TEST REPORT

Test report no.: 1-4552/17-01-03

Deutsche
Akkreditierungsstelle
D-PL-12076-01-01

<table>
<tr><td>

Testing laboratory

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Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01

</td><td>

Applicant

Robert Bosch Car Multimedia GmbH
Robert-Bosch-Straße 200
31137 Hildesheim / GERMANY
Contact: Dirk Zamow

Manufacturer

Robert Bosch Car Multimedia GmbH
Robert-Bosch-Straße 200
31137 Hildesheim / GERMANY

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</table>

Test standard/s

47 CFR Part 15	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

For further applied test standards please refer to section 3 of this test report.

Test Item

Kind of test item:	**Car Tuner Navigation System with BT & WLAN**
Model name:	**AIVIP32R0**
FCC ID:	**YBN-AIVIP32R0**
IC:	**9595A-AIVIP32R0**
Frequency:	5250 MHz to 5350 MHz & 5500 MHz to 5725 MHz
Technology tested:	WLAN (DFS only)
Antenna:	Integrated antenna
Power supply:	12.0 V DC by battery
Temperature range:	-20°C to +55°C

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:	**Test performed:**
René Oelmann	David Lang
Lab Manager	Lab Manager
Radio Communications & EMC	Radio Communications & EMC

1 Table of contents

2 General information

2.1 Notes and disclaimer

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2.2 Application details

Date of receipt of order:	2017-06-22
Date of receipt of test item:	2017-06-16
Start of test:	2017-06-16
End of test:	2017-06-16
Person(s) present during the test:	-/-

2.3 Test laboratories sub-contracted

None

3 Test standard/s and references

Test standard	Date	Description
47 CFR Part 15		Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 2	February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 4	November 2014	Spectrum Management and Telecommunications Radio Standards Specifications - General Requirements and Information for the Certification of Radio Apparatus

Guidance	Version	Description
UNII: KDB 789033 D02	v01r04	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E
ANSI C63.4-2014	-/-	American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American national standard of procedures for compliance testing of unlicensed wireless devices
UNII: KDB 905462 D02	v02	Compliance measurement procedures for unlicensed - national information infrastructure devices operating in the 5250 - 5350 MHz and 5470 - 5725 MHz bands incorporating dynamic frequency selection
UNII: KDB 905462 D03	v01r02	Client Without DFS New Rules
UNII: KDB 905462 D04	v01	Operational Modes for DFS Testing New Rules

4 Test environment

Temperature	:	T_{nom}	+22 °C during room temperature tests
		T_{max}	No extreme condition tests performed
		T_{min}	No extreme condition tests performed
Relative humidity content	:		55 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom}	12 V DC by external power supply
		V_{max}	No extreme condition tests performed
		V_{min}	No extreme condition tests performed

5 Test item

5.1 General description

Kind of test item	:	Car Tuner Navigation System with BT & WLAN
Type identification	:	AIVIP32R0
HMN	:	Not specified
PMN	:	AIVIP32R0
HVIN	:	AIVIP32R0
FVIN	:	X128
S/N serial number	:	0003548
HW hardware status	:	001
SW software status	:	344 (X128)
Frequency band	:	5250 MHz to 5350 MHz & 5500 MHz to 5725 MHz
Type of radio transmission : Use of frequency spectrum :		OFDM
Type of modulation	:	BPSK, QPSK, 16 – QAM, 64 – QAM
Antenna	:	Integrated antenna
Power supply	:	12 V DC by battery

5.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup- and EUT-photos are included in test report: 1-4552/17-01-01_AnnexA
1-4552/17-01-01_AnnexD

6 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Frequency accuracy (radar burst)	0.1 Hz
Level accuracy (radar burst)	± 0.8 dB

7 Summary of measurement results

☐	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☒	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
DFS-Testing	CFR Part 15, FCC 06-96	Pass	2017-07-11	Client DFS only

Test Standard Clause	Test Case	Bandwidth	C	NC	NA	NP	Remark
7.8.1*3	U-NII Detection Bandwidth	-/-	☐	☐	☒	☐	*1*2*3
§15.407 (h)(2)	DFS Detection Threshold	-/-	☐	☐	☒	☐	*1*2*3
§15.407 (h)(2) (ii) & 7.8.2*3	Channel Availability Check Time	-/-	☐	☐	☒	☐	*1*3
§15.407 (h)(2) (iv) & 7.8.3*3	Non-Occupancy Period	20 MHz	☒	☐	☐	☐	*1
§15.407 (h)(2) (iii) & 7.8.2*3	Channel Move Time / Channel Closing Transmission Time	80 MHz	☒	☐	☐	☐	*2
7.8.3 & 7.8.4*3	In-Service Monitoring / Statistical Performance Check	-/-	☐	☐	☒	☐	*2*3

Abbreviations/References:

C   Compliant
NC   Not compliant
NA   Not applicable
NP   Not performed
*1   Prior to use of a channel
*2   During normal operation
*3   Not applicable for Client Devices without radar detection.

8   Additional comments

Reference documents: None

Special test descriptions: All tests except the In-Service Monitoring are conducted with Pulse Type 0.

A sample with temporary antenna connector was provided to perform the measurements in a conducted way.

Configuration descriptions: Iperf was used to generate the required channel load (duty cycle greater 17 percent).

DFS functionality: ☐ Master device
☐ Client with radar detection
☒ Client without radar detection

9　RF measurements

9.1　Description of test setup

9.1.1　Conducted measurements

Setup

Figure 1 shows a setup whereby the UUT is a RLAN device operating in slave mode, without Radar Interference Detection function. This setup also contains a RLAN device operating in master mode. The radar test signals are injected into the master device. The UUT (slave device) is associated with the master device.

Figure 1 shows an example
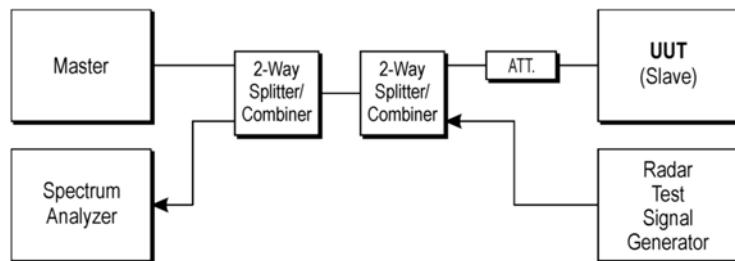
Figure 1: Setup

RPP = SG - CA
(RPP-radar pulse power; SG-signal generator power; CA-loss signal path)

Example calculation:
RPP [dBm] = -30.0 [dBm] – 33.0 [dB] = -63.0 [dBm]

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	RF-Cable DFS-Tester No. 6	Enviroflex 316 D	Huber & Suhner	Batch no. 1560522	400001262	ev	-/-	-/-
2	A	Vector Signal Generator	SMU200A	R&S	101633	300003496	k	24.01.2017	23.01.2020
3	A	Spectrum Analyzer 9kHz to 30GHz - 140..+30dBm	FSP30	R&S	100886	300003575	k	24.01.2017	23.01.2019
4	A	DFS-test site	div. Splitter, Cables, Attenuators	Mini-Circuits	na	300004557	ev	-/-	-/-
5	A *	Dual Band Gigabit Router	RT-AC68U	Asus	F1IMOH056666	400001244	ne	-/-	-/-
6	A	PC	ExOne	F+W	2890296v001	300005102	ne	-/-	-/-
7	A	RF-Cable DFS-Tester No. 1	Enviroflex 316 D	Huber & Suhner	Batch no. 1560522	400001257	ev	-/-	-/-
8	A	RF-Cable DFS-Tester No. 2	Enviroflex 316 D	Huber & Suhner	Batch no. 1560522	400001258	ev	-/-	-/-
9	A	Power Supply	HMP2020	Rohde & Schwarz	102219	300005264	ne	-/-	-/-

* FCC ID: MSQ-RTAC68U

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkI!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

9.2   Parameters of DFS test signals

9.2.1   DFS Detection Thresholds for Master Devices as well as Client Devices With Radar Detection

Maximum Transmit Power EIRP	Value (see note)
≥ 200 mW	-64 dBm
< 200 mW and power spectral density < 10 dBm/MHz	-62 dBm
< 200 mW and That do not meet the power spectral density < 10 dBm/MHz	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. Note3: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

9.2.2   DFS Response Requirement Values

Parameter	Value
Non-occupancy period	minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2.
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth. See Note 3.
Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

9.2.3 Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance.

Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a Test B: 15 unique PRI values randomly selected within the range of 518-3066 µsec, with a minimum increment of 1 µsec, excluding PRI values selected in Test A	Roundup $$\left[\left(\frac{1}{360}\right)\cdot\left[\left(\frac{19\cdot10^6}{PRI_{\mu sec}}\right)\right]\right]$$	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4.

Pulse Repetition Intervals Values for Test A

Pulse Repetition Frequency Number	Pulse Repetition Frequency (Pulses Per Second)	Pulse Repetition Interval (Microseconds)
1	1930.5	518
2	1858.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698
11	1392.8	718
12	1355	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

Long Pulse Radar Test Waveform

Radar Type	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Number of Trails
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse Radar Type waveforms.

Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (µsec)	Chirp Width (MHz)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trails
6	1	333	9	0.333	300	70%	30

For the Frequency Hopping Radar Type, the same Burst parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence defined.

The first frequency in a hopping sequence is selected randomly from the group of 475 integer frequencies from 5250 – 5724 MHz. Next, the frequency that was just chosen is removed from the group and a frequency is randomly selected from the remaining 474 frequencies in the group. This process continues until all 475 frequencies are chosen for the set.

9.3   Test preparation

9.3.1   Setting the test signal level of all radar pulses as of 9.2.1 (only pulse 0 recorded).

example plot
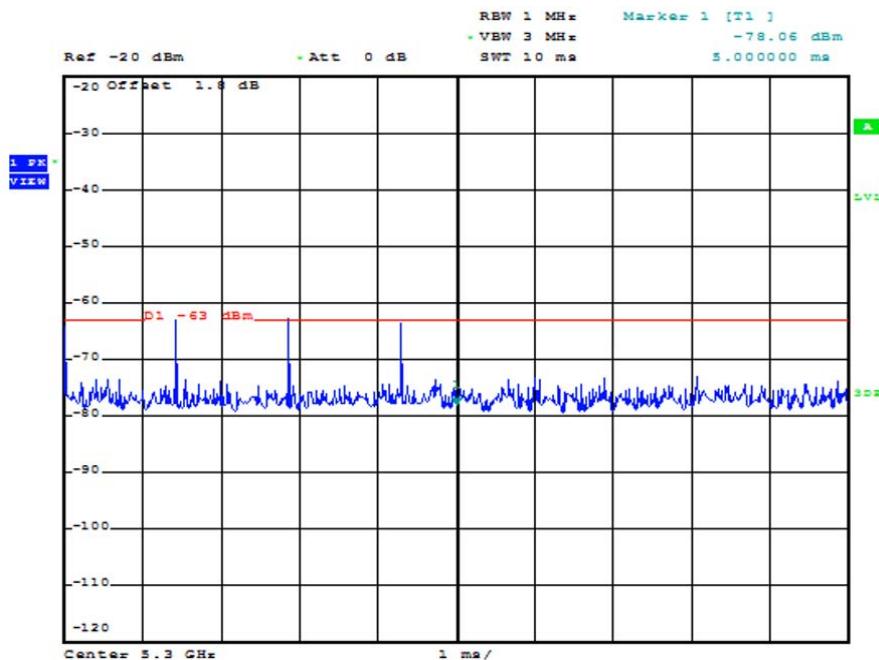
Plot 1

9.3.2 Channel loading

Timing plots are required with calculations demonstrating a minimum channel loading of approximately 17% or greater. For example, channel loading can be estimated by setting the spectrum analyser for zero span and approximate the Time On/ (Time On + Off Time). This can be done with any appropriate channel BW and modulation type.

HT80-Mode: Calculated duty cycle = 18.9%
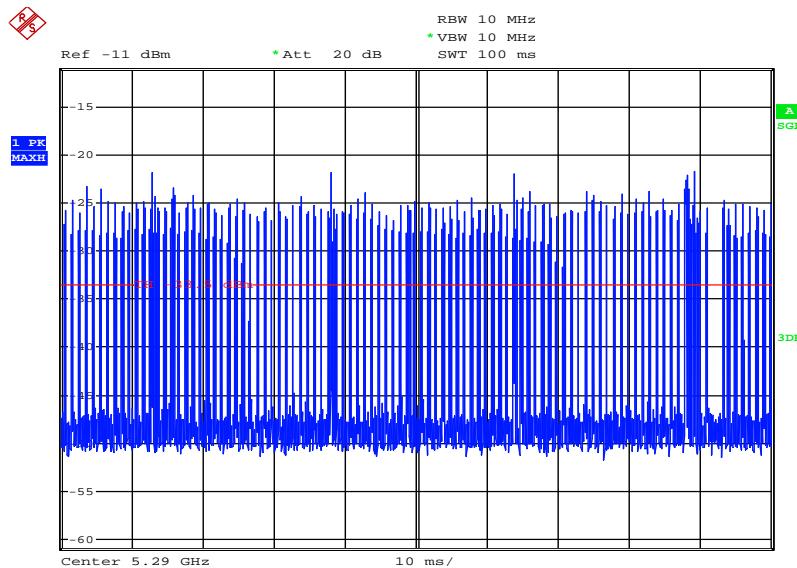
Date: 16.JUN.2017 13:54:15

Plot 2

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9.3.3 99% Bandwidth to determine the U-NII-bandwidth

HT80-Mode: 75.84 MHz


```
                                    *RBW 1 MHz      Marker 1 [T1 ]
                                    *VBW 3 MHz             -64.09 dBm
         Ref   0 dBm     *Att  10 dB   SWT 20 ms       5.210000000 GHz

       0                                  OBW 75.840000000 MHz
                                          Temp 1 [T1 OBW]
      -10                                          -30.08 dBm
                                                 5.252240000 GHz
      -20                                  Temp 2 [T1 OBW]
                                                   -28.02 dBm
                   T1                            5.328080000 GHz
      -30
      -40
      -50
      -60
      -70
      -80
      -90
     -100
        Center 5.29 GHz          16 MHz/              Span 160 MHz
```

1 PK VIEW

A

3DB
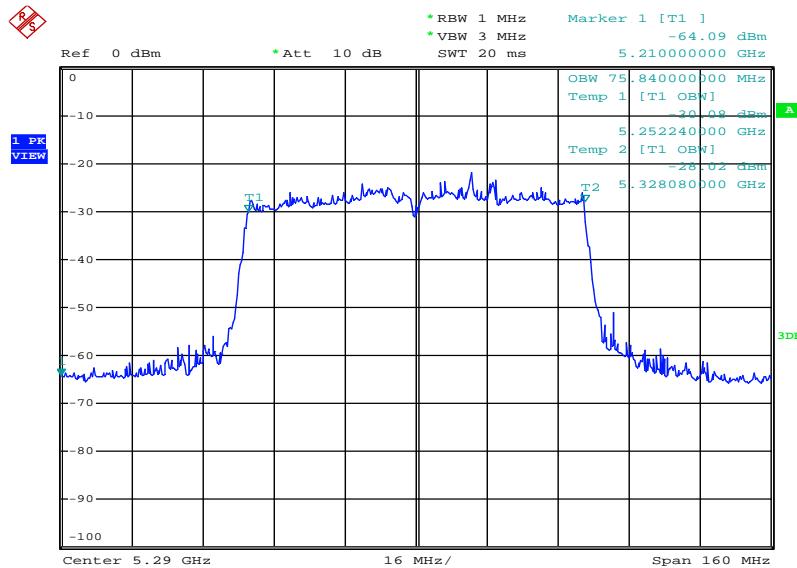
Date: 16.JUN.2017 10:55:47

Plot 3

9.4 Test results (prior to use of a channel)

Not applicable.

9.5 Test results (during normal operation)

9.5.1 Channel move time / channel closing transmission time

After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel not exceeding 60ms.

The test is performed during normal operation with the highest bandwidth supported by the DUT.

Channel Closing Time
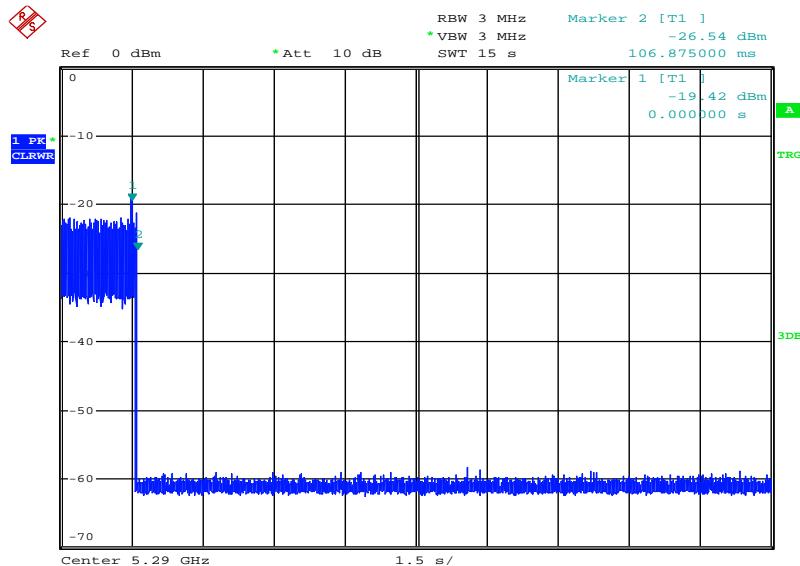
Date: 16.JUN.2017 11:36:07

Plot 5

Note: With Marker 1 at the end of the radar pulse (t = 0ms) the Channel Closing Time is determined by setting
Marker 2 to the point where the last transmission occurred.
The Channel Closing Time is 106.9 ms.

Channel Closing Transmission Time
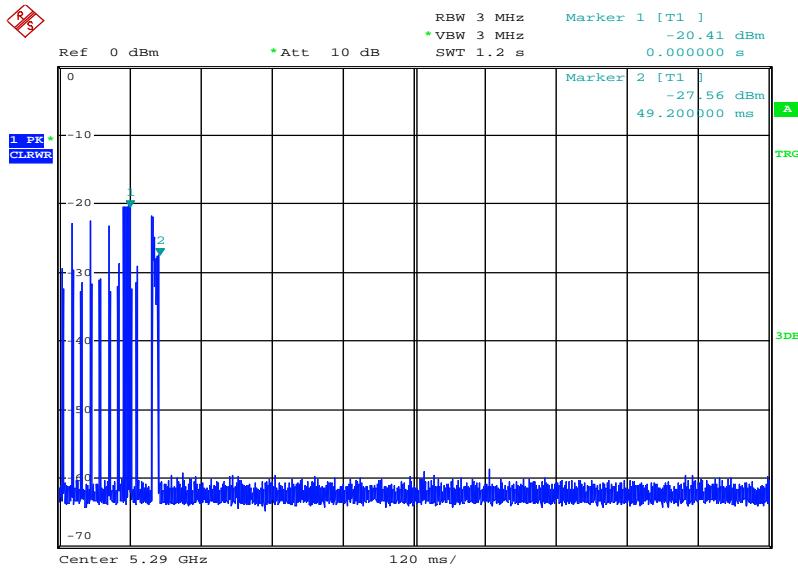
Plot 63

Note: The accumulated transmission time is calculated by the number of bins occurring after t = 200 ms multiplied with the Time-per-sweep point-factor resulting from the Sweep Time and number of Sweep Points of the Spectrum Analyser.
The Channel Closing Transmission Time is 0.0 ms.

9.5.2 Non-Occupancy Period

A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non occupancy period starts at the time when the radar system is detected.

```
                                    RBW  3 MHz    Marker 1 [T1 ]
                                   *VBW  3 MHz              -21.53 dBm
        Ref   0 dBm      *Att  10 dB   SWT 1820 s     0.000000 s
```



```
Center 5.29 GHz                 182 s/
```
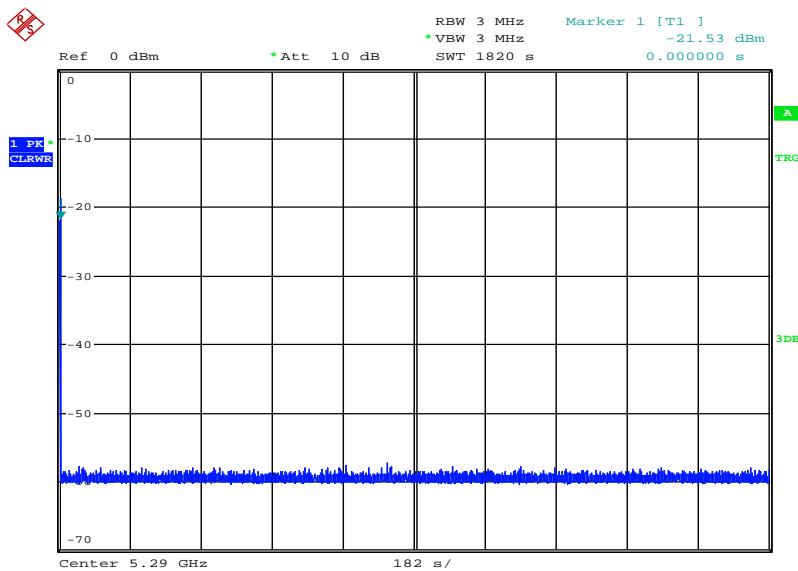
Date: 16.JUN.2017 12:35:18

Plot 74

10   Observations

No observations except those reported with the single test cases have been made.

Annex A   Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
ETSI	European Telecommunications Standard Institute
EN	European Standard
FCC	Federal Communication Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum

Annex B   Document history

Version	Applied changes	Date of release
-/-	Initial release	2017-07-11

Annex C   Accreditation Certificate

first page	last page

Note: The current certificate including annex is published on the website (link see below) of the Accreditation Body DAkkS or may be received by CTC advanced GmbH on request

http://www.dakks.de/as/ast/d/D-PL-12076-01-01.pdf

http://www.dakks.de/as/ast/d/D-PL-12076-01-02.pdf