

## TEST REPORT

Test report no.: 1-9100/19-02-18

BNNetzA-CAB-02/21-102

### Testing laboratory

**CTC advanced GmbH**

Untertuerkheimer Strasse 6 – 10

66117 Saarbruecken / Germany

Phone: + 49 681 5 98 - 0

Fax: + 49 681 5 98 - 9075

Internet: <https://www.ctcadvanced.com>

e-mail: [mail@ctcadvanced.com](mailto:mail@ctcadvanced.com)

**Accredited Testing Laboratory:**

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)

The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

### Applicant

**Hexagon Geosystems Services AG**

Baarerstrasse 133

6300 Zug / SWITZERLAND

Phone: -/-

Contact: André Reichmuth

e-mail: [andre.reichmuth@hexagon.com](mailto:andre.reichmuth@hexagon.com)

### Manufacturer

**Hexagon Geosystems Services AG**

Baarerstrasse 133

6300 Zug / SWITZERLAND

### Test standard/s

FCC - Title 47 CFR Part 15      FCC - 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:**      **Next Generation CAS Multi Functional Antenna**

**Model name:**      **QC1000 Rev. B**

**FCC ID:**      **ZKSQC1000B**

**ISED certification number:**      **9849A-QC1000B**

**Frequency:**      2400 MHz to 2483.5 MHz

**Technology tested:**      WLAN

**Antenna:**      Integrated antenna

**Power supply:**      24 V DC by external power supply

**Temperature range:**      -30°C to +70°C

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

### Test report authorized:

Michael Dorongovski  
Lab Manager  
Radio Communications

### Test performed:

Marco Bertolino  
Lab Manager  
Radio Communications

## 1 Table of contents

1	Table of contents .....	2
2	General information .....	3
2.1	Notes and disclaimer .....	3
2.2	Application details .....	3
2.3	Test laboratories sub-contracted .....	3
3	Test standard/s, references and accreditations .....	4
4	Reporting statements of conformity – decision rule .....	5
5	Test environment .....	6
6	Test item .....	6
6.1	General description .....	6
6.2	Additional information .....	6
7	Description of the test setup .....	7
7.1	Shielded fully anechoic chamber .....	8
8	Sequence of testing .....	9
8.1	Sequence of testing radiated spurious 9 kHz to 30 MHz .....	9
8.2	Sequence of testing radiated spurious 1 GHz to 18 GHz .....	10
9	Measurement uncertainty .....	11
10	Summary of measurement results .....	12
11	Additional information and comments .....	13
12	Additional EUT parameter .....	15
13	Measurement results .....	16
13.1	Radiated power @ 3 MHz RBW .....	16
13.2	Band edge compliance radiated .....	17
13.3	Spurious emissions radiated below 30 MHz .....	21
13.4	Spurious emissions radiated above 1 GHz .....	24
14	Observations .....	27
15	Glossary .....	28
16	Document history .....	29
17	Accreditation Certificate – D-PL-12076-01-04 .....	29
18	Accreditation Certificate – D-PL-12076-01-05 .....	30

## 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. CTC advanced 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.

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CTC advanced GmbH.

The testing service provided by CTC advanced GmbH has been rendered under the current "General Terms and Conditions for CTC advanced GmbH".

CTC advanced GmbH will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.

Under no circumstances does the CTC advanced GmbH test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.

Under no circumstances does the CTC advanced GmbH test report include or imply any product or service warranties from CTC advanced GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CTC advanced GmbH.

All rights and remedies regarding vendor's products and services for which CTC advanced GmbH has prepared this test report shall be provided by the party offering such products or services and not by CTC advanced GmbH. In no case this test report can be considered as a Letter of Approval.

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

### 2.2 Application details

Date of receipt of order:	2022-04-01
Date of receipt of test item:	2022-04-27
Start of test:*	2022-04-27
End of test:*	2022-04-28
Person(s) present during the test:	-/-

\*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

### 2.3 Test laboratories sub-contracted

None

### 3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 15	-/-	FCC - 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 5 incl. Amendment 1 & 2	February 2021	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

Guidance	Version	Description
KDB 558074 D01	v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
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

Accreditation	Description	
D-PL-12076-01-04	Telecommunication and EMC Canada <a href="https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf">https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf</a>	  Deutsche Akkreditierungsstelle D-PL-12076-01-04
D-PL-12076-01-05	Telecommunication FCC requirements <a href="https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf">https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf</a>	  Deutsche Akkreditierungsstelle D-PL-12076-01-05

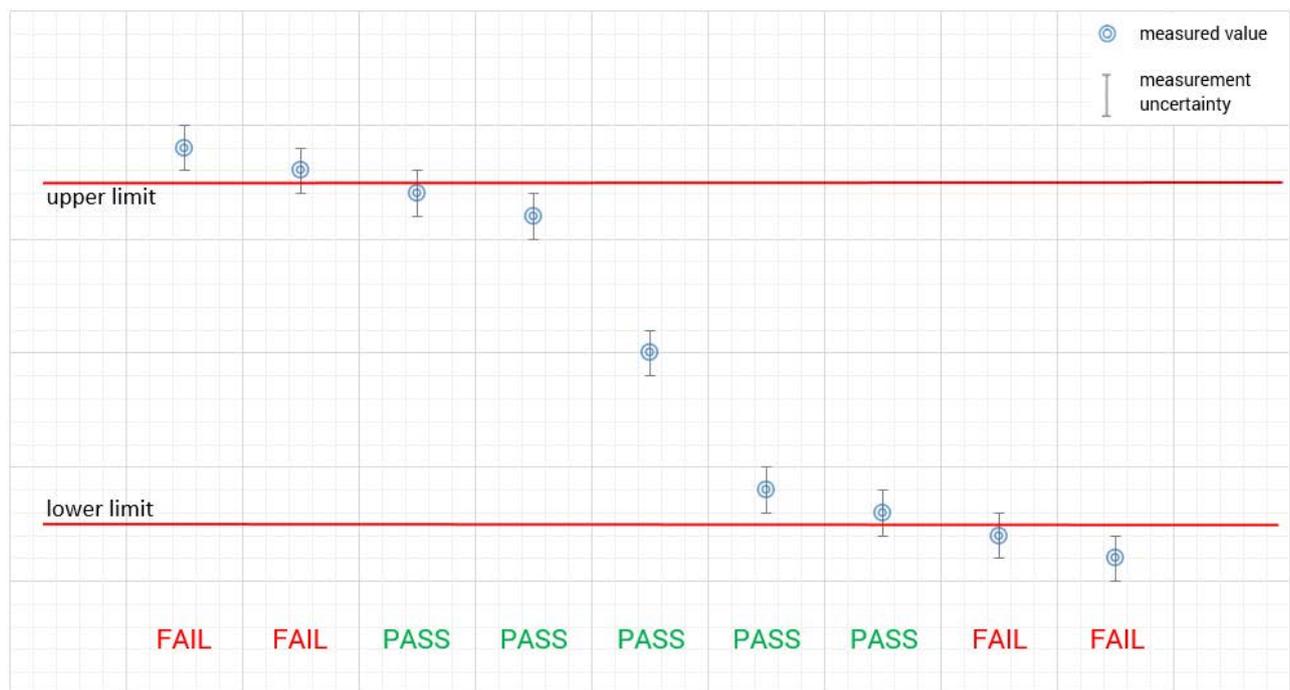
ISED Testing Laboratory Recognized Listing Number: DE0001  
 FCC designation number: DE0002

#### 4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.

The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."

measured value, measurement uncertainty, verdict



## 5 Test environment

Temperature	:	$T_{nom}$ 22 °C during room temperature tests $T_{max}$ No test under extreme temperature conditions required. $T_{min}$ No test under extreme temperature conditions required.
Relative humidity content	:	38 %
Barometric pressure	:	1021 hpa
Power supply	:	$V_{nom}$ 24 V DC by external power supply $V_{max}$ No test under extreme voltage conditions required. $V_{min}$ No test under extreme voltage conditions required.

## 6 Test item

### 6.1 General description

Kind of test item	:	Next Generation CAS Multi Functional Antenna
Model name	:	QC1000 Rev. B
HMN	:	n/a
PMN	:	QC1000
HVIN	:	QC1000 Rev.B
FVIN	:	n/a
S/N serial number	:	Test_008 (90271201080)
Hardware status	:	B
Software status	:	-/-
Firmware status	:	-/-
Frequency band	:	2400 MHz to 2483.5 MHz
Type of radio transmission	:	DSSS, OFDM
Use of frequency spectrum	:	
Type of modulation	:	CCK, (D)BPSK, (D)QPSK, 16 – QAM, 64 – QAM
Number of channels	:	11
Antenna	:	Integrated antenna
Power supply	:	24 V DC by external power supply
Temperature range	:	-30°C to +70°C

### 6.2 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:

- 1-9100/19-02-01\_AnnexA
- 1-9100/19-02-01\_AnnexB
- 1-9100/19-02-01\_AnnexD

## 7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

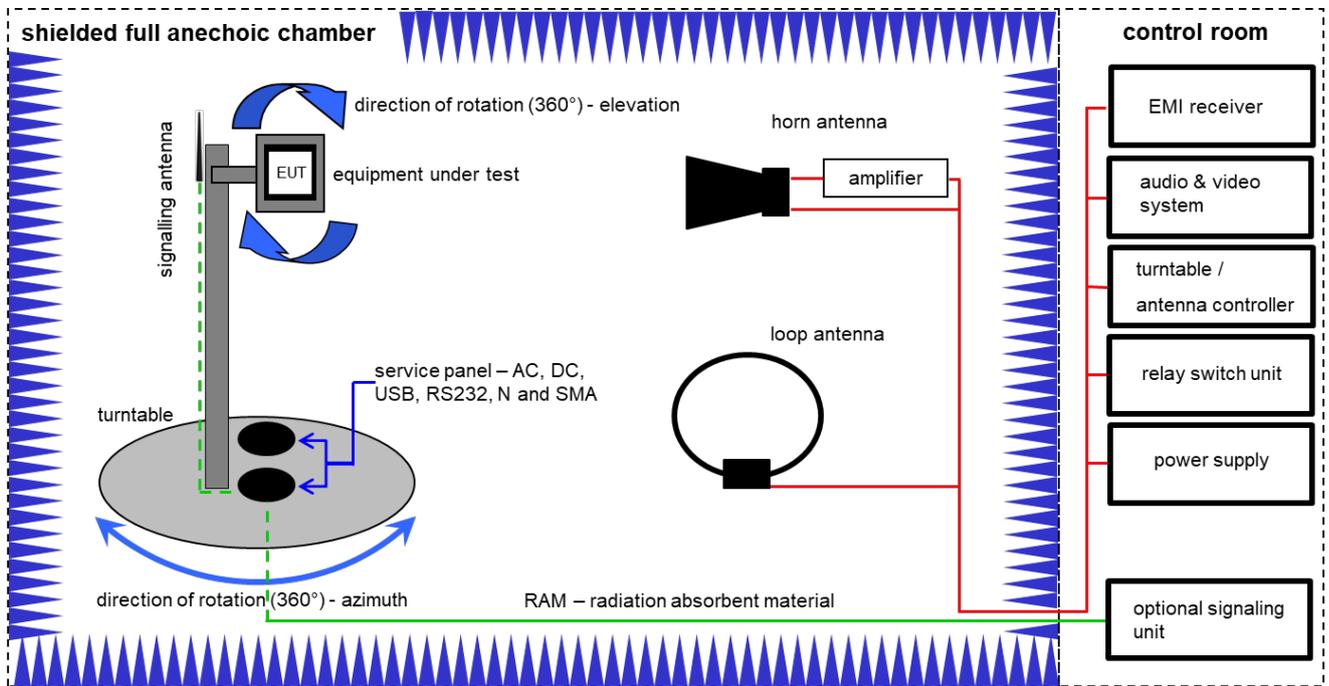
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

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

## 7.1 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter / 1 meter

$$FS = UR + CA + AF$$

(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:

$$FS \text{ [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V/m]} + (-35.8) \text{ [dB]} + 32.9 \text{ [dB/m]} = 37.1 \text{ [dB}\mu\text{V/m]} \text{ (71.61 } \mu\text{V/m)}$$

**Equipment table:**

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B, C	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vKI!	09.12.2020	08.12.2023
2	C	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vKI!	01.07.2021	31.07.2023
3	A, B, C	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	A, B, C	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
5	A, B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vKI!	11.02.2022	29.02.2024
6	B	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev	-/-	-/-
7	A, B, C	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	09.12.2021	31.12.2022
8	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
9	A, B, C	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
10	A, B, C	NEXIO EMV-Software	BAT EMC V3.21.0.27	EMCO	-/-	300004682	ne	-/-	-/-

## 8 Sequence of testing

### 8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premeasurement\*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

#### Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

\*Note: The sequence will be repeated three times with different EUT orientations.

## 8.2 Sequence of testing radiated spurious 1 GHz to 18 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 9 Measurement uncertainty

Measurement uncertainty		
Test case	Uncertainty	
Antenna gain	± 3 dB	
Power spectral density	± 1.56 dB	
DTS bandwidth	± 100 kHz (depends on the used RBW)	
Occupied bandwidth	± 100 kHz (depends on the used RBW)	
Maximum output power conducted	± 1.56 dB	
Detailed spurious emissions @ the band edge - conducted	± 1.56 dB	
Band edge compliance radiated	± 3 dB	
Spurious emissions conducted	> 3.6 GHz	± 1.56 dB
	> 7 GHz	± 1.56 dB
	> 18 GHz	± 2.31 dB
	≥ 40 GHz	± 2.97 dB
Spurious emissions radiated below 30 MHz	± 3 dB	
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB	
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB	
Spurious emissions radiated above 12.75 GHz	± 4.5 dB	
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 dB	

## 10 Summary of measurement results

<input type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input checked="" type="checkbox"/>	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
RF-Testing	CFR Part 15 RSS - 247, Issue 2	See table!	2022-05-05	Tests according customer demand

Test specification clause	Test case	Guideline	Temperature & voltage conditions	C	NC	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (f)(ii)	Antenna gain	-/-	Nominal	-/-				-/-
§15.35	Duty cycle	-/-	Nominal	-/-				-/-
§15.247(e) RSS - 247 / 5.2 (b)	Power spectral density	KDB 558074 DTS clause: 8.4	Nominal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.247(a)(2) RSS - 247 / 5.2 (a)	DTS bandwidth	KDB 558074 DTS clause: 8.2	Nominal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
RSS Gen clause 4.6.1	Occupied bandwidth	-/-	Nominal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.247(b)(3) RSS - 247 / 5.4 (d)	Maximum output power	KDB 558074 DTS clause: 8.3.1.3	Nominal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge – cond.	-/-	Nominal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance cond. or rad.	KDB 558074 DTS clause: 8.7.3	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5	TX spurious emissions cond.	KDB 558074 DTS clause: 8.5	Nominal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.209(a) RSS-Gen	TX spurious emissions rad. below 30 MHz	-/-	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	b-mode only
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions rad. 30 MHz to 1 GHz	-/-	Nominal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions rad. above 1 GHz	-/-	Nominal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	b-mode only only 1-18 GHz
§15.107(a) §15.207	Conducted emissions < 30 MHz	-/-	Nominal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-

**Notes:**

<b>C</b>	Compliant	<b>NC</b>	Not compliant	<b>NA</b>	Not applicable	<b>NP</b>	Not performed
----------	-----------	-----------	---------------	-----------	----------------	-----------	---------------

## 11 Additional information and comments

Reference documents: None

Co-applicable documents: main report 1-9100/19-01-12-B

Special test descriptions: None

Configuration descriptions:

**b-mode:**

tx txch=1;dump=0;pro=0;ir=0;deaf=0;rxch=1;gi=1;retry=0;bssid=01.00.00.c0.ff.ee;pc=2000001;dur=1;pl=1500;stat=3;ht40=0;bc=1;transmitPower=-80;reset=1;if=1;iss=0;f=2412;mactx=01.00.00.c0.ff.ee;att=0;r=1l;agg=0;macrx=01.00.00.c0.ff.ee;

**nHT20-mode:**

txch=1;dump=0;pro=0;ir=0;deaf=0;rxch=1;gi=0;retry=0;bssid=01.00.00.c0.ff.ee;pc=2000001;dur=1;pl=1500;stat=3;ht40=0;bc=1;transmitPower=-80;reset=1;if=1;iss=0;f=2412;mactx=01.00.00.c0.ff.ee;att=0;r=t0;agg=0;macrx=01.00.00.c0.ff.ee;

**nHT40-mode:**

tx txch=1;dump=0;pro=0;ir=0;deaf=0;rxch=1;gi=0;retry=0;bssid=01.00.00.c0.ff.ee;pc=2000001;dur=1;pl=1500;stat=3;ht40=1;bc=1;transmitPower=-80;reset=1;if=1;iss=0;f=2412;mactx=01.00.00.c0.ff.ee;att=0;r=f0;agg=0;macrx=01.00.00.c0.ff.ee;

- EUT selection:
- Only one device available
  - Devices selected by the customer
  - Devices selected by the laboratory (Randomly)

Provided channels:

Channels with 20 MHz channel bandwidth:

channel number & center frequency													
channel	<b>1</b>	2	3	4	5	<b>6</b>	7	8	9	10	<b>11</b>	12	13
f <sub>c</sub> / MHz	<b>2412</b>	2417	2422	2427	2432	<b>2437</b>	2442	2447	2452	2457	<b>2462</b>	2467	2472

Channels with 40 MHz channel bandwidth:

channel number & center frequency													
channel	-/-	-/-	<b>3</b>	4	5	<b>6</b>	7	8	<b>9</b>	10	11	-/-	-/-
f <sub>c</sub> / MHz	-/-	-/-	<b>2422</b>	2427	2432	<b>2437</b>	2442	2447	<b>2452</b>	2457	2462	-/-	-/-

Note: The channels used for the tests are marked in bold in the list.

## 12 Additional EUT parameter

- Test mode:
- No test mode available  
lperf was used to ping another device with the largest support packet size
  - Test mode available  
Special software is used.  
EUT is transmitting pseudo random data by itself
- Modulation types:
- Wide Band Modulation (None Hopping – e.g. DSSS, OFDM)
  - Frequency Hopping Spread Spectrum (FHSS)
- Antennas and transmit operating modes:
- Operating mode 1 (single antenna)
    - *Equipment with 1 antenna,*
    - *Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,*
    - *Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)*
  - Operating mode 2 (multiple antennas, no beamforming)
    - *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.*
  - Operating mode 3 (multiple antennas, with beamforming)
    - *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.  
In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.*

## 13 Measurement results

### 13.1 Radiated power @ 3 MHz RBW

#### Measurement:

Measurement parameter	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	3 MHz
Video bandwidth	3 MHz / 10 MHz
Trace mode	Max hold
Test setup	See chapter 7.1 setup A (radiated)
Measurement uncertainty	See chapter 9

#### Results:

	lowest channel	middle channel	highest channel
Radiated power / dBm Measured with DSSS modulation	12.9	13.8	15.8

**NOTE: These results are only informational.**

## 13.2 Band edge compliance radiated

### Description:

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to the lowest channel for the lower restricted band and to the highest channel for the upper restricted band. Measurement distance is 3 meter.

### Measurement:

	Measurement parameter for peak measurements	Measurement parameter for average measurements
		According to DTS clause: 8.7.3
Detector	Peak	RMS
Sweep time	Auto	Auto
Resolution bandwidth	1 MHz	100 kHz
Video bandwidth	1 MHz	300 kHz
Span	See plot	2 MHz
Trace mode	Max. hold	RMS Average over 101 sweeps
Analyzer function	-/-	Band power function (Compute the power by integrating the spectrum over 1 MHz)
Test setup	See chapter 7.2 setup A	
Measurement uncertainty	See chapter 9	

### Limits:

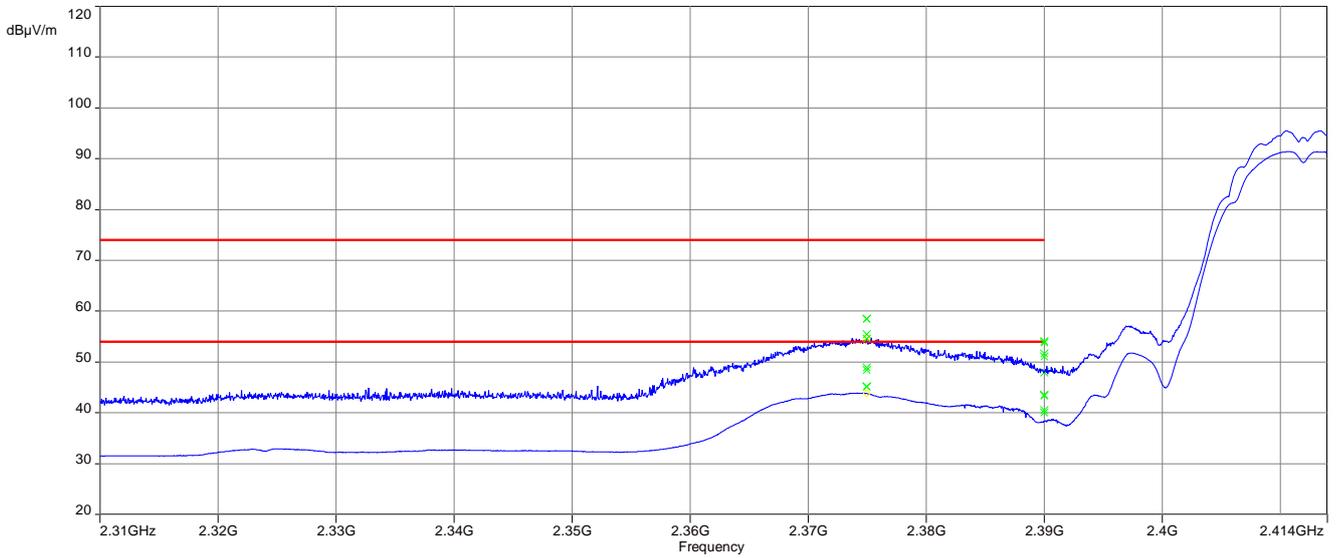
FCC	ISED
74 dBµV/m @ 3 m (Peak) 54 dBµV/m @ 3 m (AVG)	

### Results:

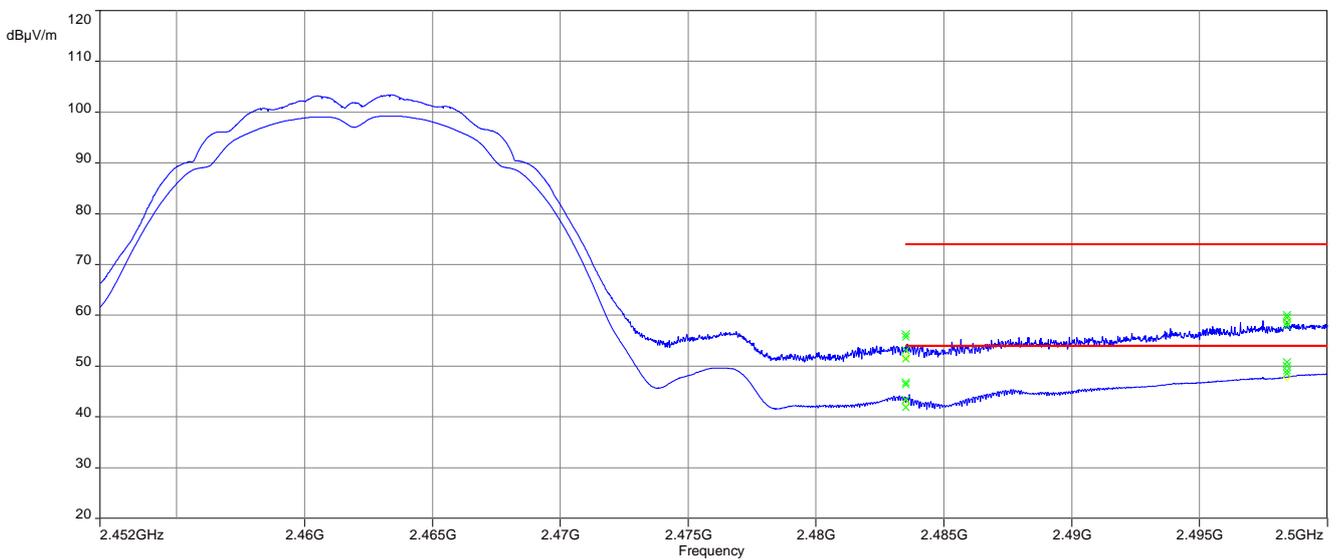
band edge compliance radiated / (dBµV / m) @ 3 m			
	DSSS	OFDM (20 MHz nominal channel bandwidth)	OFDM (40 MHz nominal channel bandwidth)
Lower band edge	54.1 Peak 43.6 AVG	66.5 Peak 52.7 AVG	61.9 Peak 50.7 AVG
Upper band edge	56.3 Peak 46.3 AVG	61.4 Peak 46.5 AVG	64.9 Peak 52.4 AVG

**Plots:** DSSS - peak / average

**Plot 1:** TX mode, lower band edge, vertical & horizontal polarization

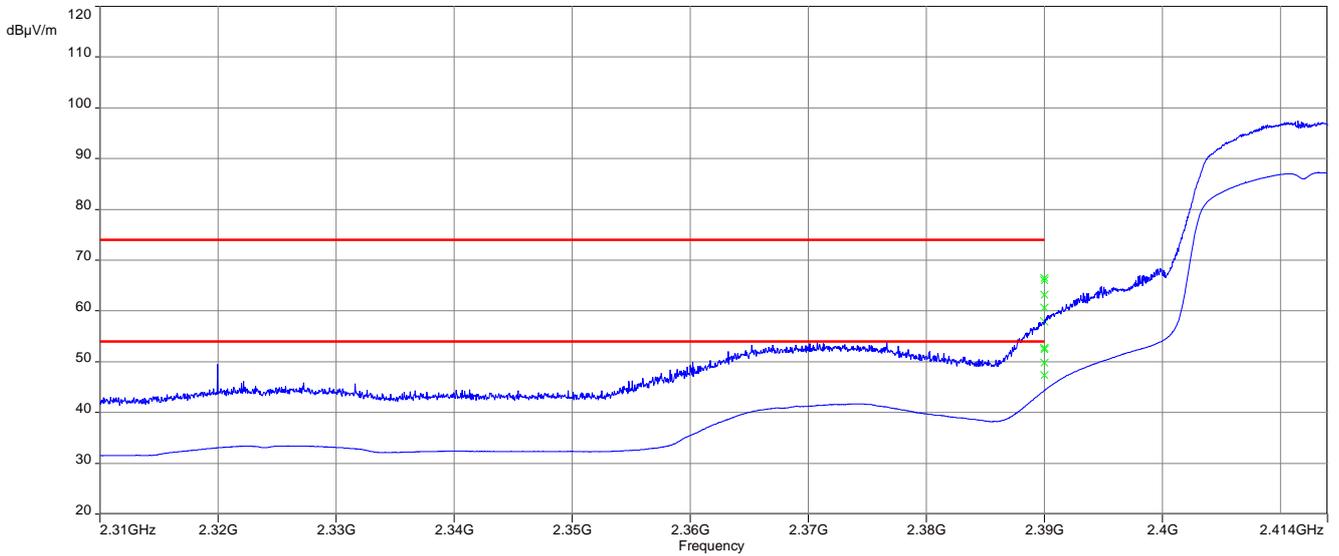


**Plot 2:** TX mode, upper band edge, vertical & horizontal polarization

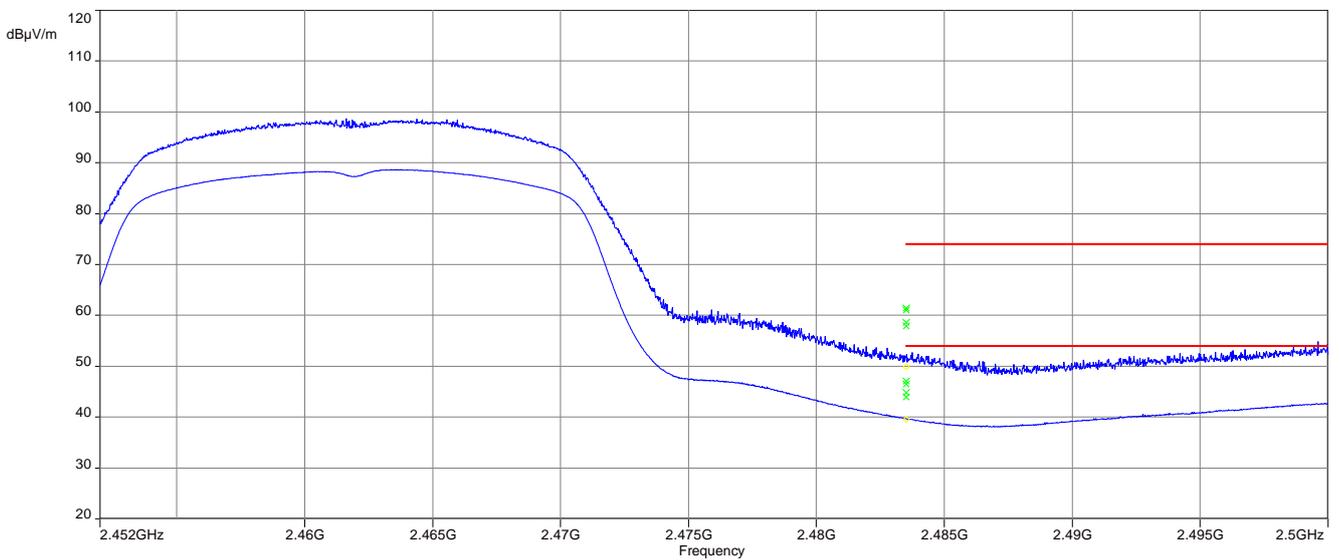


**Plots:** OFDM (20 MHz bandwidth) - peak / average

**Plot 1:** TX mode, lower band edge, vertical & horizontal polarization

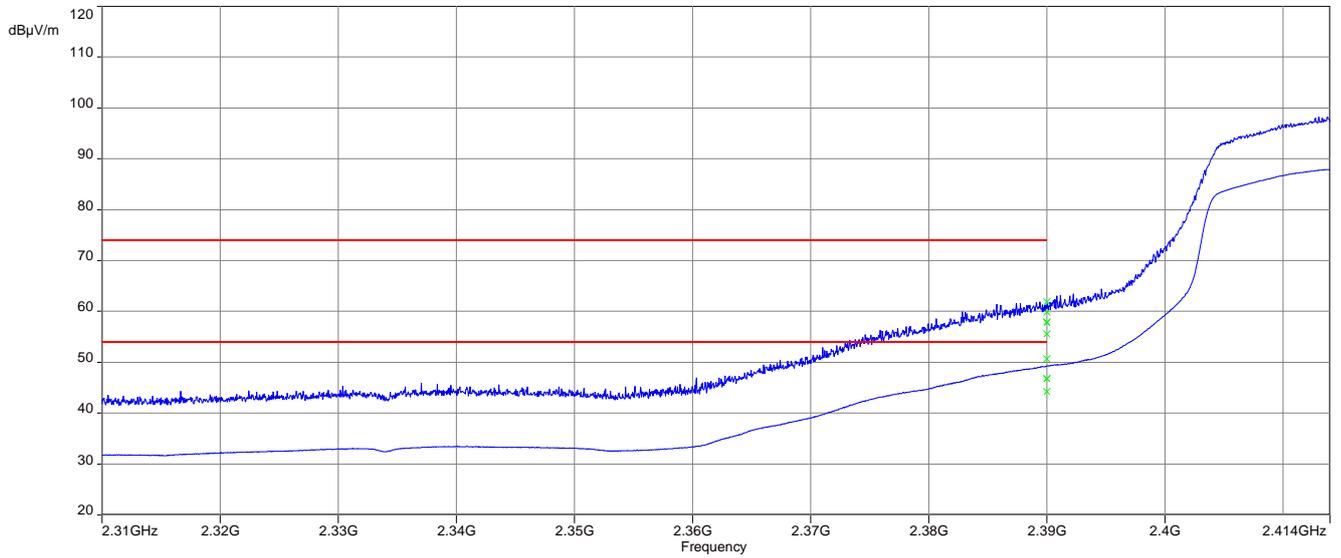


**Plot 2:** TX mode, upper band edge, vertical & horizontal polarization

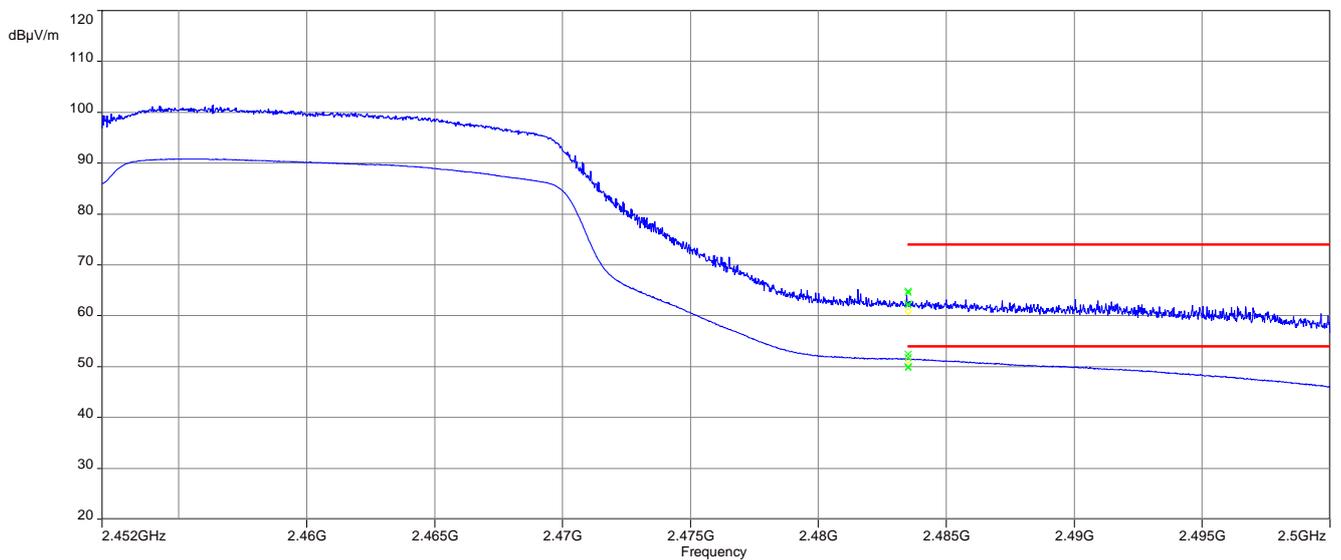


**Plots:** OFDM (40 MHz bandwidth) - mode peak / average

**Plot 1:** TX mode, lower band edge, vertical & horizontal polarization



**Plot 2:** TX mode, upper band edge, vertical & horizontal polarization



### 13.3 Spurious emissions radiated below 30 MHz

**Description:**

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The limits are recalculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

**Measurement:**

Measurement parameter	
Detector	Peak / Quasi Peak
Sweep time	Auto
Resolution bandwidth	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span	9 kHz to 30 MHz
Trace mode	Max Hold
Measured modulation	<input checked="" type="checkbox"/> DSSS b – mode <input type="checkbox"/> OFDM g – mode <input type="checkbox"/> OFDM n HT20 – mode <input type="checkbox"/> OFDM n HT40 – mode
Test setup	See chapter 7.2 setup C
Measurement uncertainty	See chapter 9

**Limits:**

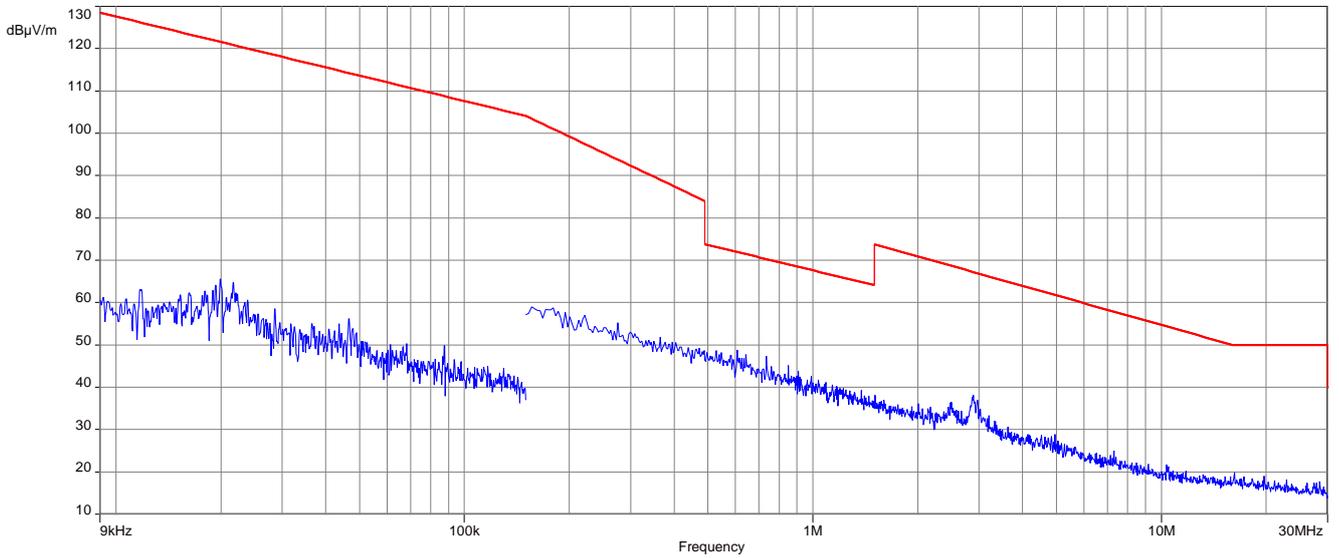
FCC		ISED	
Frequency / MHz	Field Strength / (dBµV / m)	Measurement distance / m	
0.009 – 0.490	2400/F(kHz)	300	
0.490 – 1.705	24000/F(kHz)	30	
1.705 – 30.0	30	30	

**Results:**

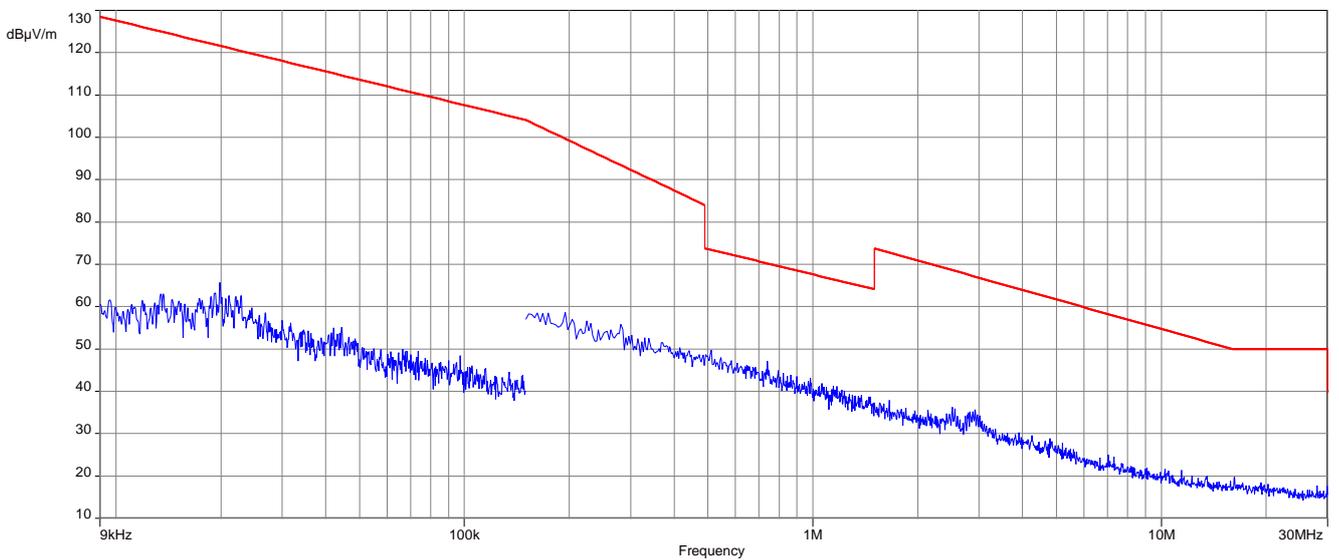
TX spurious emissions radiated < 30 MHz / (dBµV / m) @ 3 m		
Frequency / MHz	Detector	Level / (dBµV / m)
All detected peaks are more than 20 dB below the limit.		

**Plots:** DSSS

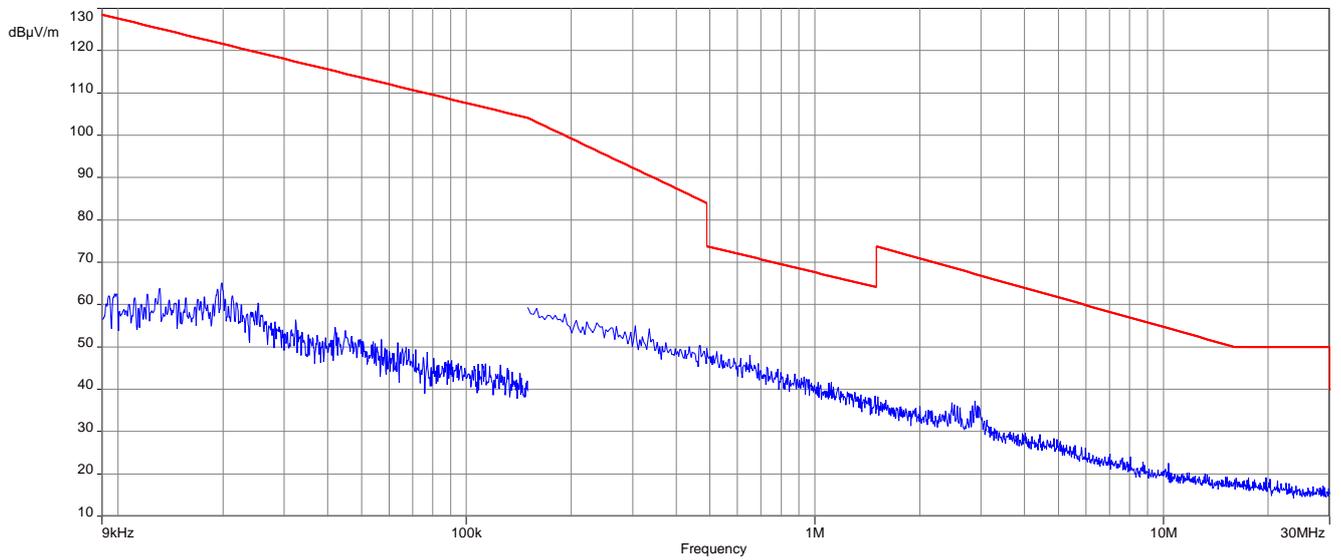
**Plot 1:** 9 kHz to 30 MHz, lowest channel



**Plot 2:** 9 kHz to 30 MHz, middle channel



**Plot 3:** 9 kHz to 30 MHz, highest channel



### 13.4 Spurious emissions radiated above 1 GHz

#### Description:

Measurement of the radiated spurious emissions above 1 GHz in transmit mode and receiver / idle mode.

#### Measurement:

Measurement parameter	
Detector	Peak / RMS
Sweep time	Auto
Resolution bandwidth	1 MHz
Video bandwidth	3 x RBW
Span	1 GHz to 18 GHz
Trace mode	Max Hold
Measured modulation	<input checked="" type="checkbox"/> DSSS b – mode <input type="checkbox"/> OFDM g – mode <input type="checkbox"/> OFDM n HT20 – mode <input type="checkbox"/> OFDM n HT40 – mode
Test setup	See chapter 7.2 setup B
Measurement uncertainty	See chapter 9

#### Limits:

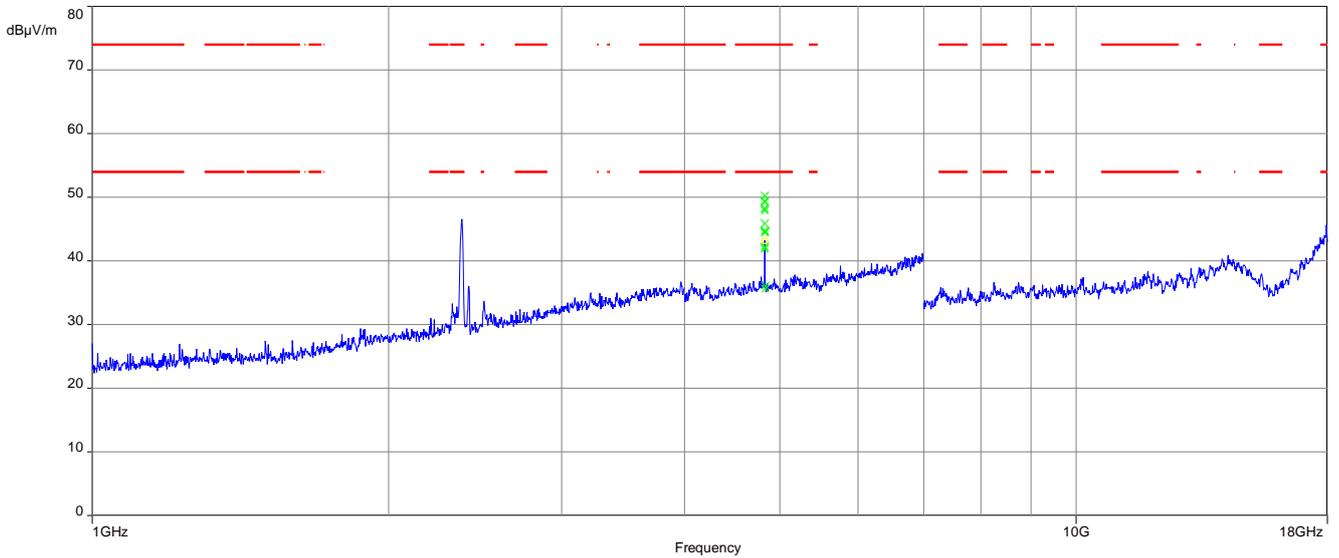
FCC	ISED	
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that 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 §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).		
Frequency / MHz	Field Strength / (dB $\mu$ V / m)	Measurement distance / m
Above 960	54.0 (AVG)	3
	74.0 (peak)	

**Results:** DSSS

TX spurious emissions radiated / dB $\mu$ V/m @ 3 m								
lowest channel			middle channel			highest channel		
f / MHz	Detector	Level / dB $\mu$ V/m	f / MHz	Detector	Level / dB $\mu$ V/m	f / MHz	Detector	Level / dB $\mu$ V/m
4824	Peak	50.3	4874	Peak	50.6	4924	Peak	49.6
	AVG	45.9		AVG	46.1		AVG	44.3
-/-	Peak	-/-	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	-/-		AVG	-/-		AVG	-/-

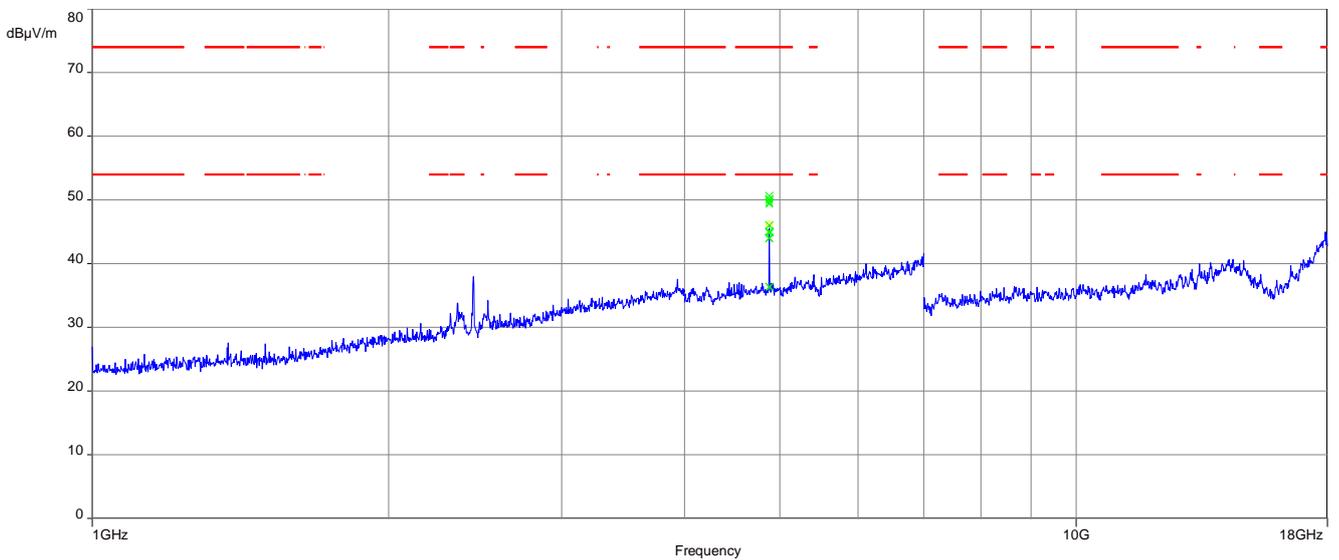
**Plots:** DSSS

**Plot 1:** Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



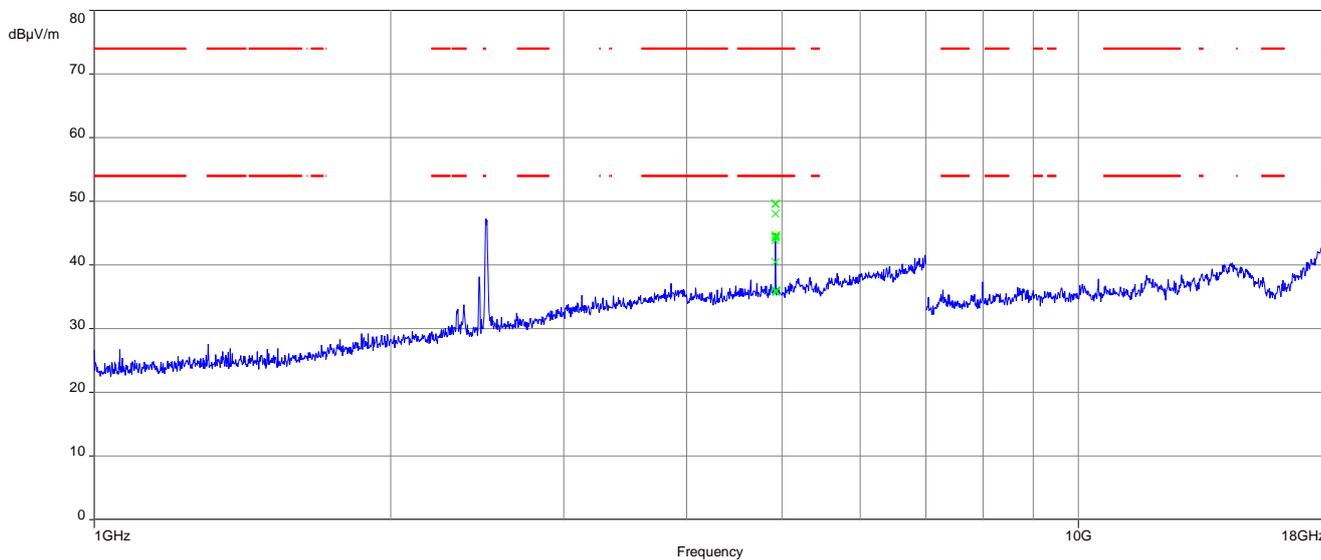
The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 2:** Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization



The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 3:** Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



The carrier signal is notched with a 2.4 GHz band rejection filter.

## 14 Observations

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

## 15 Glossary

<b>EUT</b>	Equipment under test
<b>DUT</b>	Device under test
<b>UUT</b>	Unit under test
<b>GUE</b>	GNSS User Equipment
<b>ETSI</b>	European Telecommunications Standards Institute
<b>EN</b>	European Standard
<b>FCC</b>	Federal Communications Commission
<b>FCC ID</b>	Company Identifier at FCC
<b>IC</b>	Industry Canada
<b>PMN</b>	Product marketing name
<b>HMN</b>	Host marketing name
<b>HVIN</b>	Hardware version identification number
<b>FVIN</b>	Firmware version identification number
<b>EMC</b>	Electromagnetic Compatibility
<b>HW</b>	Hardware
<b>SW</b>	Software
<b>Inv. No.</b>	Inventory number
<b>S/N or SN</b>	Serial number
<b>C</b>	Compliant
<b>NC</b>	Not compliant
<b>NA</b>	Not applicable
<b>NP</b>	Not performed
<b>PP</b>	Positive peak
<b>QP</b>	Quasi peak
<b>AVG</b>	Average
<b>OC</b>	Operating channel
<b>OCW</b>	Operating channel bandwidth
<b>OBW</b>	Occupied bandwidth
<b>OOB</b>	Out of band
<b>DFS</b>	Dynamic frequency selection
<b>CAC</b>	Channel availability check
<b>OP</b>	Occupancy period
<b>NOP</b>	Non occupancy period
<b>DC</b>	Duty cycle
<b>PER</b>	Packet error rate
<b>CW</b>	Clean wave
<b>MC</b>	Modulated carrier
<b>WLAN</b>	Wireless local area network
<b>RLAN</b>	Radio local area network
<b>DSSS</b>	Dynamic sequence spread spectrum
<b>OFDM</b>	Orthogonal frequency division multiplexing
<b>FHSS</b>	Frequency hopping spread spectrum
<b>GNSS</b>	Global Navigation Satellite System
<b>C/N<sub>0</sub></b>	Carrier to noise-density ratio, expressed in dB-Hz

## 16 Document history

Version	Applied changes	Date of release
-/-	Initial release	2022-05-05

## 17 Accreditation Certificate – D-PL-12076-01-04

first page	last page
 <p>The first page of the accreditation certificate includes the DAkkS logo (Deutsche Akkreditierungsstelle), the company name 'Deutsche Akkreditierungsstelle GmbH', and accreditation details for CTC advanced GmbH. It states that the laboratory is entrusted according to Section 8 subsection 1 of the AkkStelleG in connection with Section 1 subsection 1 of the AkkStelleGBV. The accreditation is for Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards. The certificate is signed by Ingrid Egner, Head of Division, on 09.06.2020 in Frankfurt am Main.</p>	 <p>The last page of the accreditation certificate lists the office addresses: Office Berlin (Spittelmarkt 10, 10117 Berlin), Office Frankfurt am Main (Europa-Allee 52, 60327 Frankfurt am Main), and Office Braunschweig (Bundesallee 100, 38116 Braunschweig). It contains legal disclaimers regarding the publication of extracts and the accreditation's validity.</p>

**Note: The current certificate annex is published on the websites (link see below).**

<https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-04e.pdf>

OR

[https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-04\\_Canada\\_TCEMC.pdf](https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-04_Canada_TCEMC.pdf)

**18 Accreditation Certificate – D-PL-12076-01-05**

first page	last page			
 <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition</p> <p><b>Accreditation</b> </p> <p>The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory <b>CTC advanced GmbH</b> Untertürkheimer Straße 6-10, 66117 Saarbrücken is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields: <b>Telecommunication (FCC Requirements)</b></p> <p>The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages.</p> <p>Registration number of the certificate: <b>D-PL-12076-01-05</b></p> <p>Frankfurt am Main, 09.06.2020  by <b>Dipl.-Ing. (FH) Ralf Egner</b> Head of Division</p> <p><small>The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH. <a href="https://www.dakks.de/en/content/accredited-bodies-dakks">https://www.dakks.de/en/content/accredited-bodies-dakks</a> Site valid until: 09.06.2020</small></p>	<p>Deutsche Akkreditierungsstelle GmbH</p> <table border="0"> <tr> <td>Office Berlin Spittelmarkt 10 10117 Berlin</td> <td>Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main</td> <td>Office Braunschweig Bundesallee 100 38116 Braunschweig</td> </tr> </table> <p>The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkKS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.</p> <p>No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkKS.</p> <p>The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkKS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.</p> <p>The up-to-date state of membership can be retrieved from the following websites: EA: <a href="http://www.european-accreditation.org">www.european-accreditation.org</a> ILAC: <a href="http://www.ilac.org">www.ilac.org</a> IAF: <a href="http://www.iaf.nu">www.iaf.nu</a></p>	Office Berlin Spittelmarkt 10 10117 Berlin	Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main	Office Braunschweig Bundesallee 100 38116 Braunschweig
Office Berlin Spittelmarkt 10 10117 Berlin	Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main	Office Braunschweig Bundesallee 100 38116 Braunschweig		

**Note: The current certificate annex is published on the websites (link see below).**

<https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05e.pdf>

OR

[https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05\\_TCB\\_USA.pdf](https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf)

##### END OF TEST REPORT #####