FCC ID: DMOLSP500 **IC ID: 2099A-LSP500**

EMI – TEST REPORT

- FCC Part 15.247, RSS210 -

Test Report No. : **T36407-00-04HS**	09. July 2013 Date of issue

Type / Model Name : LSP 500 PRO

Product Description : Wireless Integrated PA System

Applicant : Sennheiser electronic GmbH & Co. KG

Address : Am Labor 1

30900 WEDEMARK, GERMANY

Manufacturer : Sennheiser electronic GmbH & Co. KG

Address : Am Labor 1

30900 WEDEMARK, GERMANY

Licence holder : Sennheiser electronic GmbH & Co. KG

Address : Am Labor 1

30900 WEDEMARK, GERMANY

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

DAkkS Deutsche Akkreditierungsstelle D-PL-12030-01-01 D-PL-12030-01-02

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2012)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310	Radiofrequency radiation exposure limits
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: portable device

OET Bulletin 65, 65A, 65B, 65C Edition 97-01, August 1997 – Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

ANSI C63.4: 2003	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C95.1: 2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
CISPR 16-4-2: 2003	Uncertainty in EMC measurement
CISPR 22: 2005 EN 55022: 2006	Information technology equipment
DA 00-705	Filing and measurement guidelines for FHSS systems

2 SUMMARY

2.1 Test result summery

Bluetooth device using frequency hopping:

Operating in the 2402 MHz – 2480 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS Gen, 7.2.4.	AC power line conducted emissions	passed
15.247(a)(1)	RSS210, A8.1(a)	20 dB EBW	passed
15.247(a)(1)	RSS-210, A8.1(b)	Channel separation	passed
15.247(a)(1)	RSS-210, A8.1(d)	Dwell time	passed
15.247(b)(1)	RSS-210, A8.4(2)	Peak power	passed
15.247(d)	RSS-210, A8.5	Spurious emissions	passed
15.247(d)	RSS-210, A8.5	Out-of-band emission, radiated	passed
15.247(d)	RSS-Gen, 7.2.2	Emissions in restricted bands	passed
15.247(e)	RSS-210, A8.2(b)	Hopping sequence	passed
15.247(a)	RSS-210, A8.1(b)	Receiver input bandwith	passed
15.247(a)	RSS-210, A8.1(d)	Number of hopping channels	passed
15.247(a)	-	Equal hopping frequency use	passed
15.35(c)	RSS-Gen, 4.5	Pulsed operation	not applicable
15.247(i)	RSS 102, 2.5.2	MPE	passed
15.247(b)(4)	RSS-Gen, 7.1.2	Antenna requirement	passed
	RSS-Gen, 7.2.6	Transmitter frequency stability	not applicable
OET Bulletin 65	RSS102, 3.2	Co-location, Co-transmission	passed

The mentioned RSS Rule Parts in the above table are related to:
RSS Gen, Issue 3, December 2010
RSS 210, Issue 8, December 2010
RSS 102, Issue 4, March 2010

2.2 GENERAL REMARKS:

The EUT uses a Bluetooth module which is fully compliant to Bluetooth V2.1+EDR and has an integrated chip antenna, a temporary connector can not be implemented due to the small size of the module. A suitable test fixture can also not used to convert radiated measurements to conducted measurements therefore all measurements were performed radiated.

Items	Description
BT Module type	WT32-A
Power type	Mains and battery powered
Modulation	FHSS (GFSK / π/4-DQPSK / 8DPSK)
Frequency range	2400 MHz to 2483.5 MHz
Channel numbers	79
Data rate (Mbps)	1 (GFSK), 2 (π/4-DQPSK), 3 (8DPSK)
Antenna type	Integrated
Bluetooth version compliant to	V2.1+EDR
Bluetooth conformance test	Bluetooth QDID: B014372

Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2402	28	2429	55	2456
2	2403	29	2430	56	2457
3	2404	30	2431	57	2458
4	2405	31	2432	58	2459
5	2406	32	2433	59	2460
6	2407	33	2434	60	2461
7	2408	34	2435	61	2462
8	2409	35	2436	62	2463
9	2410	36	2437	63	2464
10	2411	37	2438	64	2465
11	2412	38	2439	65	2466
12	2413	39	2440	66	2467
13	2414	40	2441	67	2468
14	2415	41	2442	68	2469
15	2416	42	2443	69	2470
16	2417	43	2444	70	2471
17	2418	44	2445	71	2472
18	2419	45	2446	72	2473
19	2420	46	2447	73	2474
20	2421	47	2448	74	2475
21	2422	48	2449	75	2476
22	2423	49	2450	76	2477
23	2424	50	2451	77	2478
24	2425	51	2452	78	2479
25	2426	52	2453	79	2480
26	2427	53	2454		
27	2428	54	2455		

Antennas

The following antennas shall be used with the EUT:

Number	Characteristic	Certification name	Plug	*f*-range (GHz)	Gain (dBi)
1	Omni	W3008 (Chip antenna)	PCB-Soldered	2.4 - 2.4835	1.7

Operation modes:

- synchronous mode (SCO or eSCO traffic, for HV, DV or DM packets) for transmitting voice or data,
- asynchronous mode (ACL traffic, for DM or DH packets) for transmitting data,
- mixed transfer mode (for voice and data,

The most important mode is the ACL mode at a data rate of 3 Mbps for the worst case.

Packets:

A summery of the packets in ACL mode and their characteristics is shown in the following table:

Type	Payload Header (bytes)	User Payload (bytes)	FEC	CRC	Symmetric Max. Rate (kb/s)	Asymmetric Max. Rate (kb/s)	
						Forward	Reverse
DM1	1	0-17	2/3	yes	108.8	108.8	108.8
DH1	1	0-27	no	yes	172.8	172.8	172.8
DM3	2	0-121	2/3	yes	258.1	387.2	54.4
DH3	2	0-183	no	yes	390.4	585.6	86.4
DM5	2	0-224	2/3	yes	286.7	477.8	36.3
DH5	2	0-339	no	yes	433.9	723.2	57.6
AUX1	1	0-29	no	no	185.6	185.6	185.6
2-DH1	2	0-54	no	yes	345.6	345.6	345.6
2-DH3	2	0-367	no	yes	782.9	1174.4	172.8
2-DH5	2	0-679	no	yes	869.1	1448.5	115.2
3-DH1	2	0-83	no	yes	531.2	531.2	531.2
3-DH3	2	0-552	no	yes	1177.6	1766.4	235.6
3-DH5	2	0-1021	no	yes	1306.9	2178.1	177.1

Modulation types:
For the DH5 packet the pay load modulation GFSK, for 2-DH3 the modulation π/4-DQPSK, for 3-DH5 the modulation 8DPSK is used.

The different operating modes (data-mode, acquisition-mode) of a Bluetooth device don't influence the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters. Only a different hopping sequence will be used. For this reason the check of these RF parameters in one op-mode is sufficient. The packet 3-DH5 shows most of modulation side bands and means the worst case. This modulation type is chosen for testing.

The frequency range was scanned from 4 MHz to 25000 MHz. All emissions not reported in this test report are more than 20 dB below the specified limit.

2.3 FINAL ASSESSMENT:

The equipment under test **fulfills** the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 10 June 2013

Testing concluded on : 17 June 2013

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this documents
2013.07.09 13:59:16 +02'00'

Klaus Gegenfurtner
Dipl.-Ing.(FH)
Manager: Radio Group

Tested by:

Hermann Smetana
I am the author of this document
2013.07.09 13:52:39 +02'00'

Hermann Smetana
Dipl.-Ing.(FH)
Radio Senior Expert

3 EQUIPMENT UNDER TEST

3.1 Photo documentation of the EUT – Detailed photos see attachment A

3.2 Power supply system utilised

Power supply voltage : 100 - 240 VAC, alternatively 14.4 VDC (Lithium-ion battery)

3.3 Short description of the EUT

The EUT is a professional portable speaker with Bluetooth-Interface for wireless connection with host devices and a WLAN-Interface for control the inputs, outputs, mixing and equalising functions. “Link in” and “Link out” are for interconnection devices with the same type for speaker groups. The speaker can optionally load 3 receivers for wireless microphones.

Number of tested samples: 2 Samples
Serial number: RX sample: 3502390873, TX sample: 3163494347.

EUT operation mode:

The equipment under test was operated during the measurement under the following conditions:

- TX mode, GFSK
- TX mode, π/4-DQPSK
- TX mode, 8DPSK
- RX mode continuous

EUT configuration:

(The CDF filled by the applicant can be viewed at the test laboratory.)

The following peripheral devices and interface cables were connected during the measurements:

-	Aux in, 1 m	Model :	Common
-	Line out, 1 m	Model :	Common
-	XLR Link in, 10 m	Model :	Common
-	XLR Link out, 10 m	Model :	Common
-	XLR Mic in, 10 m	Model :	Common
-	USB-Stick	Model :	Common

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

mikes-testingpartners gmbh
Ohmstrasse 2-4
94342 Strasskirchen
Germany

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader may notice that tolerances within the calibration of the equipment and facilities may cause additional uncertainty. The measurement uncertainty is calculated for all measurements listed in this test report acc. to CISPR 16-4-2 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurement“ and documented in the mikes-testingpartners gmbh quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, mikes-testingpartners gmbh, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component diversity and modifications in production process of devices may result in additional deviation. If necessary, refer to the test lab for the actual measurement uncertainty for the specific test. The manufacturer has the sole responsibility of continued compliance of the EUT.

4.4 Measurement protocol for FCC and IC

4.4.1 GENERAL INFORMATION

4.4.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

IC 3009A-1

In compliance with RSS 210 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.4.1.2 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.4.1.3 Details of test procedures

The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.4 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

4.5 Determination of worst case measurement conditions

Measurements have been made in all three orthogonal axes and the settings of the EUT were changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.

Declaration of Bluetooth for FCC 15.247 requirements

1. Output power and channel separation of a Bluetooth device in the different operating modes:
The different operating modes (data-mode, acquisition-mode) of a Bluetooth device don't influence the output power and the channel spacing. There is only one transmitter which is driven by identical input parameters concerning these two parameters. Only a different hopping sequence will be used. For this reason the check of these RF parameters in one op-mode is sufficient.
2. Frequency range of a Bluetooth device:
Hereby we declare that the maximum frequency of this device is 2402 MHz to 2480 MHz. This is according the Bluetooth Core Specification (+ critical errata) for devices which will be operated in the USA. This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/04-E). Other frequency ranges (e.g. for Spain, France, Japan) which are allowed according the Core Specification are not supported by this device.
3. Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:
Bluetooth units which want to communicate with other units must be organized in a structure called piconet. This piconet consist of maximum 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from its BD address which is unique for each Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.
4. Example of a hopping sequence in data mode:
Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04
5. Equally average use of frequencies in data mode and behaviour for short transmissions:
The generation of the hopping sequence in connection mode depends essentially on two input values:
a. LAP/UAP of the master of the connection
b. Internal master clock
The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS.The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronization with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the Rx/Tx slot length of 312.5 µs. The clock has a cycle of about one day (23hr30min). In most case, it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits)

(Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission. Regarding short transmissions the Bluetooth system has the following behaviour:

The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended. The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always differ from the first one.

6. Receiver input bandwidth and behaviors for repeated single or multiple packets:

The input bandwidth of the receiver is 1 MHz. In every connection one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence (see chapter 5). The slave follows this sequence. Both devices shift between Rx and Tx time slot according to the clock of the master. Additionally the type of connection (e.g. single or multi-slot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its Tx/Rx timing according to the packet type of the connection. Also the slave of the connection will use these settings. Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

7. Dwell time in data mode

The dwell time of 0.3797s within a 30 second period in data mode is independent from the packet type (packet length). The calculation for a 30 second period is a follows:

Dwell time = time slot length * hop rate / number of hopping channels * 30s

Example for a DH1 packet (with a maximum length of one time slot)

Dwell time = 625 µs * 1600 * 1/s / 79 * 30s = 0.3797s (in a 30s period)

For multi-slot packet the hopping is reduced according to the length of the packet.

Example for a DH5 packet (with a maximum length of five time slots)

Dwell time = 5 * 625 µs * 1600 * 1/5 * 1/s / 79 * 30s = 0.3797s (in a 30s period)

This is according the Bluetooth Core Specification V 1.0B (+ critical errata) for all Bluetooth devices. There for all Bluetooth devices comply with the FCC dwell time requirement in data mode. This was checked during the Bluetooth Qualification tests. The Dwell time in hybrid mode is measured and stated in the test report.

8. Channel Separation in hybrid mode

The nominal channel spacing of the Bluetooth system is 1MHz independent of the operating mode. The maximum "initial carrier frequency tolerance" which is allowed for Bluetooth is fcenter = 75 kHz. This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/07-E) for three frequencies (2402 MHz, 2441 MHz, and 2480 MHz). Additionally an example for the channel separation is given in the test report

9. Derivation and examples for a hopping sequence in hybrid mode

For the generation of the inquiry and page hop sequences the same procedures as described for the data mode are used (see chapter 5), but this time with different input vectors:

a. For the inquiry hop sequence, a predefined fixed address is always used. This results in the same 32 frequencies used by all devices doing an inquiry but every time with a different start frequency and phase in this sequence.

b. For the page hop sequence, the device address of the paged unit is used as input vector. This results in the use of a subset of 32 frequencies which is specific for that initial state of the connection establishment between the two units. A page to different devices would result in a different subset of 32 frequencies. So it is ensured that also in hybrid mode the frequency use equally averaged.

Example of a hopping sequence in inquiry mode:

48, 50, 09, 13, 52, 54, 41, 45, 56, 58, 11, 15, 60, 62, 43, 47, 00, 02, 64, 68, 04, 06, 17, 21, 08, 10, 66, 70, 12, 14, 19, 23

Example of a hopping sequence in paging mode:

08, 57, 68, 70, 51, 02, 42, 40, 04, 61, 44, 46, 63, 14, 50, 48, 16, 65, 52, 54, 67, 18, 58, 56, 20, 53, 60, 62, 55, 06, 66, 64

10. Receiver input bandwidth and synchronization in hybrid mode:

The receiver input bandwidth is the same as in the data mode (1 MHz). When two Bluetooth devices establish contact for the first time, one device sends an inquiry access code; the other device is scanning for this inquiry access code. If two devices have been connected previously and want to start a new transmission, a similar procedure takes place. The only difference is, instead of the inquiry access code, an special access code, derived from the BD_ADDRESS of the paged device will be, will be sent by the master of this connection.

Due to the fact that both units have been connected before (in the inquiry procedure) the paging unit has timing and frequency information about the page scan of the paged unit. For this reason the time to establish the connection is

reduced considerable.

11. Spread rate / data rate of the direct sequence signal

The Spread rate / Data rate in inquiry and paging mode can be defined via the access code. The access code is the only criterion for the system to check if there is a valid transmission or not. If you regard the presence of a valid access code as one bit of information, and compare it with the length of the access code of 68 bits, the Spread rate/ Data rate will be 68/1.

12. Spurious emission in hybrid mode

The dwell time in hybrid mode is shorter than in data mode. For this reason the spurious emissions average level in data mode is worst case. The spurious emissions peak level is the same for both modes.

Following channels and test modes are selected for the final test as listed below:

Technology	Available channels	Tested channels	Modulation	Packet type
Bluetooth	1 - 79	1, 40, 79	GFSK	DH5
Bluetooth	1 - 79	1, 40, 79	π/4-DQPSK	2-DH5
Bluetooth	1 - 79	1, 40, 79	8DPSK	3-DH5

5 TEST CONDITIONS AND RESULTS

5.1 Conducted emissions

For test instruments and accessories used see section 6 Part **A 4**.

5.1.1 Description of the test location

Test location: Shielded Room S2

5.1.2 Photo documentation of the test set-up

5.1.3 Applicable standard

According to FCC Part 15, Section 15.207(a):
Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

5.1.4 Description of Measurement

The measurements are performed following the procedures set out in ANSI C63.4 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are remeasured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

5.1.5 Test result

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin -7.6 dB at 0.17 MHz

Limit according to FCC Part 15, Section 15.207(a):

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

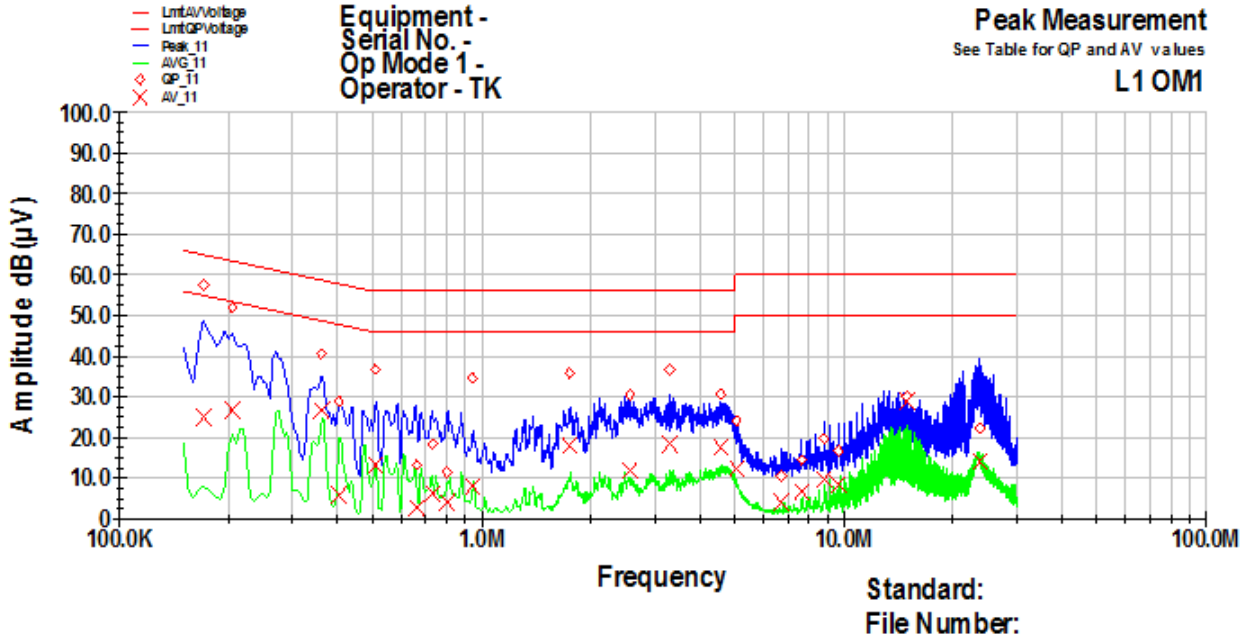
* Decreases with the logarithm of the frequency

The requirements are **FULFILLED.**

Remarks: For detailed test result please refer to following test protocols.

5.1.6 Test protocol

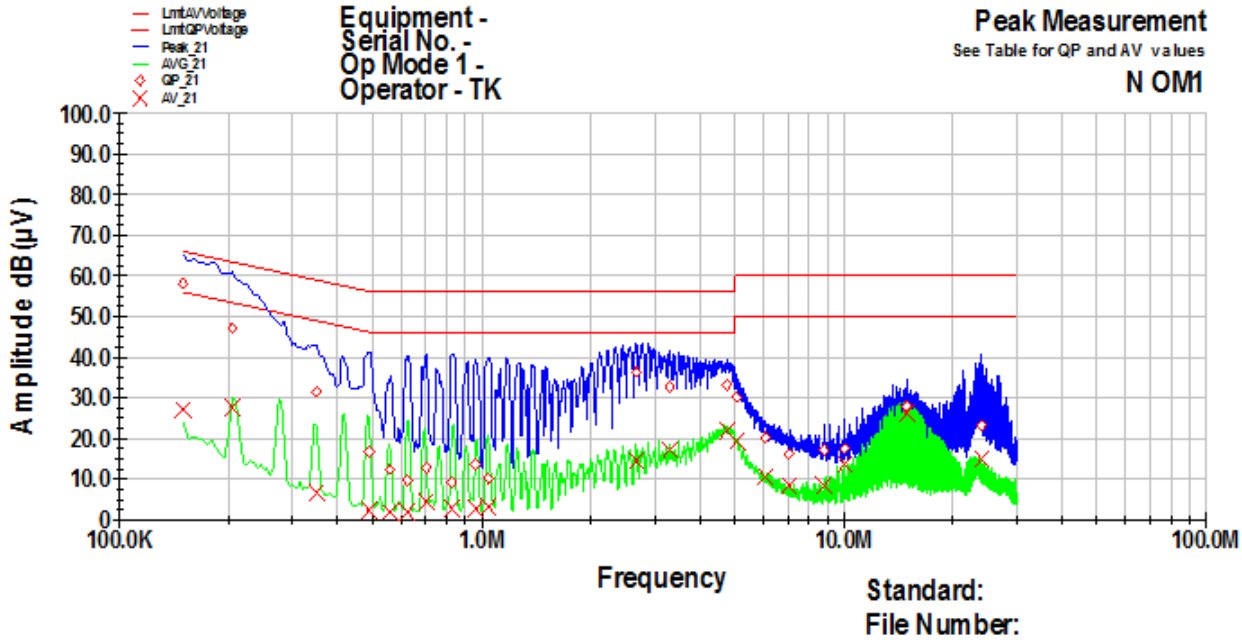
Test point L1 Result: passed
Operation mode: TX mode, GFSK
Remarks: Audio device 1/8 power



Frequency	QP Level	QP Margin	QP Limit	AV Level	AV Margin	AV Limit
MHz	dB(µV)	dB	dB	dB(µV)	dB	dB
0.17	57.4	-7.6	65.0	24.9	-30.1	55.0
0.205	52.0	-11.4	63.4	26.6	-26.8	53.4
0.36	40.5	-18.2	58.7	26.6	-22.2	48.7
0.405	29.0	-28.7	57.8	5.9	-41.8	47.8
0.51	36.7	-19.3	56.0	13.0	-33.0	46.0
0.66	13.1	-42.9	56.0	2.9	-43.1	46.0
0.73	18.6	-37.4	56.0	6.2	-39.8	46.0
0.805	11.6	-44.5	56.0	4.0	-42.0	46.0
0.945	34.5	-21.5	56.0	8.0	-38.0	46.0
1.755	35.9	-20.1	56.0	17.9	-28.1	46.0
2.56	30.6	-25.4	56.0	11.9	-34.2	46.0
3.295	36.7	-19.3	56.0	18.7	-27.3	46.0
4.565	30.6	-25.4	56.0	17.5	-28.5	46.0
5.055	23.9	-36.1	60.0	12.4	-37.5	50.0
6.7	10.8	-49.2	60.0	4.0	-46.0	50.0
7.63	14.3	-45.7	60.0	6.7	-43.3	50.0
8.825	19.6	-40.4	60.0	9.9	-40.1	50.0
9.64	16.5	-43.5	60.0	8.3	-41.7	50.0
14.95	30.3	-29.7	60.0	28.9	-21.1	50.0
23.65	22.2	-37.8	60.0	14.0	-36.0	50.0

FCC ID: DMOLSP500 **IC ID: 2099A-LSP500**

Test point N Result: passed
Operation mode: TX mode, GFSK
Remarks: Audio device 1/8 power



Frequency	QP Level	QP Margin	QP Limit	AV Level	AV Margin	AV Limit
MHz	dB(µV)	dB	dB	dB(µV)	dB	dB
0.15	58.0	-8.0	66.0	27.3	-28.7	56.0
0.205	47.1	-16.3	63.4	27.4	-26.0	53.4
0.35	31.5	-27.5	59.0	6.5	-42.5	49.0
0.49	16.9	-39.3	56.2	2.4	-43.8	46.2
0.56	12.4	-43.6	56.0	2.0	-44.0	46.0
0.625	9.8	-46.2	56.0	1.7	-44.3	46.0
0.705	12.9	-43.1	56.0	4.4	-41.6	46.0
0.83	9.1	-46.9	56.0	3.0	-43.0	46.0
0.96	13.5	-42.5	56.0	2.8	-43.3	46.0
1.045	10.3	-45.7	56.0	3.0	-43.0	46.0
2.665	36.3	-19.7	56.0	14.6	-31.4	46.0
3.3	32.9	-23.1	56.0	17.0	-29.0	46.0
4.74	33.4	-22.6	56.0	21.9	-24.1	46.0
5.03	30.1	-29.9	60.0	19.5	-30.5	50.0
6.06	20.0	-40.0	60.0	10.5	-39.5	50.0
7.08	16.3	-43.7	60.0	8.5	-41.5	50.0
8.82	17.1	-42.9	60.0	8.3	-41.7	50.0
10	17.6	-42.4	60.0	13.7	-36.3	50.0
14.95	27.9	-32.1	60.0	26.3	-23.7	50.0
23.895	23.2	-36.8	60.0	15.0	-35.0	50.0

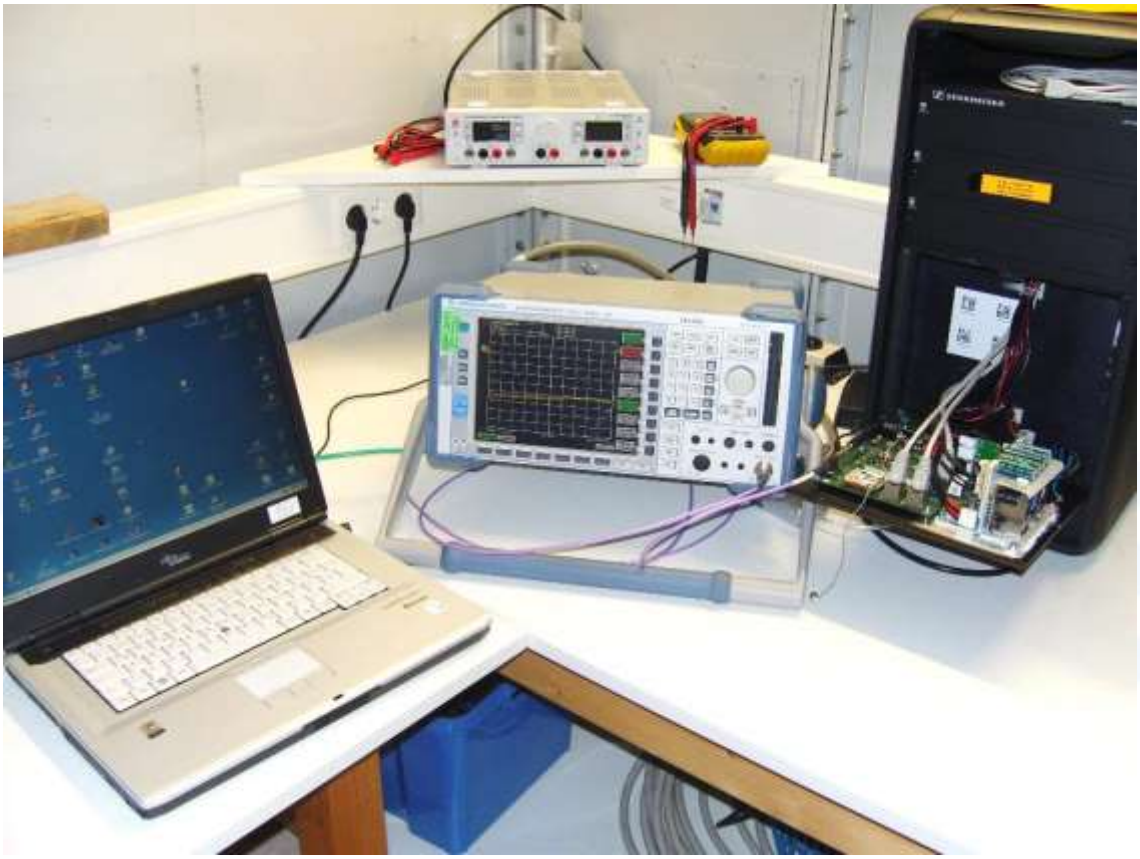
5.2 Emission bandwidth

For test instruments and accessories used see section 6 Part **MB**.

5.2.1 Description of the test location

Test location: AREA4

5.2.2 Photo documentation of the test set-up



5.2.1 Applicable standard

According to FCC Part 15C, Section 15.247(a):
Frequency hopping systems shall have hopping carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

5.2.2 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -20 dB. The reference level is the level of the highest signal amplitude observed from the transmitter at either the fundamental frequency or the first-order modulation products in all typical modes of operation.
Analyser settings:
RBW: 30 kHz, VBW: 100 kHz, Sweep time: auto, Detector: Peak, Trace mode: Max hold

5.2.3 Test result

DH5 Packet

Channel	f	EBW 20 dB
	(MHz)	(MHz)
CH1	2402	0.811
CH40	2441	0.935
CH79	2480	0.937

2-DH5 Packet

Channel	f	EBW 20 dB
	(MHz)	(MHz)
CH1	2402	1.182
CH40	2441	1.182
CH79	2480	1.181

3-DH5 Packet

Channel	f	EBW 20 dB
	(MHz)	(MHz)
CH1	2402	1.167
CH40	2441	1.162
CH79	2480	1.158

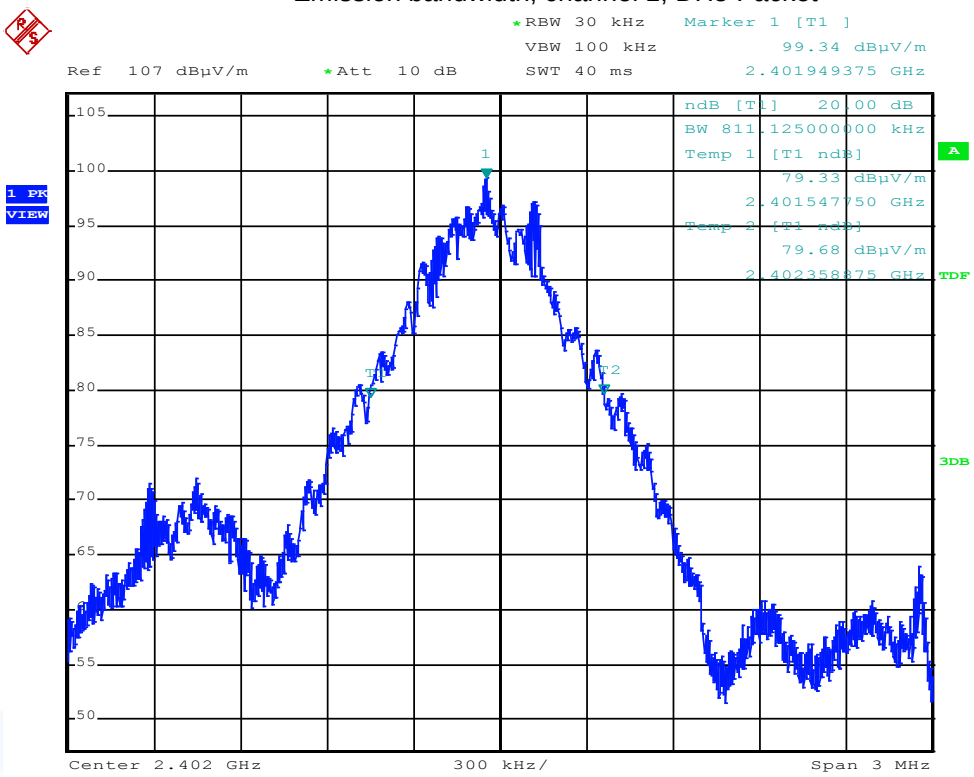
There is no bandwidth limit according to FCC Part15C, Section 15.247(a).

The requirements are FULFILLED.

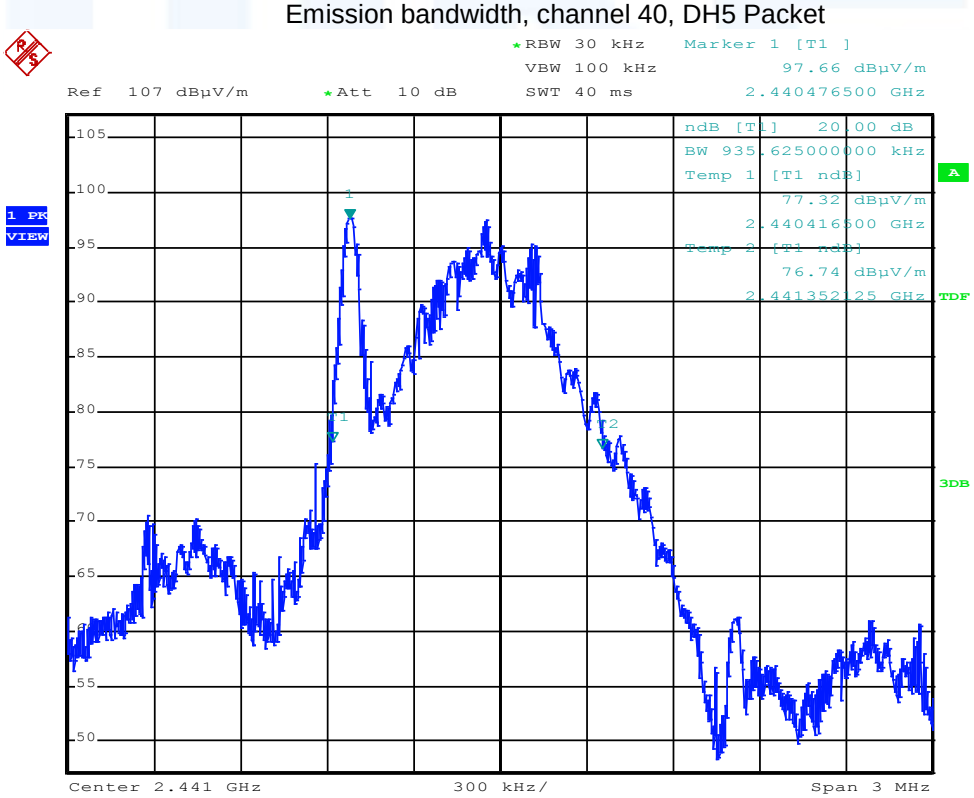
Remarks: For detailed test result please refer to following test protocols.

5.2.4 Test protocol

Emission bandwidth, channel 1, DH5 Packet

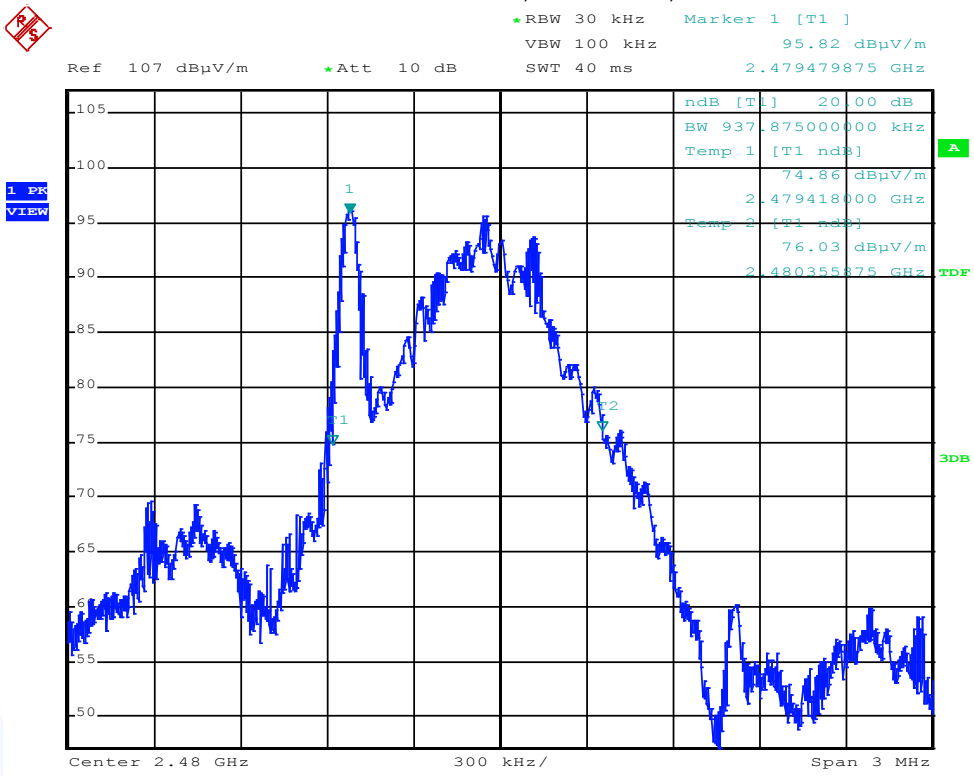


Emission bandwidth, channel 40, DH5 Packet

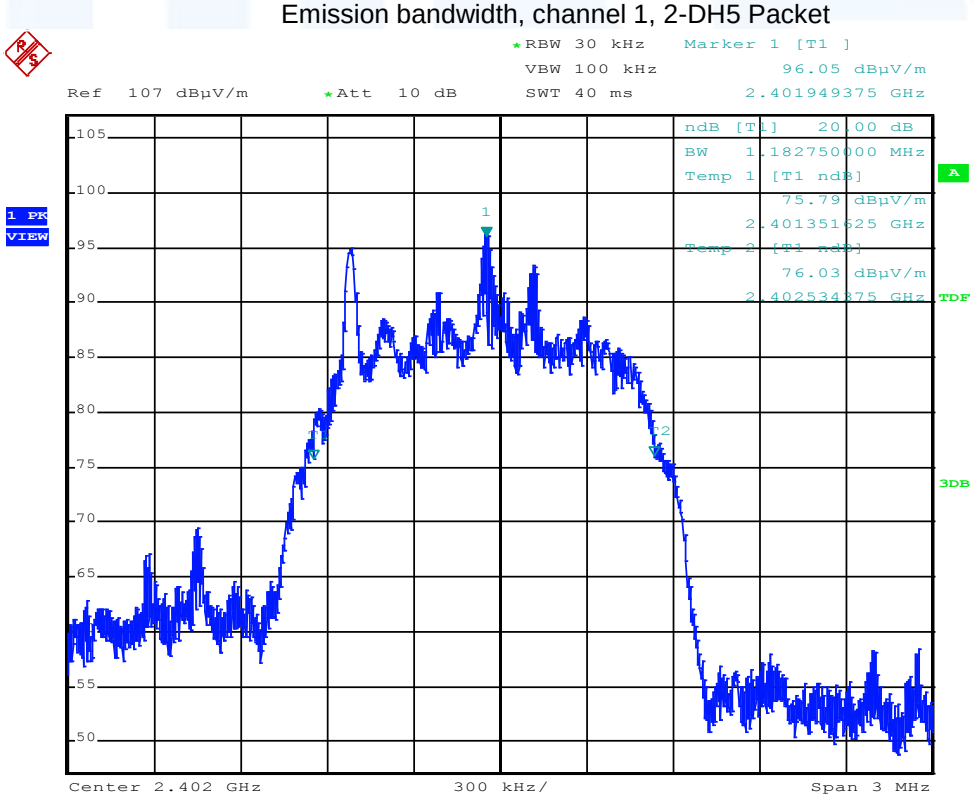


FCC ID: DMOLSP500 IC ID: 2099A-LSP500

Emission bandwidth, channel 79, DH5 Packet

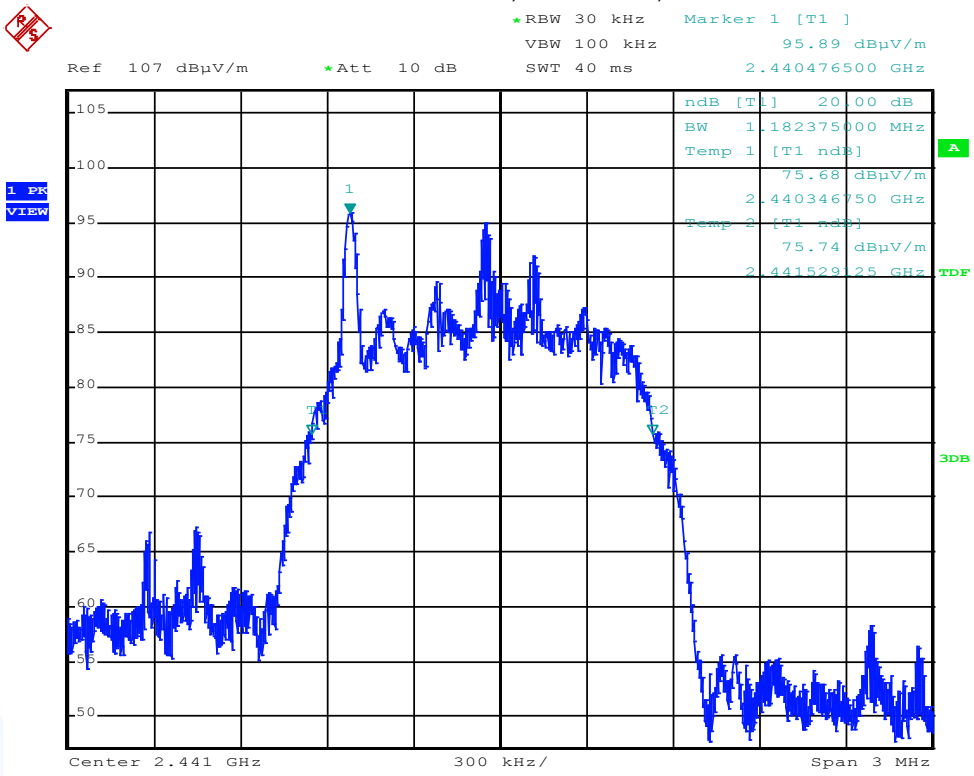


Emission bandwidth, channel 1, 2-DH5 Packet

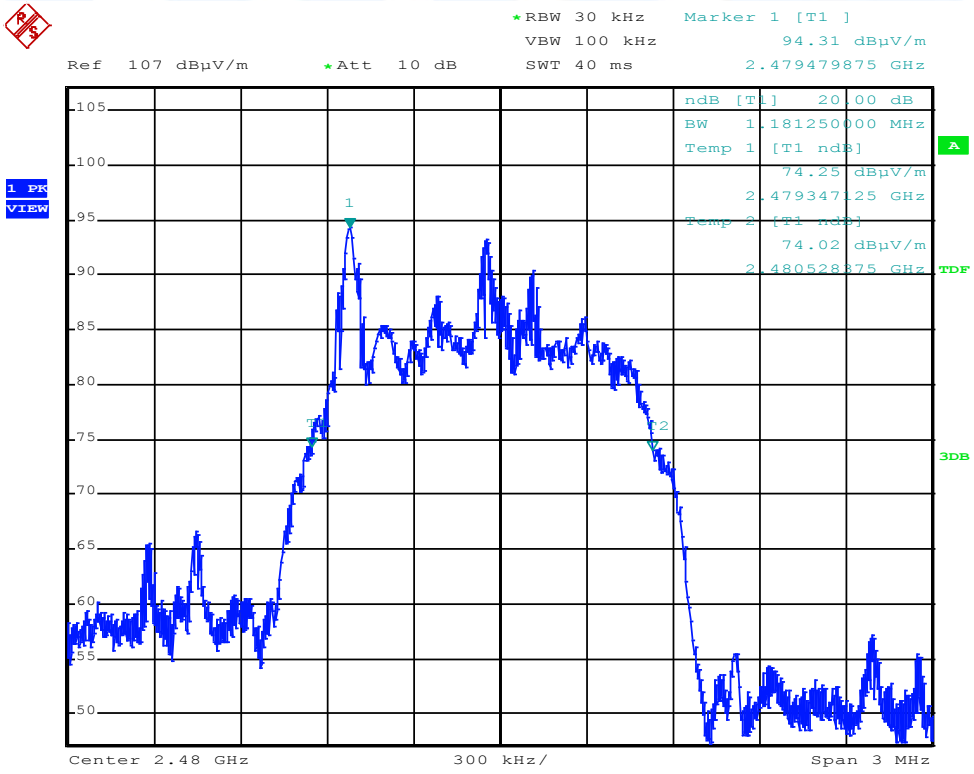


FCC ID: DMOLSP500 IC ID: 2099A-LSP500

Emission bandwidth, channel 40, 2-DH5 Packet

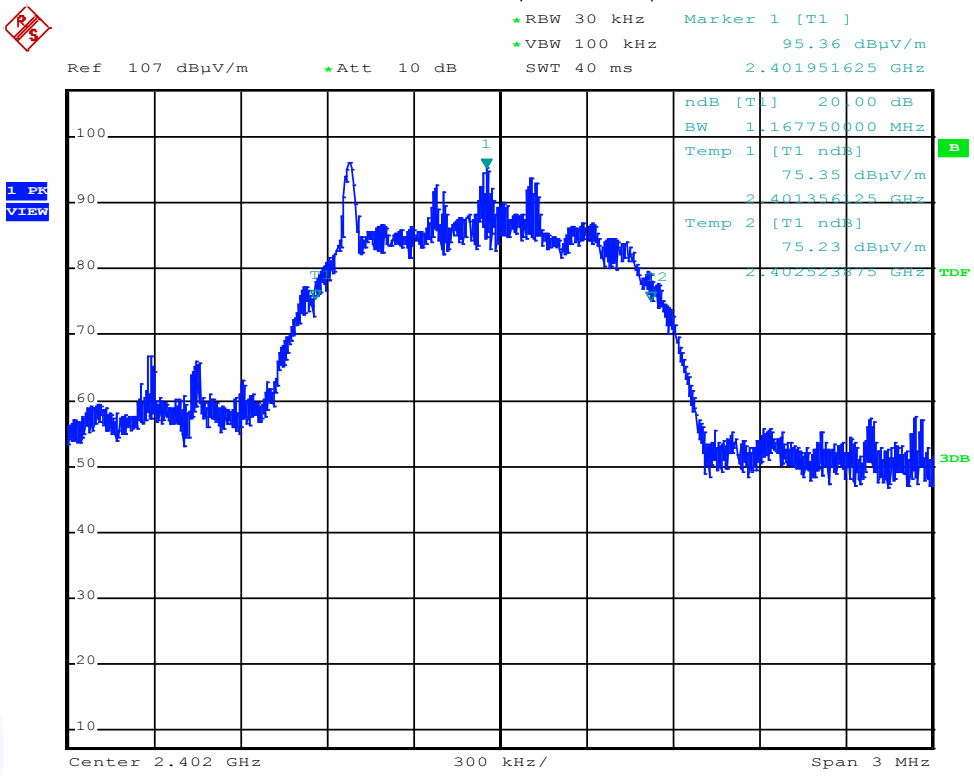


Emission bandwidth, channel 79, 2-DH5 Packet

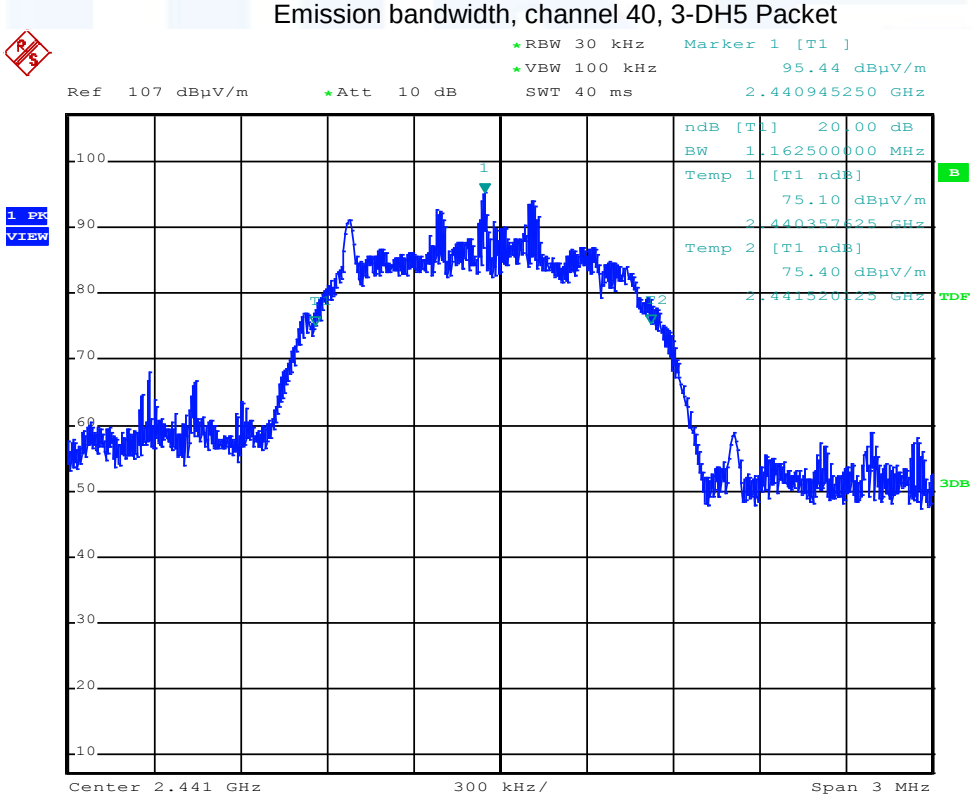


FCC ID: DMOLSP500 **IC ID: 2099A-LSP500**

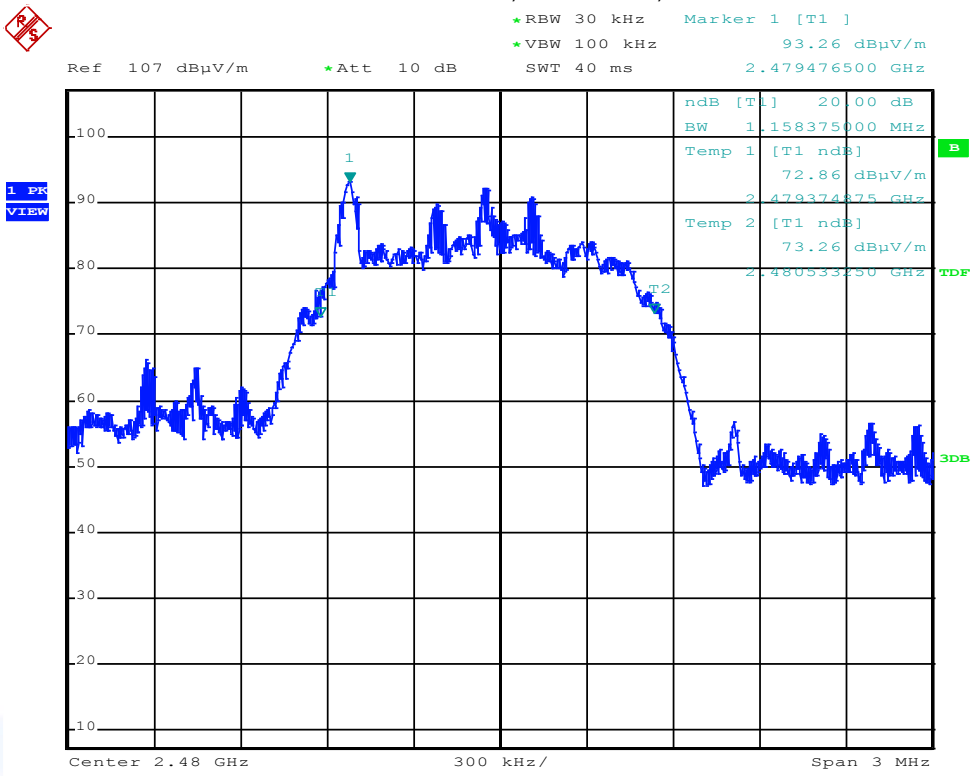
Emission bandwidth, channel 1, 3-DH5 Packet



Emission bandwidth, channel 40, 3-DH5 Packet



Emission bandwidth, channel 79, 3-DH5 Packet



5.3 Maximum peak output power radiated

For test instruments and accessories used see section 6 Part **CPR 3**.

5.3.1 Description of the test location

Test location: Anechoic chamber 2

5.3.2 Photo documentation of the test set-up

5.3.3 Applicable standard

According to FCC Part 15C, Section 15.247(a)(1):
The maximum peak output power of an intentional radiator shall not exceed the limit defined in dependency of the channel separation and of the number of hopping channels.

5.3.4 Description of Measurement

A spectrum analyser is connected to the output of the transmitter via a suitable attenuator while EUT is operating in transmit mode using the assigned frequency according to DA 00-705. The correction factor takes the cable loss into account.

Analyser settings:
RBW: 3 MHz, VBW ≥ RBW, Detector: Max peak, Trace: Max hold, Sweep time: auto

5.3.5 Test result

DH5 Packet

Channel	f	EIRP	Gain	P	Limit	Delta
	(MHz)	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
CH1	2402	-4.7	1.7	-6.4	30	-36.4
CH40	2441	-6.3	1.7	-8	30	-38.0
CH79	2480	-8	1.7	-9.7	30	-39.7

2-DH5 Packet

Channel	f	EIRP	Gain	P	Limit	Delta
	(MHz)	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
CH1	2402	-4.7	1.7	-6.4	30	-36.4
CH40	2441	-8	1.7	-9.7	30	-39.7
CH79	2480	-9.8	1.7	-11.5	30	-41.5

3-DH5 Packet

Channel	f	EIRP	Gain	P	Limit	Delta
	(MHz)	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
CH1	2402	-10.7	1.7	-12.4	30	-42.4
CH40	2441	-8.5	1.7	-10.2	30	-40.2
CH79	2480	-9.3	1.7	-11	30	-41.0

Peak Power Limit according to FCC Part 15C, Section 15.247(b)(1):

Frequency	Channel separation	Hop	Peak power limit	
(MHz)		Channels	(dBm)	(Watt)
2400-2483.5	-	≥ 75	30	1

The requirements are **FULFILLED.**

Remarks: _____

_____

5.4 Out-of-band emission, radiated

For test instruments and accessories used see section 6 Part **SER1, SER2 and SER3**.

5.4.1 Description of the test location

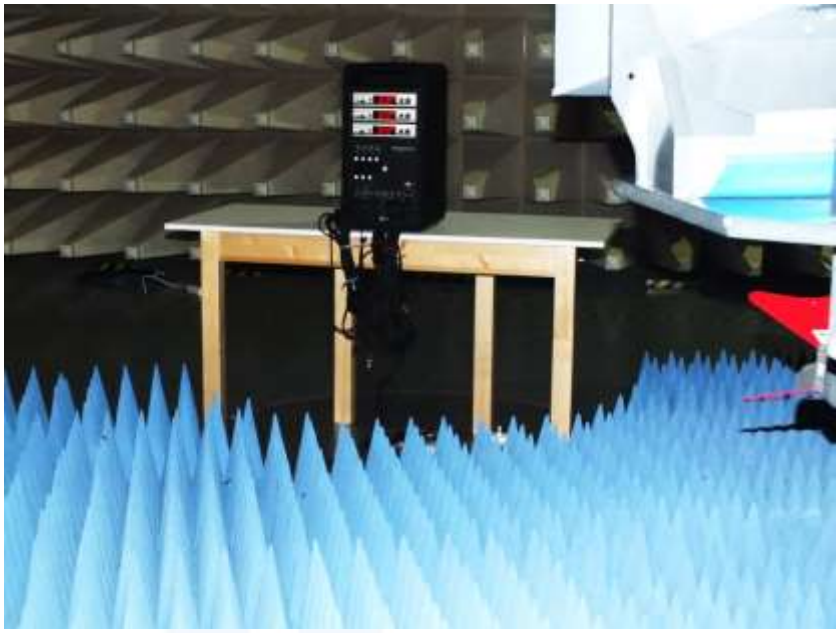
Test location: OATS 1
Test location: Anechoic chamber 1
Test distance: 3 m

5.4.2 Photo documentation of the test set-up

Open area test site

Open area test site

Anechoic chamber 1



5.4.3 Applicable standard

According to FCC Part 15C, Section 15.247(d):
In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.5 MHz and 5725 – 5850 MHz, the digitally modulated 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 an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

5.4.4 Description of Measurement

The spurious emissions falling in non restricted bands are measured radiated using a spectrum analyser in a test setup following the procedures set out in ANSI C63. The measurement is performed at normal test conditions in modulated TX continuous mode.
Spectrum analyser settings:
RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Trace: Max hold, Sweep: auto

5.4.5 Test result

9 kHz < f < 1000 MHz:
3-DH5 Packet
For all kinds of modulation no emission could be detected within 20 dB to the limit.

1000 MHz < f < 25000 MHz:

3-DH5 Packet

Lowest frequency: CH1						
Test conditions: TX , Pmax, 3DH5 Packet						
Reference power level:					98.1	dBµV/m
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
1000	2400	100	1249	40.8	78.1	-37.3
2483.5	4000	100	3202	39.0	78.1	-39.1
4000	12000	100	4803	44.8	78.1	-33.3
12000	18000	100	17778	40.9	78.1	-37.2
18000	25000	100	24944	33.6	78.1	-44.5
Measurement uncertainty				±6 dB		

Middle frequency: CH40						
Test conditions: TX , Pmax, 3DH5 Packet						
Reference power level:					98.1	dBµV/m
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
1000	2400	100	1067	37.9	78.1	-40.2
2483.5	4000	100	3254	39.9	78.1	-38.2
4000	12000	100	4881	43.8	78.1	-34.3
12000	18000	100	17726	40.8	78.1	-37.3
18000	25000	100	25000	33.4	78.1	-44.7
Measurement uncertainty				±6 dB		

Highest frequency: CH79						
Test conditions: TX , Pmax, 3DH5 Packet						
Reference power level:					98.1	dBµV/m
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
1000	2400	100	1067	38.6	78.1	-39.5
2483.5	4000	100	3306	40.4	78.1	-37.7
4000	12000	100	4960	48.5	78.1	-29.6
12000	18000	100	17677	40.5	78.1	-37.6
18000	25000	100	24860	33.1	78.1	-45.0
Measurement uncertainty				±6 dB		

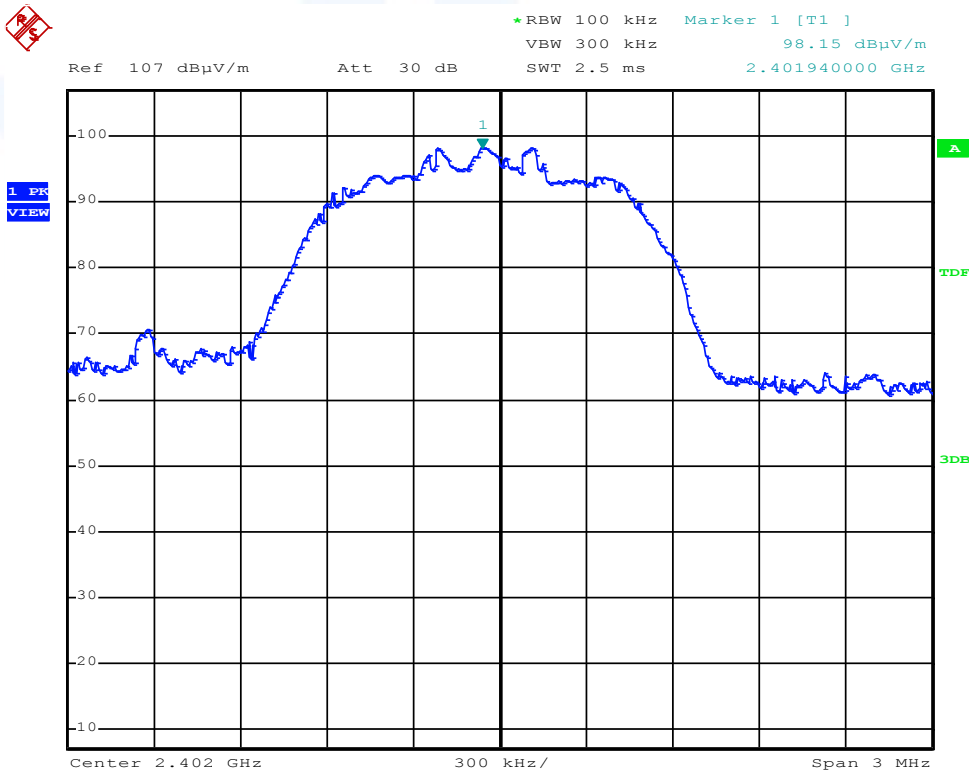
Peak-Limit according to FCC Part 15C, Section 15.247(d):
In any 100 kHz bandwidth outside the frequency band 2400 – 2483.50 MHz, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. 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 limit specified in Section 15.209(a).

The requirements are **FULFILLED.**

Remarks: For detailed test results please refer to following test protocols. Only the worst case plots are

5.4.6 Test protocol

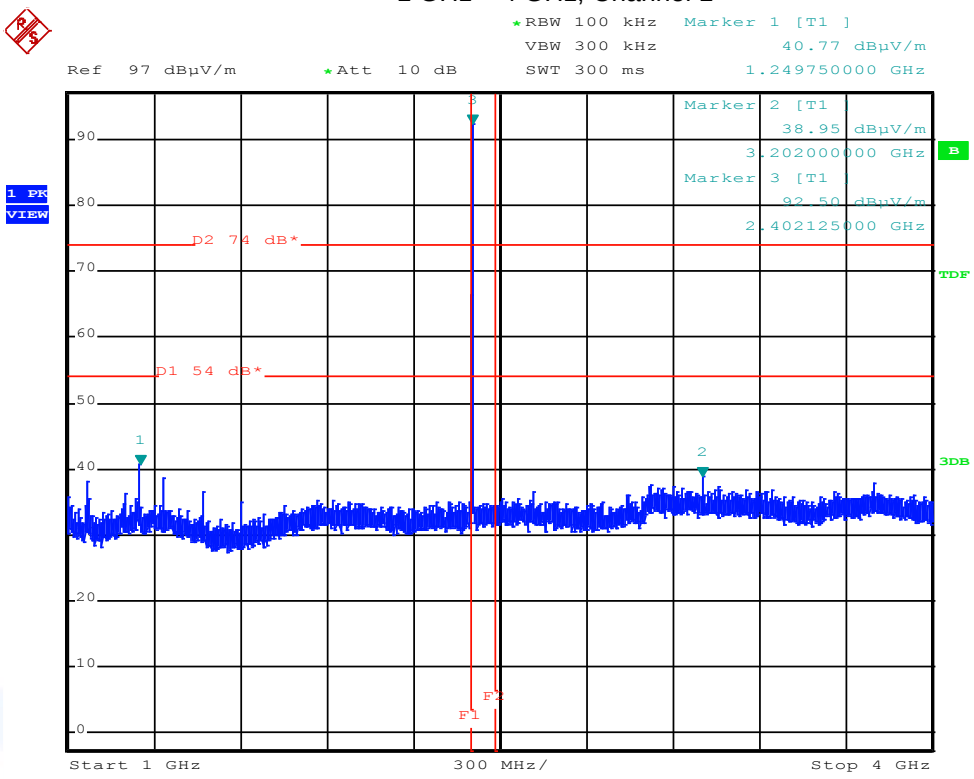
Determination of the limit level



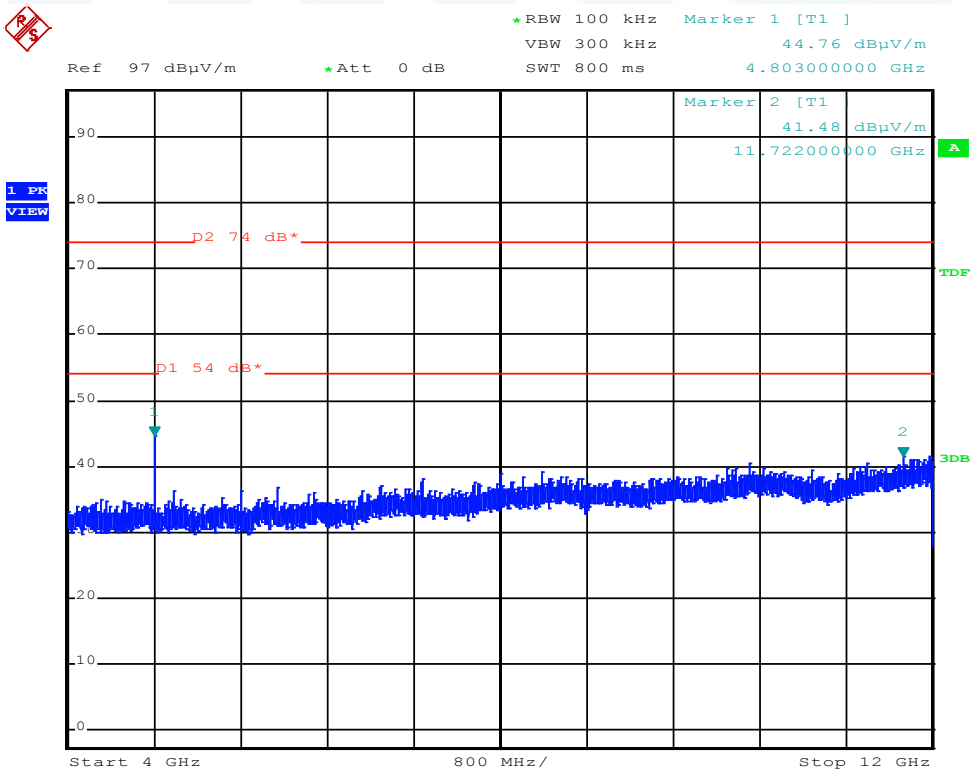
FCC ID: DMOLSP500 **IC ID: 2099A-LSP500**

Spurious emissions, 3-DH5 packet:

1 GHz – 4 GHz, Channel 1

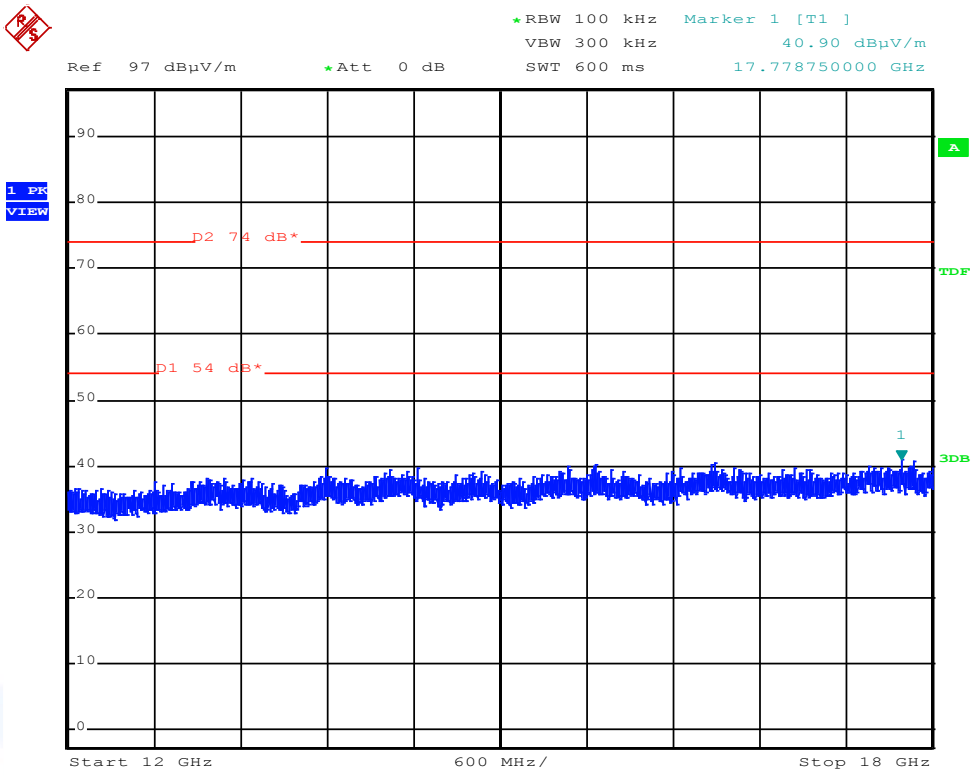


4 GHz – 12 GHz, Channel 1

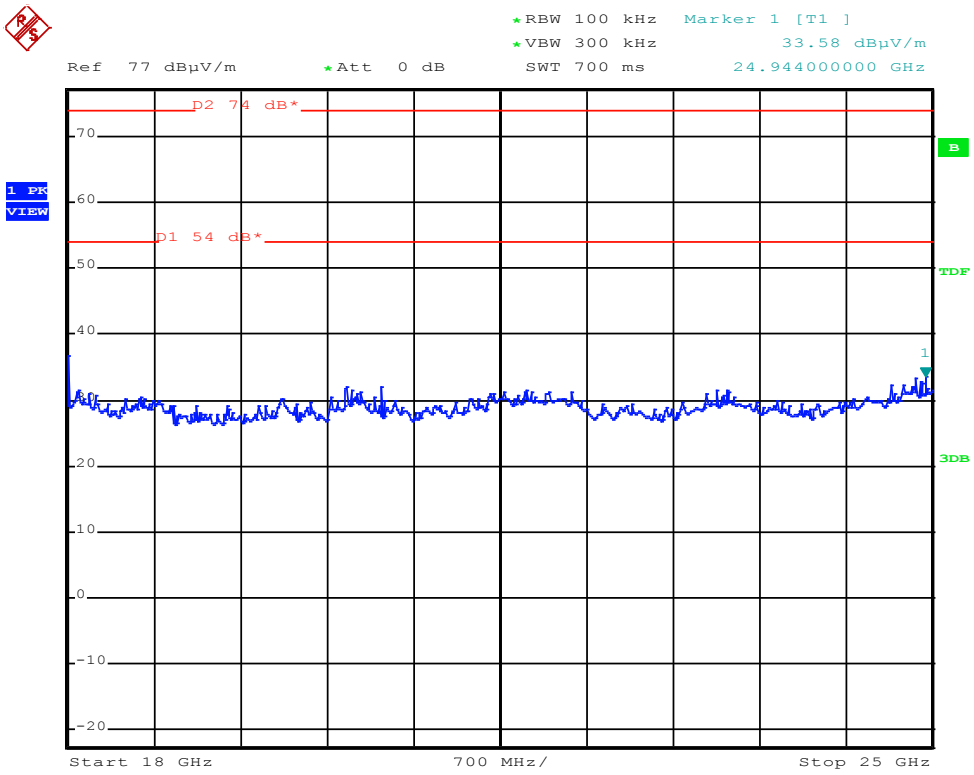


FCC ID: DMOLSP500 **IC ID: 2099A-LSP500**

12 GHz – 18 GHz, Channel 1



18 GHz – 25 GHz, Channel 1



5.5 Emissions in restricted bands, radiated

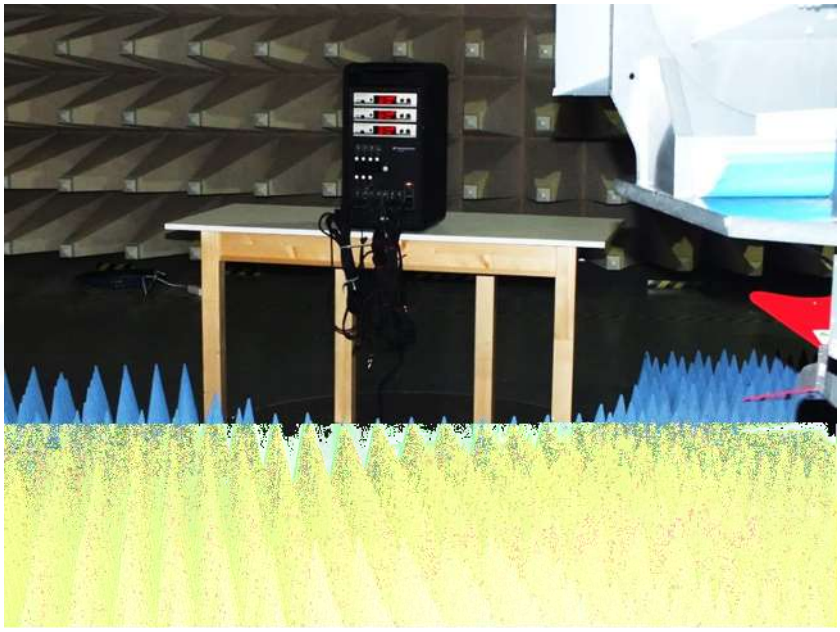
For test instruments and accessories used see section 6 Part **SER3**.

5.5.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.5.2 Photo documentation of the test set-up

Test setup 1 – 18 GHz



5.5.3 Applicable standard

According to FCC Part 15, Section 15.205(a):
In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

5.5.4 Description of Measurement

The spurious emissions falling in non restricted bands are measured radiated using a spectrum analyser in a test setup following the procedures set out in ANSI C63. The measurement is performed at normal test conditions in modulated TX continuous mode.
Spectrum analyser settings:

Peak:

9 kHz < f < 150 kHz:	RBW: 300 Hz,	VBW: 1 kHz,	Detector: Max peak,	Trace Mode: Max hold
150 kHz < f < 30 MHz:	RBW: 10 kHz,	VBW: 30 kHz,	Detector: Max peak,	Trace Mode: Max hold
30 MHz < f < 1000 MHz:	RBW: 100 kHz,	VBW: 300 kHz,	Detector: Max peak,	Trace Mode: Max hold
f > 1000 MHz:	RBW: 1 MHz,	VBW: 3 MHz,	Detector: Max peak,	Trace Mode: Max hold
AV: f > 1000 MHz:	RBW: 1 MHz,	VBW: 10 Hz,	Detector: Max peak,	Trace Mode: Max hold

5.5.5 Determination of the requirement for measuring the restricted bands:

Restricted band 2310 – 2390 MHz:	Is next to the operating band, has to be measured.
Restricted band 2483.5 – 2500 MHz:	Is next to the operating band, has to be measured.
Restricted band 2655 – 2900 MHz:	No harmonics, no other emission, no requirement to measure.
Restricted band 4500 – 5150 MHz:	Harmonics of the carrier may appear. The spurious emission measurement under item 5.4 shows harmonics at 4804 – 4960 MHz has to be measured.
Restricted band 5350 – 5460 MHz:	No Harmonics, no other emission, no requirement to measure.
Restricted band 7250 – 7750 MHz:	Harmonics of the carrier may appear. The spurious emission measurement under item 5.4 shows no harmonics, no requirement to measure.
Higher restricted bands:	No Harmonics, no other emission, no requirement to measure.

5.5.6 Test result

DH5 Packet

PK-measurement						
HIghest frequency: CH79						
Test conditions: TX , Pmax, DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
2483.5	2500	1000	2483.5	54.9	74.0	-19.1
4500	5150	1000	4960	55.5	74.0	-18.5
Measurement uncertainty				±6 dB		

AV-measurement						
HIghest frequency: CH79						
Test conditions: TX , Pmax, DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
2483.5	2500	1000	2483.5	46.1	54.0	-7.9
4500	5150	1000	4960	40.2	54.0	-13.8
Measurement uncertainty				±6 dB		

2DH5 Packet

PK-measurement						
HIghest frequency: CH79						
Test conditions: TX , Pmax, 2DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
2483.5	2500	1000	2483.5	57.4	74.0	-16.6
4500	5150	1000	4960	51.7	74.0	-22.3
Measurement uncertainty				±6 dB		

AV-measurement						
HIghest frequency: CH79						
Test conditions: TX , Pmax, 2DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
2483.5	2500	1000	2483.5	46.5	54.0	-7.5
Measurement uncertainty				±6 dB		

3DH5 Packet

PK-measurement						
Lowest frequency: CH1						
Test conditions: TX , Pmax, 3DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
2310	2390	1000	2315	43.6	74.0	-30.4
4500	5150	1000	4804	54.7	74.0	-19.3
Measurement uncertainty				±6 dB		

AV-measurement						
Lowest frequency: CH1						
Test conditions: TX , Pmax, 3DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4804	44.3	54.0	-9.7
Measurement uncertainty				±6 dB		

PK-measurement						
Middle frequency: CH40						
Test conditions: TX , Pmax, 3DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4882	54.0	74.0	-20.0
Measurement uncertainty				±6 dB		

AV-measurement						
Middle frequency: CH40						
Test conditions: TX , Pmax, 3DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
4500	5150	1000	4882	43.7	54.0	-10.3
Measurement uncertainty				±6 dB		

FCC ID: DMOLSP500 IC ID: 2099A-LSP500

PK-measurement						
HIghest frequency: CH79						
Test conditions: TX , Pmax, 3DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
2483.5	2500	1000	2483.5	54.8	74.0	-19.2
4500	5150	1000	4960	52.8	74.0	-21.2
Measurement uncertainty				±6 dB		

AV-measurement						
HIghest frequency: CH79						
Test conditions: TX , Pmax, 3DH5 Packet						
			Test results			
Start *f*	Stop *f*	RBW	Maximum emission		Limit	Margin
(MHz)	(MHz)	(kHz)	(MHz)	(dBµV/m)	(dBµV/m)	(dB)
2483.5	2500	1000	2483.5	46.7	54.0	-7.3
4500	5150	1000	4960	41.4	54.0	-12.6
Measurement uncertainty				±6 dB		

Peak-Limit according to FCC Part 15C, Section 15.205(a):
In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

Frequency	Limits acc. 15.209		Measurement distance
(MHz)	PK dB(µV/m)	AV dB(µV/m)	(m)
Above 960	74	54	3

Restricted bands of operation:
The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

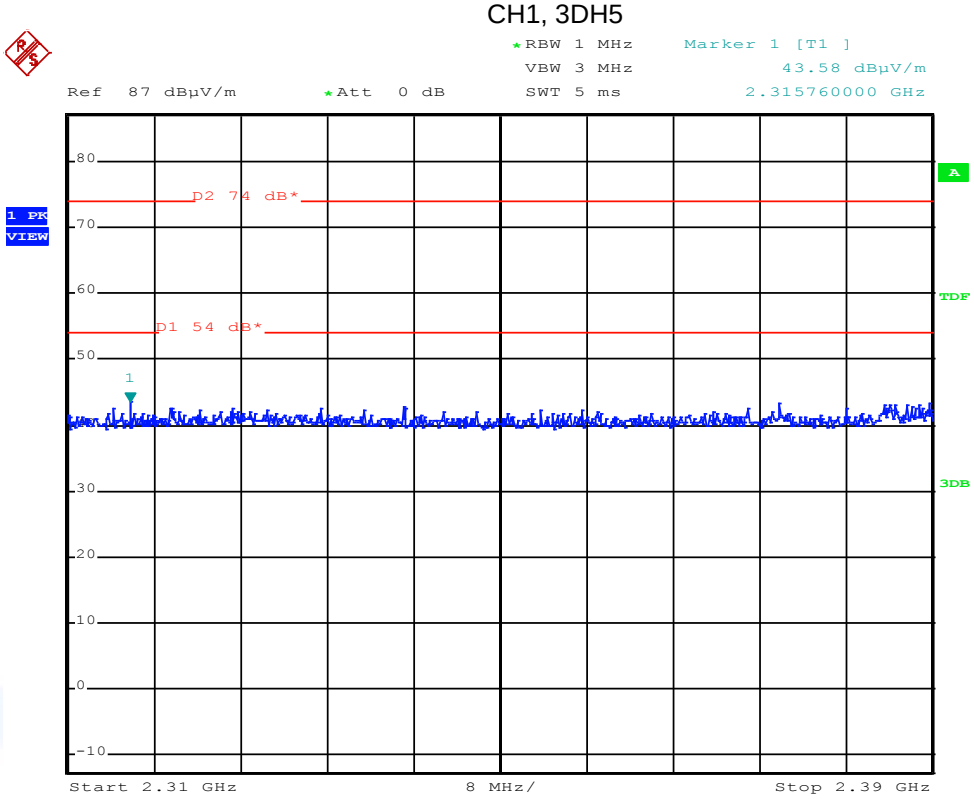
The requirements are **FULFILLED.**

Remarks: For detailed test result please refer to following test protocol. Only the worst case plots are listed.

5.5.7 Test protocol

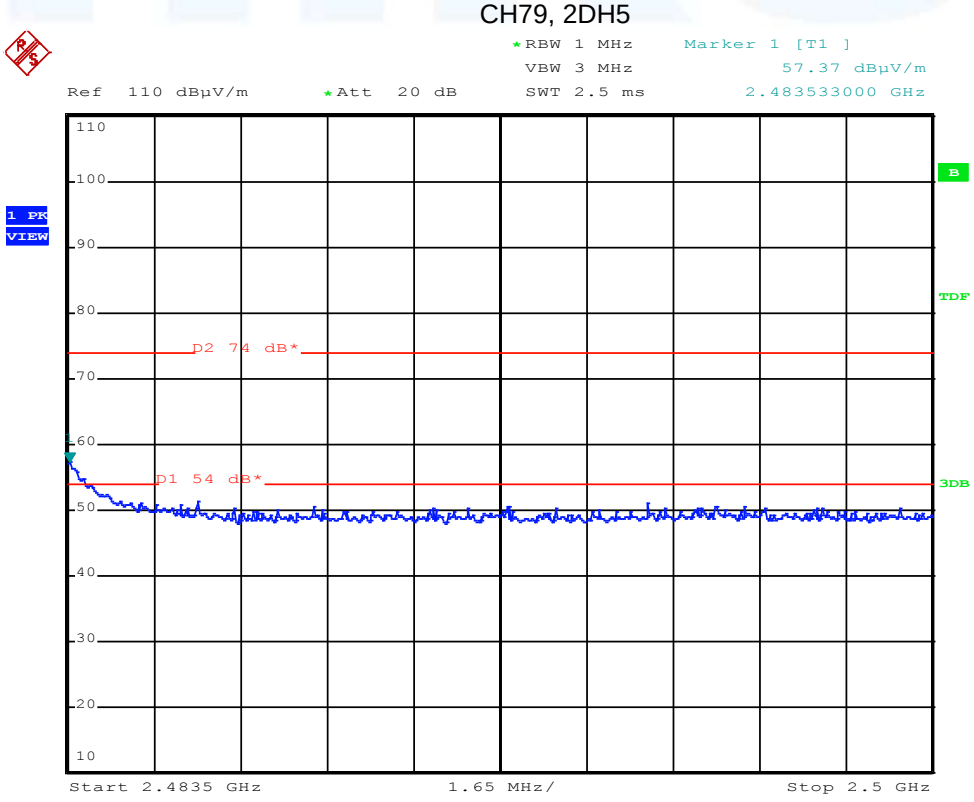
Restricted band 2310 – 2390 MHz:

CH1, 3DH5



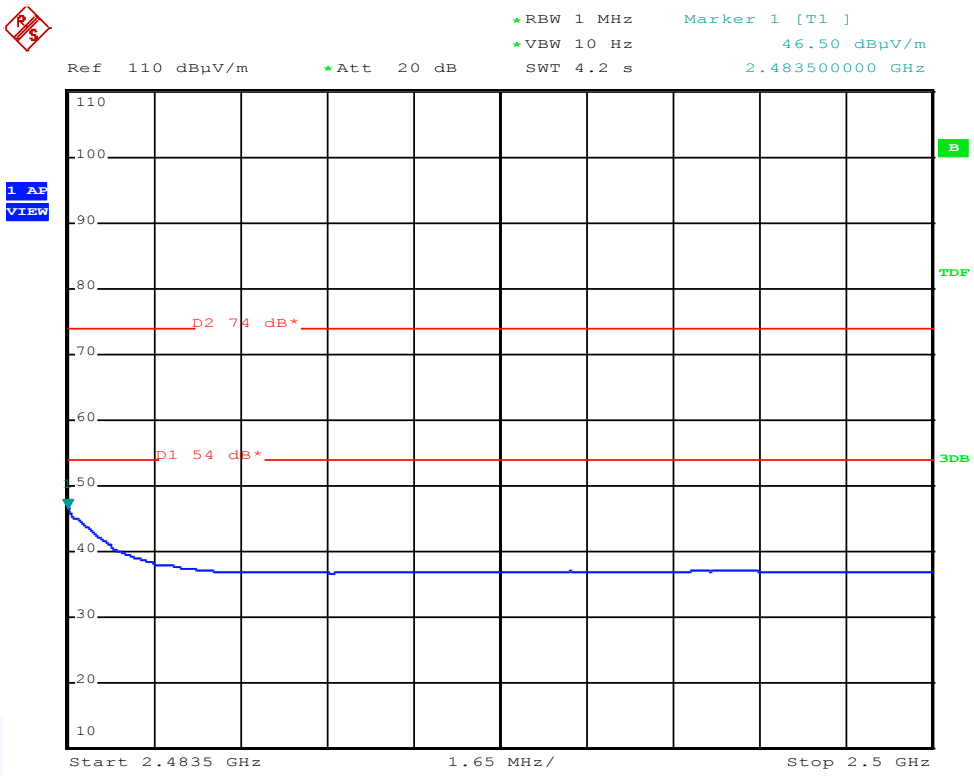
Restricted band 2483.5 – 2500 MHz:

CH79, 2DH5



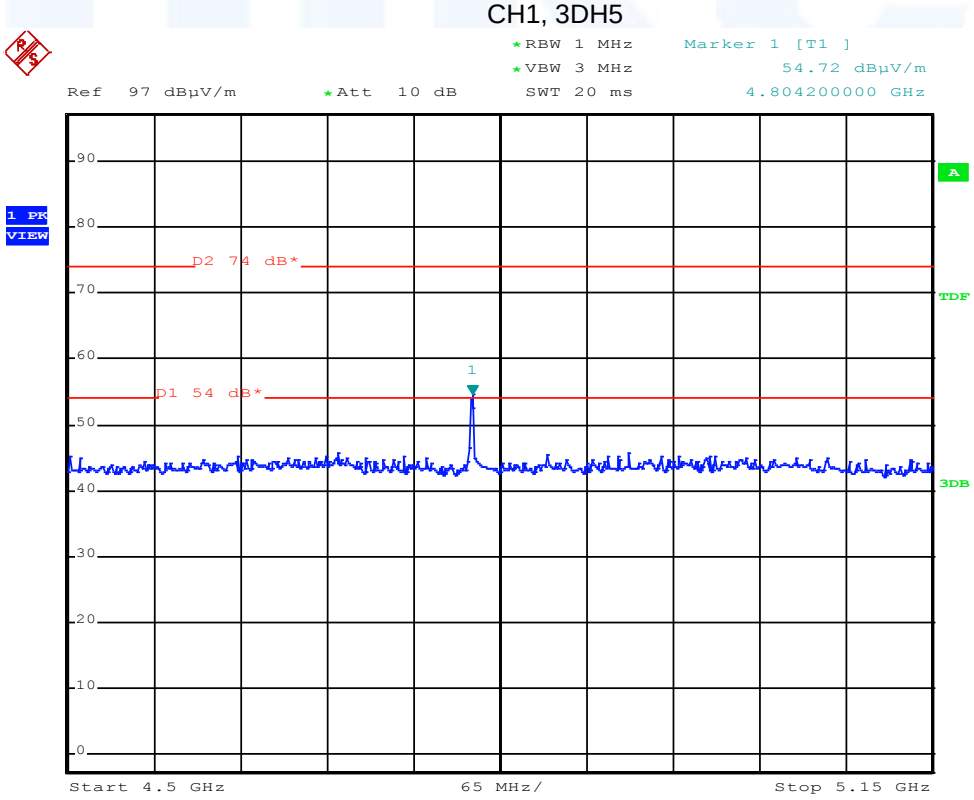
FCC ID: DMOLSP500 IC ID: 2099A-LSP500

CH79, 2DH5
AV-measurement

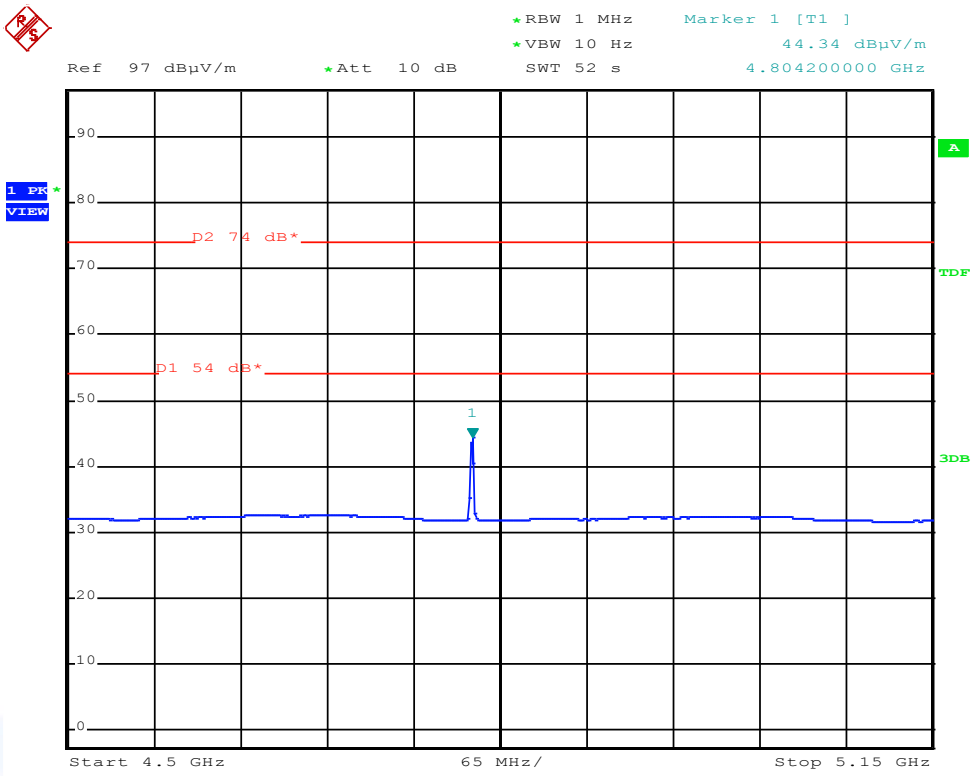


Restricted band 4500 – 5150 MHz:

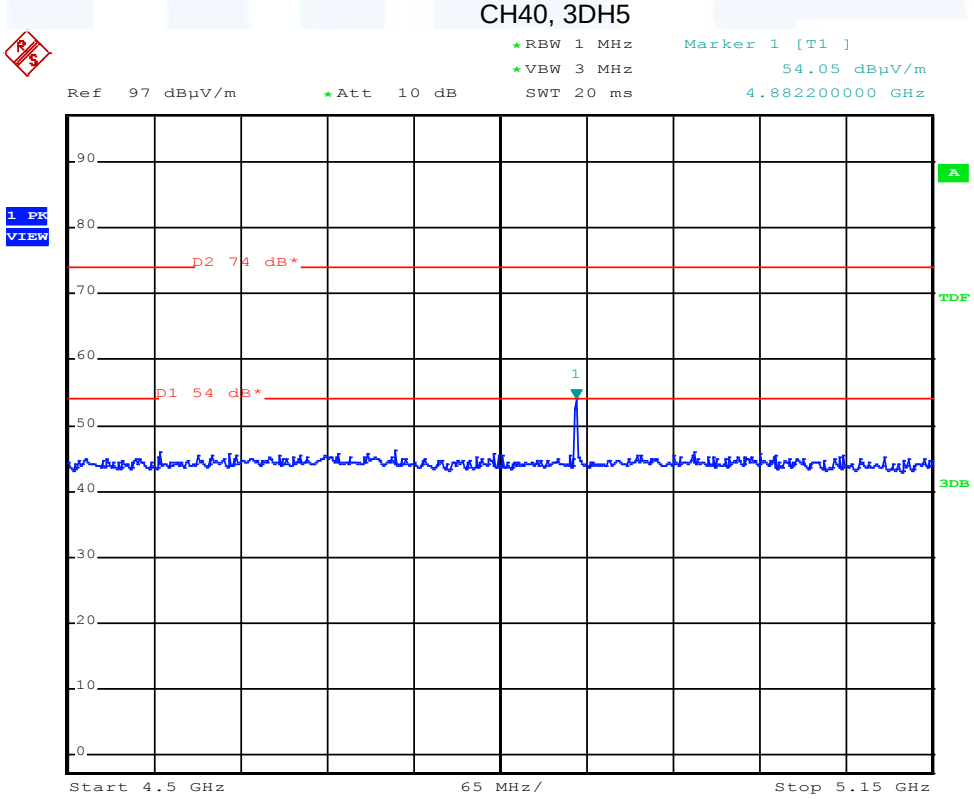
CH1, 3DH5



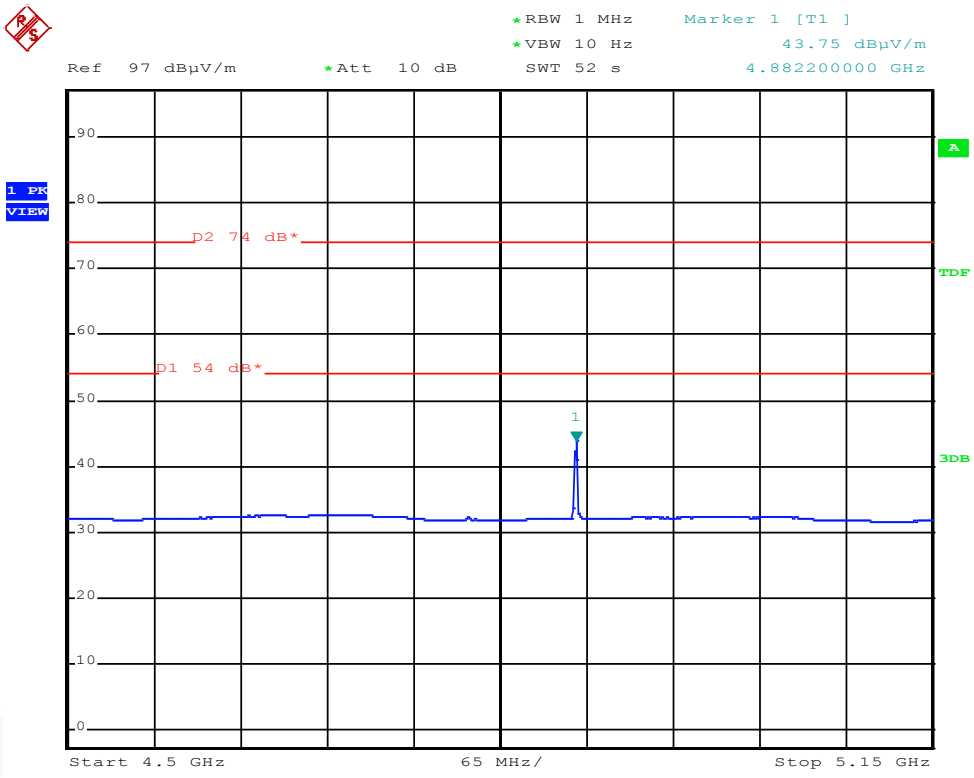
AV-measurement



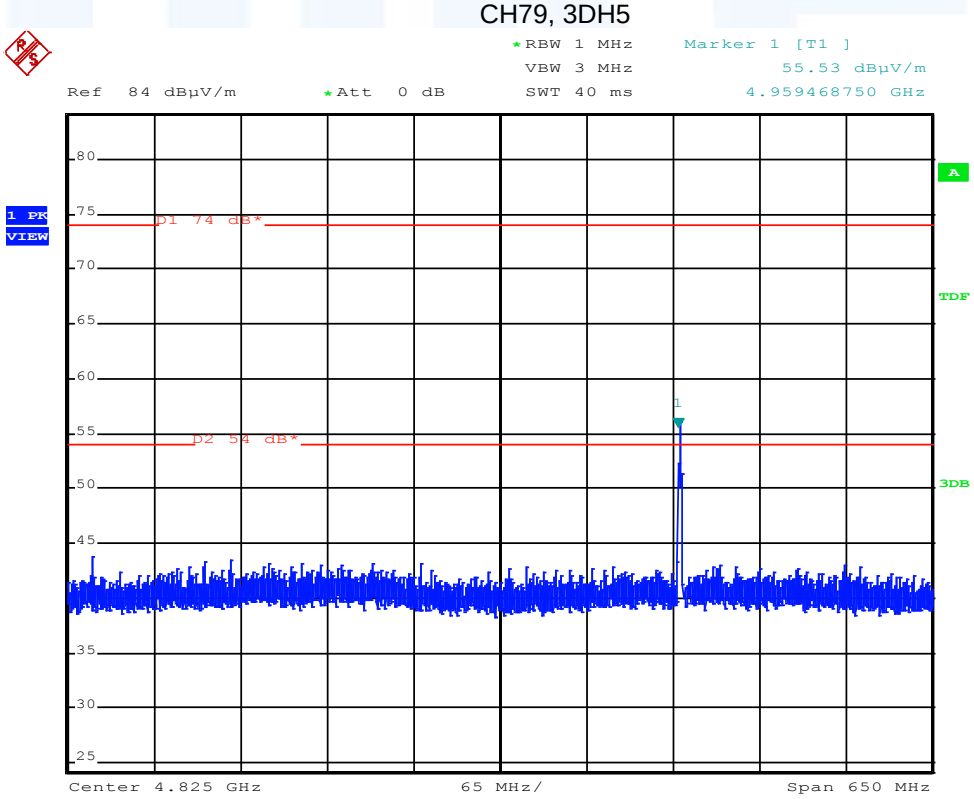
CH40, 3DH5



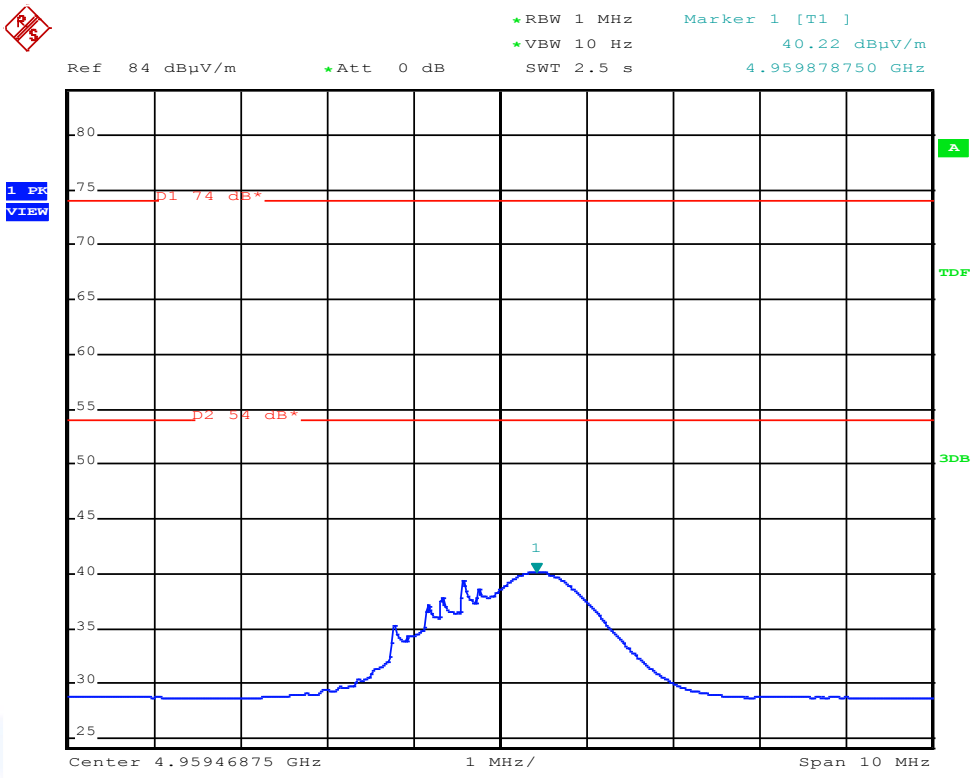
AV-measurement



CH79, 3DH5



AV-measurement



5.6 Pseudorandom frequency hopping sequence

Requirement according to FCC Part 15C, Section 15.247(a):
The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies.

Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:
Bluetooth units which want to communicate with other units must be organized in a structure called piconet. This piconet consists of maximum 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from its BD address which is unique for each Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.
Example of a 79 hopping sequence in data mode:
40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04

Derivation and examples for a hopping sequence in hybrid mode
For the generation of the inquiry and page hop sequences the same procedures as described for the data mode are used (see chapter 5), but this time with different input vectors:
a. For the inquiry hop sequence, a predefined fixed address is always used. This results in the same 32 frequencies used by all devices doing an inquiry but every time with a different start frequency and phase in this sequence.
b. For the page hop sequence, the device address of the paged unit is used as input vector. This results in the use of a subset of 32 frequencies which is specific for that initial state of the connection establishment between the two units. A page to different devices would result in a different subset of 32 frequencies.
So it is ensured that also in hybrid mode the frequency use equally averaged.
Example of a hopping sequence in inquiry mode:
48, 50, 09, 13, 52, 54, 41, 45, 56, 58, 11, 15, 60, 62, 43, 47, 00, 02, 64, 68, 04, 06, 17, 21, 08, 10, 66, 70, 12, 14, 19, 23
Example of a hopping sequence in paging mode:
08, 57, 68, 70, 51, 02, 42, 40, 04, 61, 44, 46, 63, 14, 50, 48, 16, 65, 52, 54, 67, 18, 58, 56, 20, 53, 60, 62, 55, 06, 66, 64

Remarks: This item is part of the Bluetooth Core Specifications V2.1+EDR compliance and approved.

5.7 Equal hopping frequency use

Requirement according to FCC Part 15C, Section 15.247(a):
Each frequency must be used equally on the average by each transmitter.

The generation of the hopping sequence in connection mode depends essentially on two input values:
1. LAP/UAP of the master of the connection.
2. Internal master clock.

The LAP (lower address part) is the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS. The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronization with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the Rx/Tx slot length of 312.5 µs. The clock has a cycle of about one day (23hr30min). In most case, it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.
Regarding short transmissions the Bluetooth system has the following behaviour: The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended. The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value the hopping sequence will always differ from the first one, because the period between the two transmissions is longer and it cannot be shorter than the minimum resolution of the clock is 312.5 µs. This circumstance is always the same therefore the average of the frequency use is the same on all transmitters.

Remarks: This item is part of the Bluetooth Core Specifications V2.1+EDR compliance and approved.

5.8 Correction for pulsed operation (duty cycle)

Remarks: Not applicable.

5.9 Dwell time

5.9.1 Applicable standard

According to FCC Part 15, Section 15.247(a):
In Section 15.247(a)(1i)(1ii) and (1iii) are dwell times defined for the special frequency ranges should not exceed by a frequency hopping system.

Dwell time in data mode:
The dwell time of 0.3797s within a 30 second period in data mode is independent from the packet type (packet length). The calculation for a 30 second period is a follows:

Dwell time = time slot length * hop rate / number of hopping channels * 30s
Example for a DH1 packet (with a maximum length of one time slot)
Dwell time = 625 µs * 1600 * 1/s / 79 * 30s = 0.3797s (in a 30s period)

For multi-slot packet the hopping is reduced according to the length of the packet.
Example for a DH5 packet (with a maximum length of five time slots)
Dwell time = 5 * 625 µs * 1600 * 1/5 * 1/s / 79 * 30s = 0.3797s (in a 30s period)

This is according the Bluetooth Core Specification V 1.0B (+ critical errata) for all Bluetooth devices. There for all Bluetooth devices comply with the FCC dwell time requirement in data mode.
This was checked during the Bluetooth Qualification tests and approved.

The Dwell time in hybrid mode is approximately 2.6 ms (in a 12.8 s period).

Remarks: This item is part of the Bluetooth Core Specifications V2.1+EDR compliance and approved.

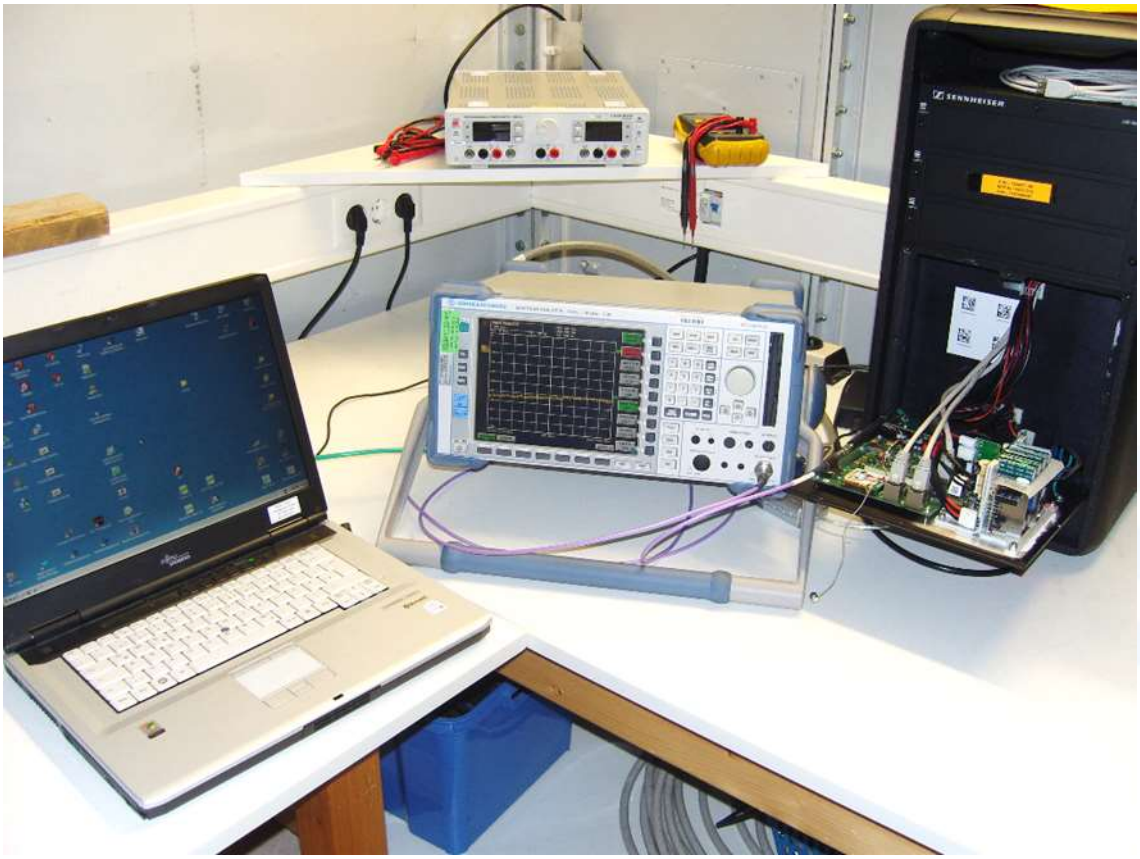
5.10 Carrier frequency separation

For test instruments and accessories used see section 6 Part **MB**.

5.10.1 Description of the test location

Test location: AREA4

5.10.2 Photo documentation of the test set-up



5.10.3 Applicable standard

According to FCC Part 15, Section 15.247(a):
Frequency hopping systems operating in the frequency band of 2400 MHz – 2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or 2/3 of the 20 dB bandwidth of the hopping channel.

5.10.4 Description of Measurement

The measurement is performed using a spectrum analyser in single sweep mode. A part of the operating frequency is used for better resolution. In normal application mode all the channels of the part of operating frequency are displayed and the separation is measured. The 20 dB OBW has to be measured before to compare whether the OBW requirement is fulfilled.

5.10.5 Test result

Channel separation in hybrid mode:
The nominal channel spacing of the Bluetooth system is 1 MHz independent of the operating mode. The maximum "initial carrier frequency tolerance" which is allowed for Bluetooth is f_{center} = 75 kHz.
This was checked during the Bluetooth Qualification tests (Test Case: TRM/CA/07-E) for three frequencies (2402 MHz, 2441 MHz, and 2480 MHz) and approved.

Additionally an example for the channel separation is given below:

Channel	f	EBW 20 dB	hopping channels	Separation	Limit
	(MHz)	(MHz)		(MHz)	(MHz)
CH1	2402	0.811	79	1.0	0.811
CH40	2441	0.935	79	1.0	0.935
CH79	2480	0.937	79	1.0	0.937

Limit according to FCC Part 15C, Section 15.247(a):

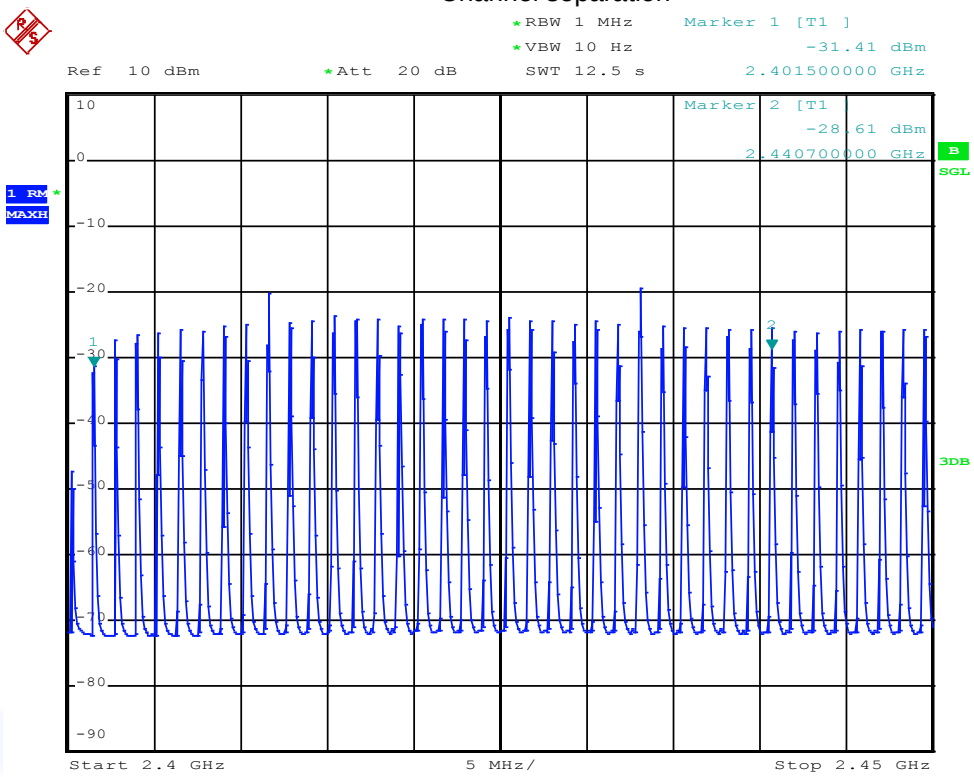
Frequency	Hopping channels	Limit channel separation
(MHz)		
All systems		> 25 kHz or 20 dB bandwidth, which ever is greater
2400 - 2483.5	≥ 15	> 25 kHz or 2/3 of 20 dB bandwidth, which ever is greater

The requirements are **FULFILLED.**

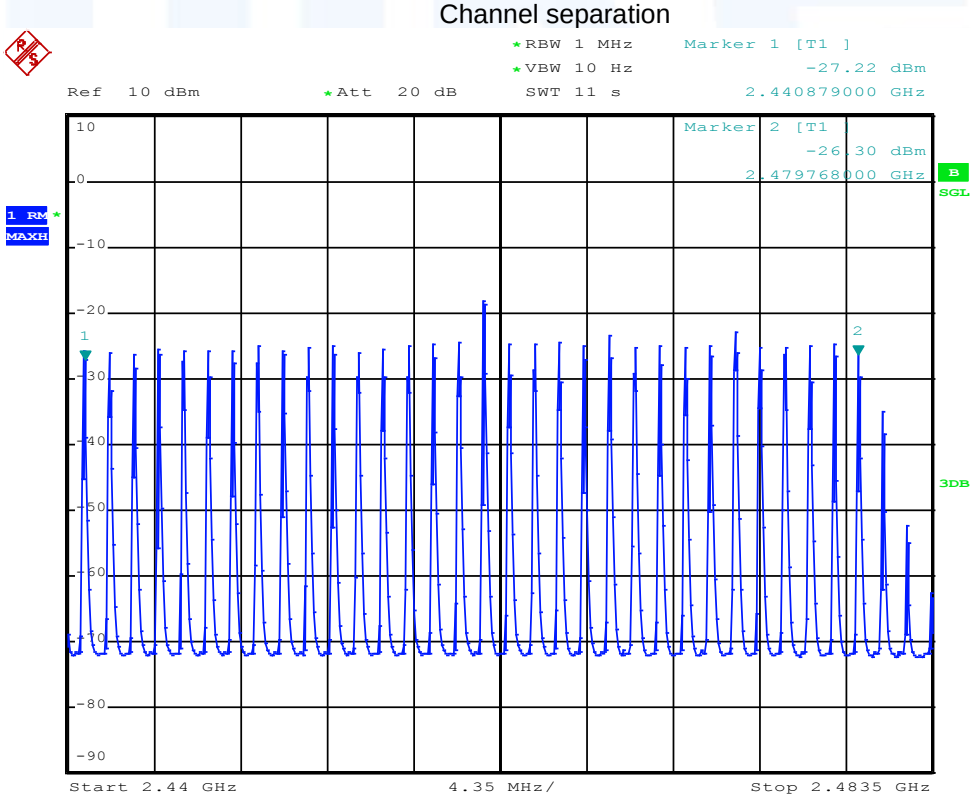
Remarks: For detailed test result please refer to following test protocol.

5.10.6 Test protocol

Channel separation



Channel separation



5.11 Number of hopping channels

For test instruments and accessories used see section 6 Part **MB**.

5.11.1 Description of the test location

Test location: AREA4

5.11.2 Test result

Hopping channel frequency range	Number of all available hopping channels
2402 - 2480	79

Limit according to FCC Part 15C, Section 15.247(1):

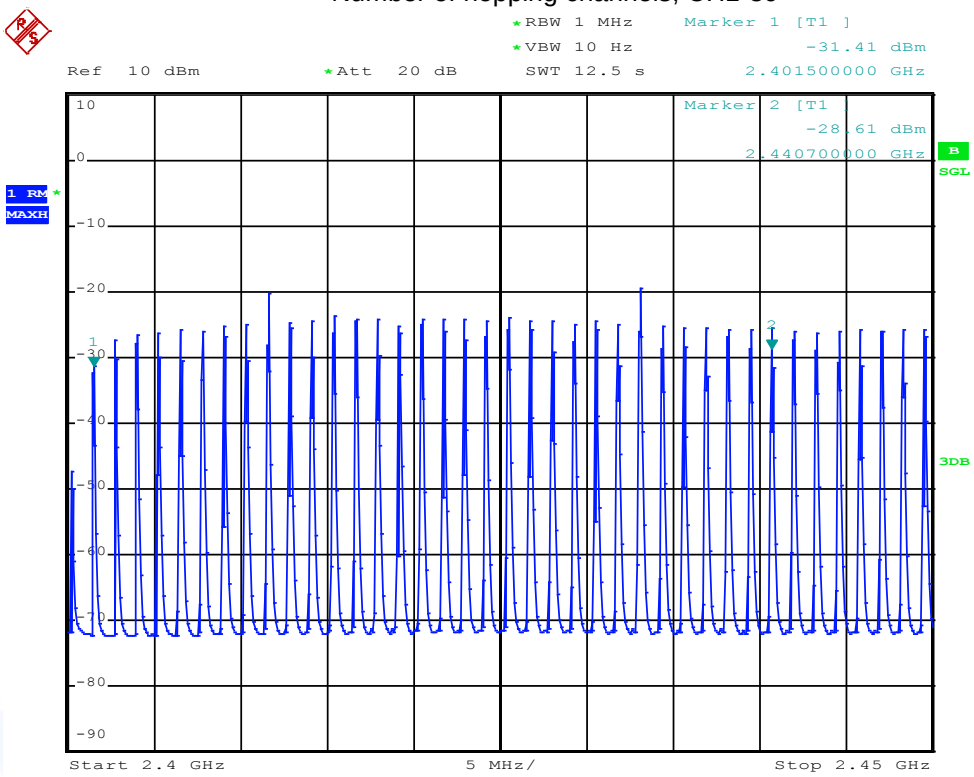
Frequency range (MHz)	LIMIT (Number of Hopping Channels)			
	20dB Bandwidth < 250kHz	20dB Bandwidth > 250kHz	20dB Bandwidth < 1 MHz	20dB Bandwidth > 1MHz
2400 – 2483.5	15	15	15	15

The requirements are

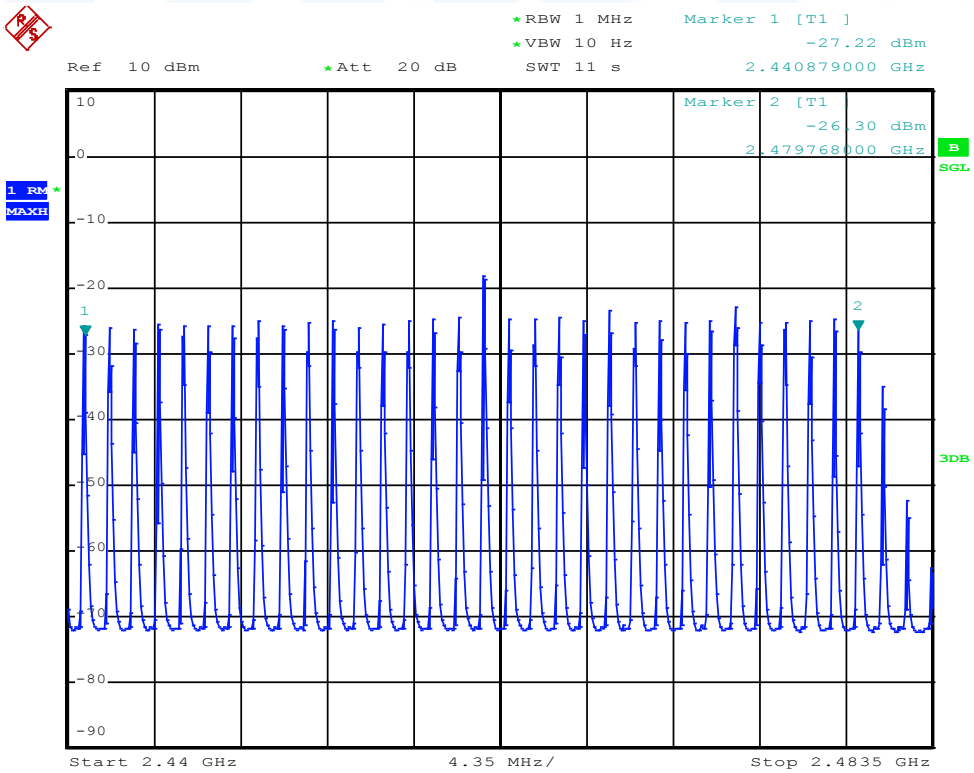
Remarks: For detailed test result please refer to following test protocol.

5.11.3 Test protocol

Number of hopping channels, CH1-39



CH40-79



5.12 Antenna application

5.12.1 Applicable standard

According to FCC Part 15C, Section 15.203:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has a integrated chip antenna; special tools are needed for replacing the antenna that prevents manipulation by a user. No external power amplifier can be connected. The requirements of part 15.203 and 15.204 are met.

5.12.2 Antenna requirements

According to FCC Part 15C, Section 15.247 (b)(4):
The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For the used chip antenna an output power reduction is not necessary.

Remarks: _____

_____

5.13 Maximum permissible exposure (MPE)

For test instruments and accessories used see section 6 Part **CPR 3**.

5.13.1 Description of the test location

Test location: Anechoic chamber 2
Test distance: 3 m

5.13.2 Photo documentation of the test set-up

5.13.3 Applicable standard

According to FCC Part 15, Section 15.247(i):
Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.
The test methods used comply with ANSI/IEEE C95.1, "IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz".
This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

5.13.4 Description of Measurement

The maximum total power input to the antenna is measured conducted as described in clause 5.3 of this document. To calculate the MPE in a defined distance away from the product the Friis transmission formula is used.

Friis transmission formula:

$$P_d = \frac{P_{out} * G}{4 * \Pi * r^2}$$

Where
P_d = power density (mW/cm^2)
P_{out} = output power to antenna (mW)
G = gain of antenna (linear scale)
r = distance between antenna and observation point (cm)

According to FCC Rules 47CFR 2.1093(b) the EUT is not a portable device. The EUT is designed to be used that radiating structures are 20 cm outside of the body of the user. (r = 20 cm)

5.13.5 Test result

3-DH5

Channel	Power setting	A	Antgain	A	G	P	S	Limit S_{eq}
No.		(dBm)	(dBi)	(mW)	linear	(mW)	(mW/cm^2)	(mW/cm^2)
CH1	Pmax	-4.7	1.7	0.34	1.48	0.50	0.000100	1.0
CH40	Pmax	-6.3	1.7	0.23	1.48	0.35	0.000069	1.0
CH79	Pmax	-8.0	1.7	0.16	1.48	0.23	0.000047	1.0

Limits for maximum permissible exposure (MPE):

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
(B) Limits for General Population / Uncontrolled Exposure				
0.3 – 3.0	614	1.63	100	30
3.0 – 30	824/*f*	2.19/*f*	180/ f^2	30
30 - 300	27.5	0.073	0.2	30
300-1500	---	---	*f*/1500	30
1500-100000	**---**	**---**	**1.0**	**30**

f = Frequency (MHz)

The requirements are **FULFILLED.**

Remarks: The MPE is measured that the resulting radiation can be calculated providing a second transmitter is used simulanously.

5.14 Co-location and Co-transmission

Applicable standard:
OET Bulletin 65, Edition 97-01, Section 2: Multiple-transmitter sites and Complex Environments

The FCC's MPE limits vary with frequency. Therefore, in mixed or broadband RF fields where several sources and frequencies are involved, the fraction of the recommended limit (in terms of power density or square of the electric or magnetic field strength) incurred within each frequency interval should be determined, and the sum of all fractional contributions should not exceed 1.0, or 100 % in terms of percentage.

1. MPE of WLAN:	P_d = 0.03 mW/cm^2 Limit: 1.0 mW/cm^2 Fraction of MPE: 3.0 %
2. MPE of Bluetooth:	P_d = 0.0001 mW/cm^2 Limit: 1.0 mW/cm^2 Fraction of MPE: 0.01 %
3. Sum of total power density	$P_{d1} + P_{d2}$ = 3.0 + 0.01 = 3.01 % < 100 %

The requirements are **FULFILLED.**

Remarks: _____

_____

6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
A 4	ESHS 30	02-02/03-05-002	11/07/2013	11/07/2012		
	NNLK 8129	02-02/20-05-001	22/07/2013	22/01/2013		
	ESH 2 - Z 5	02-02/20-05-004	06/06/2015	06/06/2013	06/12/2013	06/06/2013
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	ESH 3 - Z 2	02-02/50-05-155	05/10/2013	05/04/2013		
	SP 103 /3.5-60	02-02/50-05-182				
CPR 3	FSP 30	02-02/11-05-001	18/10/2013	18/10/2012		
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	3117	02-02/24-05-009	04/04/2014	04/04/2013		
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
MB	FSP 30	02-02/11-05-001	18/10/2013	18/10/2012		
SER 1	FMZB 1516	01-02/24-01-018	14/02/2014	14/02/2013		
	ESCI	02-02/03-05-005	03/12/2013	03/12/2012		
	S10162-B	02-02/50-05-031				
	KK-EF393-21N-16	02-02/50-05-033				
	NW-2000-NB	02-02/50-05-113				
SER 2	ESVS 30	02-02/03-05-006	26/06/2013	26/06/2012		
	VULB 9168	02-02/24-05-005	11/04/2014	11/04/2013	11/10/2013	11/04/2013
	S10162-B	02-02/50-05-031				
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
SER 3	FSP 30	02-02/11-05-001	18/10/2013	18/10/2012		
	AMF-4F-04001200-15-10P	02-02/17-05-004				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	3117	02-02/24-05-009	04/04/2014	04/04/2013		
	R1 _ 18 - 40 GHz	02-02/30-09-002	08/01/2014	08/01/2013		
	WHJS 1000-10EE	02-02/50-05-070				
	Sucoflex N-1000-SMA	02-02/50-05-072				
	Sucoflex N-1600-SMA	02-02/50-05-073				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	WHK 3.0/18G-10EF	02-02/50-05-180				