
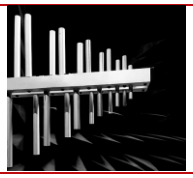
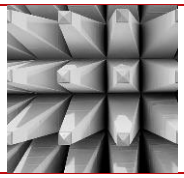

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TEST REPORT

Test report no.: 1-1248/16-01-10

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

Testing laboratory

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
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e-mail: ict@cetecom.com

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

Applicant

Sennheiser electronic GmbH & Co. KG
Am Labor 1
30900 Wedemark / GERMANY
Phone: +49 5130 600-0
Fax: +49 5130 600-574
Contact: Marco Happ
e-mail: marco.happ@sennheiser.com
Phone: +49 5130 600-2621

Manufacturer

Sennheiser electronic GmbH & Co. KG
Am Labor 1
30900 Wedemark / GERMANY

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 1	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:	**Wireless conference system**
Model name:	**ADN-W C1 / ADN-W D1**
FCC ID:	**DMOADNWDU**
IC:	**2099A-ADNWDU**
Frequency:	UNII Bands 5250 MHz to 5350 MHz and 5470 MHz to 5865 MHz
Technology tested:	Proprietary
Antenna:	2 integrated antennas
Power supply:	6.2 V to 7.5 V DC by external power supply
Temperature range:	+5°C to +45°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:

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Test performed:

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David Lang
Lab Manager
Radio Communications & EMC

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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2.2 Application details

Date of receipt of order:	2016-04-20
Date of receipt of test item:	2016-05-27
Start of test:	2016-06-27
End of test:	2016-07-21
Person(s) present during the test:	-/-

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 1	May 2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

Guidance	Version	Description
DTS: KDB 558074 D01	v03r05	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
UNII: KDB 789033 D02	v01r02	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E
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
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
KDB 662911 D01	V02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+20 °C during room temperature tests +45 °C during high temperature tests +5 °C during low temperature tests
Relative humidity content	:		55 %
Barometric pressure	:		not relevant for this kind of testing
Power supply	:	V_{nom} V_{max} V_{min}	7.4 V DC by external power supply 7.5 V 6.2 V

5 Test item

5.1 General description

Kind of test item	:	Wireless conference system
Type identification	:	ADN-W C1 / ADN-W D1
HMN	:	-/-
PMN	:	ADN-W C1 / ADN-W D1
HVIN	:	ADN-W C1 / ADN-W D1
FVIN	:	1.2.0.6
S/N serial number	:	1231100009
HW hardware status	:	FPGA : 2_8_5_prod2/ D1w_LX45_PROD_TX_279.bin
SW software status	:	ADNW_TERMINAL.EXE from 16.11.2012; APP:001120
Frequency band	:	UNII Bands 5250 MHz to 5350 MHz and 5470 MHz to 5865 MHz
Type of radio transmission Use of frequency spectrum	: :	OFDM (Frame based equipment)
Type of modulation	:	Fixed QPSK- Modulation Scheme, Coding Rate 1/2
Number of channels	:	42
Antenna	:	2 integrated antennas The test sample provided was equipped with an SMA connector. Tests performed assuming a 0dBi antenna gain.
Power supply	:	6.2 V to 7.5 V DC by external power supply
Temperature range	:	+5°C to +45°C

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: 1-1248/16-01-01_AnnexA
1-1248/16-01-01_AnnexB
1-1248/16-01-01_AnnexH

6 Test laboratories sub-contracted

None

7 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Occupied bandwidth	± 100 kHz (depends on the used RBW)
Frequency accuracy (radar burst)	0.1 Hz
Level accuracy (radar burst)	± 0.5 dB
Maximum output power	± 0.5 dB

8 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	2016-08-02	DFS only for client device

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

Abbreviations/References:

C Compliant
NC Not compliant
NA Not applicable
NP Not performed

9 Additional comments

Reference documents:	None
Special test descriptions:	Radar pulse type 0 used for all tests reported in this document.
Configuration descriptions:	All tests performed in normal test mode (during normal operation) were carried out with 4 client devices (AND-W D1) associated to the DUT. One AND-W D1 was actively transmitting audio.

10 RF measurements

10.1 Description of test setup

10.1.1 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

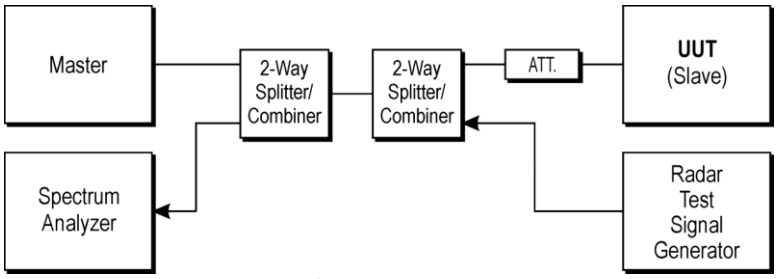


Figure 1: Setup

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	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
11	A	Vektor Signal Generator	SMU200A	R&S	101633	300003496	k	07.04.2014	07.04.2017
2	A	Spectrum Analyzer 9kHz to 30GHz - 140..+30dBm	FSP30	R&S	100886	300003575	k	27.01.2016	27.01.2018
3	A	DFS-test site	div. Splitter, Cables, Attenuators	Mini-Circuits	na	300004557	ev	-/-	-/-
4	A	Master Device	AND-W AM-US	Sennheiser	1231100009	-/-	ne	-/-	-/-
5	A	RF-Cable WLAN-Tester Port 1	ST18/SMAm/SMAm/36	Huber & Suhner	Batch no. 601494	400001216	ev	-/-	-/-
6	A	RF-Cable WLAN-Tester Port 2	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 54877	400001217	ev	-/-	-/-
7	A	RF-Cable WLAN-Tester Port 3	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 54877	400001218	ev	-/-	-/-
8	A	RF-Cable WLAN-Tester Port 4	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 1273777	400001219	ev	-/-	-/-
9	A	RF-Cable WLAN-Tester Analyzer	ST18/SMAm/SMAm/36	Huber & Suhner	Batch no. 54876	400001220	ev	-/-	-/-
10	A	RF-Cable WLAN-Tester Vector Signal Generator	ST18/SMAm/SMAm/60	Huber & Suhner	Batch no. 606844	400001222	ev	-/-	-/-
11	A	RF-Cable WLAN-Tester Reserve	ST18/SMAm/SMAm/36	Huber & Suhner	Batch no. 54876	400001223	ev	-/-	-/-
12	A	PC	ExOne	F+W	2890296v001	300005102	ne	-/-	-/-

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
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

10.2 Parameters of DFS test signals

10.2.1 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.

10.2.2 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.

10.2.3 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	Roundup $\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{\mathrm{PRI}_{\mu\mathrm{sec}}}\right)\right\}$	60%	30
		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			
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.

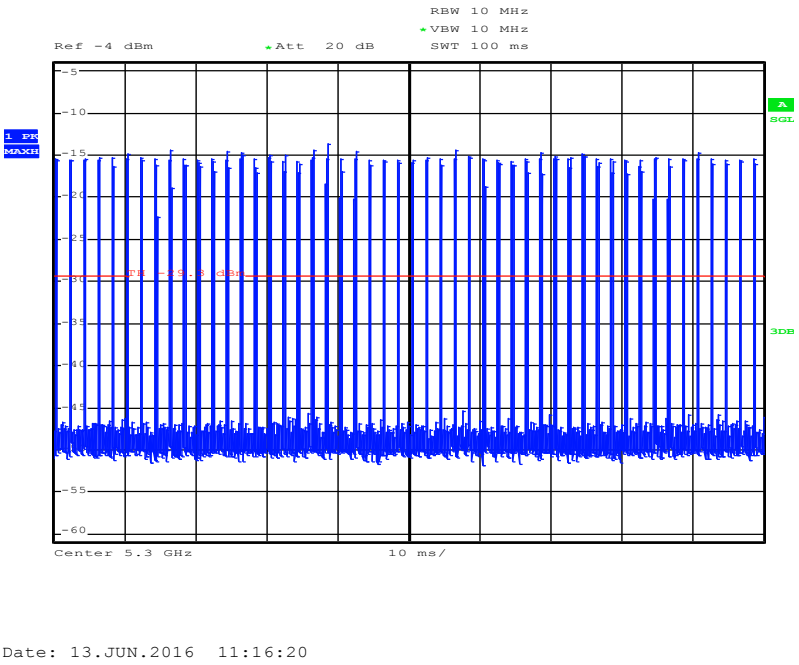
10.3 Test preparation

10.3.1 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 analyzer for zero span and approximate the Time On/ (Time On + Off Time). This can be done with any appropriate channel BW and modulation type.

Note (Frame Based Systems): The channel loading test file will be transferred from the *Master Device* to the *Client Device* for all test configurations. For frame based systems with a fixed talk/listen ratio, the ratio systems will be set to the worst case (maximum) that is user configurable during this test as specified by the manufacturer. For frame based systems that dynamically allocate the talk/listen ratio, the channel loading test file will be transferred from the *Master Device* to the *Client Device* for all test configurations

20 MHz-mode: Calculated duty cycle = 10.0%

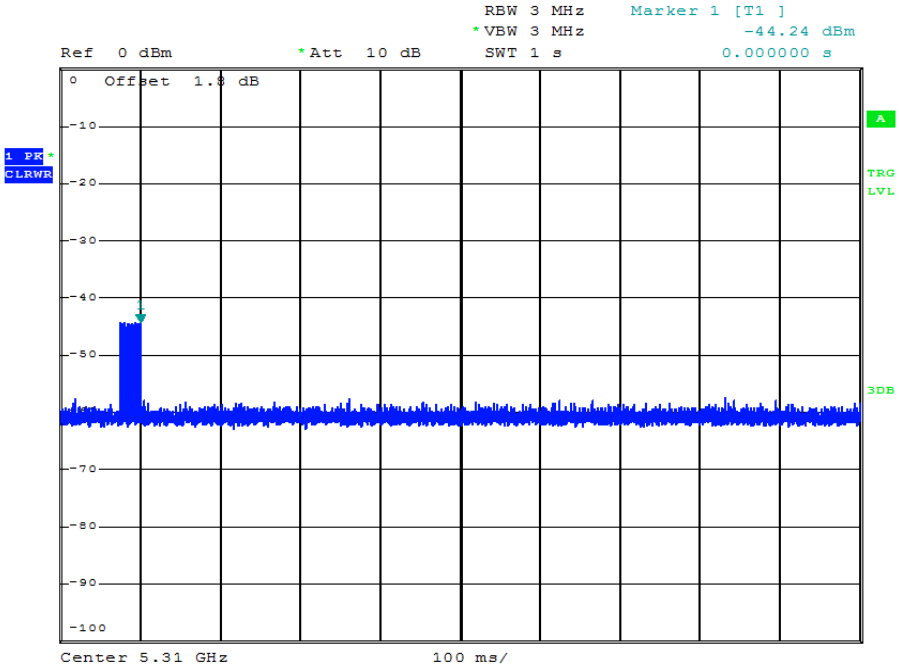


Plot 1

10.3.2 Radar burst timing signal

To accurately determine the channel closing time and channel closing transmission time the spectrum analyser is triggered at the end of the radar burst (see marker at *t* = 0ms).

Example plot



Plot 2

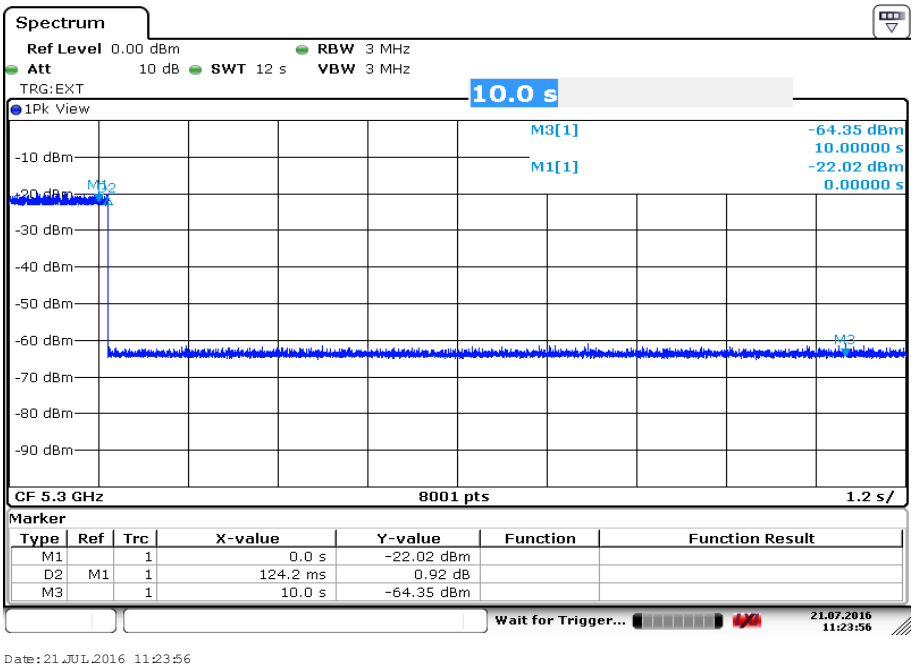
10.4 Test results (during normal operation)

10.4.1 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.

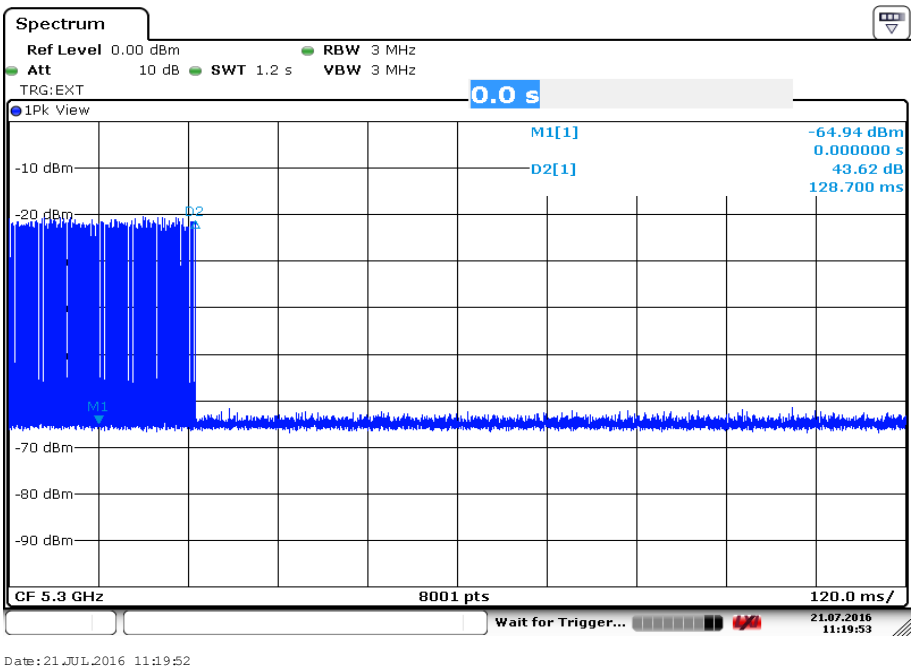
Channel Closing Time



Plot 3

Note: With Marker 1 at the end of the radar pulse (t = 0ms) the Channel Closing Time is determined by setting a Delta-Marker to the point where the last transmission occurred.
The Channel Closing Time is 124.2 ms.

Channel Closing Transmission Time

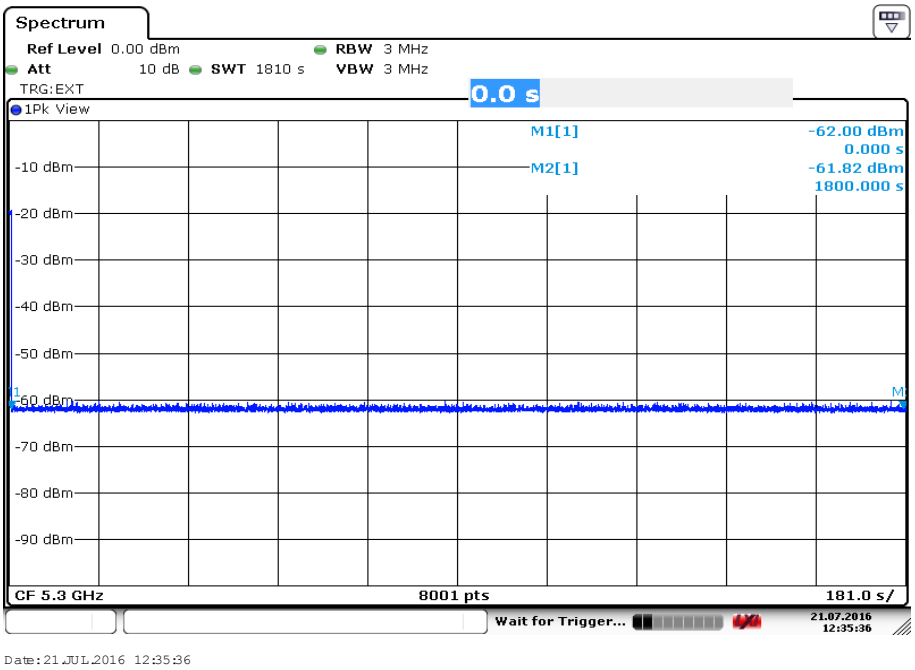


Plot 4

Note: With Marker 1 at the end of the radar pulse (t = 0ms) the Channel Closing Time is determined by setting a Delta-Marker to the point where the last transmission occurred.
The accumulated transmission time is less than the delta between *Marker 1* and *Marker 2* (128.7ms) hence it is less than 200 ms + 60 ms.

10.4.2 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.



Plot 5

11 Observations

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

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2016-08-02

Annex B Further information

Glossary

AVG - Average
DUT - Device under test
EMC - Electromagnetic Compatibility
EN - European Standard
EUT - Equipment under test
ETSI - European Telecommunications Standard Institute
FCC - Federal Communication Commission
FCC ID - Company Identifier at FCC
HW - Hardware
IC - Industry Canada
Inv. No. - Inventory number
N/A - Not applicable
PP - Positive peak
QP - Quasi peak
S/N - Serial number
SW - Software
PMN - Product marketing name
HMN - Host marketing name
HVIN - Hardware version identification number
FVIN - Firmware version identification number

Annex C Accreditation Certificate

Front side of certificate

DAkkS
Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

CETECOM ICT Services GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

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Mobilfunk (GSM / DCS) + OTA
Elektromagnetische Verträglichkeit (EMV)
Produktsicherheit
SAR / EMF
Umwelt
Smart Card Technology
Bluetooth®
Automotive
WI-FI-Services
Kanadische Anforderungen
US-Anforderungen
Akustik
Near Field Communication (NFC)

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 04.05.2016 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig bis 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 63 Seiten.

Registrierungsnummer der Urkunde: **D-PL-12076-01-01**

Frankfurt, 04.05.2016

Im Auftrag Dipl.-Ing. (FH) Ralf Egner
Abteilungsleiter

Siehe Hinweise auf der Rückseite

Back side of certificate

Deutsche Akkreditierungsstelle GmbH

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60327 Frankfurt am Main

Standort Braunschweig
Bundesallee 100
38116 Braunschweig

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Note:
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