FCC Measurement/Technical Report on

Host-based multiradio module with Wi-Fi, Bluetooth and NFC

EMMY-W161

in Bluetooth mode

FCC ID: XPYEMMYW161
IC: 8595A-EMMYW161

Test Report Reference: MDE_UBLOX_1551_FCCh_Rev_1

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

DAkkS Deutsche Akkreditierungsstelle D-PL-12140-01-01

Table of contens

1 Applied Standards and Test Summary

1.1 Applied Standards

Type of Authorization
Certification for an Intentional Radiator.

Applicable FCC Rules

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

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

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

Note 1:
The tests were selected and performed with reference to the FCC Public Notice "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, 558074 D01 DTS Meas Guidance v03r05, 2016-04-08".

Note 2:
ANSI C63.10–2013 is applied.

Note 3:
The EUT is classified in this test report as DTS-equipment.

Summary Test Results:

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

1.2 FCC-IC Correlation Table

Correlation of measurement requirements for DTS equipment from FCC and IC

DTS equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 4: 8.8
Occupied bandwidth	§ 15.247 (a) (2)	RSS-247 Issue 1: 5.2 (1)
Peak conducted output power	§ 15.247 (b) (3), (4)	RSS-247 Issue 1: 5.4 (4)
Transmitter spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen Issue 4: 6.13 / 8.9/8.10; RSS-247 Issue 1: 5.5
Transmitter spurious radiated emissions	§ 15.247 (d); § 15.209 (a)	RSS-Gen Issue 4: 6.13 / 8.9/8.10; RSS-247 Issue 1: 5.5
Band edge compliance	§ 15.247 (d)	RSS-247 Issue 1: 5.5
Power density	§ 15.247 (e)	RSS-247 Issue 1: 5.2 (2)
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 4: 8.3
Receiver spurious emissions	–	–

1.3 Measurement Summary / Signatures

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

Conducted Emissions at AC Mains

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

OP-Mode	Setup	FCC	IC
Operating mode			
worst case Remark: measured at lab power supply PeakTec	DE1015031 aa01	Passed	Passed

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

Occupied Bandwidth (6 dB)

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

OP-Mode	Setup	FCC	IC
Radio Technology, Operating Frequency			
Bluetooth BDR, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth BDR, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth BDR, mid Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, mid Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, mid Remark: -	DE1015031 ba01	Passed	Passed

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

Occupied Bandwidth (99%)

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

OP-Mode	Setup	FCC	IC
Bluetooth BDR, high Remark: -	DE1015031 ba01	N/A	Tested
Bluetooth BDR, low Remark: -	DE1015031 ba01	N/A	Tested
Bluetooth BDR, mid Remark: -	DE1015031 ba01	N/A	Tested
Bluetooth EDR 2, high Remark: -	DE1015031 ba01	N/A	Tested
Bluetooth EDR 2, low Remark: -	DE1015031 ba01	N/A	Tested
Bluetooth EDR 2, mid Remark: -	DE1015031 ba01	N/A	Tested
Bluetooth EDR 3, high Remark: -	DE1015031 ba01	N/A	Tested
Bluetooth EDR 3, low Remark: -	DE1015031 ba01	N/A	Tested
Bluetooth EDR 3, mid Remark: -	DE1015031 ba01	N/A	Tested

Remark: No applicable limit. Measurement results for information purpose.

47 CFR CHAPTER I FCC PART 15 Subpart C § 15.247 (b) (3) (4) §15.247

Peak Power Output

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

OP-Mode Radio Technology, Operating Frequency, Measurement method	Setup	FCC	IC
Bluetooth BDR, high, conducted Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth BDR, low, conducted Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth BDR, mid, conducted Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, high, conducted Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, low, conducted Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, mid, conducted Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, high, conducted Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, low, conducted Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, mid, conducted Remark: -	DE1015031 ba01	Passed	Passed

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

Spurious RF Conducted Emissions
The measurement was performed according to ANSI C63.10 **Final Result**

OP-Mode Radio Technology, Operating Frequency	Setup	FCC	IC
Bluetooth BDR, high Remark: noise floor	DE1015031 ba01	Passed	Passed
Bluetooth BDR, low Remark: noise floor	DE1015031 ba01	Passed	Passed
Bluetooth BDR, mid Remark: noise floor	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, high Remark: noise floor	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, low Remark: noise floor	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, mid Remark: noise floor	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, high Remark: noise floor	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, low Remark: noise floor	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, mid Remark: noise floor	DE1015031 ba01	Passed	Passed

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

Spurious RF Conducted Emissions in restricted bands
The measurement was performed according to ANSI C63.10 **Final Result**

OP-Mode Radio Technology, Operating Frequency, Measurement range	Setup	FCC	IC
Bluetooth BDR, high, 1 GHz - 26 GHz Remark: conducted measurements in restricted bands	DE1015031 bb01	Passed	Passed
Bluetooth BDR, high, 30 MHz - 1 GHz Remark: conducted measurements in restricted bands	DE1015031 bb01	Passed	Passed
Bluetooth BDR, low, 1 GHz - 26 GHz Remark: conducted measurements in restricted bands	DE1015031 bb01	Passed	Passed
Bluetooth BDR, low, 30 MHz - 1 GHz Remark: conducted measurements in restricted bands	DE1015031 bb01	Passed	Passed
Bluetooth BDR, mid, 1 GHz - 26 GHz Remark: conducted measurements in restricted bands	DE1015031 bb01	Passed	Passed
Bluetooth BDR, mid, 30 MHz - 1 GHz Remark: conducted measurements in restricted bands	DE1015031 bb01	Passed	Passed
Bluetooth EDR 2, high, 1 GHz - 8 GHz Remark: conducted measurements in restricted bands	DE1015031 bb01	Passed	Passed
Bluetooth EDR 2, low, 1 GHz - 8 GHz Remark: conducted measurements in restricted bands	DE1015031 bb01	Passed	Passed
Bluetooth EDR 2, mid, 1 GHz - 8 GHz Remark: conducted measurements in restricted bands	DE1015031 bb01	Passed	Passed

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

OP-Mode	**Setup**	**FCC**	**IC**
Radio Technology, Operating Frequency, Measurement range			
Bluetooth BDR, high, 1 GHz - 26 GHz Remark: noise floor	DE1015031 aa01	Passed	Passed
Bluetooth BDR, high, 30 MHz - 1 GHz Remark: noise floor	DE1015031 aa01	Passed	Passed
Bluetooth BDR, low, 1 GHz - 26 GHz Remark: noise floor	DE1015031 aa01	Passed	Passed
Bluetooth BDR, low, 30 MHz - 1 GHz Remark: noise floor	DE1015031 aa01	Passed	Passed
Bluetooth BDR, mid, 1 GHz - 26 GHz Remark: noise floor	DE1015031 aa01	Passed	Passed
Bluetooth BDR, mid, 30 MHz - 1 GHz Remark: noise floor	DE1015031 aa01	Passed	Passed
Bluetooth BDR, mid, 9 kHz - 30 MHz Remark: noise floor	DE1015031 aa01	Passed	Passed
Bluetooth EDR 2, high, 1 GHz - 8 GHz Remark: noise floor	DE1015031 aa01	Passed	Passed
Bluetooth EDR 2, low, 1 GHz - 8 GHz Remark: noise floor	DE1015031 aa01	Passed	Passed
Bluetooth EDR 2, mid, 1 GHz - 8 GHz Remark: noise floor	DE1015031 aa01	Passed	Passed

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

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

OP-Mode Radio Technology, Operating Frequency, Band Edge	Setup	FCC	IC
Bluetooth BDR, high, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth BDR, hopping, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth BDR, hopping, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth BDR, low, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, high, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, hopping, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, hopping, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, low, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, high, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, hopping, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, hopping, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, low, low Remark: -	DE1015031 ba01	Passed	Passed

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

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

OP-Mode Radio Technology, Operating Frequency, Band Edge	Setup	FCC	IC
Bluetooth BDR, high, high Remark: -	DE1015031 bb01	Passed	Passed
Bluetooth EDR 2, high, high Remark: -	DE1015031 bb01	Passed	Passed
Bluetooth EDR 3, high, high Remark: -	DE1015031 bb01	Passed	Passed

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

Band Edge Compliance Radiated

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

OP-Mode Radio Technology, Operating Frequency, Band Edge	Setup	FCC	IC
Bluetooth BDR, high, high Remark: -	DE1015031 aa01	Passed	Passed
Bluetooth EDR 2, high, high Remark: -	DE1015031 aa01	Passed	Passed
Bluetooth EDR 3, high, high Remark: -	DE1015031 aa01	Passed	Passed

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

Power Density

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

OP-Mode Radio Technology, Operating Frequency	Setup	FCC	IC
Bluetooth BDR, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth BDR, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth BDR, mid Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 2, mid Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, high Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, low Remark: -	DE1015031 ba01	Passed	Passed
Bluetooth EDR 3, mid Remark: -	DE1015031 ba01	Passed	Passed

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

Simultaneous Transmission - Spurious Radiated Emissions

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

OP-Mode Active Transmitters	Setup	FCC	IC
NFC + Bluetooth BDR + WLAN 5 GHz	DE1015031 ad01	Passed	Passed

Duty Cycle

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

OP-Mode Radio Technology, Operating Frequency	Setup	FCC	IC
Bluetooth BDR, low Remark: measured to calculate the duty cycle correction factor	DE1015031 bb01	Tested	Tested
Bluetooth EDR 2, low Remark: measured to calculate the duty cycle correction factor	DE1015031 bb01	Tested	Tested
Bluetooth EDR 3, low Remark: measured to calculate the duty cycle correction factor	DE1015031 bb01	Tested	Tested

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

(responsible for accreditation scope)
Mr. Andreas Petz

(responsible for testing and report)
Mr. Wolfgang Richter

1.4 Revision History

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2016-07-04	--	invalid
Rev_1	2016-08-08	3.1: EUT description changed for clarification from "test vehicle" to "evaluation board", 3.2: Sample ad01 added, 3.6: Duty cycle information added, 4.2.3: 6 dB Bandwidth values rounded also to one decimal digit for 2-DH1 and 3-DH1 4.6: Spurious RF Conducted Emissions re-measured from 30 MHz to 1 GHz with other test system and other setting to improve dynamic (lower noise floor) 4.12: Chapter Simultaneous Transmission added 4.13: Chapter Duty Cycle	valid

2 Administrative Data

2.1 Testing Laboratory

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

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

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

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

Laboratory accreditation no:	DAkkS D-PL-12140-01-01
Responsible for accreditation scope:	Mr. Marco Kullik
Report Template Version:	2016-05-12

2.2 Project Data

Responsible for testing and report:	Mr. Wolfgang Richter
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2016-07-08
Testing Period:	2015-12-16 to 2016-06-02

2.3 Applicant Data

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

2.4 Manufacturer Data

Company Name:	please see applicant data
Address:	
Contact Person:	

3 Test object Data

3.1 General EUT Description

Kind of Device product description	WLAN 2.4 GHz, 5 GHz, BT, NFC, SRD (5.8 GHz) - Single Antenna
Product name	Host-based multiradio module with Wi-Fi, Bluetooth and NFC
Type	EMMY-W161
Declared EUT data by the supplier	
Voltage Type	DC
Voltage Level	normal: 3,3 V DC low: 3,0 V DC high: 3,6 V DC
Tested Modulation Type	GFSK, pi/4-DQPSK, 8DPSK
General product description	EMMY-W161 and EMMY-W163 are ultra-compact multi-radio modules providing Wi-Fi, Classic Bluetooth, Bluetooth low energy and NFC mode of operation. It is designed for both simultaneous and independent operations of: • Wi-Fi IEEE 802.11ac and a/b/g/n • Dual-mode Bluetooth 4.2 • NFC
Specific product description for the EUT	EMMY-W161: Shielded module, single antenna pin for WLAN 802.11 ac/a/b/g/n and Bluetooth communication
The EUT provides the following ports:	- DC power supply - antenna port - signal ports
Tested modes	BDR, BT GFSK (1-DH1) BDR, BT GFSK (1-DH5) EDR 2, BT pi/4 DQPSK (2-DH1) EDR 3, BT 8-DPSK (3-DH1)

3.2 EUT Main components

Sample Name	Sample Code	Description
DE1015031aa01	aa01	Radiated Sample "#1"
Sample Parameter	**Value**	
Integral Antenna	Antenna on evaluation board (target platform): Antenova, Type A10194, SMD chip antenna, 1.8 dBi Peak gain in 2.4 GHz band, 4.1 dBi Peak gain in 5 GHz band	
Serial No.	-	
HW Version	03	
SW Version	N/A	
Comment	-	

Sample Name	Sample Code	Description
DE1015031ad01	ad01	Radiated Sample "#1c"
Sample Parameter	**Value**	
Antenna	Antenna on evaluation board (target platform): Antenova, Type A10194, SMD chip antenna, 1.8 dBi Peak gain in 2.4 GHz band, 4.1 dBi Peak gain in 5 GHz band	
Serial No.	-	
HW Version	03	
SW Version	N/A	
Comment	-	

Sample Name	Sample Code	Description
DE1015031ba01	ba01	Conducted Sample "#2"

Sample Parameter	Value
Antenna	Antenna connector on evaluation board (target platform): The following antennas are designated for 2.4 and 5 GHz WLAN transmission on EMMY-W161, as well as Bluetooth on EMMY-W161. - Table 2 of Test Object Specification:

				Peak gain [dBi]	
#	Manufacturer	Part number	Antenna type	2.4 GHz band	5 GHz band
W1	Antenova	A10194 [1]	SMD chip antenna 10x10x0.9 [mm]	1.8	4.1
W2	Linx	ANT-DB1-RAF-RPS [4]	Dual-band dipole antenna	2.5	**4.6**
W3	Taoglas	GW.40.2153	Dual-band dipole antenna	**3.74**	2.5
W4	Taoglas	GW.59.3153 [5]	Dual-band dipole antenna	2.37	2.93
W5	Walsin	RFDPA870900SBLB8G1	Dual-band dipole antenna	2	3
W6	Linx	ANT-2.4-CW-RCT-RP [3]	Single-band dipole antenna	2.2	N/A
W7	Delock	88395 [6]	Dual-band dipole antenna	1.5	2.1

Serial No.	-
HW Version	03
SW Version	N/A
Comment	-

Sample Name	Sample Code	Description
DE1015031bb01	bb01	Conducted Sample "#2a"

Sample Parameter	Value
Antenna	Antenna connector on evaluation board (target platform): The following antennas are designated for 2.4 and 5 GHz WLAN transmission on EMMY-W161, as well as Bluetooth on EMMY-W161. - Table 2 of Test Object Specification:

				Peak gain [dBi]	
#	Manufacturer	Part number	Antenna type	2.4 GHz band	5 GHz band
W1	Antenova	A10194 [1]	SMD chip antenna 10x10x0.9 [mm]	1.8	4.1
W2	Linx	ANT-DB1-RAF-RPS [4]	Dual-band dipole antenna	2.5	**4.6**
W3	Taoglas	GW.40.2153	Dual-band dipole antenna	**3.74**	2.5
W4	Taoglas	GW.59.3153 [5]	Dual-band dipole antenna	2.37	2.93
W5	Walsin	RFDPA870900SBLB8G1	Dual-band dipole antenna	2	3
W6	Linx	ANT-2.4-CW-RCT-RP [3]	Single-band dipole antenna	2.2	N/A
W7	Delock	88395 [6]	Dual-band dipole antenna	1.5	2.1

Serial No.	-
HW Version	03
SW Version	N/A
Comment	-

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

3.3 Ancillary Equipment

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

Device	Details (Manufacturer, Type Model, OUT Code)	Description
target platform	u-blox , 03, -, -	u-blox EVB-W16

3.4 Auxiliary Equipment

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

Device	Details (Manufacturer, HW, SW, S/N)	Description
AC/DC power supply (115 V 60 Hz)	PeakTech, -, -, 081062045	PeakTech 6005D

3.5 EUT Setups

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

Setup	Combination of EUTs	Description and Rationale
DE1015031aa01	DE1015031aa01, target platform, AC/DC power supply	Setup for radiated measurement
DE1015031ad01	DE1015031ad01, target platform, AC/DC power supply	Setup for radiated measurement
DE1015031ba01	DE1015031ba01, target platform, AC/DC power supply	Setup for conducted measurement
DE1015031bb01	DE1015031bb01, target platform, AC/DC power supply	Setup for conducted measurement

3.6 Operating Modes

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

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

Bluetooth Power Class 1

Duty Cycle = 33,88 %

3.7 Product labelling

3.7.1 FCC ID label

Please refer to the documentation of the applicant.

3.7.2 Location of the label on the EUT

Please refer to the documentation of the applicant.

4 Test Results

4.1 Conducted Emissions at AC Mains

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.1.1Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.10.
The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50µH || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.

The measurement procedure consists of two steps. It is implemented into the EMI test software EMC-32 from R&S.

Step 1: Preliminary scan
Intention of this step is, to determine the conducted EMI-profile of the EUT.
EMI receiver settings:
- Detector: Peak – Maxhold & Average
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 2.5 kHz
- IF–Bandwidth: 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)
- Measurement on phase + neutral lines of the power cords

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

Step 2: Final measurement
Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies identified in step 1.
EMI receiver settings:
- Detector: Quasi-Peak
- IF Bandwidth: 9 kHz
- Measuring time: 1 s / frequency

At each frequency determined in step 1, four measurements are performed in the following combinations:
1) Neutral lead - reference ground (PE grounded)
2) Phase lead - reference ground (PE grounded)
3) Neutral lead - reference ground (PE floating)
4) Phase lead - reference ground (PE floating)

The highest value is reported.

4.1.2Test Requirements / Limits

FCC Part 15, Subpart C, §15.207

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

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

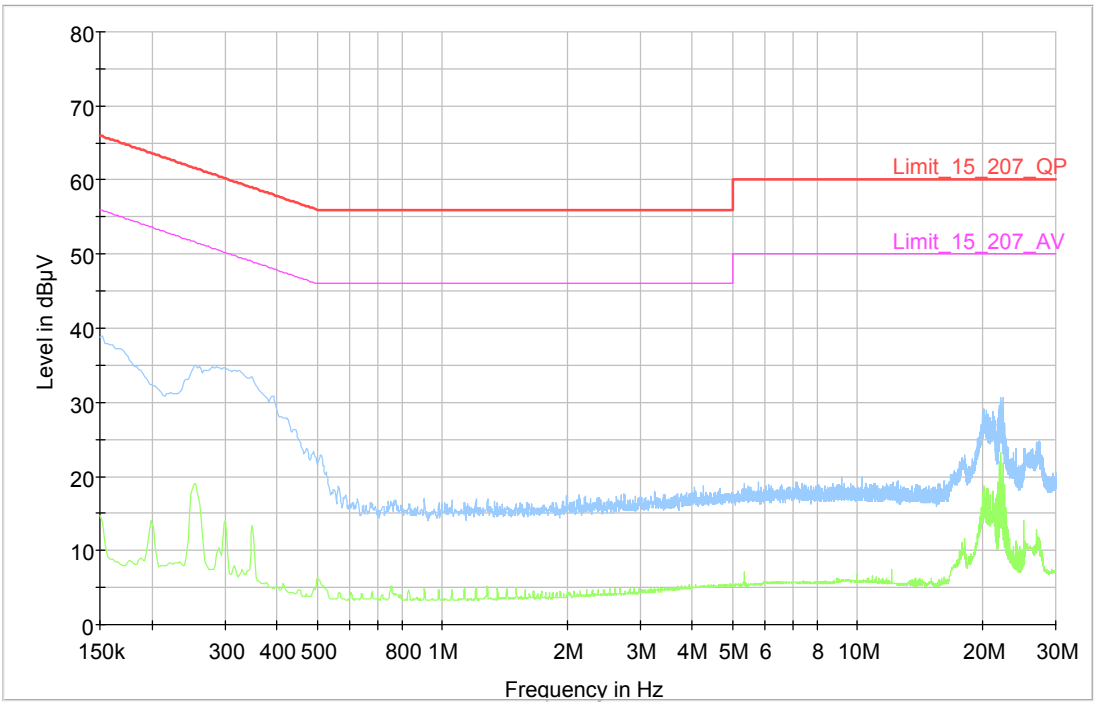
4.1.3Test Protocol

Temperature: 24 °C
Air Pressure: 992 hPa
Humidity: 34 %

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

Remark: Measured at 120 V 60 Hz input of lab power supply, BT BDR, CH39, WLAN 5 GHz CH149

4.1.4Measurement Plot (showing the highest value, “worst case”)



4.1.5Test Equipment used

Conducted Emissions

4.2 Occupied Bandwidth (6 dB)

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.2.1 Test Description

The Equipment Under Test (EUT) was set up to perform the occupied bandwidth measurements.
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.
The results recorded were measured with the modulation which produces the worst-case (smallest) emission bandwidth.

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

Analyzer settings:

- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Span: 3 MHz
- Trace: Maxhold
- Sweeps: 2000
- Sweep time: 5 ms (auto coupled)
- Detector: Peak

4.2.2 Test Requirements / Limits

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

4.2.3Test Protocol

Ambient temperature: 23°C
Air Pressure: 1017 hPa
Humidity: 41%

BT GFSK (1-DH1)

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [kHz]	Limit [kHz]	Margin to Limit [kHz]
2.4 GHz ISM	0	2402,0	511,0	500,0	**11,0**
	39	2441,0	511,0	500,0	11,0
	78	2480,0	517,0	500,0	17,0

BT π/4 DQPSK (2-DH1)

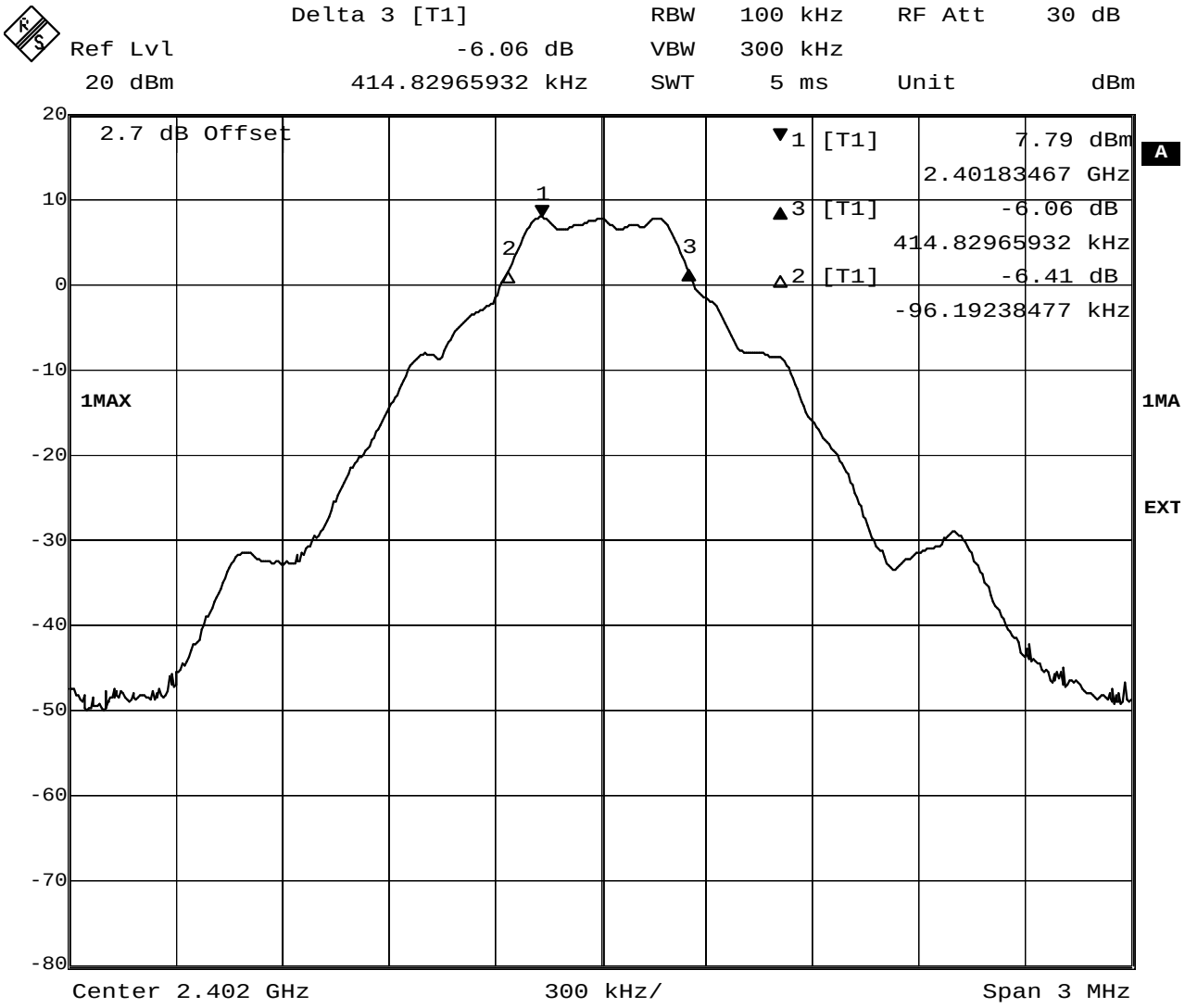
Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [kHz]	Limit [kHz]	Margin to Limit [kHz]
2.4 GHz ISM	0	2402,0	576,2	500,0	76,2
	39	2441,0	576,2	500,0	76,2
	78	2480,0	576,2	500,0	76,2

BT 8-DPSK (3-DH1)

Band	Channel No.	Frequency [MHz]	6 dB Bandwidth [kHz]	Limit [kHz]	Margin to Limit [kHz]
2.4 GHz ISM	0	2402,0	576,2	500,0	76,2
	39	2441,0	576,2	500,0	76,2
	78	2480,0	576,2	500,0	76,2

Remark: -

4.2.4Measurement Plot (showing the lowest value, “worst case”)



Date: 20.MAY.2016 13:01:34

BT GFSK (1-DH1), Channel 0

4.2.5Test Equipment used

Regulatory Bluetooth RF Test Solution

4.3 Occupied Bandwidth (99%)

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.3.1Test Description

The Equipment Under Test (EUT) was set up to perform the occupied bandwidth measurements.
The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.
The EUT was connected to spectrum analyzer via a short coax cable with a known loss.
Analyzer settings:

- Resolution Bandwidth (RBW): 30 kHz
- Video Bandwidth (VBW): 100 kHz
- Span: 3 MHz
- Trace: Maxhold
- Sweeps: 2000
- Sweep time: 8,5 ms
- Detector: Sample

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

4.3.2Test Requirements / Limits

No applicable limit. Measurement results for information purpose.

4.3.3Test Protocol

Ambient temperature: 23°C
Air Pressure: 1017 hPa
Humidity: 41%

BT GFSK (1-DH1)

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [kHz]
2.4 GHz ISM	0	2402,0	872,6
	39	2441,0	864,0
	78	2480,0	881,3

BT pi/4 DQPSK (2-DH1)

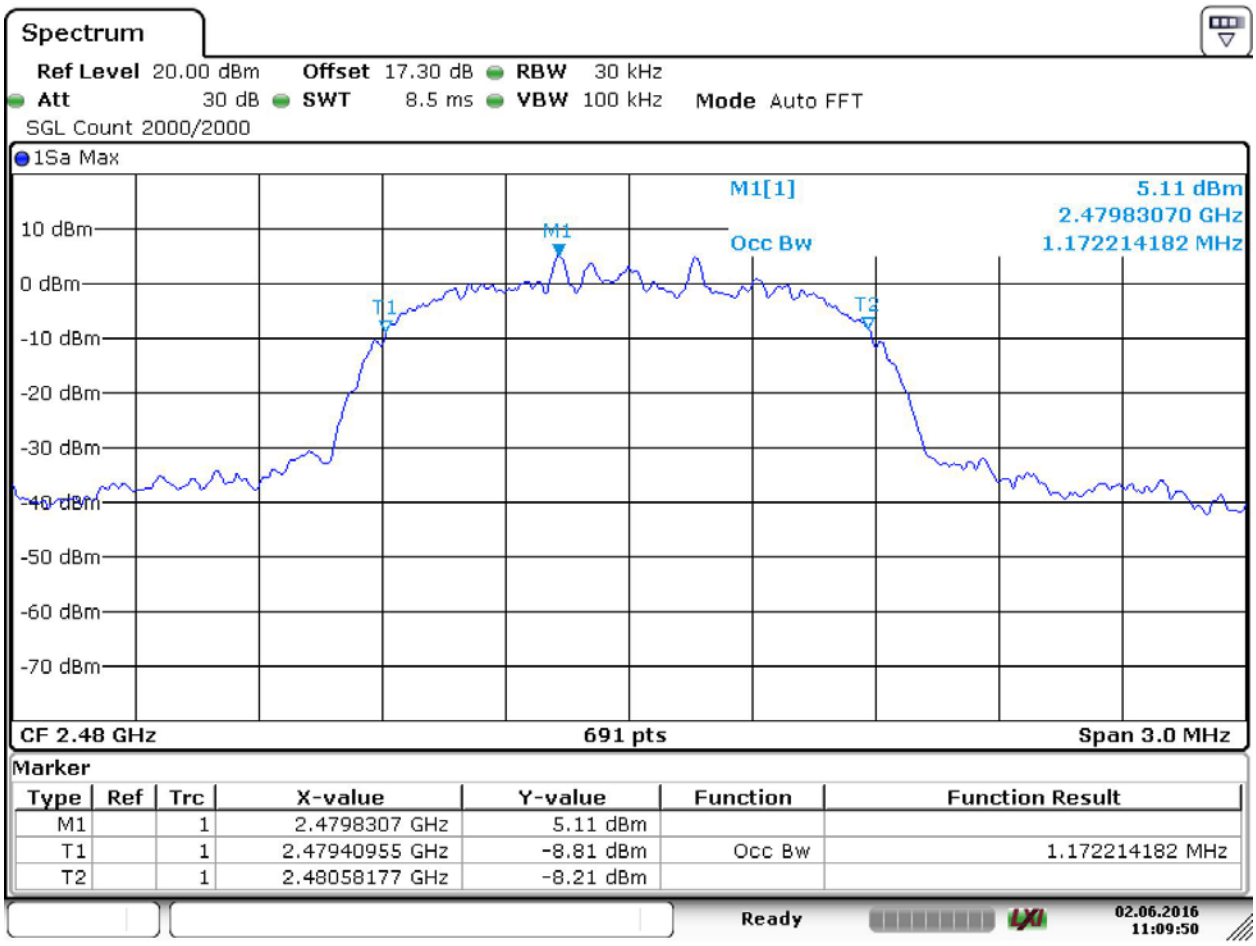
Band	Channel No.	Frequency [MHz]	99 % Bandwidth [kHz]
2.4 GHz ISM	0	2402,0	1150,5
	39	2441,0	1141,8
	78	2480,0	1167,9

BT 8-DPSK (3-DH1)

Band	Channel No.	Frequency [MHz]	99 % Bandwidth [kHz]
2.4 GHz ISM	0	2402,0	1172,2
	39	2441,0	1167,8
	78	2480,0	**1172,2**

Remark: -

4.3.4Measurement Plot (showing the highest value)



Date: 2.JUN.2016 11:09:50

BT 8-DPSK (3-DH1), Channel 78

4.3.5Test Equipment used

R&S TS8997

4.4 Peak Power Output

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.4.1 Test Description

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

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

Analyzer settings:

- Resolution Bandwidth (RBW): 3 MHz
- Video Bandwidth (VBW): 3 MHz
- Trace: Maxhold
- Sweeps: 2000
- Sweep time: 5 ms (auto coupled)
- Detector: Peak

4.4.2 Test Requirements / Limits

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

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

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

4.4.3Test Protocol

Ambient temperature: 23°C
Air Pressure: 1017 hPa
Humidity: 41 %

BT GFSK (1-DH1)

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]
2.4 GHz ISM	0	2402,0	**9,4**	30,0	20,6
	39	2441,0	9,3	30,0	20,7
	78	2480,0	8,9	30,0	21,1

BT pi/4 DQPSK (2-DH1)

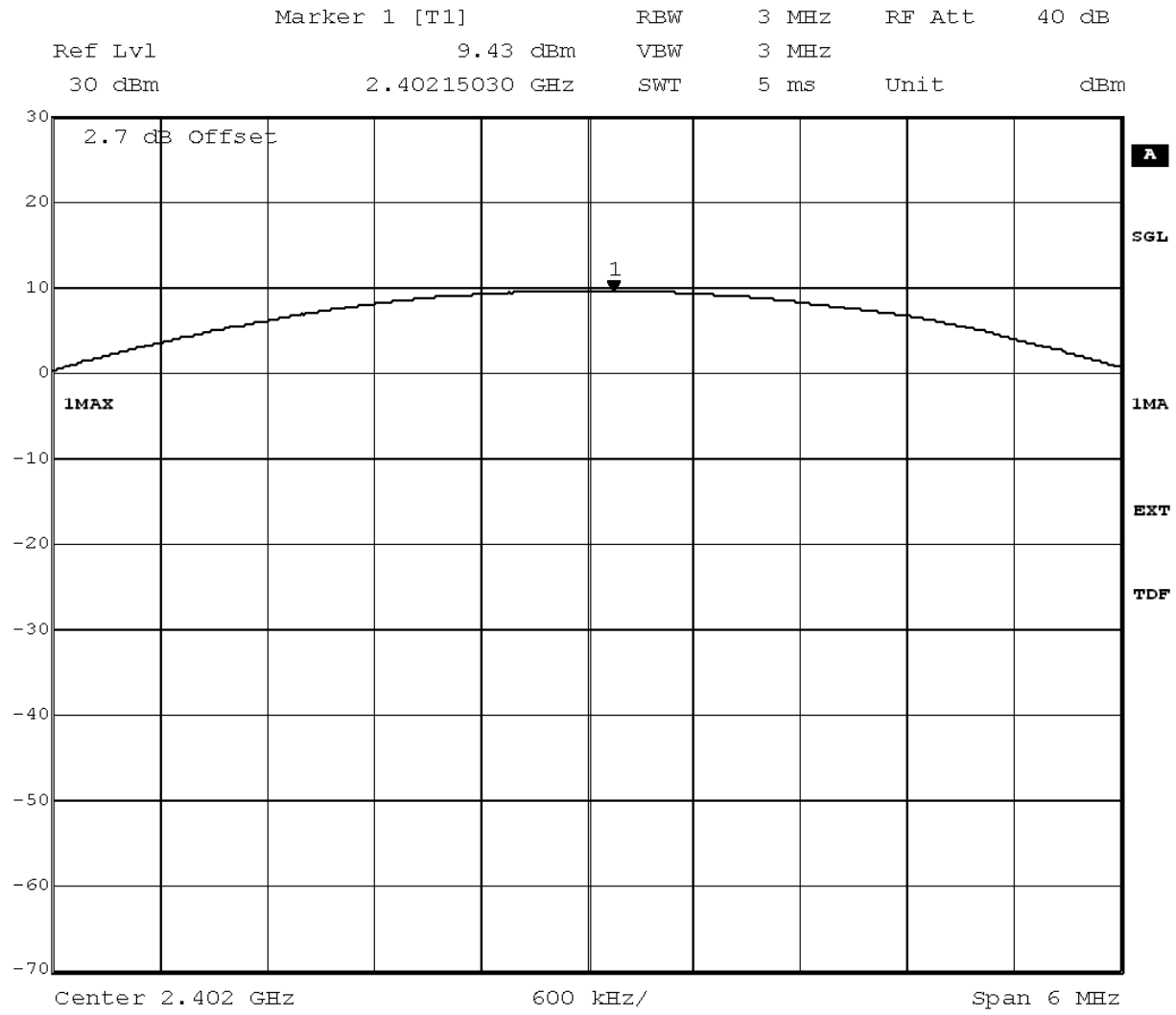
Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]
2.4 GHz ISM	0	2402,0	8,6	30,0	21,5
	39	2441,0	8,6	30,0	21,4
	78	2480,0	8,3	30,0	21,7

BT 8-DPSK (3-DH1)

Band	Channel No.	Frequency [MHz]	Peak Power [dBm]	Limit [dBm]	Margin to Limit [dB]
2.4 GHz ISM	0	2402,0	8,6	30,0	21,5
	39	2441,0	8,7	30,0	21,3
	78	2480,0	8,3	30,0	21,7

Remark: -

4.4.4Measurement Plot (showing the highest value, “worst case”)



Title: Peak outputpower Power
Comment A: CH B: 2402 MHz
Date: 16.DEC.2015 09:48:21

4.4.5Test Equipment used

REGULATORY BLUETOOTH RF TEST SOLUTION

4.5 Spurious RF Conducted Emissions

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.5.1 Test Description

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

- Frequency range: 30 – 25000 MHz
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Trace: Maxhold
- Sweeps: 2
- Sweep Time: 330 s
- Detector: Peak

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

4.5.2 Test Requirements / Limits

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

4.5.3Test Protocol

Ambient temperature: 23 °C
Air Pressure: 1002 hPa
Humidity: 39 %

BT GFSK (1-DH1)

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	2402.0	-	-	PEAK	100.0	9.3	-10.7	> 20
39	2441.0	-	-	PEAK	100.0	9.3	-10.7	> 20
78	2480.0	-	-	PEAK	100.0	8.7	-11.3	> 20

BT pi/4 DQPSK (2-DH1)

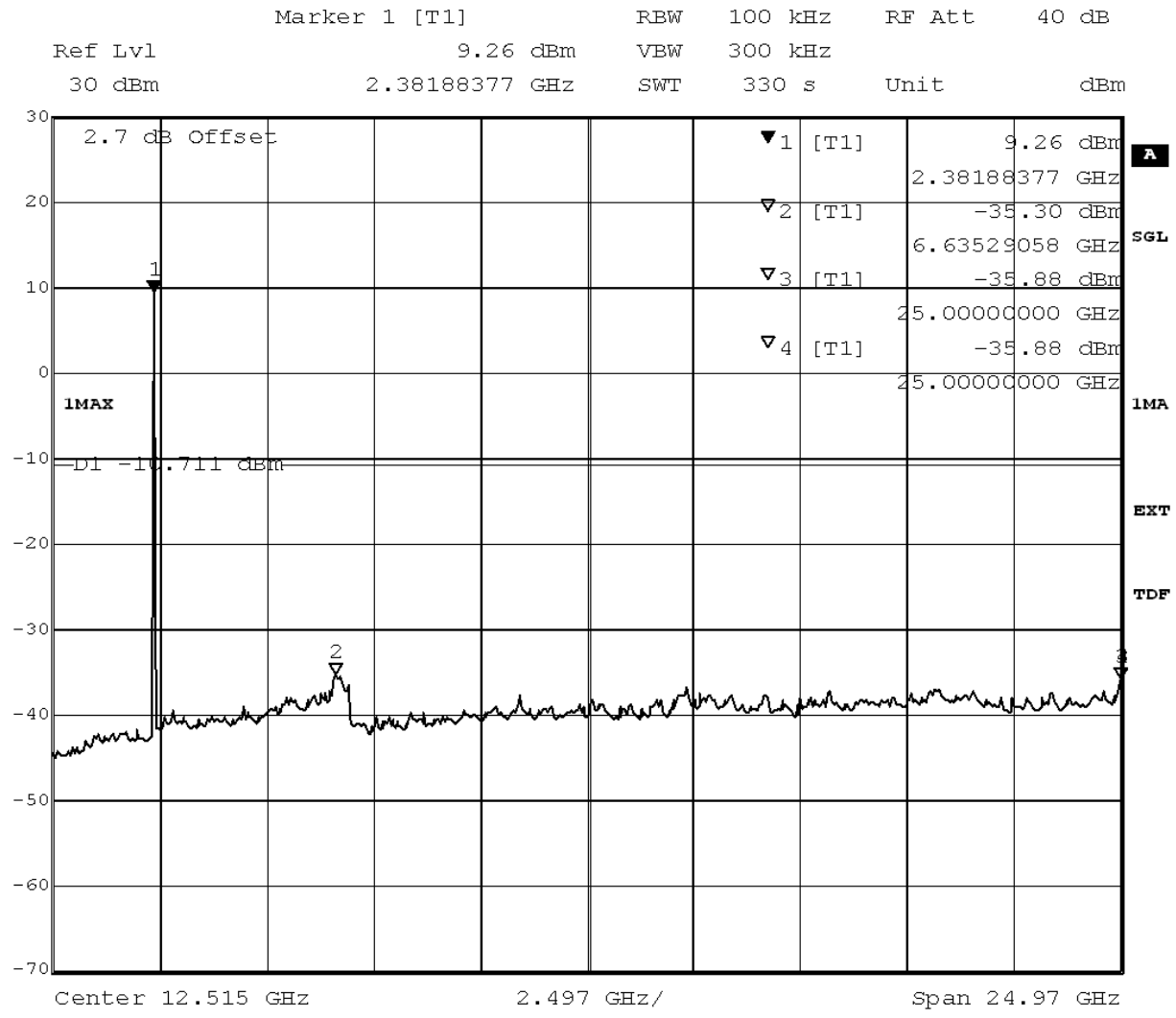
Channel No	Channel Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402,0	-	-	PEAK	100,0	6,4	-13,6	> 20
39	2441,0	-	-	PEAK	100,0	6,5	-13,5	> 20
78	2480,0	-	-	PEAK	100,0	6,2	-13,8	> 20

BT 8-DPSK (3-DH1)

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	2402,0	-	-	PEAK	100,0	6,2	-13,8	> 20
39	2441,0	-	-	PEAK	100,0	6,2	-13,8	> 20
78	2480,0	-	-	PEAK	100,0	6,2	-13,8	> 20

Remark: -

4.5.4Measurement Plot (showing the highest value, “worst case”)



Title: spurious emissions
Comment A: CH B: 2402 MHz
Date: 16.DEC.2015 10:01:04

4.5.5Test Equipment used

REGULATORY BLUETOOTH RF TEST SOLUTION

4.6 Spurious RF Conducted Emissions in Restricted Bands

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.6.1 Test Description

The Equipment Under Test (EUT) was set up to perform the conducted spurious emissions measurements. The antenna port of the EUT was connected to spectrum analyzer via a short coax cable with a known cable loss C_L. The measured voltage U_{meas} at the 50 Ohm input of the analyser was used to calculate the EUT output power at the antenna port:

$P = U_{meas} + C_L - 107$

where
P is the output power in dBm
U_{meas} is the measured voltage at the 50 Ohm input of the analyzer in dBµV
C_L is the cable loss of the used cable.

The maximum transmit isotropically antenna gain G_i (in dBi) was added to the measured output power P to determine the equivalent isotropically radiated power EIRP.

$EIRP = P + Gi$

where
P is the output power in dBm
G_i is maximum transmit antenna gain in dBi.

The resultant EIRP level was converted to an equivalent electric filed strength using the following relationship:

$E = EIRP - 20 \log d + 104.8$

where
E is the electric field strength in dBµV/m
EIRP is the equivalent isotropically radiated power in dBm
d is the specified measurement distance in m.

The appropriate maximum ground reflection factor was added to the EIRP:
6 dB for frequencies ≤ 30 MHz;
4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive; and
0 dB for frequencies > 1000 MHz).

Frequency range [MHz]	measurement distance d [m]	-20 log d [dB]	ground reflection factor [dB]
0,009 – 0,49	300	-49,54	6
0,49 – 30	30	-29,54	6
30 – 1000	3	-9,54	4,7
>1000	3	-9,54	0

1. Measurement up to 30 MHz

Step 1: pre measurement

This is a preliminary test to identify the highest amplitudes relative to the limit.

- Detector: Peak-Maxhold/ Quasipeak (FFT-based)
- 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 EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: final measurement

EMI receiver settings:

- Detector: Peak / Average / Quasi-Peak (depending on frequency)
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 0.2 - 10 kHz (depending on frequency)
- Measuring time / Frequency step: 1 s

2. Measurement above 30 MHz and up to 1 GHz

Step 1: pre measurement

This is a preliminary test to identify the highest amplitudes relative to the limit.

Settings:

- 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

Step 2: final measurement

EMI receiver settings:

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

3. Measurement above 1 GHz

Step 1: pre measurement

Ssettings:

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

Step 2: final measurement

Spectrum analyzer settings:

- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz
- Measuring time: 1 s

4.6.2Test 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

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

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

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

4.6.3Test Protocol

Ambient temperature: 21–25 °C
Air Pressure: 1002–1020 hPa
Humidity: 38–45 %
BT GFSK (1-DH1)

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	2402,0	-	noise	- - -	-	-	> 10	RB
39	2441,0	-	noise	- - -	-	-	> 14	RB
78	2480,0	2483,670500	42,5	AV	1000	54,0	11,5	BE

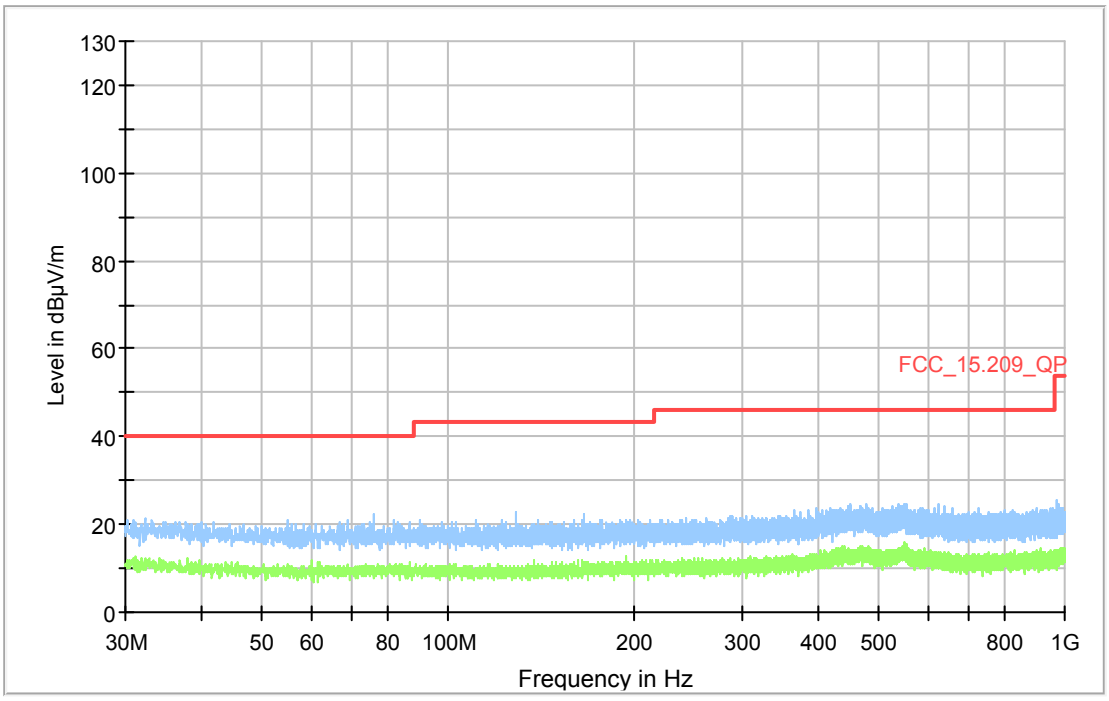
BT pi/4 DQPSK (2-DH1)

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	2402,0	-	noise	- - -	-	-	> 10	RB
39	2441,0	-	noise	- - -	-	-	> 14	RB
78	2480,0	2483,5	42,3	AV	1000	54,0	11,7	BE

Remark:
Duty cycle = 30,88 %, applied duty cycle correction for AV-Detector: 10,2 dB
No duty cycle correction used for AV-Detector for noise floor of test system.

4.6.4Measurement Plot (showing the highest value, “worst case”)

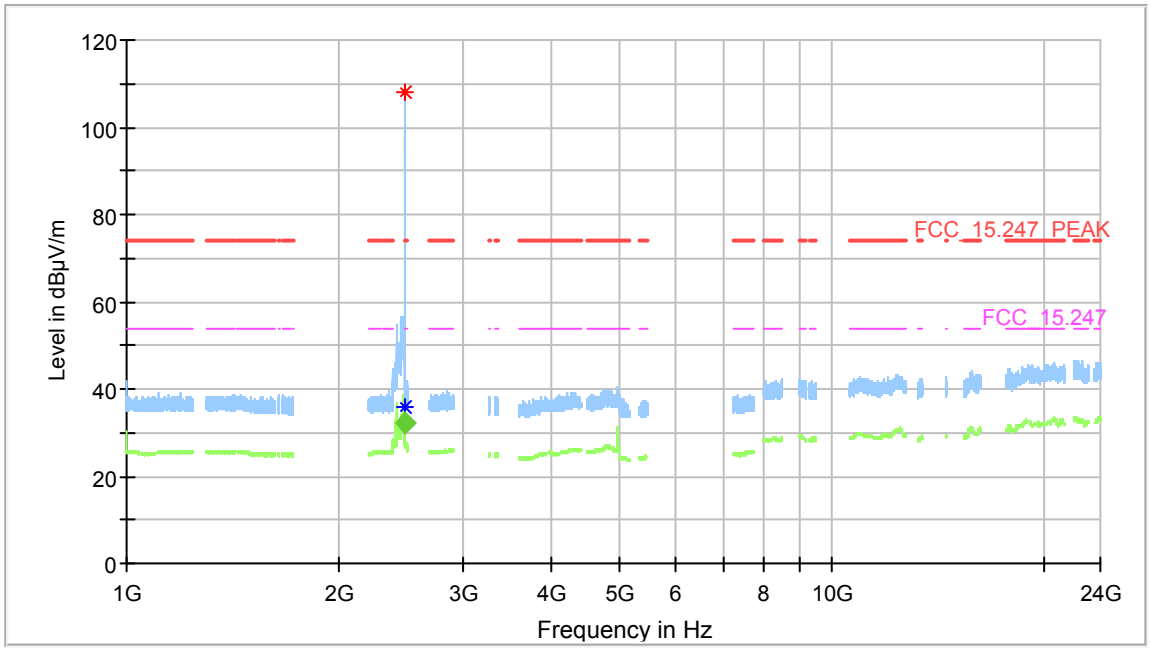
Operating Conditions: BT 1-DH1 CH78

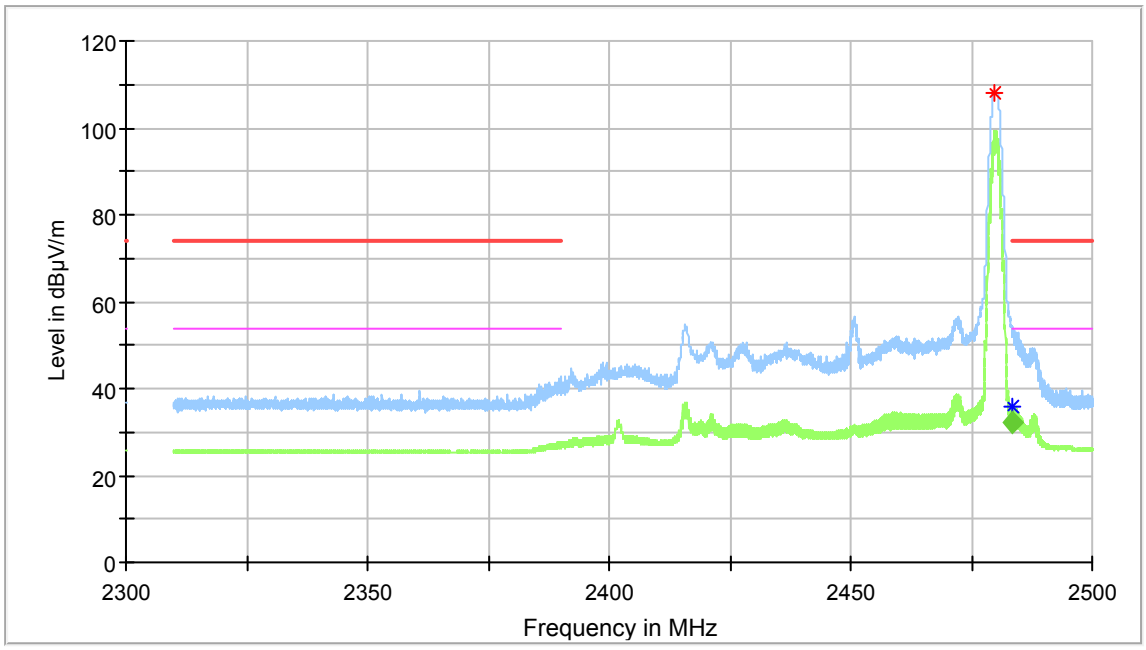


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Comment
-	-	-	-	-	-	-	Noise floor

Operating Conditions: BT 1-DH1 CH78





Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
2483.670500	---	32.34	54.00	21.66	1000.0	1000.000	-5.8

4.6.5Test Equipment used

Radiated Emissions

4.7 Transmitter Spurious Radiated Emissions

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.7.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

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

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

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

Step 2: final measurement
For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.
- Open area test side
- Antenna distance: according to the Standard
- Detector: Quasi-Peak
- Frequency range: 0.009 – 30 MHz
- Frequency steps: measurement at frequencies detected in step 1
- IF–Bandwidth: 0.2 - 10 kHz
- Measuring time / Frequency step: 1 s

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

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

Step 2: Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by ± 100 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

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

3. Measurement above 1 GHz
The following modifications apply to the measurement procedure for the frequency range above 1 GHz:
Step 1:
The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.
All steps were performed with one height (1.5 m) of the receiving antenna only.
The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.
The turn table step size (azimuth angle) for the preliminary measurement is 45 °.
Step 2:
Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.
The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°
EMI receiver settings (for all steps):
- Detector: Peak, Average
- IF Bandwidth = 1 MHz
Step 3:
Spectrum analyser settings for step 3:
- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz
- Measuring time: 1 s

4.7.2Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (d)
... In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

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

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

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

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

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

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

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

4.7.3Test Protocol

Ambient temperature: 21–25 °C
Air Pressure: 1002–1020 hPa
Humidity: 38–45 %
BT GFSK (1-DH1)

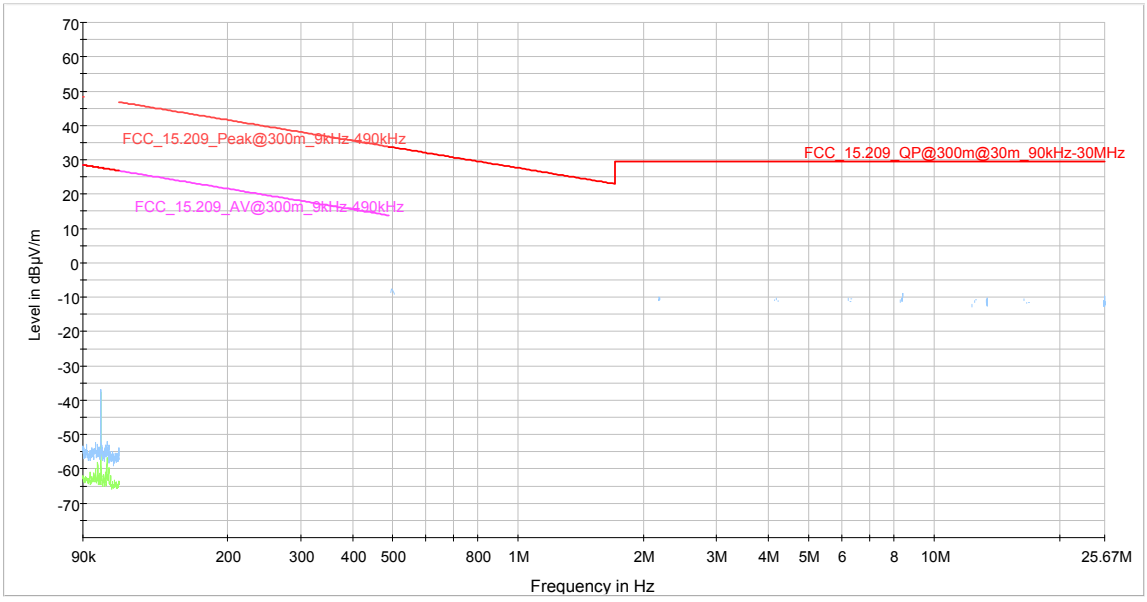
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
0	2402,0	-	noise	- - -	-	-	> 9	RB
39	2441,0	-	noise	- - -	-	-	> 9	RB
78	2480,0	-	noise	- - -	-	-	> 9	RB

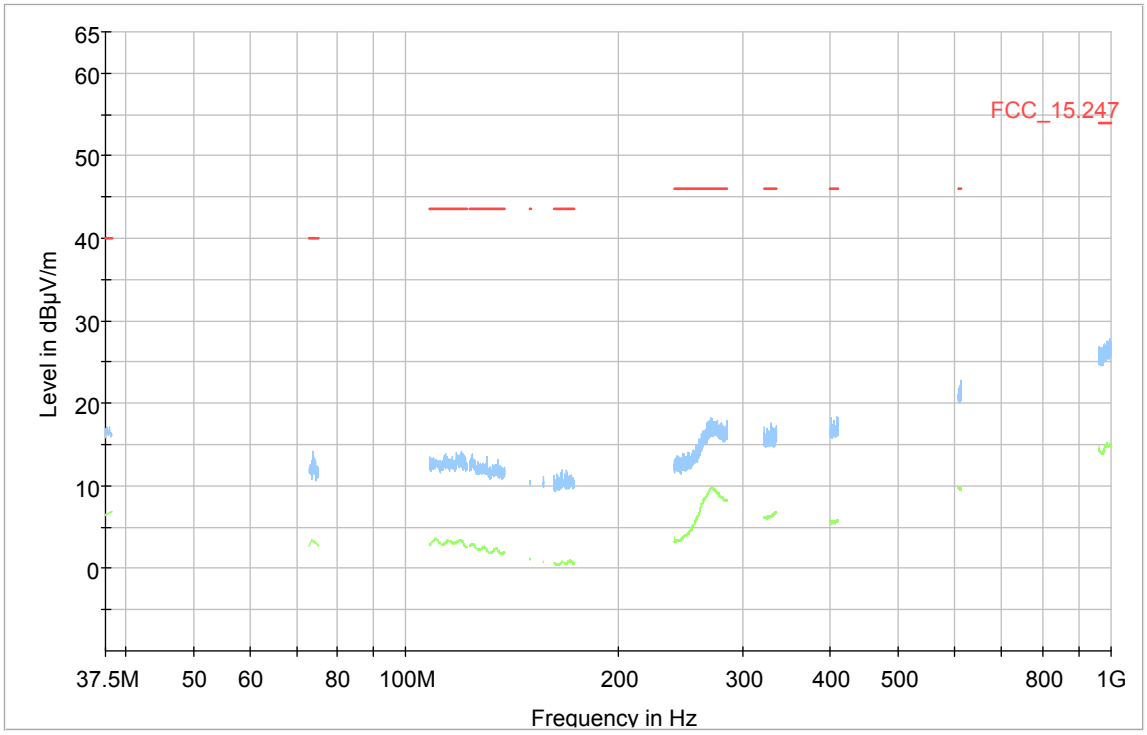
BT pi/4 DQPSK (2-DH1)

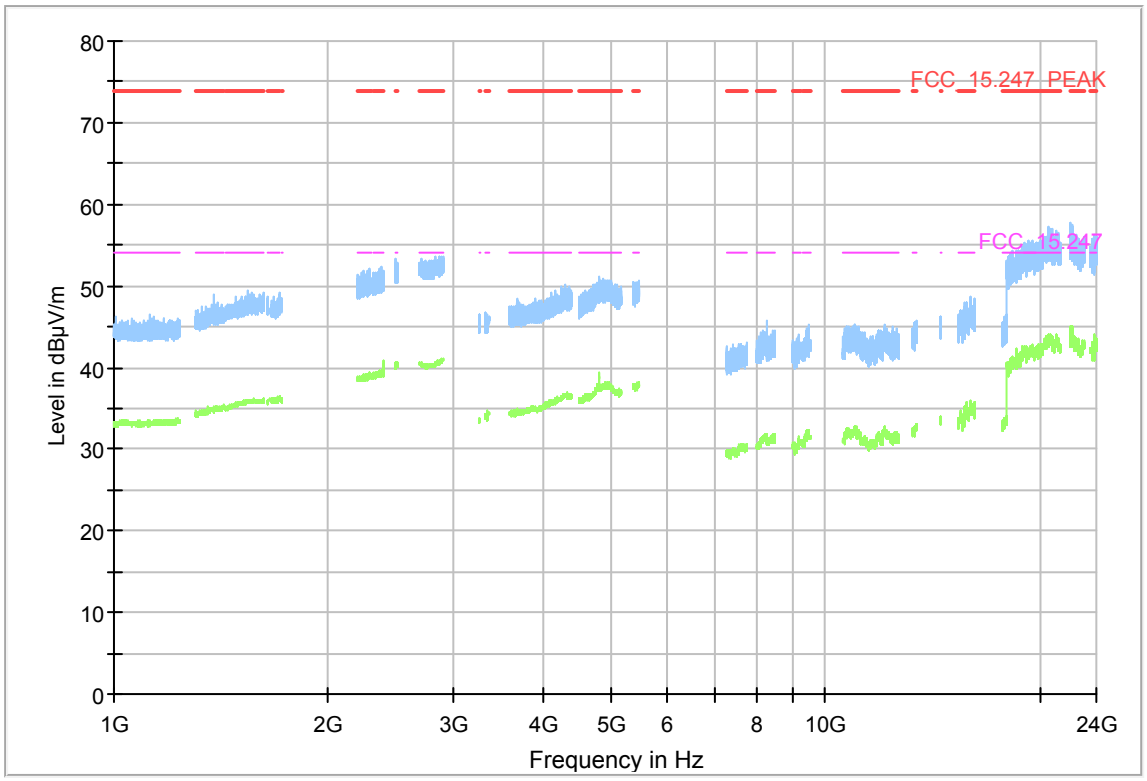
Ch. No.	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
0	2402,0	-	noise	- - -	-	-	> 9	RB
39	2441,0	-	noise	- - -	-	-	> 9	RB
78	2480,0	-	noise	- - -	-	-	> 9	RB

Remark: No duty cycle correction used for AV-Detector for noise floor of test system.

4.7.4Measurement Plot (showing the highest value, “worst case”)







4.7.5Test Equipment used

Radiated Emissions

4.8 Band Edge Compliance Conducted

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.8.1 Test Description

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

Analyzer settings:

- Frequency Range
  at 2,4 GHz band edge: Channel 0 = 2402 MHz + 1 MHz /- 5 MHz
  at 2,4835 GHz band edge: Channel 78 = 2480 MHz + 5 MHz /- 1 MHz
- Detector: Peak
- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Sweep time: 5 ms
- Sweeps: 2
- Trace: Maxhold

4.8.2 Test Requirements / Limits

FCC Part 15.247 (d)
"In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. ...
If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c))."

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

4.8.3Test Protocol

Ambient temperature: 23°C
Air Pressure: 1017 hPa
Humidity: 41 %

BT GFSK (1-DH1)

Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detec-tor	RBW [kHz]	Ref. Level [dBm]	Limit [dBµV/m]	Margin to Limit [dB]
0	2402,0	2400,0	-42,5	PEAK	100,0	9,3	-10,7	**31,8**
78	2480,0	2483,5	-55,8	PEAK	100,0	8,9	-11,1	44,7
hopping	hopping	2400,0	-49,9	PEAK	100,0	8,1	-11,9	38,0
hopping	hopping	2483,5	-51,9	PEAK	100,0	7,7	-12,3	39,6

BT pi/4 DQPSK (2-DH1)

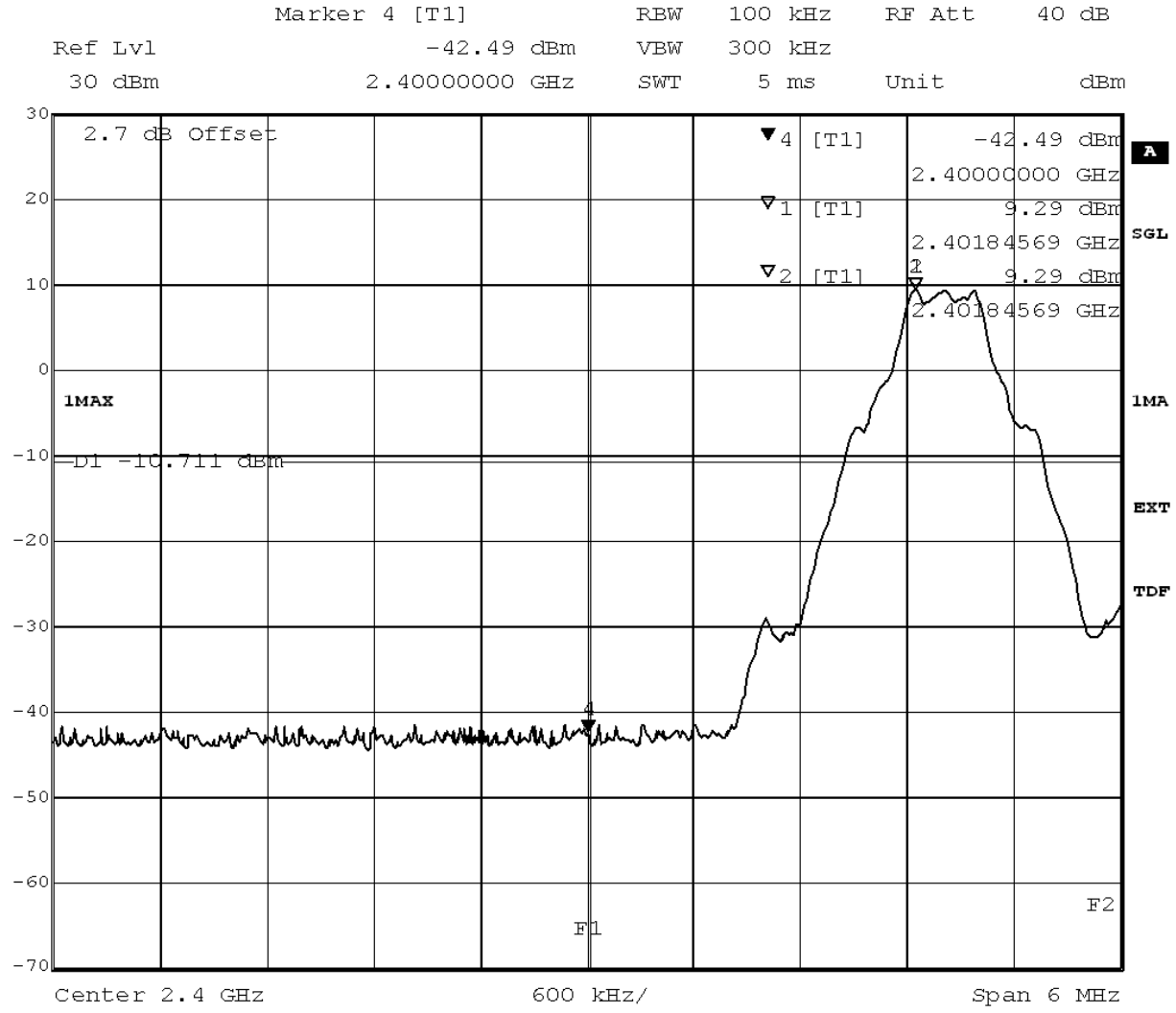
Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detec-tor	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402,0	2400,0	-49,9	PEAK	100,0	6,4	-13,6	36,2
78	2480,0	2483,5	-56,9	PEAK	100,0	6,2	-13,8	43,1
hopping	hopping	2400,0	-48,1	PEAK	100,0	5,3	-14,7	33,4
hopping	hopping	2483,5	-48,8	PEAK	100,0	4,5	-15,5	33,3

BT 8-DPSK (3-DH1)

Channel No.	Channel Center Frequency [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBm]	Detec-tor	RBW [kHz]	Ref. Level [dBm]	Limit [dBm]	Margin to Limit [dB]
0	2402,0	2400,0	-48,6	PEAK	100,0	6,3	-13,7	34,9
78	2480,0	2483,5	-53,7	PEAK	100,0	6,2	-13,8	39,9
hopping	hopping	2400,0	-47,1	PEAK	100,0	5,2	-14,8	32,3
hopping	hopping	2483,5	-46,7	PEAK	100,0	5,1	-14,9	**31,8**

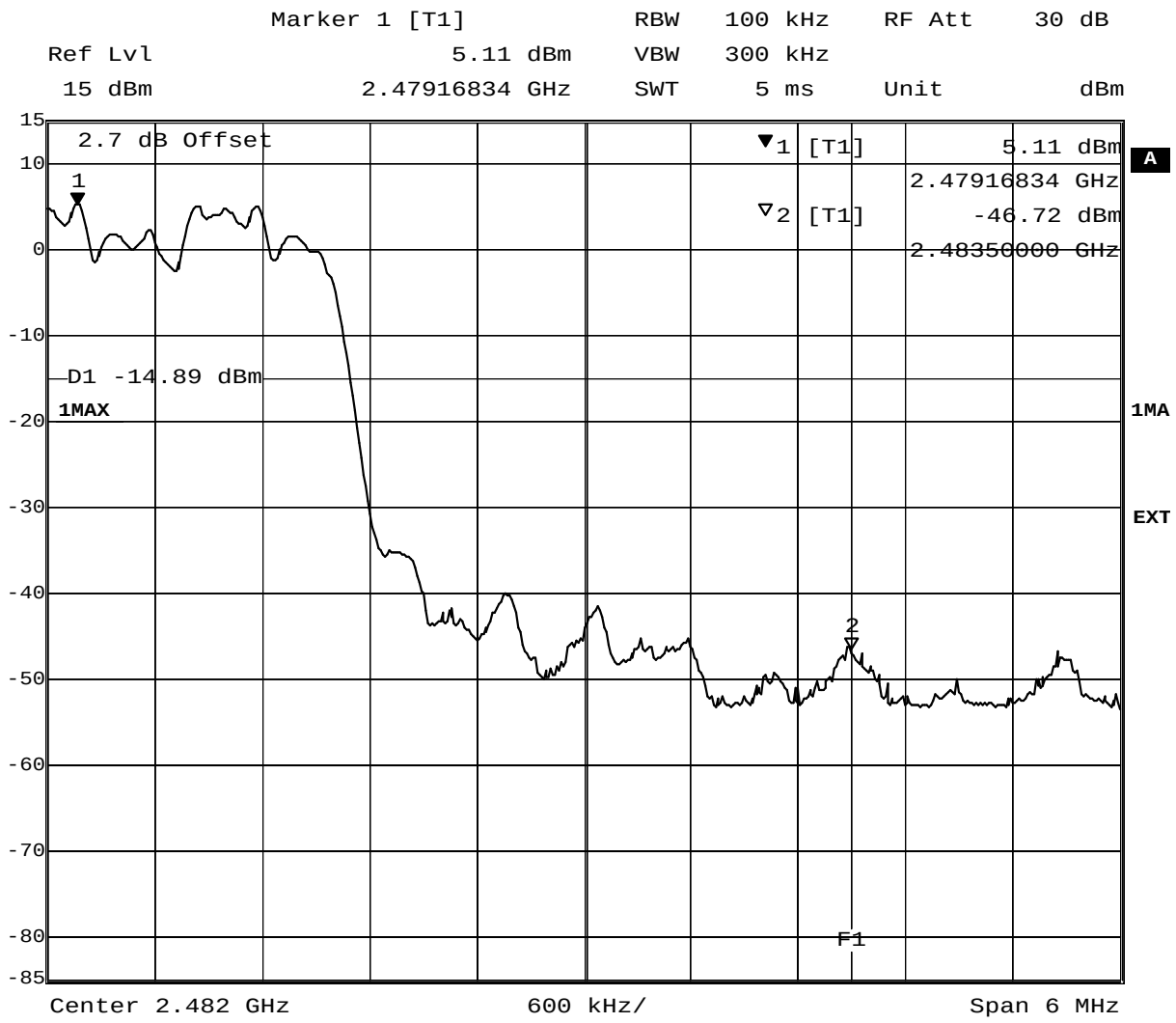
Remark: Please see next sub-clause for the measurement plot.

4.8.4Measurement Plot (showing the highest value, “worst case”)



Title: Band Edge Compliance
Comment A: CH B: 2402 MHz
Date: 16.DEC.2015 09:49:06

BT GFSK (1-DH1)



BT 8-DPSK (3-DH1), hopping

4.8.5Test Equipment used

REGULATORY BLUETOOTH RF TEST SOLUTION

4.9 Band Edge Compliance Conducted at Restricted Band

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.9.1 Test Description

Please see test description for the test case "Spurious RF Conducted Emissions in restricted bands"

4.9.2 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

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

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

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

4.9.3Test Protocol

Ambient temperature: 21–24 °C
Air Pressure: 985–1007 hPa
Humidity: 39–45 %

BT GFSK (1-DH1)

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480,0	2483,5	53,5	PEAK	1000,0	74,0	20,5	BE
78	2480,0	2483,5	42,5	AV	1000,0	54,0	11,5	BE

BT pi/4 DQPSK (2-DH1)

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480,0	2483,5	53,1	PEAK	1000,0	74,0	20,9	BE
78	2480,0	2483,5	42,3	AV	1000,0	54,0	11,7	BE

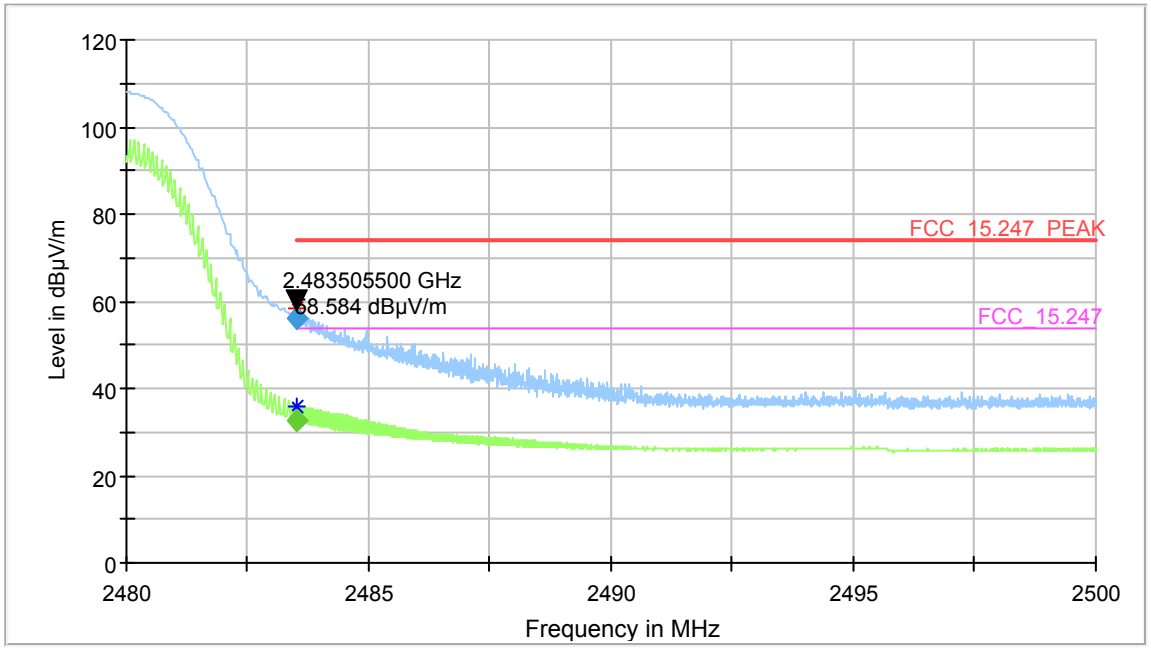
BT 8-DPSK (3-DH1)

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480,0	2483,5	56,3	PEAK	1000,0	74,0	**17,7**	BE
78	2480,0	2483,5	43,0	AV	1000,0	54,0	**11,0**	BE

Remark: Duty cycle = 30,88 %, applied duty cycle correction for AV-Detector: 10,2 dB

4.9.4Measurement Plot (showing the highest value, “worst case”)

BT 3-DH1 CH78



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)
2483.505500	---	32.76	54.00	21.24	1000.0	1000.000	-5.8
2483.505500	56.17	---	74.00	17.83	1000.0	1000.000	-5.8
2483.511000	---	32.73	54.00	21.27	1000.0	1000.000	-5.8
2483.511000	56.27	---	74.00	17.73	1000.0	1000.000	-5.8

4.9.5Test Equipment used

Radiated Emissions

4.10 Band Edge Compliance Radiated

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.10.1Test Description

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

4.10.2Test Requirements / Limits

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

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

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

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

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

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

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

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

4.10.3Test Protocol

Ambient temperature: 21–23 °C
Air Pressure: 980–1002 hPa
Humidity: 39–41 %

BT GFSK (1-DH1)

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480,0	2483,5	53,2	PEAK	1000,0	74,0	20,8	BE
78	2480,0	2483,5	50,3	AV	1000,0	54,0	3,7	BE

BT pi/4 DQPSK (2-DH1)

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480,0	2483,5	52,2	PEAK	1000,0	74,0	21,8	BE
78	2480,0	2483,5	48,0	AV	1000,0	54,0	6,0	BE

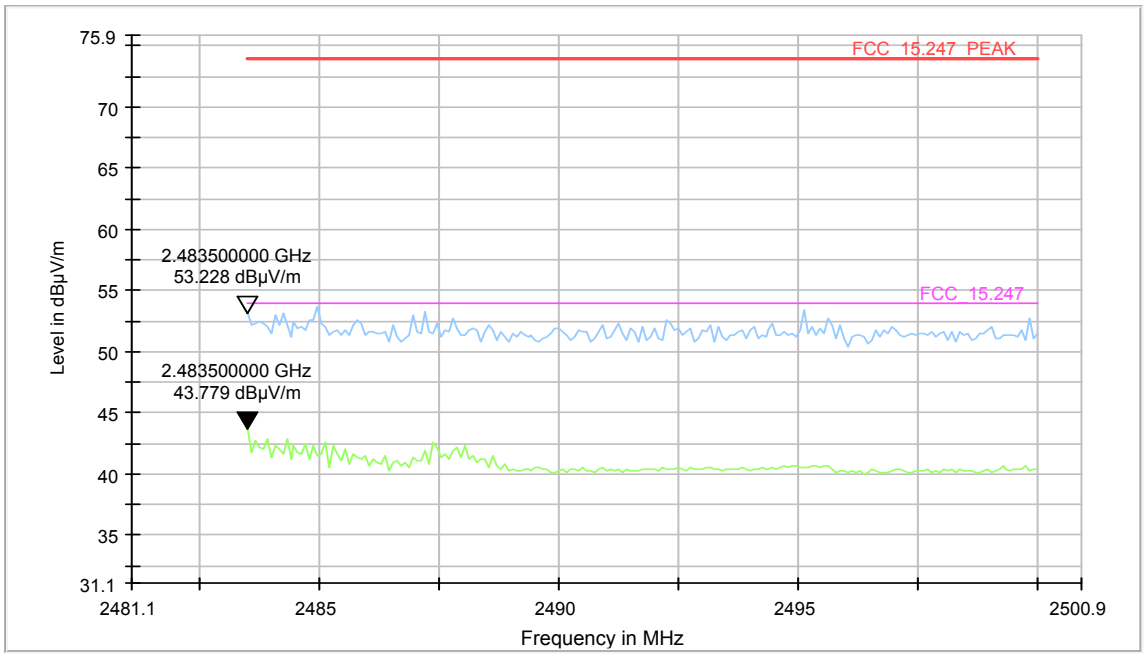
BT 8-DPSK (3-DH1)

Ch. No.	Ch. Center Freq. [MHz]	Band Edge Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]	Limit Type
78	2480,0	2483,5	55,0	PEAK	1000,0	74,0	19,0	BE
78	2480,0	2483,5	50,2	AV	1000,0	54,0	3,8	BE

Remark: Duty cycle = 30,88 %, applied duty cycle correction for AV-Detector: 10,2 dB

4.10.4Measurement Plot (showing the highest value, “worst case”)

BT GFSK (1-DH1)



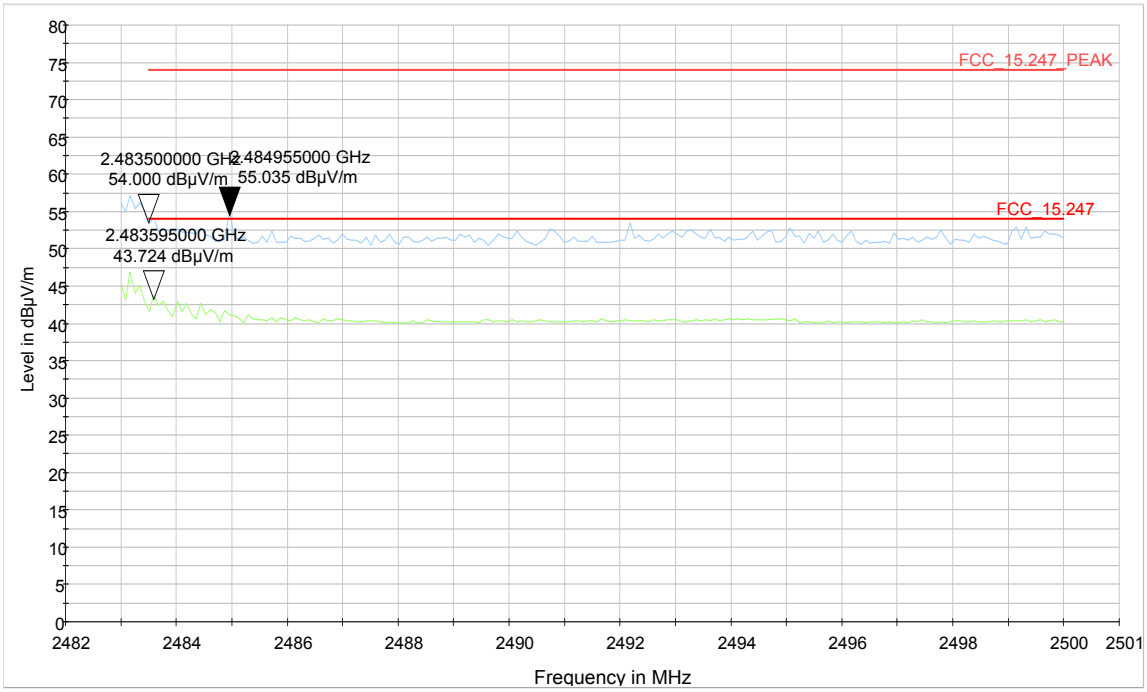
Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2483.350000	---	43.78	54.00	10.22	---	1000.000	150	H	270	-45

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)
2483.350000	---	40.13	54.00	13.87	1000.0	1000.000	150	H	271	-52

BT 8-DPSK (3-DH1)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2483.359500	---	43.73	54.00	10.27	---	1000.000	150	H	270	-45

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)
2483.350000	---	40.08	54.00	13.92	1000.0	1000.000	150	H	275	-48

4.10.5Test Equipment used

Radiated Emissions

4.11 Power Density

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.11.1Test Description

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

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

Analyzer settings:

- Resolution Bandwidth (RBW): 3 kHz
- Video Bandwidth (VBW): 10 kHz
- Trace: Maxhold
- Sweeps: 2000
- Sweep time: 420 ms
- Detector: Peak

4.11.2Test Requirements / Limits

FCC Part 15, Subpart C, §15.247 (e)

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

4.11.3Test Protocol

Ambient temperature: 23 °C
Air Pressure: 1017 hPa
Humidity: 41 %

BT GFSK (1-DH1)

Band	Channel No.	Frequency [MHz]	Power Density [dBm / 3kHz]	Limit [dBm / 3kHz]	Margin to Limit [dB]
2.4 GHz ISM	0	2402,0	5,6	8,0	2,4
	39	2441,0	5,7	8,0	**2,3**
	78	2480,0	5,2	8,0	2,8

BT pi/4 DQPSK (2-DH1)

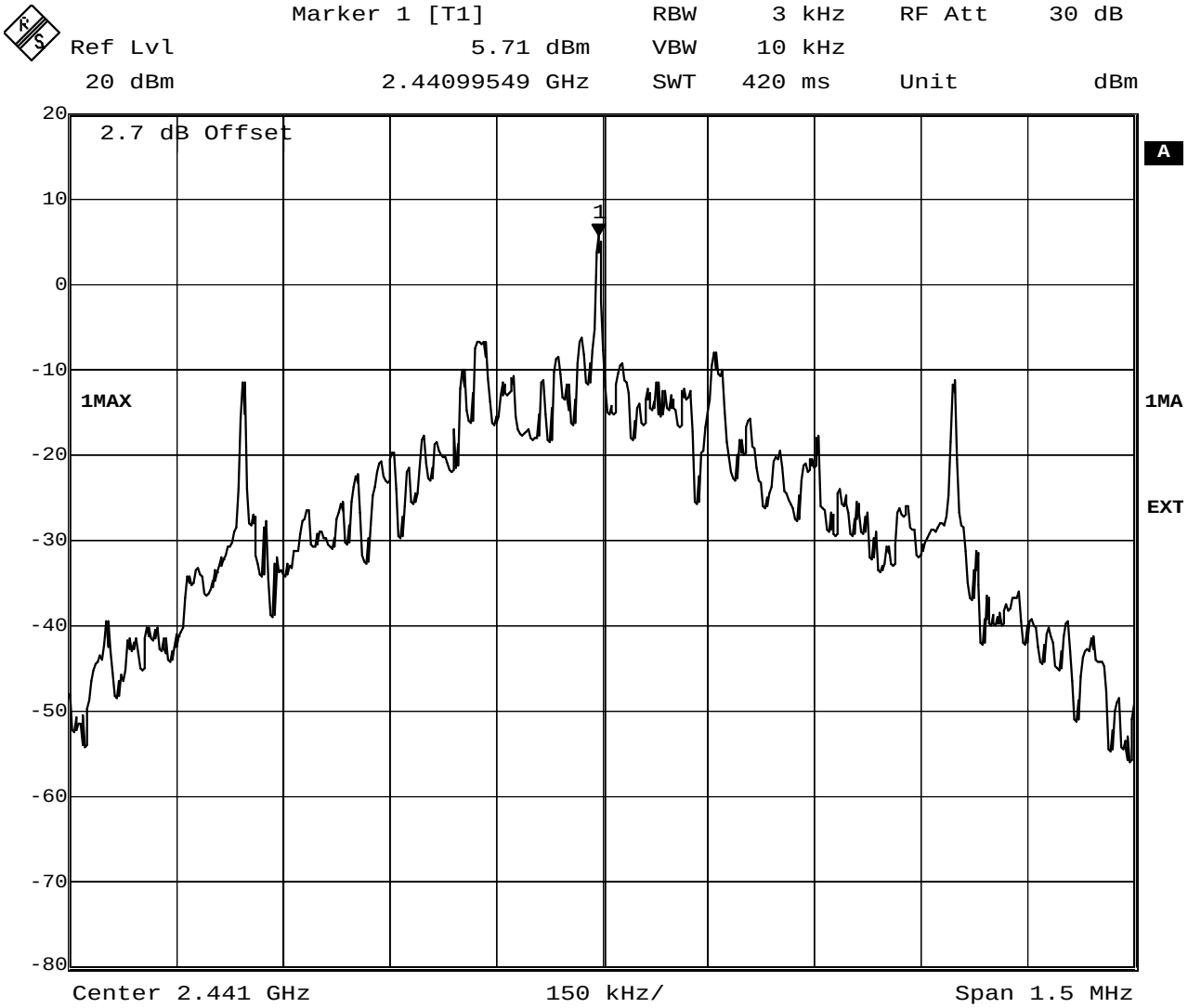
Band	Channel No.	Frequency [MHz]	Power Density [dBm / 3kHz]	Limit [dBm / 3kHz]	Margin to Limit [dB]
2.4 GHz ISM	0	2402,0	3,1	8,0	4,9
	39	2441,0	3,2	8,0	4,8
	78	2480,0	2,7	8,0	5,3

BT 8-DPSK (3-DH1)

Band	Channel No.	Frequency [MHz]	Power Density [dBm / 3kHz]	Limit [dBm / 3kHz]	Margin to Limit [dB]
2.4 GHz ISM	0	2402,0	-0,1	8,0	8,1
	39	2441,0	-0,1	8,0	8,1
	78	2480,0	-0,4	8,0	8,4

4.11.4Measurement Plot (showing the highest value, “worst case”)

Radio Technology = Bluetooth (1-DH1), Operating Frequency = mid



Date: 20.MAY.2016 12:47:20

4.11.5Test Equipment used

Regulatory Bluetooth RF Test Solution

4.12 SIMULTANEOUS TRANSMISSION - SPURIOUS RADIATED EMISSIONS

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

4.12.1 Test Description

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

4.12.2 Test Requirements / Limits

Bluetooth:
Please see "Test Requirements / Limits" for the test case "Transmitter Spurious Radiated Emissions"

Additional for NFC:
FCC §15.225 (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

Additional for WLAN 5 GHz:
A) FCC
FCC Part 15 Subpart E, §15.407 (b)(1)
For transmitters operating in the 5150–5250 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E, §15.407 (b)(2)
For transmitters operating in the 5250–5350 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5350 MHz.

FCC Part 15 Subpart E, §15.407 (b)(3)
For transmitters operating in the 5470–5725 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5470–5725 MHz.

FCC Part 15 Subpart E, §15.407 (b)(4)
For transmitters operating in the 5725–5850 MHz band:
Limit: –27 dBm/MHz EIRP outside of the band 5715–5860 MHz and additionally
Limit: –17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5850–5860 MHz.

B) IC
Different frequency bands and limits apply, as compared to the FCC requirements.

RSS-247, 6.2.1 (2), Emissions outside the band 5150-5250 MHz, indoor operation only:
Limit: –27 dBm/MHz EIRP outside of the band 5150–5250 MHz.

RSS-247, 6.2.2 (2), Emissions outside the band 5250-5350 MHz:
Limit: –27 dBm/MHz EIRP outside of the band 5250–5350 MHz.

RSS-247, 6.2.3 (2), Emissions outside the bands 5470-5600 MHz and 5650-5725 MHz:
Limit: –27 dBm/MHz EIRP outside of the band 5470–5725 MHz.
Note: No operation is permitted for the frequency range 5600–5650 MHz.

RSS-247, 6.2.4 (2), Emissions outside the band 5725-5825 MHz:
Limit: –27 dBm/MHz EIRP outside of the band 5715–5835 MHz and additionally
Limit: –17 dBm/MHz EIRP within the frequency ranges 5715–5725 and 5825–5835 MHz.

C) FCC & IC

FCC Part 15 Subpart E, §15.405
The provisions of §§ 15.203 and 15.205 are included.

§15.407 (b)(6)
Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209.

§15.407 (b)(7)
The provisions of §15.205 apply to intentional radiators operating under this section

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)
- Limit (dBµV/m) = EIRP [dBm] – 20 log (d [m]) + 104.8

4.12.3Test Protocol

Possible simultaneous operating modes according to applicant's description	Remark
NFC + WLAN 2.4 GHz	Not part of this report
NFC + BT	covered from worst case mode: NFC + BT + WLAN 5 GHz
NFC + BT-LE	BT-LE covered from BT
NFC + WLAN 5 GHz	covered from worst case mode: NFC + BT + WLAN 5 GHz
NFC + BT + WLAN 5 GHz	Worst case operating mode, no intended operating mode, only possible with special SW, Selected worst case operating modes: channels and modes with highest output power

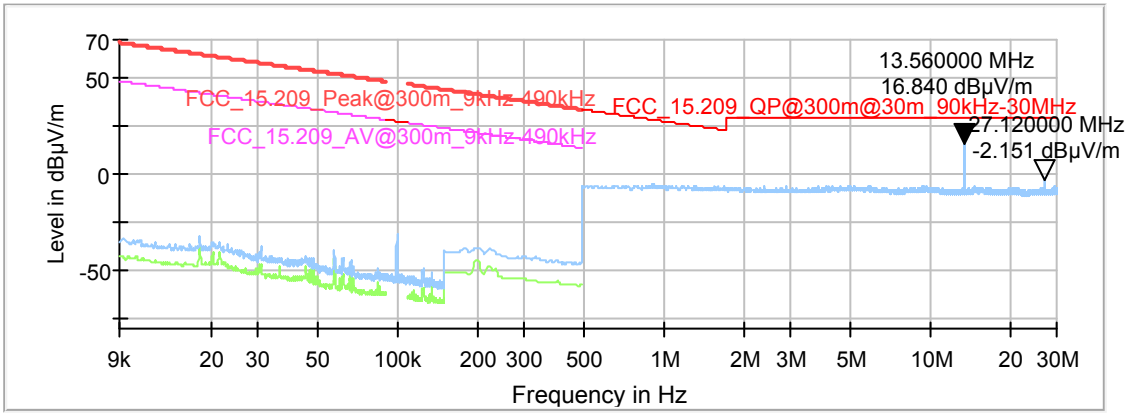
Ambient temperature: 21–25 °C
Air Pressure: 1002–1020 hPa
Humidity: 38–45 %
WLAN b-Mode; 20 MHz

Mode / Set EUT target power	Ch. Center Freq. [MHz]	Spurious Freq. [MHz]	Spurious Level [dBµV/m]	Detec-tor	RBW [kHz]	Limit [dBµV/m]	Margin to Limit [dB]
BT BDR (DH1, Ch.0) / max. power WLAN 5 GHz (a-Mode; 20 MHz; 6 Mbit/s) / 16 dBm NFC in continuous modulation mode	2402,0 5240,0 13,56	0,009 to 30	noise	Peak, AV	-	(13,56 MHz excluded)	> 20
BT BDR (DH1, Ch.0) / max. power WLAN 5 GHz (a-Mode; 20 MHz; 6 Mbit/s) / 16 dBm NFC in continuous modulation mode	2402,0 5240,0 13,56	40.68 352,56	35,1 35,6	QP	120	40 46	4,9 10,4
BT BDR (DH1, Ch.0) / max. power WLAN 5 GHz (a-Mode; 20 MHz; 6 Mbit/s) / 16 dBm NFC in continuous modulation mode	2402,0 5240,0 13,56	2835,32 15719,75	44,7 45,1 (100 % duty cycle, no duty cycle correction applicable)	AV	1000	54 54 (CF at 2402 MHz and 5240 MHz excluded)	9,3 8,9

BT BDR (DH1, Ch.0) / max. power WLAN 5 GHz (a-Mode; 20 MHz; 6 Mbit/s) / 16 dBm NFC in continuous modulation mode	2402,0 5240,0 13,56	26000 to 40000	noise	Peak, AV	-	74 54	> 20

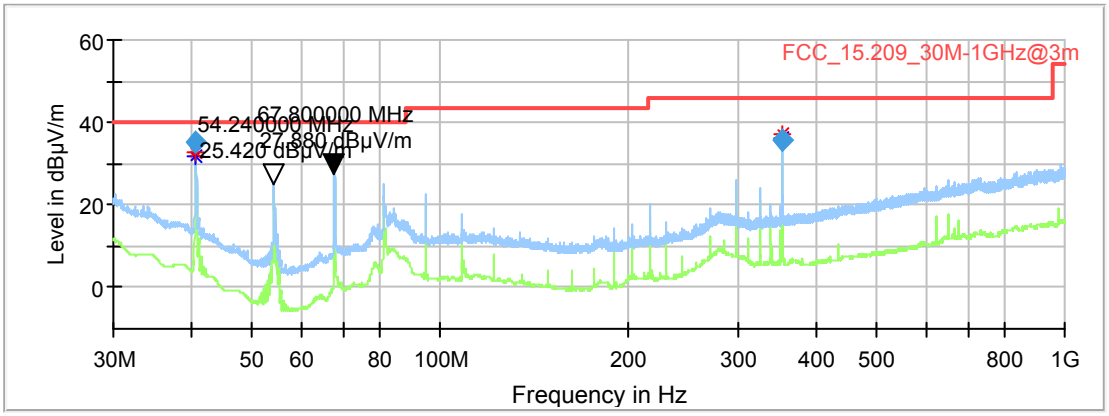
Remark: Please see next sub-clause for the measurement plot.

4.12.4Measurement Plot (showing the highest value, “worst case”)



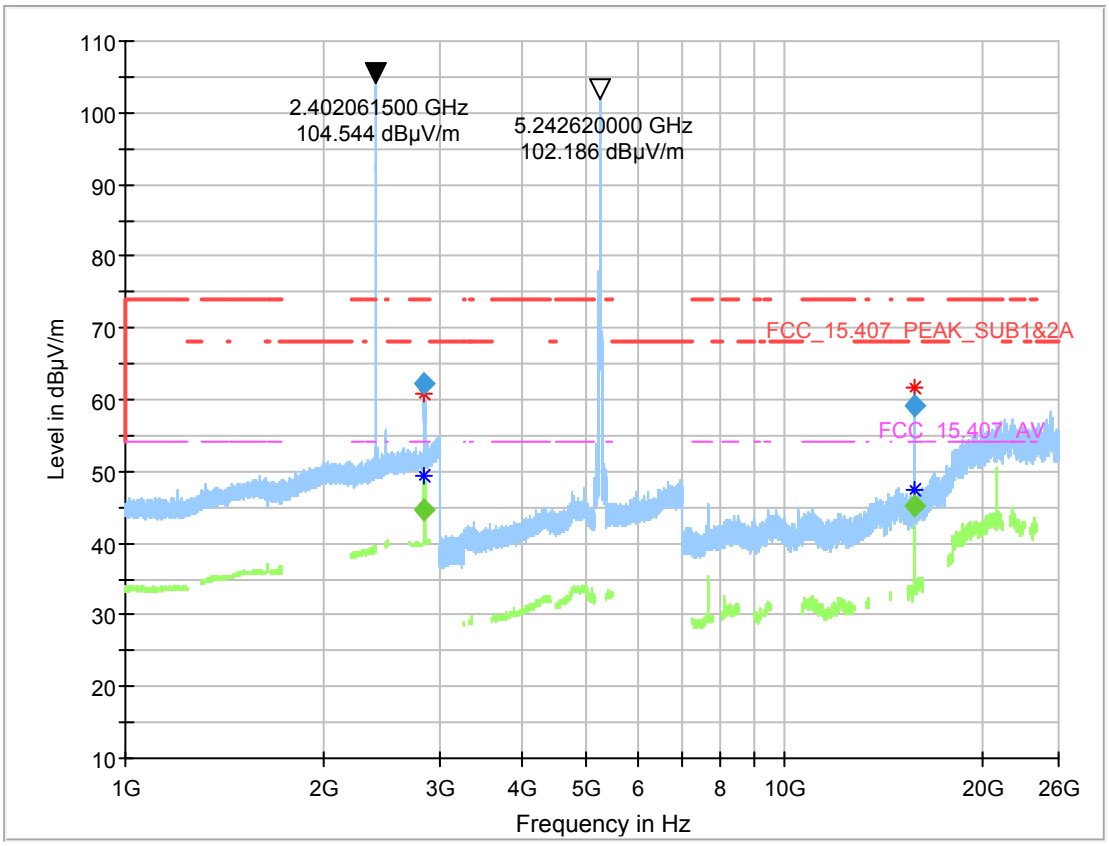
Final_Result

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



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40,680000	35,08	40,00	**4,92**	1000,0	120,000	100,0	V	-132,0	13,3
54,240000	25,42	40,00	14,58	1000,0	120,000	102,0	V	-130,0	10,1
67,800000	27,88	40,00	12,12	1000,0	120,000	100,0	V	-132,0	12,3
81,360000	23,54	40,00	16,46	1000,0	120,000	100,0	V	-130,0	13,2
352,560000	35,59	46,00	10,41	1000,0	120,000	102,0	H	-180,0	15,1

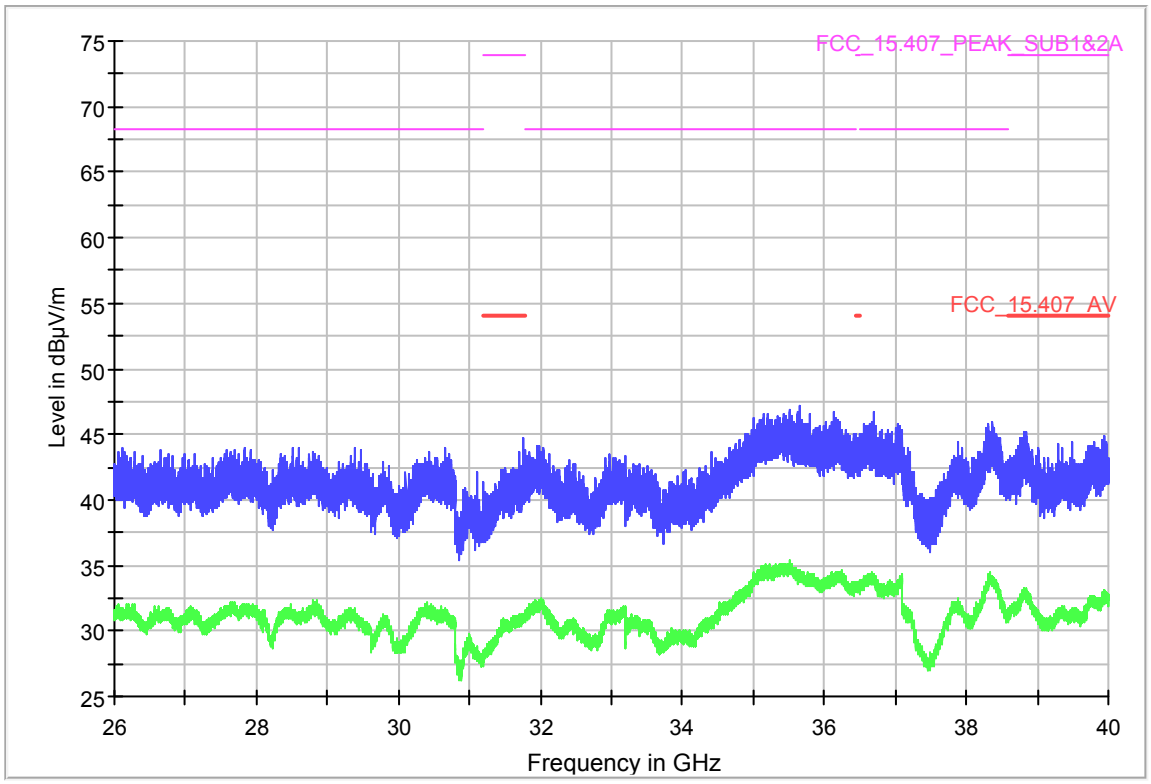


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)
2834,900000	60,74	---	74,00	13,26	---	---	150,0	V	92,0	74,9
2835,320000	---	49,26	54,00	4,74	---	---	150,0	V	92,0	87,9
15716,633333	61,58	---	74,00	12,42	---	---	150,0	V	-11,0	90,8
15719,750000	---	47,55	54,00	6,45	---	---	150,0	V	-6,0	96,6

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)
2834,900000	62,18	---	74,00	11,82	1000,0	1000,000	150,0	V	92,0	75,0
2835,320000	---	44,65	54,00	9,35	1000,0	1000,000	150,0	V	92,0	88,0
15716,633333	59,04	---	74,00	14,96	1000,0	1000,000	150,0	V	-11,0	90,7
15719,750000	---	45,13	54,00	**8,87**	1000,0	1000,000	150,0	V	-6,0	96,7



4.12.5Test Equipment used

Radiated Emissions

4.13 Duty Cycle

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10 with Zero span mode on a spectrumanalyzer

4.13.1Test Description

The Equipment Under Test (EUT) was set up to perform the duty cycle measurements. The results recorded were measured at one channel with different modulations. The reference level of the spectrum analyzer was set higher than the output power of the EUT.

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

Analyzer settings:

- Center frequency = center of channel frequency
- Resolution Bandwidth (RBW) ≥ occupied bandwidth (OBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Trace: view
- Sweeps: 1
- Sweep time: 2 ms
- Detector: Auto Peak
- Trigger Video
- Zero Span

4.13.2Test Requirements / Limits

DTS devices:
558074 D01 DTS Meas Guidance:
When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternate procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle.

4.13.3 Sample calculation

t_{on} is the "on time" = delta marker D1 = 386 µs
T is the period of the pulse train = delta marker D2 = 1,25 ms = 1250 µs
Duty cycle = t_{on} / T = 386 µs / 1250 µs = 0,3088 = 30,88 %
Duty cycle correction factor (applied to field strength) = 20 log (1/duty cycle) = 10,2 dB

The duty cycle correction value is added to the measured AV field strength value:
Measured @ 2483.305500 MHz with CISPR AV detector = 32,76 dBµV/m
Corrected with duty cycle correction factor = 32,8 dBµV/m + 10,2 dB = 43,0 dBµV/m

4.13.4Test Protocol

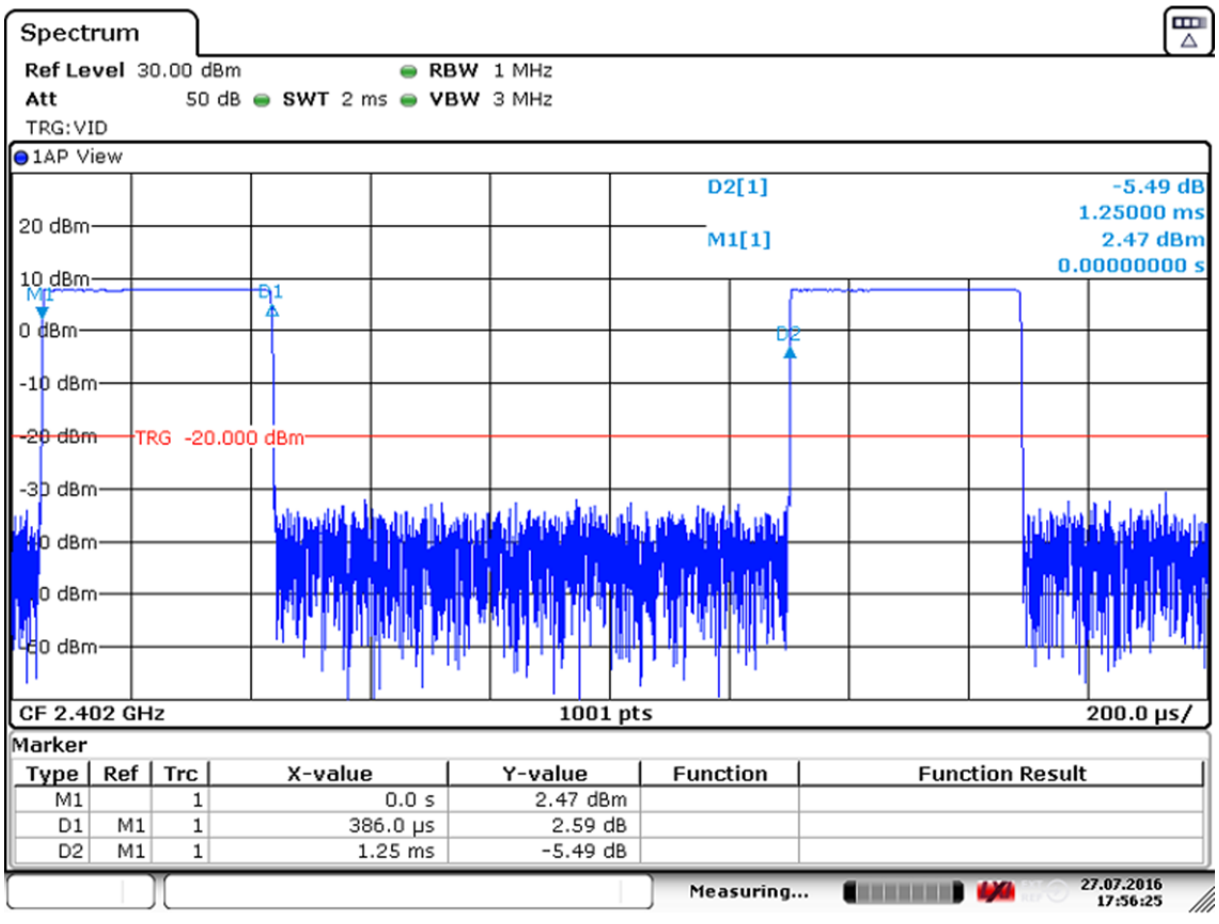
Ambient temperature:	23°C
Air Pressure:	1019 hPa
Humidity:	45 %

Modulation	Frequency [MHz]	On time t_{on} (Marker D1) [µs]	Period T (Marker D2) [ms]	Duty cycle [%]	Duty cycle correction factor [dB]
BT GFSK (1-DH1)	2402,0	386	1,25	30,88	10,2
BT pi/4 DQPSK (2-DH1)	2402,0	386	1,25	30,88	10,2
BT 8-DPSK (3-DH1)	2402,0	386	1,25	30,88	10,2

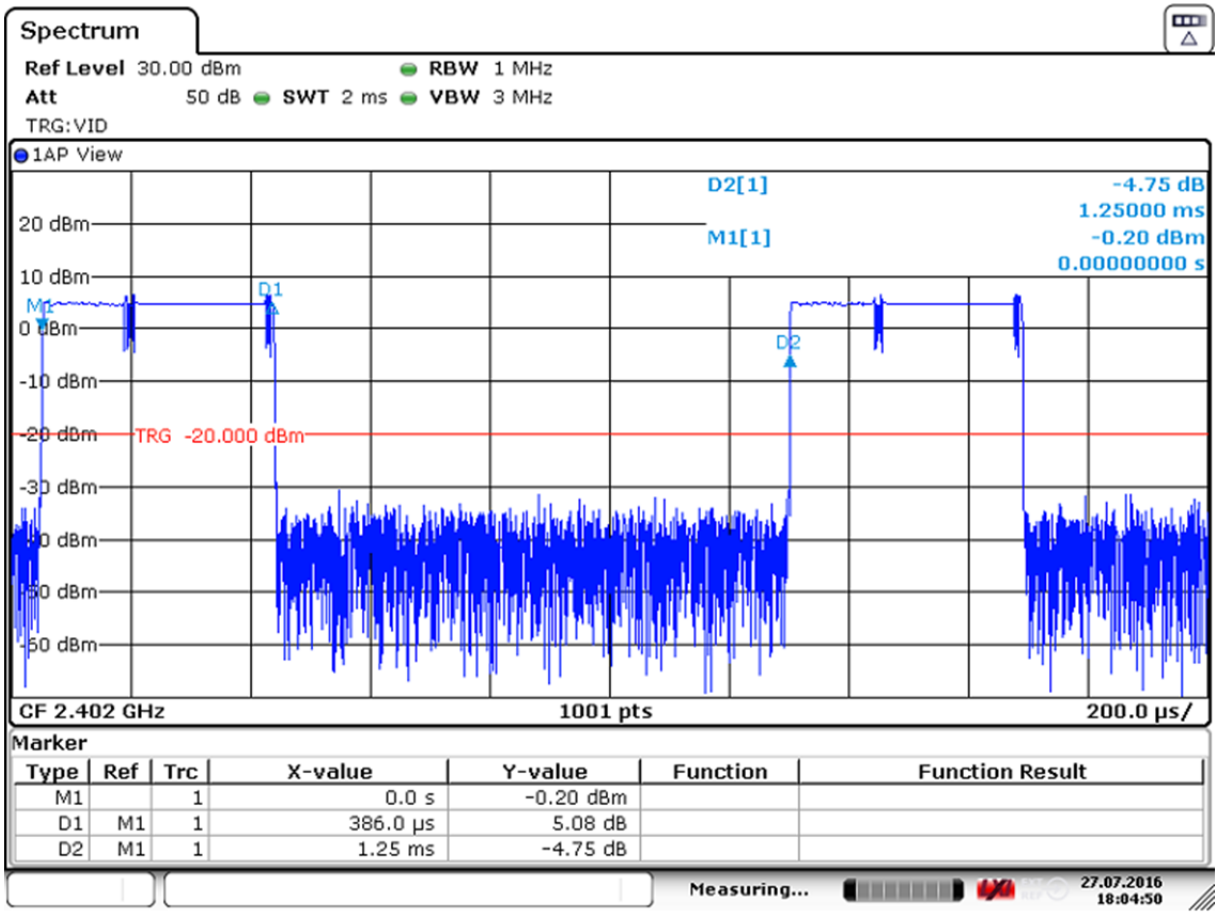
Remark: -

4.13.5Measurement Plot

Radio Technology = Bluetooth (1-DH1), Operating Frequency = low

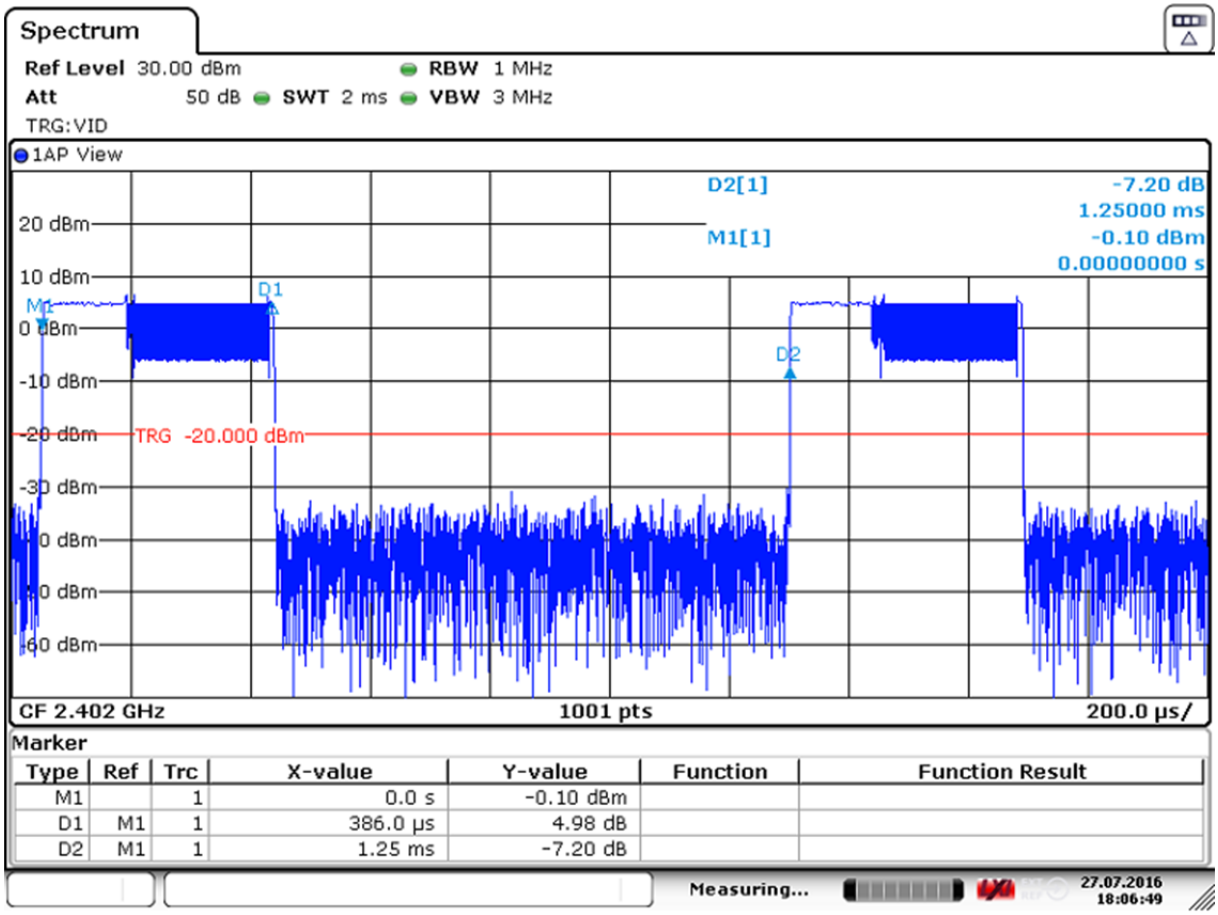


Radio Technology = Bluetooth (2-DH1), Operating Frequency = low



Date:27.JUL.2016 18:04:51

Radio Technology = Bluetooth (3-DH1), Operating Frequency = low



4.13.6Test Equipment used

R&S TS8997

5 Test Equipment

1 Conducted Emissions

Shielded Room 02

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
	ESH 3-Z5	Two-Line V-Network	Rohde & Schwarz	828304/029	2015-03	2017-03
	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2014-11	2016-11
	EP 1200/B, NA/B1	Amplifier with integrated variable Oscillator	Spitzenberger & Spieß	B6278	2015-07	2018-07
	ESIB 26	Spectrum Analyzer	Rohde & Schwarz	830482/004	2015-12	2017-12
	Opus10 THI (8152.00)	ThermoHygro Datalogger 02 (Environ)	Lufft Mess- und Regeltechnik GmbH	7489	2015-02	2017-02
	ESH 3-Z5	Two-Line V-Network	Rohde & Schwarz	829996/002	2015-03	2017-03
	Opus10 TPR (8253.00)	ThermoAirpressure Datalogger 13 (Environ)	Lufft Mess- und Regeltechnik GmbH	13936	2015-02	2017-02
	CMD 55	Digital Radio Communication Tester	Rohde & Schwarz	831050/020	2014-12	2017-12
	Chroma 6404	AC Power Source	Chroma ATE INC.	64040001304		
	CMW 500	CMW 500	Rohde & Schwarz	107500	2015-07	2017-07

2 Radiated Emissions

Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronic GmbH	00083069		
	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright	09		
	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008		
	Fully Anechoic Room	8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	2015-07	2018-07
	AM 4.0	Antenna mast	Maturo GmbH	AM4.0/180/11920513		
	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2014-11	2016-11
	TT 1.5 WI	Turn Table	Maturo GmbH	-		
	Anechoic Chamber	10.58 x 6.38 x 6.00 m³	Frankonia	none	2014-01	2017-01
	ESIB 26	Spectrum Analyzer	Rohde & Schwarz	830482/004	2015-12	2017-12
	Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	Maturo GmbH	TD1.5-10kg/024/3790709		
	5HC2700/12750-1.5-KK	High Pass Filter	Trilithic	9942012		
	AS 620 P	Antenna mast	HD GmbH	620/37		
	4HC1600/12750-1.5-KK	High Pass Filter	Trilithic	9942011		
	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		
	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
	HL 562	Ultralog new biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2015-06	2018-06
	Opus10 THI (8152.00)	ThermoHygro Datalogger 12 (Environ)	Lufft Mess- und Regeltechnik GmbH	12482	2015-03	2017-03
	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
	HFH2-Z2	Loop Antenna	Rohde & Schwarz GmbH & Co. KG	829324/006	2014-11	2017-11

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2014-11	2016-11
	Opus10 TPR (8253.00)	ThermoAirpressure Datalogger 13 (Environ)	Lufft Mess- und Regeltechnik GmbH	13936	2015-02	2017-02
	Chroma 6404	AC Power Source	Chroma ATE INC.	64040001304		
	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronik GmbH	00086675		
	HL 562 Ultralog	Log.-per. Antenna	Rohde & Schwarz GmbH & Co. KG	100609	2016-04	2019-04
	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
	HF 907	Double-ridged horn	Rohde & Schwarz GmbH & Co. KG	102444	2015-05	2018-05

3 Regulatory Bluetooth RF Test Solution

Regulatory Bluetooth RF Tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
	CBT	IL BT RF Test Solution	Rohde & Schwarz GmbH & Co. KG	100302	2015-08	2016-08
	EX520	Digital Multimeter 12 (Multimeter)	Extech Instruments Corp	05157876	2016-02	2018-02
	SMIQ03B	Options: B5 B11 B19 B20 B50 Battery Pack	Rohde & Schwarz GmbH & Co. KG	832870/017	2013-07	2016-07
	Datum MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2015-08	2016-08
	FSIQ26	IL BT RF Test Solution Ratingen 1119.6001.26	Rohde & Schwarz GmbH & Co. KG	832695/007	2014-08	2016-08
	NRVD	Powermeter	Rohde & Schwarz GmbH & Co. KG	832025/059	2015-08	2016-08
	TOCT Switching Unit		7 layers, Inc	040107		
	Opus10 THI (8152.00)	T/H Logger 15	Lufft Mess- und Regeltechnik GmbH	13985	2015-03	2017-03
	NRV Z1 A	Power Sensor	Rohde & Schwarz GmbH & Co. KG	832279/013	2015-08	2016-08
	ADU 200 Relay Box 7	used for automated testing (EMMI) only	Ontrak Control Systems Inc	A04380		
	R&S CBT	Bluetooth Signalling Unit	Rohde & Schwarz	100589	2015-01	2018-01
	KWP 120/70	Temperature Chamber Weiss 01	Weiss	5922601219001 0	2016-03	2018-03
	NGSM 32/10	Power Supply	Rohde & Schwarz GmbH & Co. KG	2725	2015-06	2017-06
	SMP02	Signal Generator	Rohde & Schwarz GmbH & Co. KG	829076/017	2013-07	2016-07

4 R&S TS8997
EN300328/301893 Test Lab

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
	OSP120	Switching Unit with integrated power meter	Rohde & Schwarz GmbH & Co. KG	101158	2015-08	2016-08
	A8455-4	4 Way Power Divider (SMA)		-		
	Opus10 THI (8152.00)	ThermoHygro Datalogger 03 (Environ)	Lufft Mess- und Regeltechnik GmbH	7482	2015-02	2017-02
	SMB100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz GmbH & Co. KG	107695	2014-06	2017-06
	VT 4002	Climatic Chamber	Vötsch	58566002150010	2016-03	2018-03
	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2016-02	2018-02
	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz GmbH & Co. KG	259291	2013-08	2016-08
	Voltcraft M-3860M	Digital Multimeter 01 (Multimeter)	Voltcraft	IJ096055		
	1515 / 93459	Broadband Power Divider SMA (Aux)	Weinschel Associates	LN673		
	Datum, Model: MFS	Rubidium Frequency Standard	Datum-Beverly	5489/001	2015-06	2016-06

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

6 Antenna Factors, Cable Loss and Sample Calculations

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

6.1 LISN R&S ESH3-Z5 (150 kHz – 30 MHz)

Frequency		Corr.	LISN insertion loss ESH3-Z5	cable loss (incl. 10 dB atten-uator)
MHz		dB	dB	dB
0,15		10,1	0,1	10,0
5		10,3	0,1	10,2
7		10,5	0,2	10,3
10		10,5	0,2	10,3
12		10,7	0,3	10,4
14		10,7	0,3	10,4
16		10,8	0,4	10,4
18		10,9	0,4	10,5
20		10,9	0,4	10,5
22		11,1	0,5	10,6
24		11,1	0,5	10,6
26		11,2	0,5	10,7
28		11,2	0,5	10,7
30		11,3	0,5	10,8

Sample calculation

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

6.2 Antenna R&S HFH2-Z2 (9 kHz – 30 MHz)

Frequency	AF HFH-Z2)	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-40 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
0,009	20,50	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,01	20,45	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,015	20,37	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,02	20,36	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,025	20,38	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,03	20,32	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,05	20,35	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,08	20,30	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,1	20,20	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,2	20,17	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,3	20,14	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,49	20,12	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,490001	20,12	-39,6	0,1	0,1	0,1	0,1	-40	30	3
0,5	20,11	-39,6	0,1	0,1	0,1	0,1	-40	30	3
0,8	20,10	-39,6	0,1	0,1	0,1	0,1	-40	30	3
1	20,09	-39,6	0,1	0,1	0,1	0,1	-40	30	3
2	20,08	-39,6	0,1	0,1	0,1	0,1	-40	30	3
3	20,06	-39,6	0,1	0,1	0,1	0,1	-40	30	3
4	20,05	-39,5	0,2	0,1	0,1	0,1	-40	30	3
5	20,05	-39,5	0,2	0,1	0,1	0,1	-40	30	3
6	20,02	-39,5	0,2	0,1	0,1	0,1	-40	30	3
8	19,95	-39,5	0,2	0,1	0,1	0,1	-40	30	3
10	19,83	-39,4	0,2	0,1	0,2	0,1	-40	30	3
12	19,71	-39,4	0,2	0,1	0,2	0,1	-40	30	3
14	19,54	-39,4	0,2	0,1	0,2	0,1	-40	30	3
16	19,53	-39,3	0,3	0,1	0,2	0,1	-40	30	3
18	19,50	-39,3	0,3	0,1	0,2	0,1	-40	30	3
20	19,57	-39,3	0,3	0,1	0,2	0,1	-40	30	3
22	19,61	-39,3	0,3	0,1	0,2	0,1	-40	30	3
24	19,61	-39,3	0,3	0,1	0,2	0,1	-40	30	3
26	19,54	-39,3	0,3	0,1	0,2	0,1	-40	30	3
28	19,46	-39,2	0,3	0,1	0,3	0,1	-40	30	3
30	19,73	-39,1	0,4	0,1	0,3	0,1	-40	30	3

Sample calculation

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

6.3 Antenna R&S HL562 (30 MHz – 1 GHz)

(d_{Limit} = 3 m)

Frequency	AF R&S HL562	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18,6	0,6	0,29	0,04	0,23	0,02	0,0	3	3
50	6,0	0,9	0,39	0,09	0,32	0,08	0,0	3	3
100	9,7	1,2	0,56	0,14	0,47	0,08	0,0	3	3
150	7,9	1,6	0,73	0,20	0,59	0,12	0,0	3	3
200	7,6	1,9	0,84	0,21	0,70	0,11	0,0	3	3
250	9,5	2,1	0,98	0,24	0,80	0,13	0,0	3	3
300	11,0	2,3	1,04	0,26	0,89	0,15	0,0	3	3
350	12,4	2,6	1,18	0,31	0,96	0,13	0,0	3	3
400	13,6	2,9	1,28	0,35	1,03	0,19	0,0	3	3
450	14,7	3,1	1,39	0,38	1,11	0,22	0,0	3	3
500	15,6	3,2	1,44	0,39	1,20	0,19	0,0	3	3
550	16,3	3,5	1,55	0,46	1,24	0,23	0,0	3	3
600	17,2	3,5	1,59	0,43	1,29	0,23	0,0	3	3
650	18,1	3,6	1,67	0,34	1,35	0,22	0,0	3	3
700	18,5	3,6	1,67	0,42	1,41	0,15	0,0	3	3
750	19,1	4,1	1,87	0,54	1,46	0,25	0,0	3	3
800	19,6	4,1	1,90	0,46	1,51	0,25	0,0	3	3
850	20,1	4,4	1,99	0,60	1,56	0,27	0,0	3	3
900	20,8	4,7	2,14	0,60	1,63	0,29	0,0	3	3
950	21,1	4,8	2,22	0,60	1,66	0,33	0,0	3	3
1000	21,6	4,9	2,23	0,61	1,71	0,30	0,0	3	3

(d_{Limit} = 10 m)

30	18,6	-9,9	0,29	0,04	0,23	0,02	-10,5	10	3
50	6,0	-9,6	0,39	0,09	0,32	0,08	-10,5	10	3
100	9,7	-9,2	0,56	0,14	0,47	0,08	-10,5	10	3
150	7,9	-8,8	0,73	0,20	0,59	0,12	-10,5	10	3
200	7,6	-8,6	0,84	0,21	0,70	0,11	-10,5	10	3
250	9,5	-8,3	0,98	0,24	0,80	0,13	-10,5	10	3
300	11,0	-8,1	1,04	0,26	0,89	0,15	-10,5	10	3
350	12,4	-7,9	1,18	0,31	0,96	0,13	-10,5	10	3
400	13,6	-7,6	1,28	0,35	1,03	0,19	-10,5	10	3
450	14,7	-7,4	1,39	0,38	1,11	0,22	-10,5	10	3
500	15,6	-7,2	1,44	0,39	1,20	0,19	-10,5	10	3
550	16,3	-7,0	1,55	0,46	1,24	0,23	-10,5	10	3
600	17,2	-6,9	1,59	0,43	1,29	0,23	-10,5	10	3
650	18,1	-6,9	1,67	0,34	1,35	0,22	-10,5	10	3
700	18,5	-6,8	1,67	0,42	1,41	0,15	-10,5	10	3
750	19,1	-6,3	1,87	0,54	1,46	0,25	-10,5	10	3
800	19,6	-6,3	1,90	0,46	1,51	0,25	-10,5	10	3
850	20,1	-6,0	1,99	0,60	1,56	0,27	-10,5	10	3
900	20,8	-5,8	2,14	0,60	1,63	0,29	-10,5	10	3
950	21,1	-5,6	2,22	0,60	1,66	0,33	-10,5	10	3
1000	21,6	-5,6	2,23	0,61	1,71	0,30	-10,5	10	3

Sample calculation

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

6.4 Antenna R&S HF907 (1 GHz – 18 GHz)

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay + cable inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit, atten-uator & pre-amp)	cable loss 4 (to receiver)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24,4	-19,4	0,99	0,31	-21,51	0,79		
2000	28,5	-17,4	1,44	0,44	-20,63	1,38		
3000	31,0	-16,1	1,87	0,53	-19,85	1,33		
4000	33,1	-14,7	2,41	0,67	-19,13	1,31		
5000	34,4	-13,7	2,78	0,86	-18,71	1,40		
6000	34,7	-12,7	2,74	0,90	-17,83	1,47		
7000	35,6	-11,0	2,82	0,86	-16,19	1,46		

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (inside chamber)	cable loss 3 (outside chamber)	cable loss 4 (switch unit, atten-uator & pre-amp)	cable loss 5 (to receiver)	used for FCC 15.247
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31,0	-23,4	0,47	1,87	0,53	-27,58	1,33	
4000	33,1	-23,3	0,56	2,41	0,67	-28,23	1,31	
5000	34,4	-21,7	0,61	2,78	0,86	-27,35	1,40	
6000	34,7	-21,2	0,58	2,74	0,90	-26,89	1,47	
7000	35,6	-19,8	0,66	2,82	0,86	-25,58	1,46	

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (High Pass)	cable loss 3 (pre-amp)	cable loss 4 (inside chamber)	cable loss 5 (outside chamber)	cable loss 6 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35,6	-57,3	0,56	1,28	-62,72	2,66	0,94	1,46
8000	36,3	-56,3	0,69	0,71	-61,49	2,84	1,00	1,53
9000	37,1	-55,3	0,68	0,65	-60,80	3,06	1,09	1,60
10000	37,5	-56,2	0,70	0,54	-61,91	3,28	1,20	1,67
11000	37,5	-55,3	0,80	0,61	-61,40	3,43	1,27	1,70
12000	37,6	-53,7	0,84	0,42	-59,70	3,53	1,26	1,73
13000	38,2	-53,5	0,83	0,44	-59,81	3,75	1,32	1,83
14000	39,9	-56,3	0,91	0,53	-63,03	3,91	1,40	1,77
15000	40,9	-54,1	0,98	0,54	-61,05	4,02	1,44	1,83
16000	41,3	-54,1	1,23	0,49	-61,51	4,17	1,51	1,85
17000	42,8	-54,4	1,36	0,76	-62,36	4,34	1,53	2,00
18000	44,2	-54,7	1,70	0,53	-62,88	4,41	1,55	1,91

Sample calculation

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

6.5 Antenna EMCO 3160-09 (18 GHz – 26.5 GHz)

Frequency	AF EMCO 3160-09	Corr.	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 (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

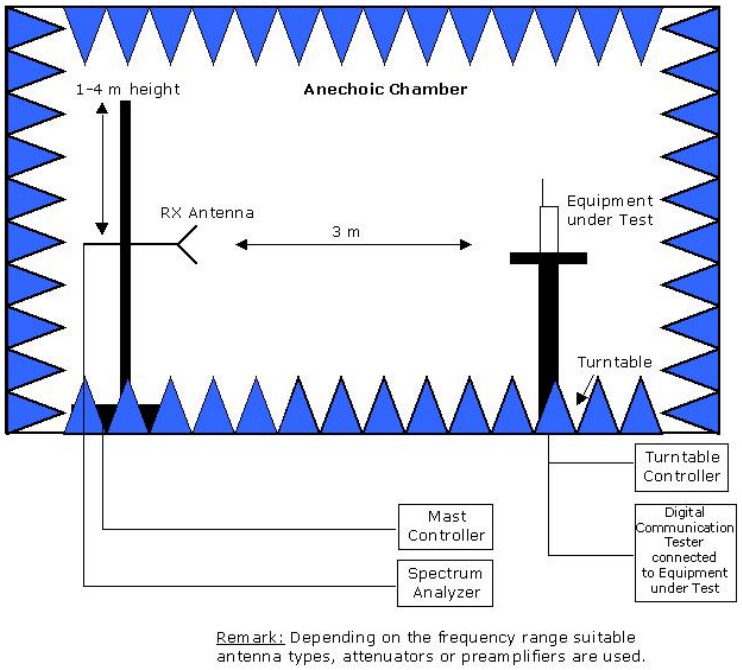
6.6 Antenna EMCO 3160-10 (26.5 GHz – 40 GHz)

Frequency	AF EMCO 3160-10	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26,5	43,4	-11,2	4,4				-15,6	3	0,5
27,0	43,4	-11,2	4,4				-15,6	3	0,5
28,0	43,4	-11,1	4,5				-15,6	3	0,5
29,0	43,5	-11,0	4,6				-15,6	3	0,5
30,0	43,5	-10,9	4,7				-15,6	3	0,5
31,0	43,5	-10,8	4,7				-15,6	3	0,5
32,0	43,5	-10,7	4,8				-15,6	3	0,5
33,0	43,6	-10,7	4,9				-15,6	3	0,5
34,0	43,6	-10,6	5,0				-15,6	3	0,5
35,0	43,6	-10,5	5,1				-15,6	3	0,5
36,0	43,6	-10,4	5,1				-15,6	3	0,5
37,0	43,7	-10,3	5,2				-15,6	3	0,5
38,0	43,7	-10,2	5,3				-15,6	3	0,5
39,0	43,7	-10,2	5,4				-15,6	3	0,5
40,0	43,8	-10,1	5,5				-15,6	3	0,5

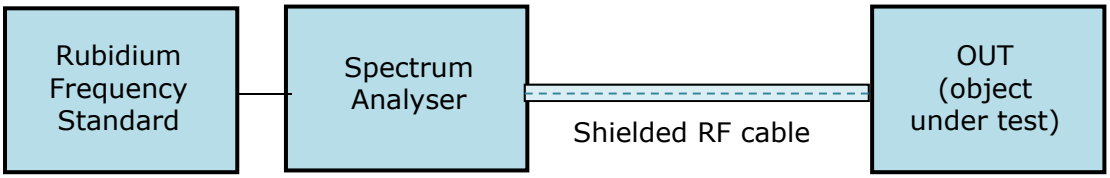
Sample calculation

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

7 Setup Drawings



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



Drawing 2: Setup for conducted radio tests.

8 Measurement Uncertainties

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

9 Photo Report

Please see separate photo report.