.5
327.370000	34.65	46.00	11.35	1000.0	120.000	110.0	H	317.0	14.7
334.630000	33.32	46.00	12.68	1000.0	120.000	113.0	H	341.0	14.9
407.130000	26.47	46.00	19.53	1000.0	120.000	245.0	H	112.0	17.1

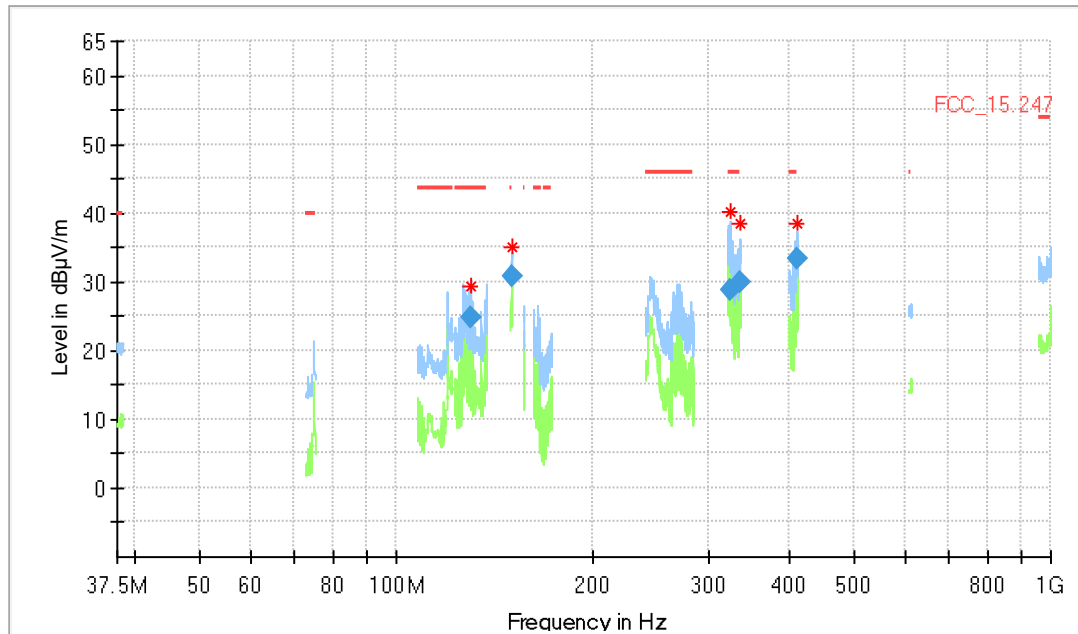
Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 39
Measurements range = 30 MHz – 1 GHz
(S01_BC03#S3.5)



Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
129.810000	26.32	43.50	17.18	1000.0	120.000	181.0	H	288.0	11.0
149.990000	33.82	43.50	9.68	1000.0	120.000	192.0	H	8.0	9.5
327.340000	27.37	46.00	18.63	1000.0	120.000	109.0	H	62.0	14.7
409.590000	32.06	46.00	13.94	1000.0	120.000	104.0	H	210.0	17.2

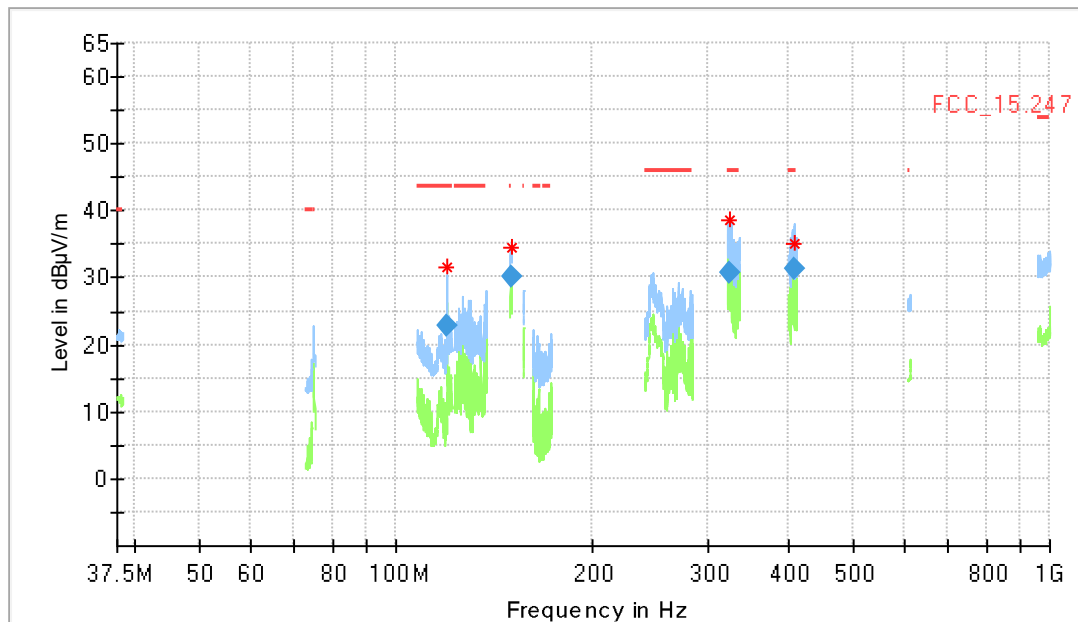
Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 78
Measurements range = 30 MHz – 1 GHz
(S01_BC03#S3.5)



Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
129.810000	24.72	43.50	18.78	1000.0	120.000	194.0	H	144.0	11.0
149.990000	30.71	43.50	12.79	1000.0	120.000	110.0	V	206.0	9.5
323.560000	28.89	46.00	17.11	1000.0	120.000	104.0	V	39.0	14.5
334.990000	29.83	46.00	16.17	1000.0	120.000	107.0	V	113.0	14.9
409.590000	33.41	46.00	12.59	1000.0	120.000	100.0	H	208.0	17.2

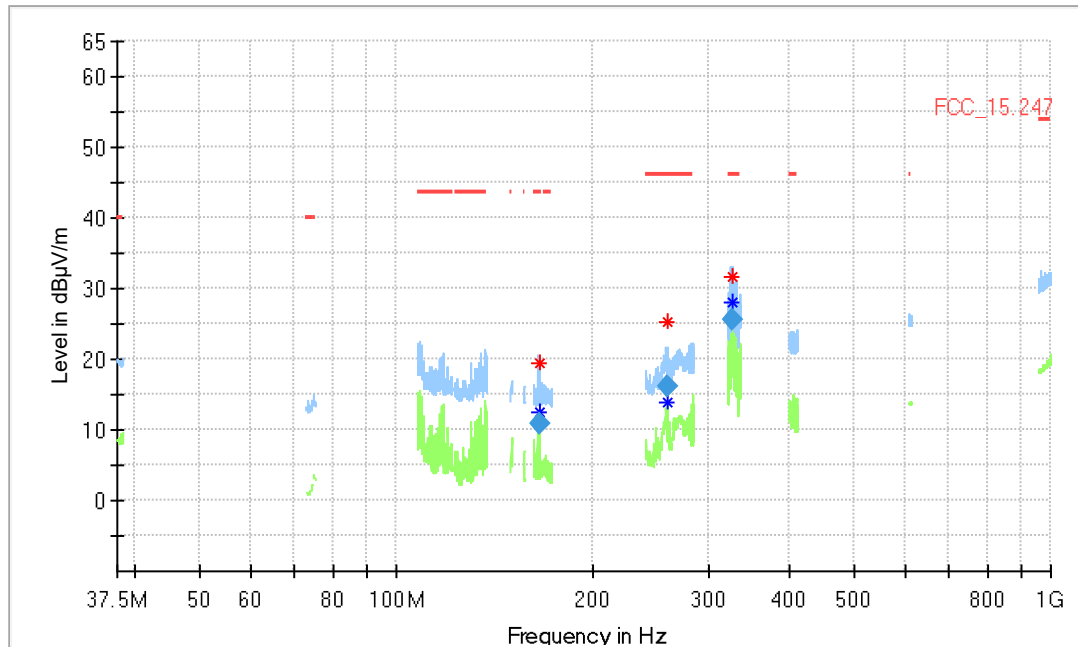
Chip02, Modulation= Bluetooth EDR 3, Operating Channel = 0
 Measurements range = 30 MHz – 1 GHz
 (S01_BC03#S3.5)



Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
119.940000	22.82	43.50	20.68	1000.0	120.000	301.0	H	62.0	11.5
149.990000	30.00	43.50	13.50	1000.0	120.000	110.0	V	225.0	9.5
323.590000	30.83	46.00	15.17	1000.0	120.000	110.0	V	243.0	14.5
406.530000	31.28	46.00	14.72	1000.0	120.000	216.0	H	118.0	17.1

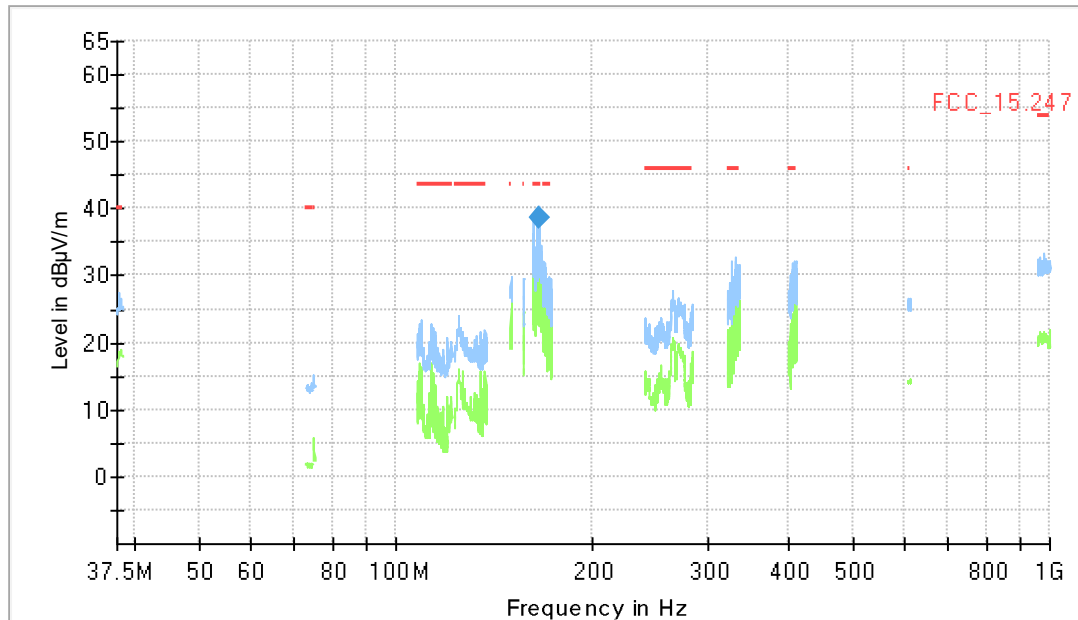
Chip02, Modulation= Bluetooth EDR 3, Operating Channel = 39
Measurements range = 30 MHz – 1 GHz
(S01_BC03#S3.5)



Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
165.192500	10.8	43.50	32.7	1000.0	120.000	116.0	V	353	9.5
259.620000	16.2	46.00	29.8	1000.0	120.000	139.0	H	143	12.4
327.370000	25.5	46.00	20.5	1000.0	120.000	106.0	H	96	14.7

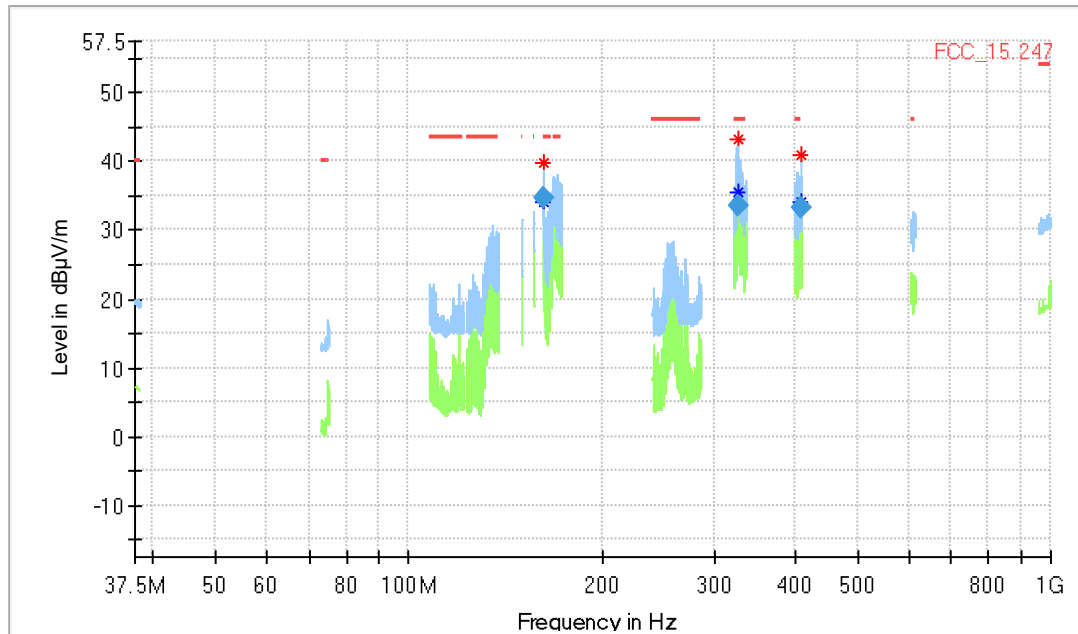
Chip02, Modulation= Bluetooth EDR 3, Operating Channel = 78
 Measurements range = 30 MHz – 1 GHz
 (S01_BC03#S3.5)



Final_Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
165.192500	38.71	43.50	4.79	1000.0	120.000	100.0	V	184.0	9.5

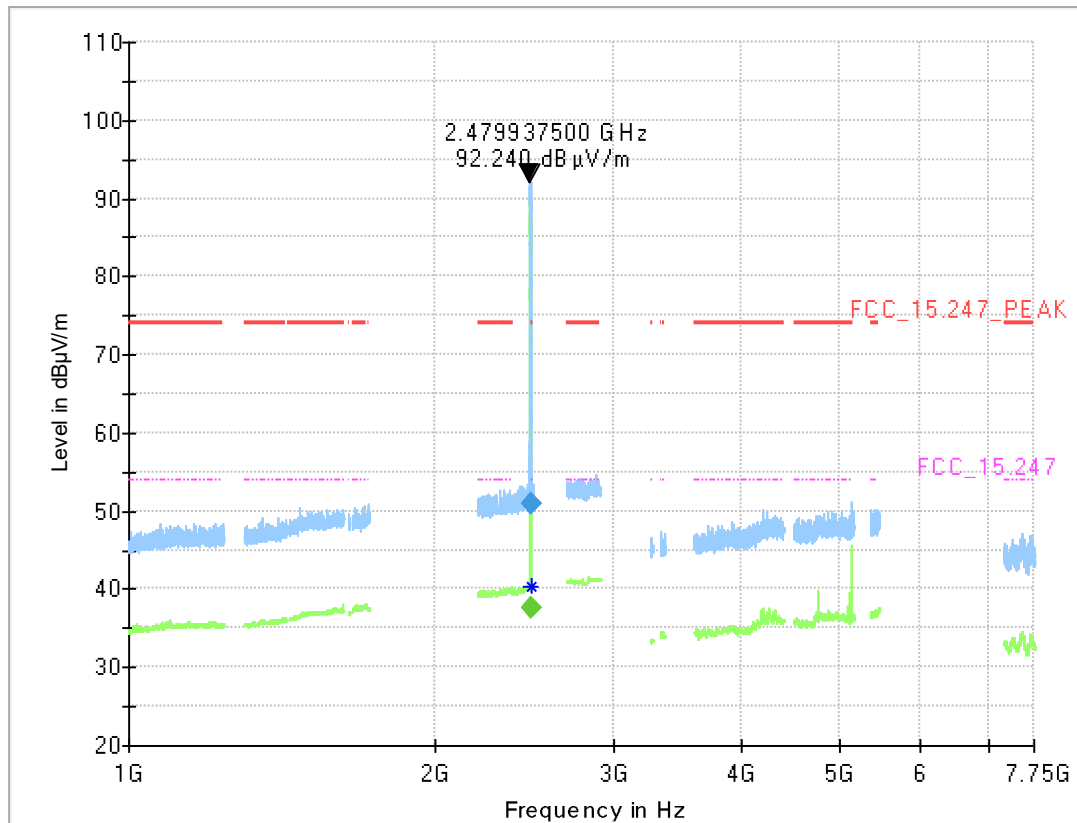
Chip02, Modulation= Bluetooth EDR 3, Operating Channel = 0
Measurements range = 30 MHz – 1 GHz
(S01_BB03#S3.0)



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
162.252500	34.6	43.50	8.9	1000.0	120.000	147.0	H	277	9.5
325.060000	33.6	46.00	12.4	1000.0	120.000	133.0	H	213	14.6
409.980000	33.1	46.00	12.9	1000.0	120.000	104.0	V	172	17.2

Chip01, Modulation= Bluetooth EDR 2, Operating Channel = 78
Measurements range = 1 GHz – 7.75 GHz
(S01_BC03#S3.5)

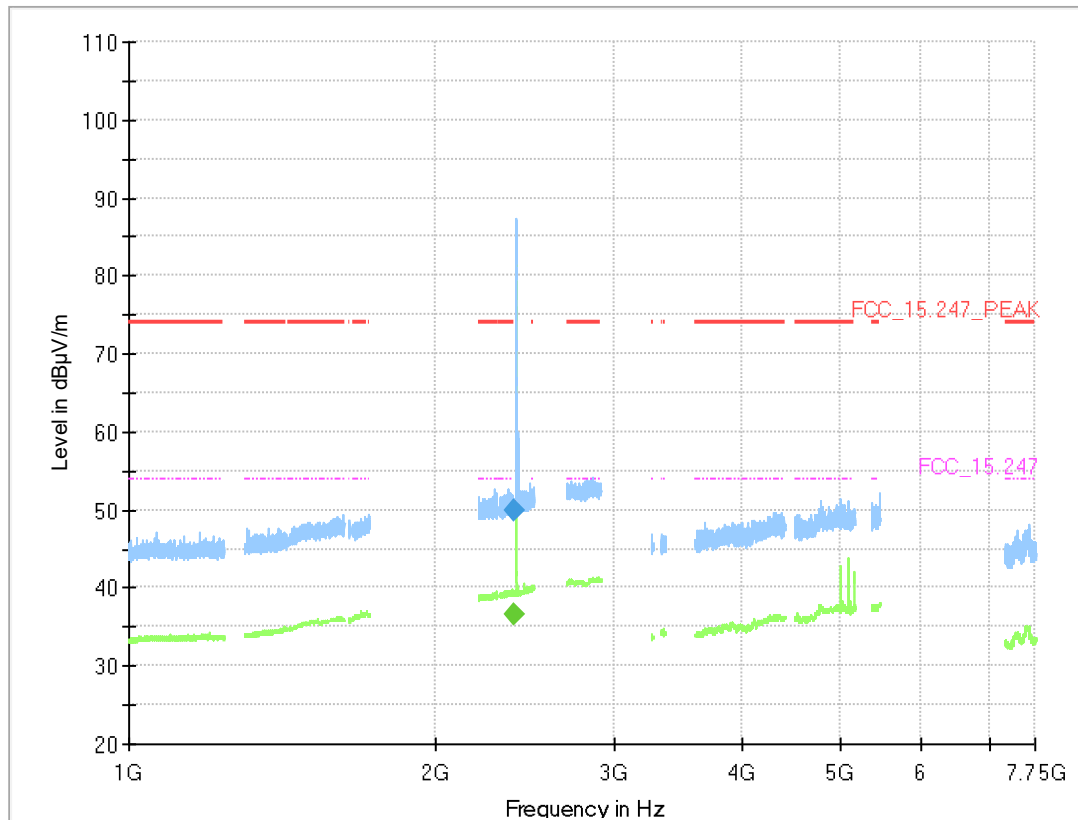


Final Result

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)
2484.500	50.8	---	74.00	23.15	1000.0	1000.000	149.0	V	-58.0	20.0	8.0
2484.500	---	37.7	54.00	16.35	1000.0	1000.000	149.0	V	-58.0	20.0	8.0

(Note: the peak at 2480 MHz is the wanted signal)

Chip02, Modulation= Bluetooth EDR 2, Operating Channel = 0
Measurements range = 1 GHz – 7.75 GHz
(S01_BC03#S3.5)

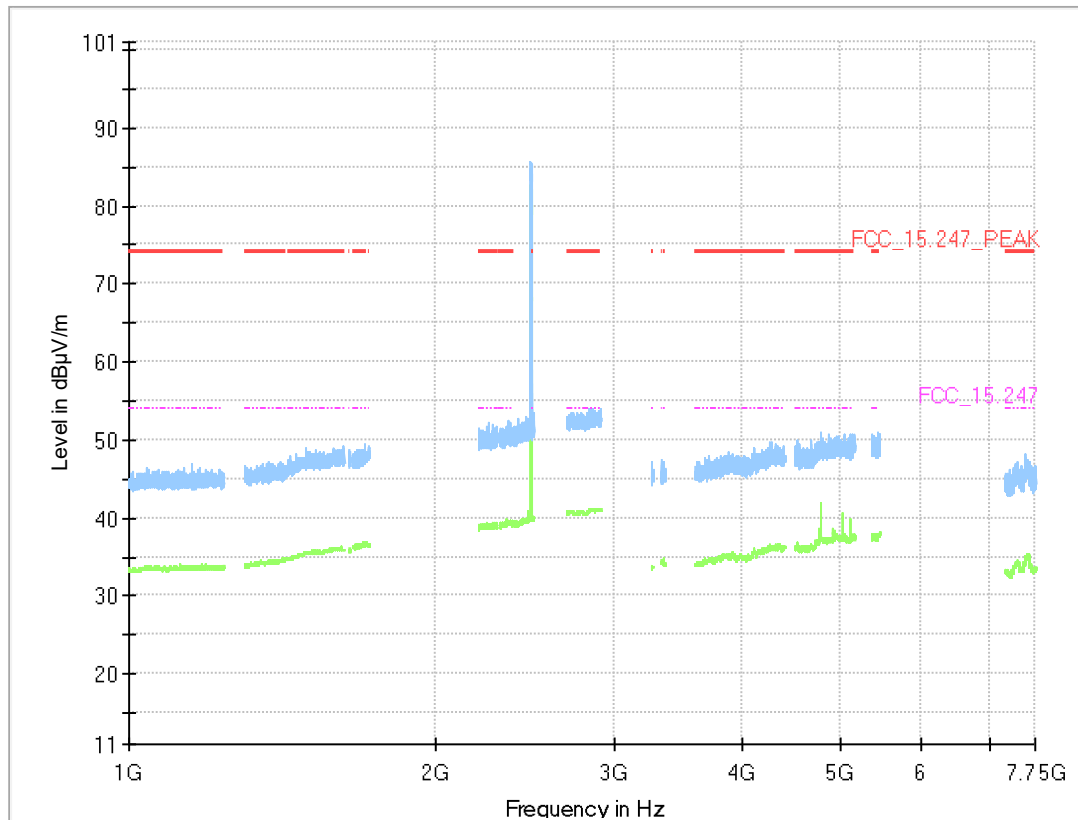


Final Result

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)
2389.740	---	36.6	54.00	17.39	1000.0	1000.000	150.0	V	-186.0	22.0	7.0
2389.740	50.0	---	74.00	24.05	1000.0	1000.000	150.0	V	-186.0	22.0	7.0

(Note: the peak at 2402 MHz is the wanted signal)

Chip02, Modulation= Bluetooth EDR 2, Operating Channel = 78
Measurements range = 1 GHz – 7.75 GHz
(S01_BC03#S3.5)

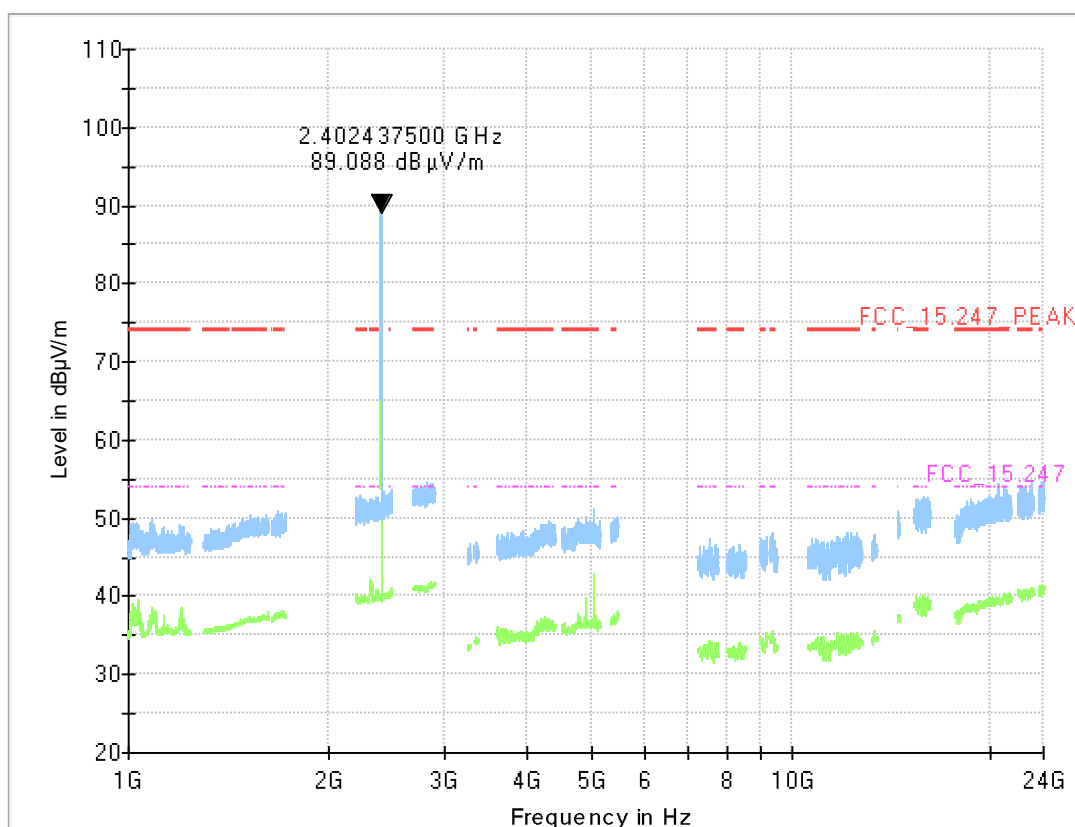


Final Result

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)
---	---	---	---	---	---	---	---	---	---	---	---

(Note: the peak at 2480 MHz is the wanted signal)

Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 0
 Measurements range = 1 GHz - 24 GHz
 (S01_BC03#S3.5)

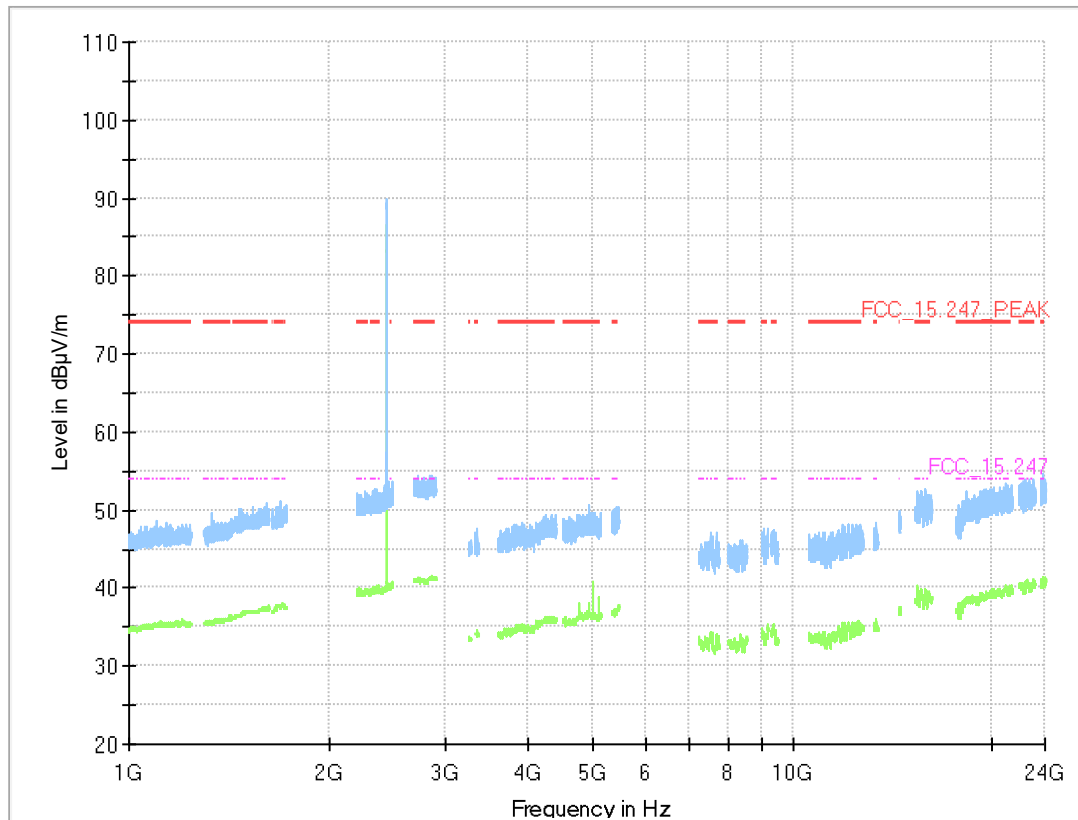


Final Result

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)
---	---	---	---	---	---	---	---	---	---	---	---

(Note: the peak at 2402 MHz is the wanted signal)

Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 39
 Measurements range = 1 GHz - 24 GHz
 (S01_BC03#S3.5)

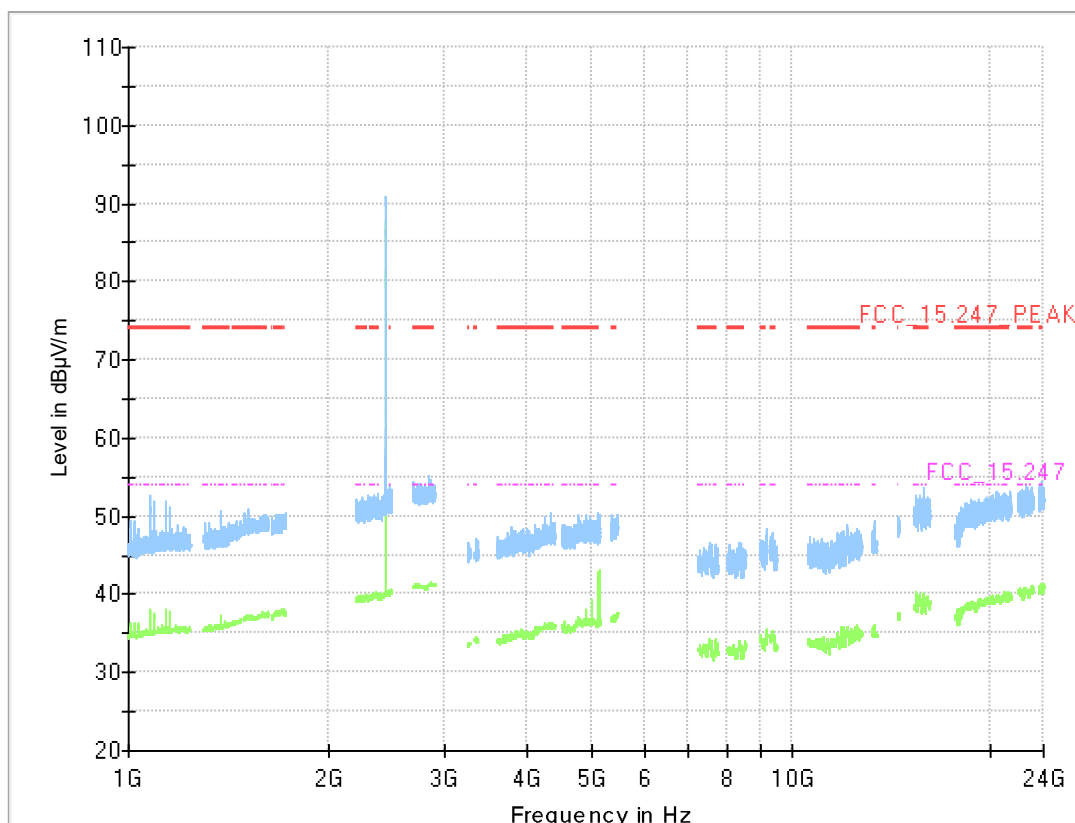


Final Result

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)
---	---	---	---	---	---	---	---	---	---	---	---

(Note: the peak at 2440.8 MHz is the wanted signal)

Chip02, Modulation= Bluetooth EDR 3, Operating Channel = 39
 Measurements range = 1 GHz - 24 GHz
 (S01_BC03#S3.5)

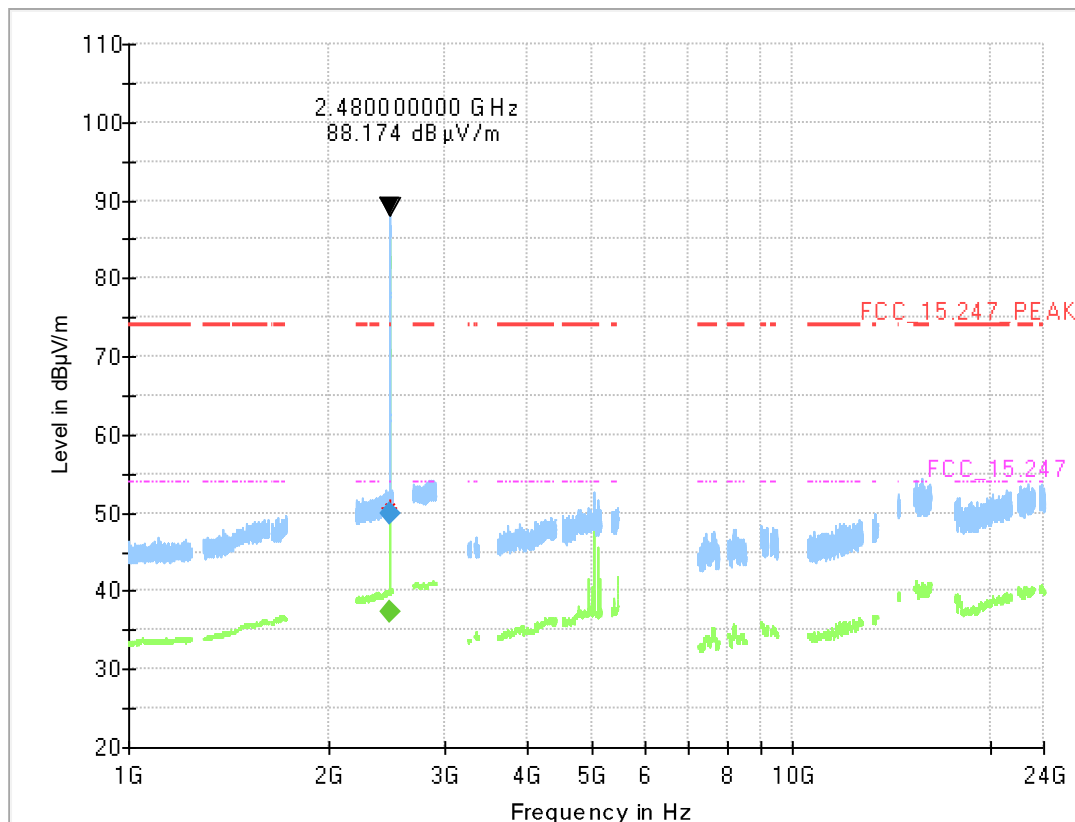


Final Result

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)
---	---	---	---	---	---	---	---	---	---	---	---

(Note: the peak at 2440 MHz is the wanted signal)

Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 78
Measurements range = 1 GHz - 24 GHz
(S01_BB03#S3.0)

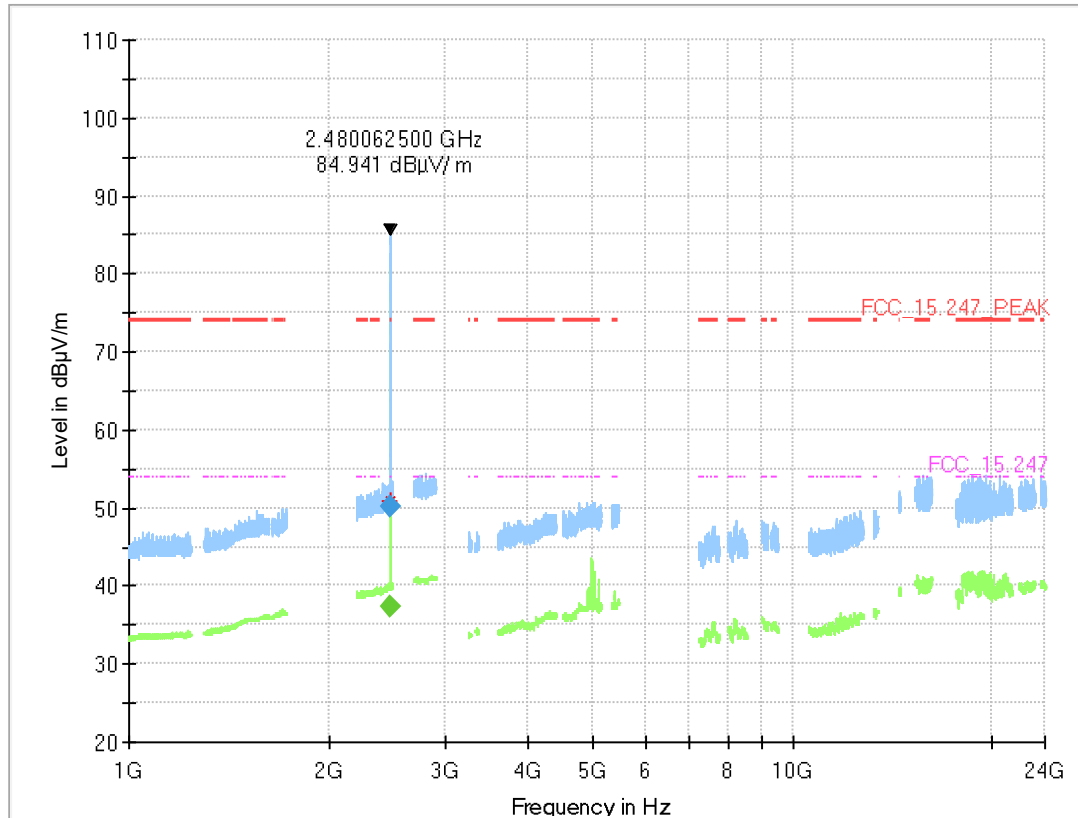


Final Result

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)
2484.063	50.0	---	74.00	24.03	1000.0	1000.000	150.0	V	-19.0	105.0	7.7
2484.063	---	37.3	54.00	16.71	1000.0	1000.000	150.0	V	-19.0	105.0	7.7

(Note: the peak at 2480 MHz is the wanted signal)

Chip02, Modulation= Bluetooth EDR 3, Operating Channel = 78
Measurements range = 1 GHz - 24 GHz
(S01_BB03#S3.0)



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)
2485.250	---	37.3	54.00	16.67	1000.0	1000.000	150.0	H	131.0	14.0	7.7
2485.250	50.1	---	74.00	23.86	1000.0	1000.000	150.0	H	131.0	14.0	7.7

(Note: the peak at 2480 MHz is the wanted signal)

5.2.5 TEST EQUIPMENT USED

- Radiated Emissions FAR 2.4 GHz FCC
- Radiated Emissions SAC H-Field
- Radiated Emissions SAC up to 1 GHz

5.3 BAND EDGE COMPLIANCE RESTRICTED BANDS

Standard **FCC Part 15 Subpart C**

The test was performed according to:

ANSI C63.10, chapter 6.6.5

5.3.1 TEST DESCRIPTION

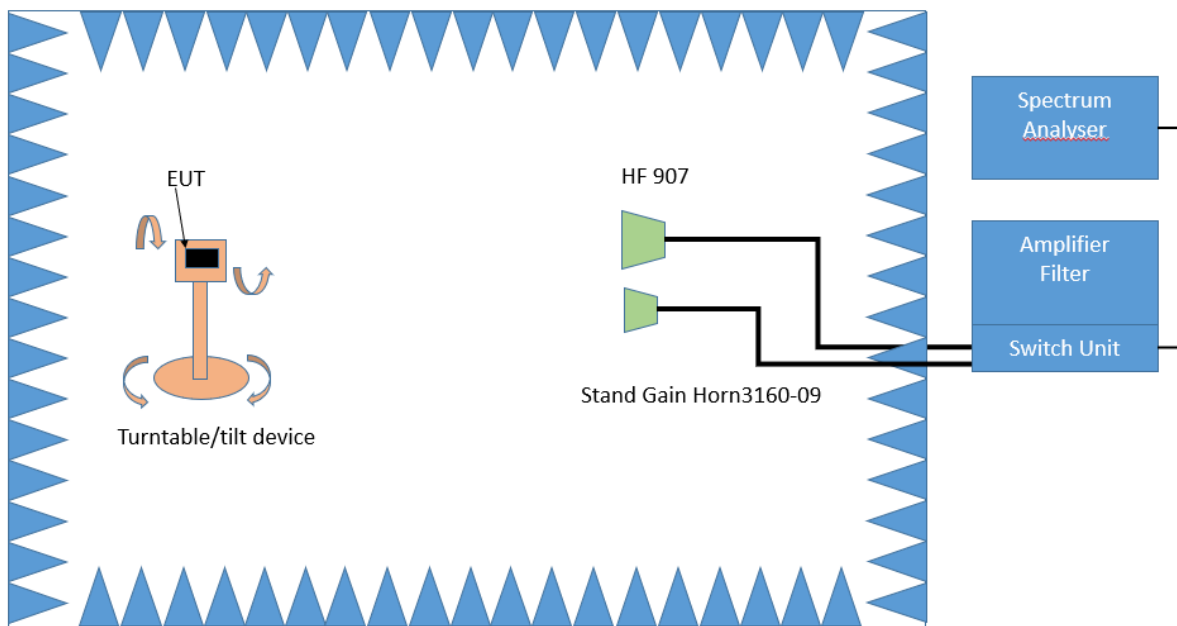
The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The measurements were performed according the following sub-chapter of ANSI C63.10:

- 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

5.3.2 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 ($\mu\text{V}/\text{m}$)	Measurement distance (m)	Limits ($\text{dB}\mu\text{V}/\text{m}$)
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 ($\mu\text{V}/\text{m}$)	Measurement distance (m)	Limits ($\text{dB}\mu\text{V}/\text{m}$)
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: $\text{Limit (dB}\mu\text{V/m)} = 20 \log (\text{Limit } (\mu\text{V/m})/1\mu\text{V/m})$

The average values have been calculated from the Peak measurements based on “duty cycles correction” method in ANSI C63.10, chapter 7.5.

The Duty Cycle Measurements are listed in Chapter 4.7 of this Report.

5.3.3 TEST PROTOCOL

Ambient temperature: 20–22 °C
 Air Pressure: 999–1010 hPa
 Humidity: 38–45 %

Chip01(S01_BC03#S3.5)

BT DQPSK (2-DH5)

Applied duty cycle correction (AV): 2.3 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]
78	2480	2483.5	50.8	PEAK	1000	74.0	23.2
78	2480	2483.5	48.5	AV	1000	54.0	5.5

BT 8-DPSK (3-DH5)

Applied duty cycle correction (AV): 2.3 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]
0	2402	2390.0	50.6	PEAK	1000	74.0	23.4
0	2402	2390.0	48.3	AV	1000	54.0	5.7
78	2480	2483.5	52.4	PEAK	1000	74.0	21.6
78	2480	2483.5	50.1	AV	1000	54.0	3.9

Chip02(S01_BC03#S3.5)

BT DQPSK (2-DH5)

Applied duty cycle correction (AV): 2.3 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]
0	2402	2390.0	50.0	PEAK	1000	74.0	24.0
0	2402	2390.0	47.7	AV	1000	54.0	6.3
78	2480	2483.5	53.1	PEAK	1000	74.0	20.9
78	2480	2483.5	50.8	AV	1000	54.0	3.2

BT 8-DPSK (3-DH5)

Applied duty cycle correction (AV): 2.3 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]
78	2480	2483.5	52.3	PEAK	1000	74.0	21.7
78	2480	2483.5	50.0	AV	1000	54.0	4.0

=====

Chip01(S01_BB03#S3.0)

BT GFSK (1-DH5)

Applied duty cycle correction (AV): 2.3 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]
78	2480	2483.5	52.5	PEAK	1000	74.0	21.5
78	2480	2483.5	50.2	AV	1000	54.0	3.8

BT 8-DPSK (3-DH5)

Applied duty cycle correction (AV): 2.3 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]
78	2480	2483.5	50.0	PEAK	1000	74.0	24.0
78	2480	2483.5	47.7	AV	1000	54.0	6.3

Chip02(S01_BB03#S3.0)

BT GFSK (1-DH5)

Applied duty cycle correction (AV): 2.3 dB

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]
78	2480	2483.5	51.9	PEAK	1000	74.0	22.1
78	2480	2483.5	49.6	AV	1000	54.0	4.4

BT 8-DPSK (3-DH5)

Applied duty cycle correction (AV): 2.3 dB

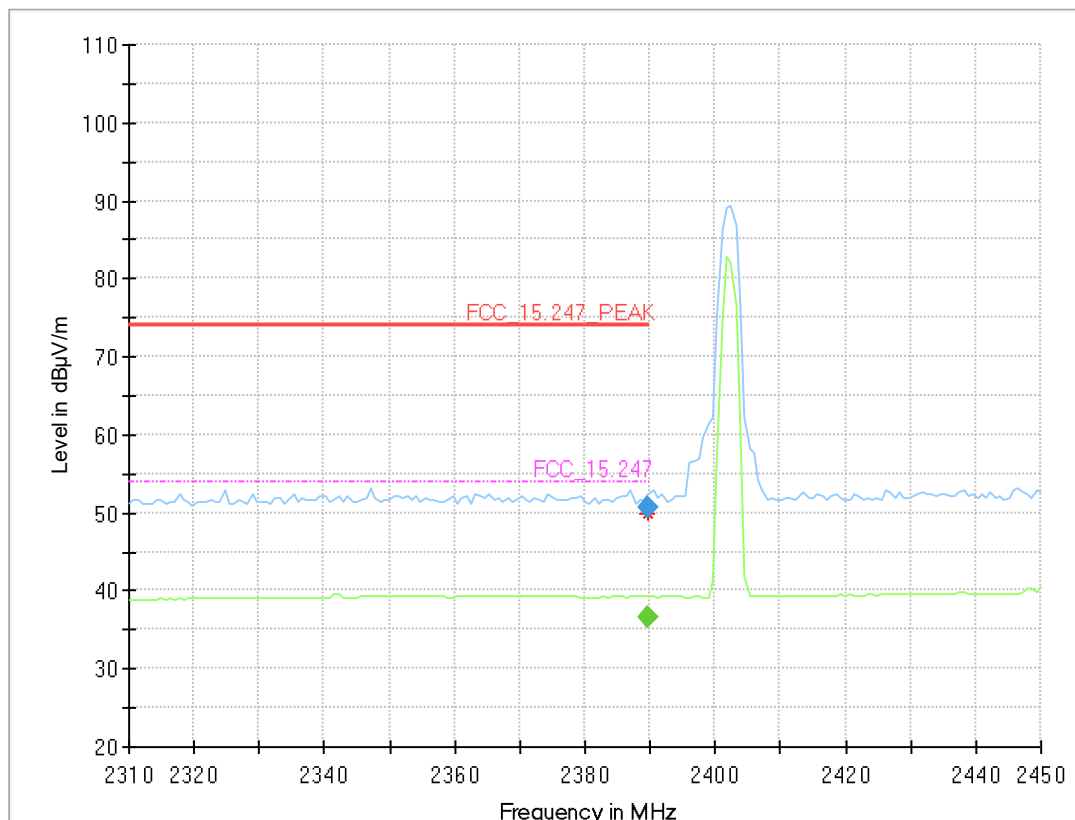
Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]
78	2480	2483.5	50.1	PEAK	1000	74.0	23.9
78	2480	2483.5	47.8	AV	1000	54.0	6.2

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

- The measurements have been performed only on worst-case modes, which they had the highest spurious Emission in the Reference Report: "MDE_BOSCH_2411_FCC_05_rev01".

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

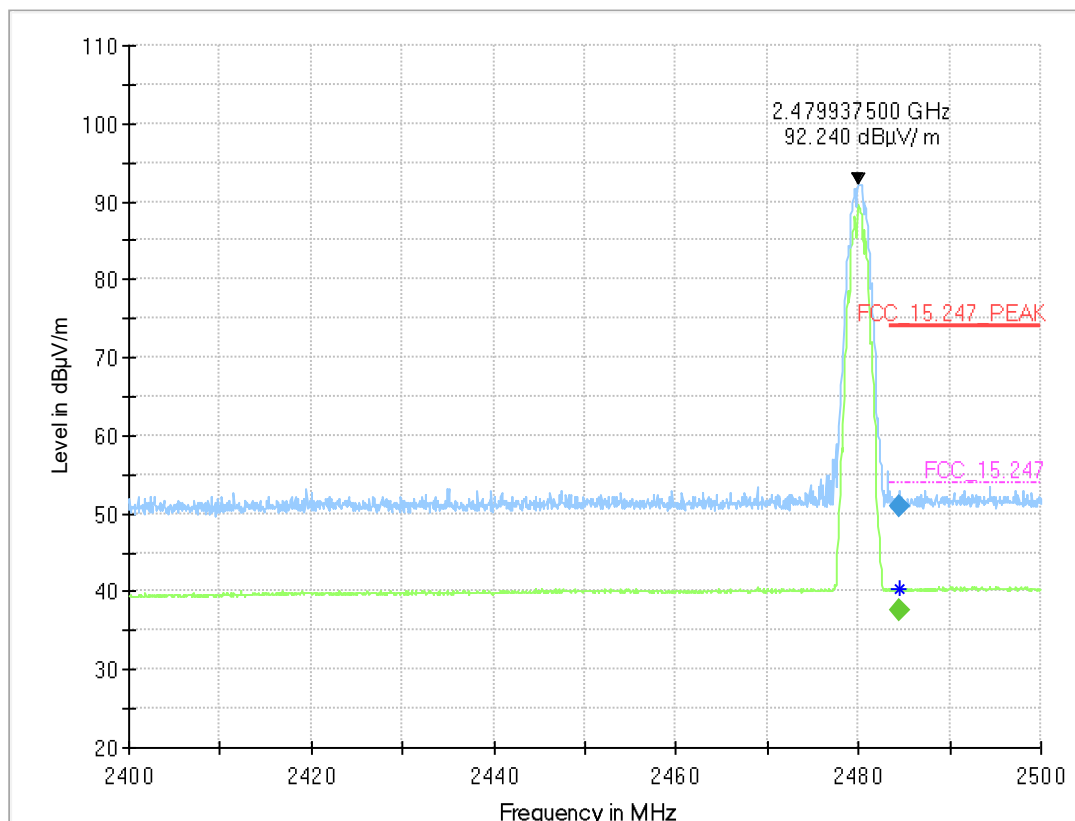
Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 0, Band Edge = low
(S01_BC03#S3.5)



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)
2389.800	---	36.7	54.00	17.32	1000.0	1000.000	150.0	H	-59.0	100.0	7.0
2389.800	50.6	---	74.00	23.43	1000.0	1000.000	150.0	H	-59.0	100.0	7.0

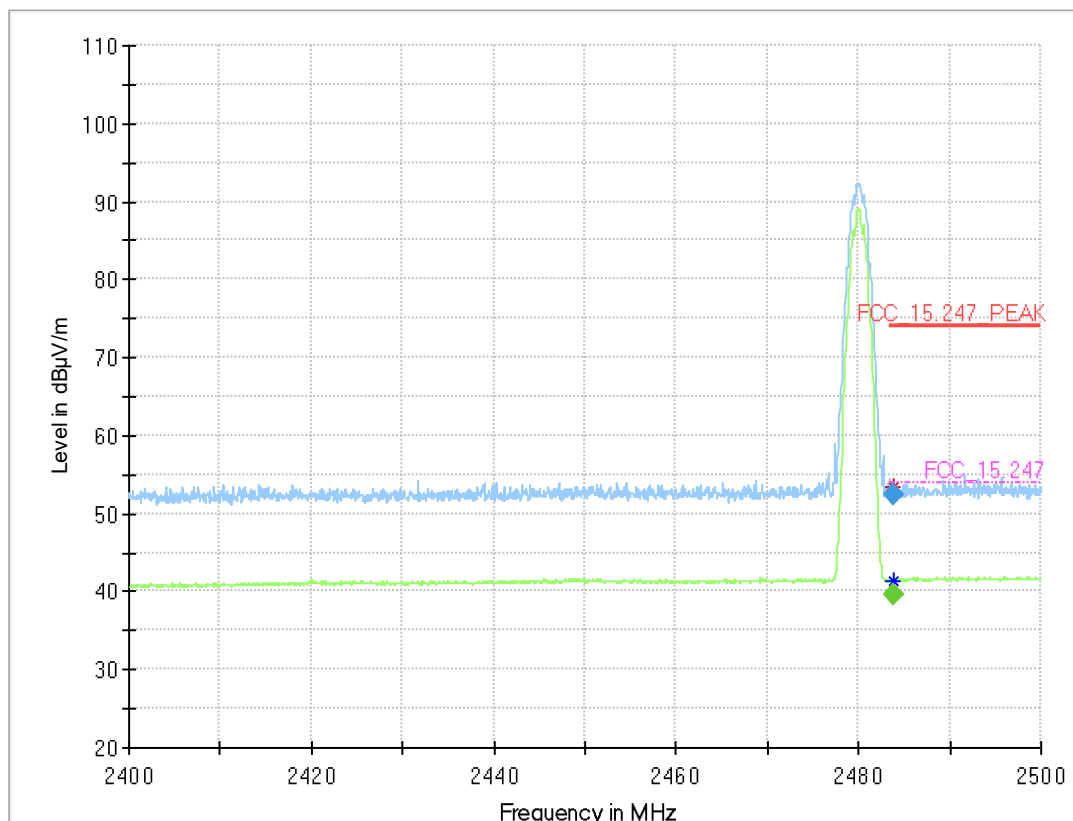
Chip01, Modulation= Bluetooth EDR 2, Operating Channel = 78, Band Edge = high
(S01_BC03#S3.5)



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)
2484.500	---	37.7	54.00	16.35	1000.0	1000.000	149.0	V	-58.0	20.0	8.0
2484.500	50.8	---	74.00	23.15	1000.0	1000.000	149.0	V	-58.0	20.0	8.0

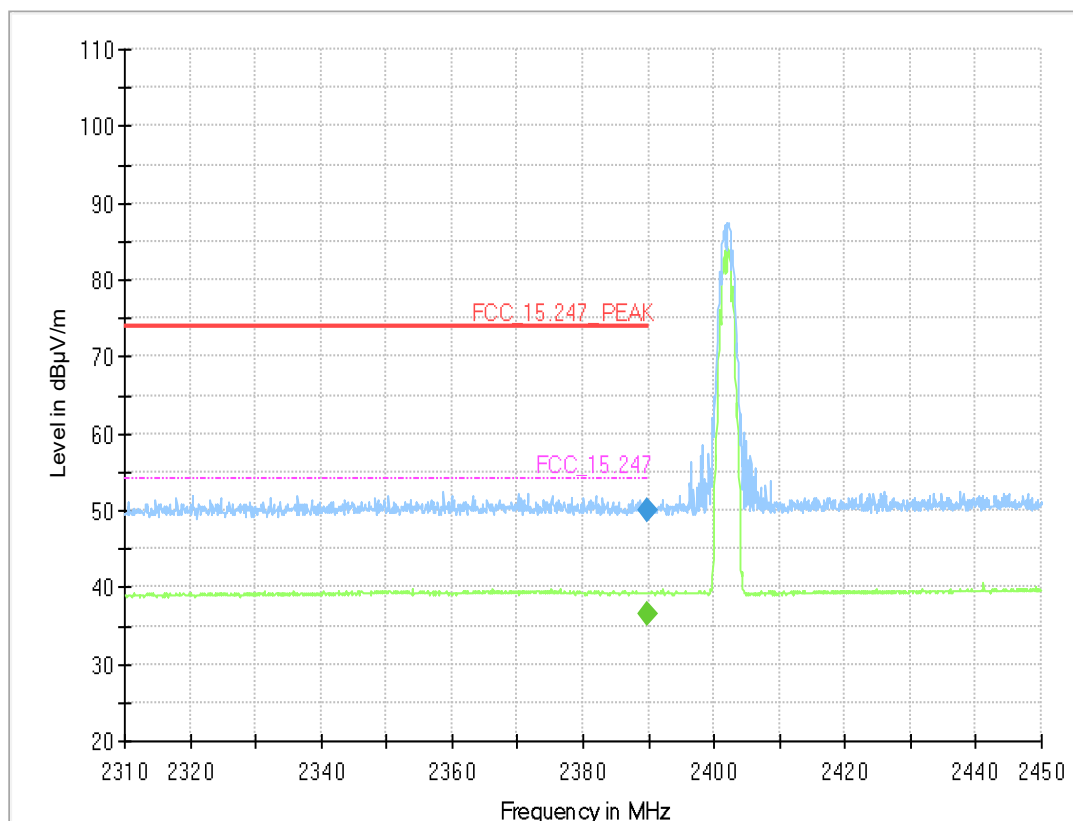
Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 78, Band Edge = high
(S01_BC03#S3.5)



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)
2483.750	---	39.6	54.00	14.43	1000.0	1000.000	150.0	H	-169.0	84.0	8.0
2483.750	52.4	---	74.00	21.58	1000.0	1000.000	150.0	H	-169.0	84.0	8.0

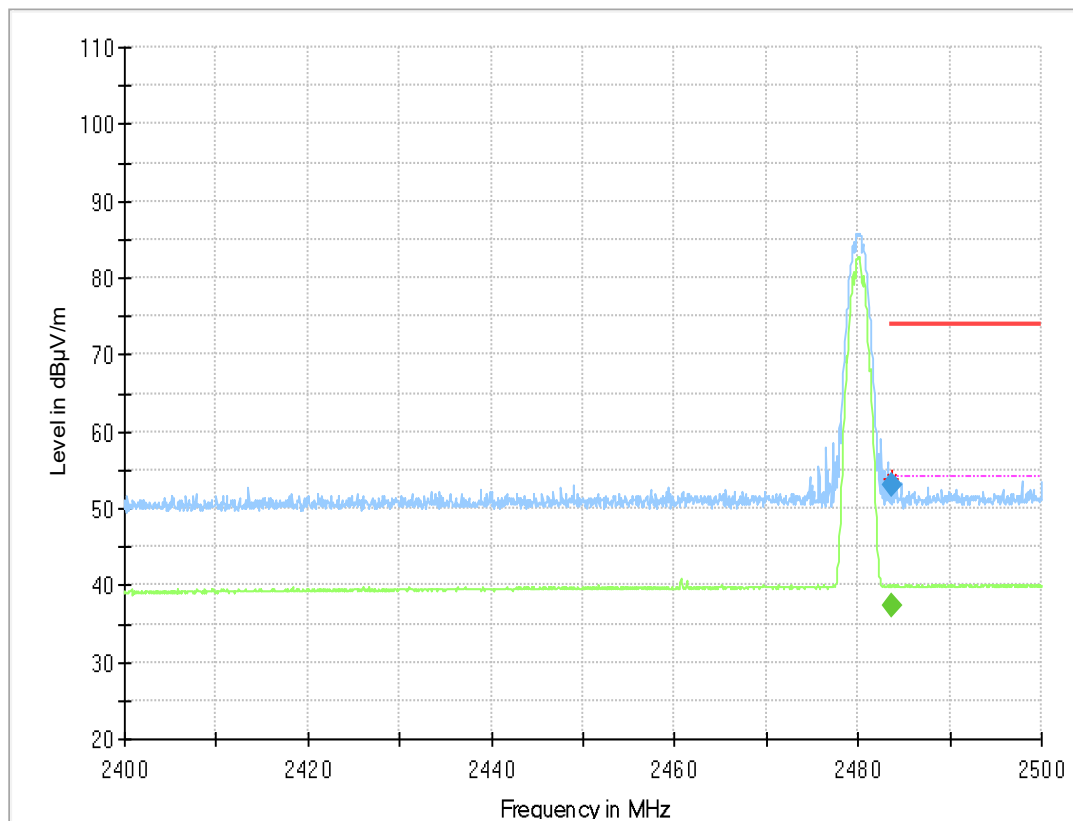
Chip02, Modulation= Bluetooth EDR 2, Operating Channel = 0, Band Edge = low
(S01_BC03#S3.5)



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)
2389.740	50.0	---	74.00	24.05	1000.0	1000.000	150.0	V	-186.0	22.0	7.0
2389.740	---	36.6	54.00	17.39	1000.0	1000.000	150.0	V	-186.0	22.0	7.0

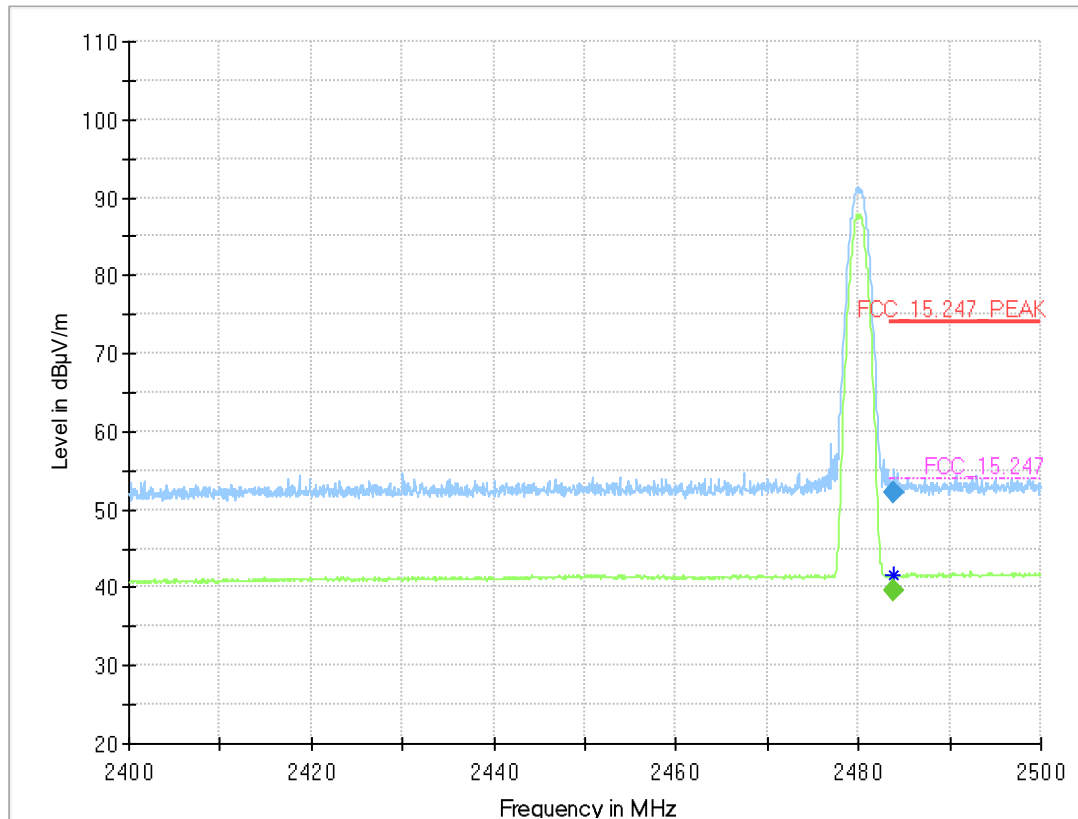
Chip02, Modulation= Bluetooth EDR 2, Operating Channel = 78, Band Edge = high
 (S01_BC03#S3.5)



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)
2483.688	---	37.3	54.00	16.68	1000.0	1000.000	150.0	H	-126.0	109.0	7.7
2483.688	53.1	---	74.00	20.86	1000.0	1000.000	150.0	H	-126.0	109.0	7.7

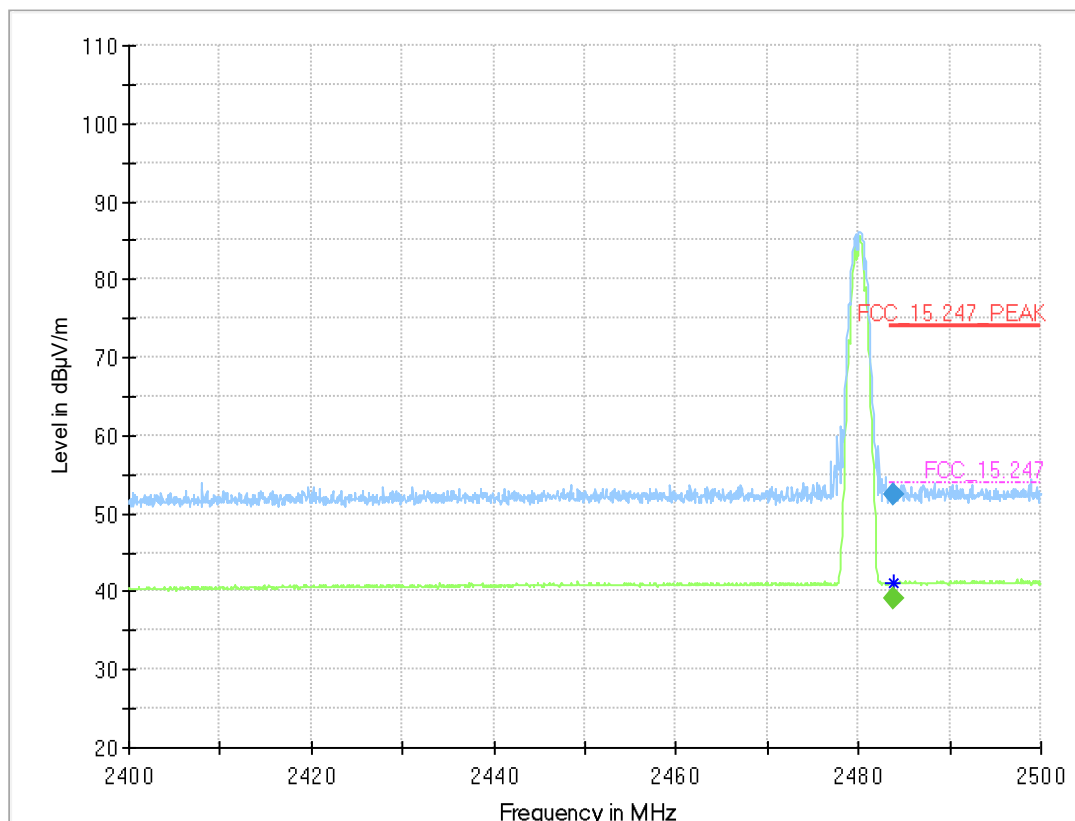
Chip02, Modulation= Bluetooth EDR 3, Operating Channel = 78, Band Edge = high
(S01_BC03#S3.5)



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)
2483.813	---	39.6	54.00	14.44	1000.0	1000.000	150.0	H	-8.0	2.0	8.0
2483.813	52.3	---	74.00	21.72	1000.0	1000.000	150.0	H	-8.0	2.0	8.0

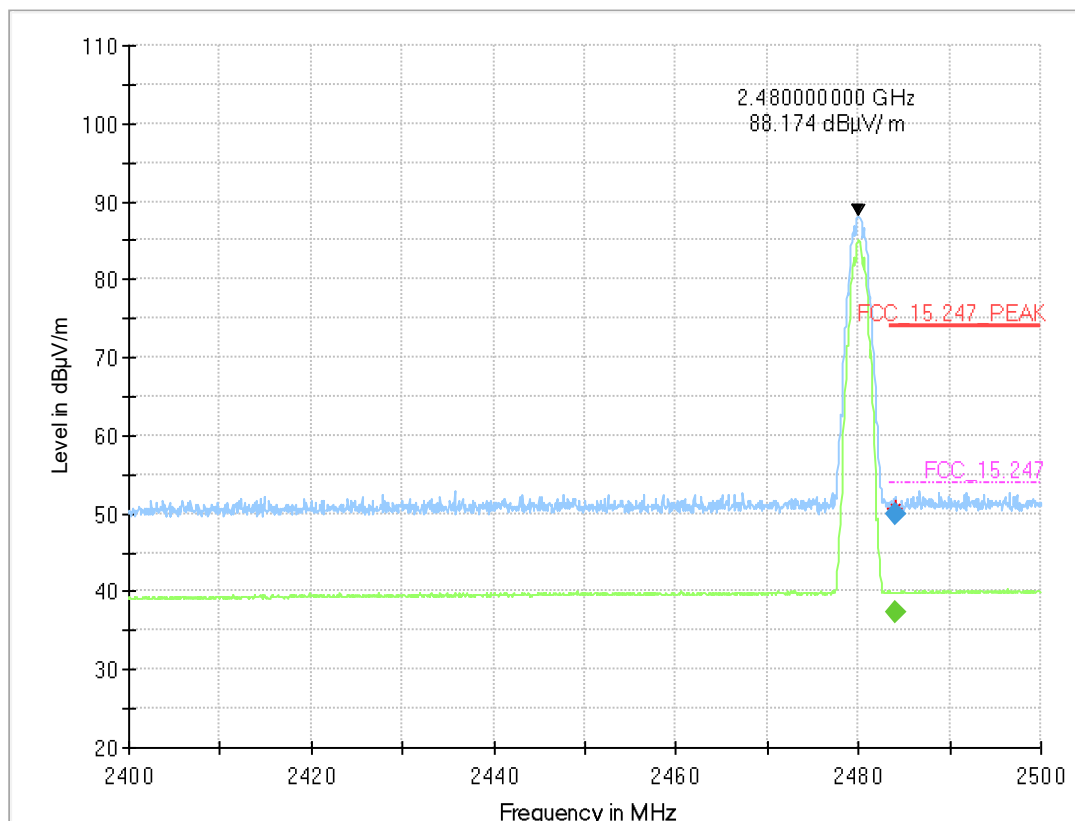
Chip01, Modulation= Bluetooth BR, Operating Channel = 78, Band Edge = high
(S01_BB03#S3.0)



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)
2483.750	---	39.1	54.00	14.88	1000.0	1000.000	150.0	H	111.0	92.0	7.7
2483.750	52.5	---	74.00	21.47	1000.0	1000.000	150.0	H	111.0	92.0	7.7

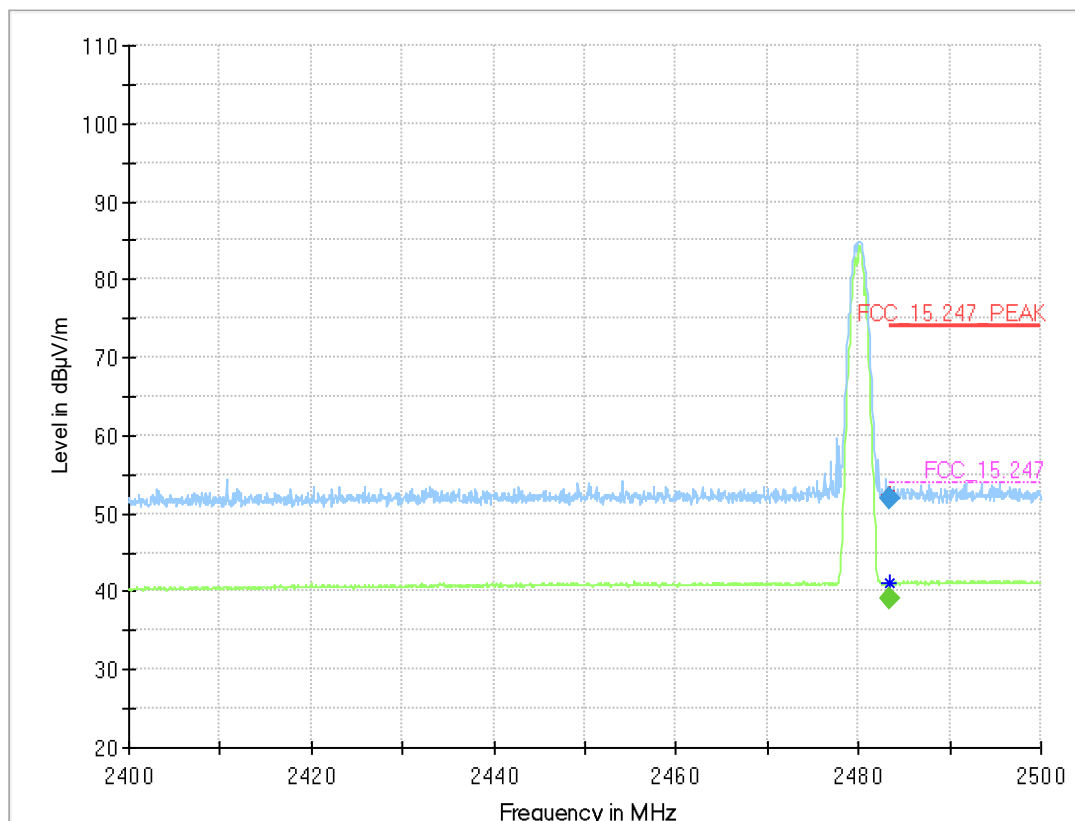
Chip01, Modulation= Bluetooth EDR 3, Operating Channel = 78, Band Edge = high
(S01_BB03#S3.0)



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)
2484.063	---	37.3	54.00	16.71	1000.0	1000.000	150.0	V	-19.0	105.0	7.7
2484.063	50.0	---	74.00	24.03	1000.0	1000.000	150.0	V	-19.0	105.0	7.7

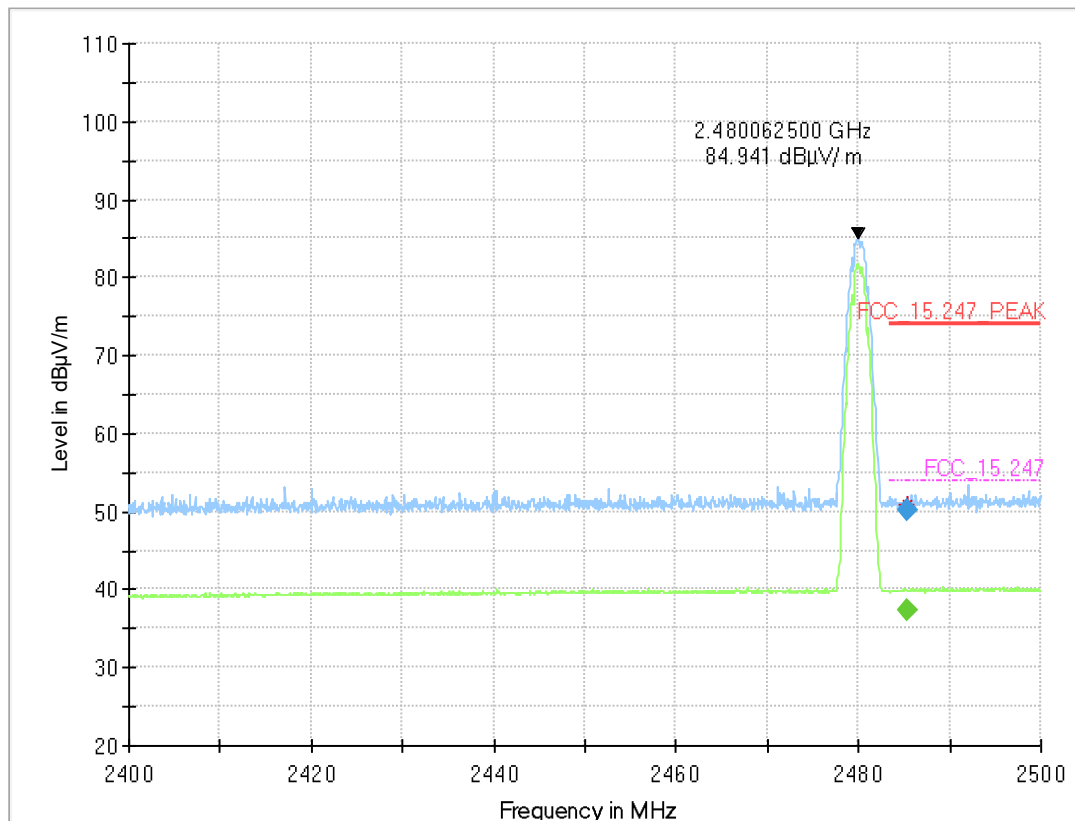
Chip02, Modulation= Bluetooth BR, Operating Channel = 78, Band Edge = high
(S01_BB03#S3.0)



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)
2483.500	---	39.1	54.00	14.91	1000.0	1000.000	150.0	V	41.0	4.0	7.6
2483.500	51.9	---	74.00	22.08	1000.0	1000.000	150.0	V	41.0	4.0	7.6

Chip02, Modulation= Bluetooth EDR 3, Operating Channel = 78, Band Edge = high
(S01_BB03#S3.0)



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)
2485.250	---	37.3	54.00	16.67	1000.0	1000.000	150.0	H	131.0	14.0	7.7
2485.250	50.1	---	74.00	23.86	1000.0	1000.000	150.0	H	131.0	14.0	7.7

5.3.5 TEST EQUIPMENT USED

- Radiated Emissions FAR 2.4 GHz FCC

6 TEST EQUIPMENT

6.1 TEST EQUIPMENT HARDWARE

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

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
1.2	SMB100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	107695	2024-07	2027-07
1.3	EX520	Digital Multimeter 12	Extech Instruments Corp	05157876	2024-12	2026-12
1.4	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2023-08	2025-08
1.5	Opus10 THI (8152.00N)	T/H Logger 01	Lufft Mess- und Regeltechnik GmbH	5809	2023-12	2025-12
1.6	Temperature Chamber VT 4002	Temperature Chamber Vötsch 03	Vötsch	58566002150010	2024-07	2026-07
1.7	FSW43	Signal Analyser	Rohde & Schwarz GmbH & Co. KG	102013	2023-07	2025-07
1.8	Opus10 THI (8152.00)	T/H Logger 14	Lufft Mess- und Regeltechnik GmbH	13993	2023-12	2025-12
1.9	HMP2020	Programmable Power Supply	Rohde & Schwarz GmbH & Co. KG	101992	N/A	N/A
1.10	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	259291	2023-01	2026-01
1.11	OSP120	Contains Power Meter and Switching Unit OSP-B157W8 PLUS	Rohde & Schwarz	101158	2024-08	2027-08
1.12	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100321	2023-10	2025-10
1.13	CBT	Bluetooth Tester	Rohde & Schwarz	100302	2024-09	2027-09

2 Radiated Emissions FAR 2.4 GHz FCC
Radiated emission tests for 2.4 GHz ISM devices in a fully anechoic room

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
2.2	Innco Systems CO3000	Controller for bore sight mast FAC	innco systems GmbH	CO3000/1460/54740522/P	N/A	N/A
2.3	AMF-7D00101800-30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq		N/A	N/A
2.4	Anechoic Chamber 03	FAR, 8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	N/A	N/A
2.5	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2023-08	2025-08
2.6	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785	N/A	N/A
2.7	FSW43	Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	103779	2024-12	2026-12
2.8	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
2.9	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronik GmbH	00083069	N/A	N/A
2.10	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright Instruments GmbH	09	N/A	N/A
2.11	MA3000/0800-XP-ET-compact	Bore Sight Antenna Mast	innco systems GmbH	9210522	N/A	N/A
2.12	TT 1.5 WI	Turn Table	Maturo GmbH	-	N/A	N/A
2.13	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008	N/A	N/A
2.14	Opus 20 THI (8120.00)	ThermoHygro Datalogger	Lufft Mess- und Regeltechnik GmbH	115.0318.0802.033	2023-08	2025-08
2.15	TD1.5-10kg	EUT Tilt Device (Rohacell)	Maturo GmbH	TD1.5-10kg/024/3790709	N/A	N/A
2.16	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324	N/A	N/A
2.17	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2024-10	2027-10
2.18	CBT	Bluetooth Tester	Rohde & Schwarz	100302	2024-09	2027-09

3 Radiated Emissions SAC H-Field
Radiated emission tests in the H-Field in a semi anechoic room

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515	N/A	N/A
3.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
3.3	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2024-03	2026-03
3.4	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia Germany EMC Solution GmbH	none	N/A	N/A
3.5	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2023-08	2025-08
3.6	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2023-12	2025-12
3.7	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
3.8	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99	N/A	N/A
3.9	HFH2-Z2	Loop Antenna + 3 Axis Tripod	Rohde & Schwarz GmbH & Co. KG	829324/006	2024-04	2027-04
3.10	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100321	2023-10	2025-10
3.11	CBT	Bluetooth Tester	Rohde & Schwarz	100302	2024-09	2027-09

4 Radiated Emissions SAC up to 1 GHz
Radiated emission tests up to 1 GHz in a semi anechoic room

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
4.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515	N/A	N/A
4.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
4.3	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2024-03	2026-03
4.4	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia Germany EMC Solution GmbH	none	N/A	N/A
4.5	HL 562 ULTRALOG	Biconical-log-per antenna (30 MHz - 3 GHz) with HL 562E biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003		
4.6	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2023-08	2025-08
4.7	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2023-12	2025-12
4.8	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
4.9	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99	N/A	N/A
4.10	HL562E ULTRALOG	Biconical-log-per Antenna (30 MHz - 6 GHz)	Rohde & Schwarz GmbH & Co. KG	102299	2024-07	2027-07
4.11	Chase CBL6111C + INMET 64671 18N-6dB	Hybrid Antenna with 6dB Attenuator		2624 Kartei-Nr E-003226/K1026	2023-03	2026-03
4.12	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100321	2023-10	2025-10
4.13	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/1192 0513	N/A	N/A
4.14	CBT	Bluetooth Tester	Rohde & Schwarz	100302	2024-09	2027-09

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

6.2 TEST EQUIPMENT SOFTWARE

Semi-Anechoic Chamber:	
Software	Version
EMC32 Measurement Software	10.60.10
INNCO Mast Controller	1.02.62
INNCO Mast Height	34.10
INNCO Mast Elevation	36.11
MATURO Controller	1.24
MATURO Mast	12.19
MATURO Turn-Table	30.10
Fully-Anechoic Chamber:	
Software	Version
EMC32 Measurement Software	10.60.10
MATURO Controller	1.30
MATURO Turn-Unit	11.10
MATURO Mast	12.10
MATURO Turntable	12.11
INNCO Controller	1.03.02
INNCO Mast Height	34.10
INNCO Mast Elevation	36.11
TS 8997	
WMS32 Measurement Software	11.60.00 (till 2024-03-19), 11.70.00 + Hotfix 01
Conducted AC Emissions:	
Software	Version
EMC32 Measurement Software	10.60.20

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 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

Frequency MHz	AF HFH- Z2) dB (1/m)	Corr. dB	cable loss 1 (inside chamber) dB	cable loss 2 (outside chamber) dB	cable loss 3 (switch unit) dB	cable loss 4 (to receiver) dB	distance corr. (-40 dB/ decade) dB	d _{Limit} (meas. distance (limit) m	d _{used} (meas. distance (used) 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

7.2 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

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

7.3 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.

7.4 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)

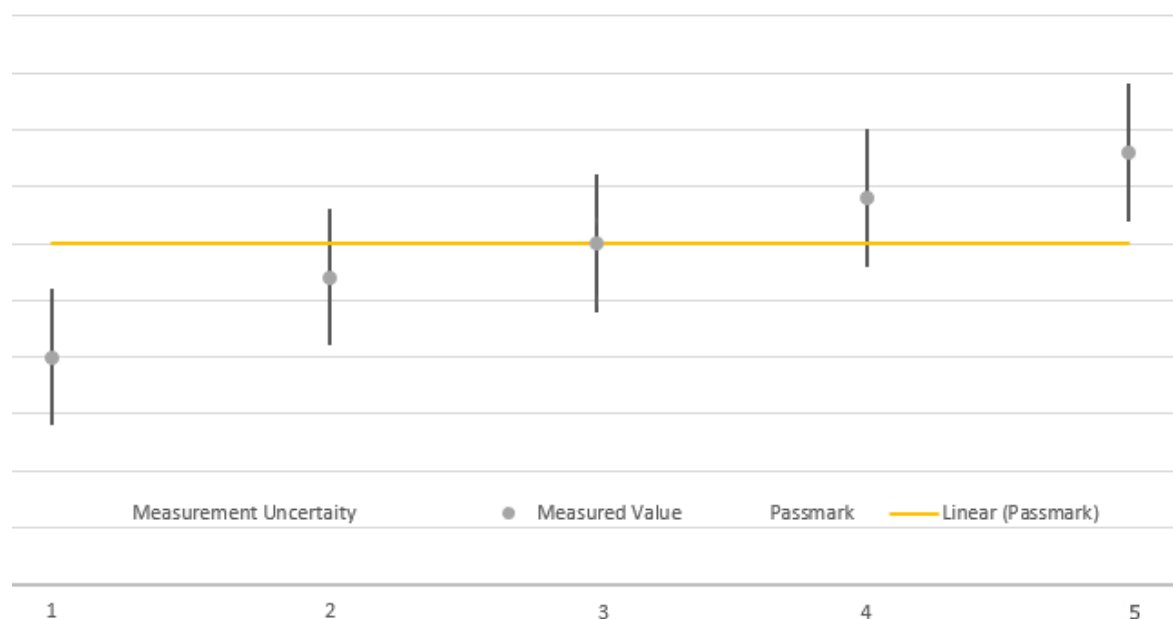
Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values.

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	on pass mark	within pass mark	Passed
4	above pass mark	within pass mark	Failed
5	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.

*****END OF TEST REPORT*****