
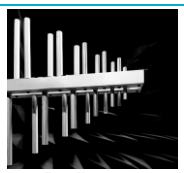
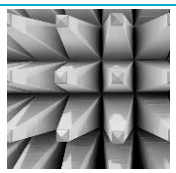

CTC advanced
member of RWTÜV group

TEST REPORT

Test report no.: 1-4472/17-01-02

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

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: http://www.ctcadvanced.com
e-mail: mail@ctcadvanced.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

Dialog Semiconductor BV
Het Zuiderkruis 53
5215 MV°s Hertogenbosch / NETHERLANDS
Phone: -/-
Fax: +31 73 640 88 23
Contact: Steven Leussink
e-mail: steven.leussink@diasemi.com
Phone: +31 73 680 22 10

Manufacturer

Dialog Semiconductor BV
Het Zuiderkruis 53
5215 MV°s Hertogenbosch / NETHERLANDS

Test standard/s

ETSI EN 300 328 V2.1.1	Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

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

Test Item

Kind of test item:	**Bluetooth LE chip**
Model name:	**DA14581**
Frequency:	ISM band 2400 MHz to 2483.5 MHz
Technology tested:	Bluetooth® Low Energy
Antenna:	Integrated antenna
Power supply:	3.0 V DC by battery / external power supply
Temperature range:	-40°C to +85°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:

cn=Joerg Warken, o=CTC advanced GmbH, ou=WAK-281116, email=joerg.warken@ctcadvanced.com, c=DE
2017.07.31 10:13:53 +02'00'

Joerg Warken
Lab Manager
Radio Communications & EMC

Test performed:

cn=Mihail Dorongovskij, o=CTC advanced GmbH, ou=DOR-281116, email=Mihail.Dorongovskij@ctcadvanced.com, c=DE
2017.07.31 10:18:15 +02'00'

Mihail Dorongovskij
Testing 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. 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.
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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:	2017-06-26
Date of receipt of test item:	2017-07-26
Start of test:	2017-07-26
End of test:	2017-07-26
Person(s) present during the test:	Mr. Kai Lewandowski

2.3 Test laboratories sub-contracted

None

3 Test standard/s

Test standard	Date	Test standard description
ETSI EN 300 328 V2.1.1	2016-11	Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests +85 °C during high temperature tests -40 °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}	5.0 V DC by USB -/- V -/- V

5 Test item

5.1 General description

Kind of test item	:	Bluetooth LE chip
Type identification	:	DA14581
S/N serial number	:	Rad. 1415_00026 Cond. 1415_00019
HW hardware status	:	BE
SW software status	:	SDK 5.0.4
Frequency band	:	ISM band 2400 MHz to 2483.5 MHz Lowest channel: 2402 MHz / Highest channel: 2480 MHz
Type of radio transmission **Use of frequency spectrum**	: :	DSSS
Type of modulation	:	GFSK
Number of channels	:	40
Channel bandwidth (B)	:	1 MHz
Channel spacing	:	2 MHz
Receiver category	:	2
Antenna	:	Integrated antenna
Power supply	:	3.0 V DC by battery / external power supply
Temperature range	:	-40°C to +85°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: 1-4472/17-01-01_AnnexA
1-4472/17-01-01_AnnexC

6 Description of the test setup

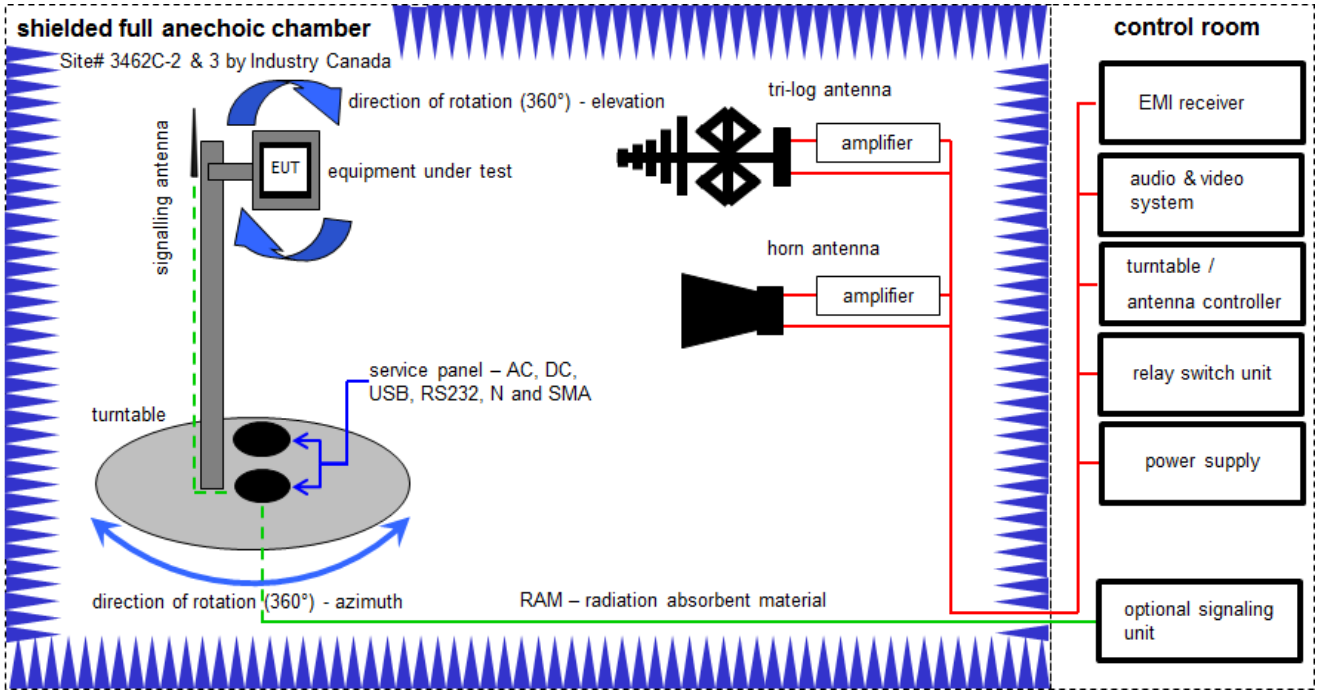
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements 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).

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

6.1 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter

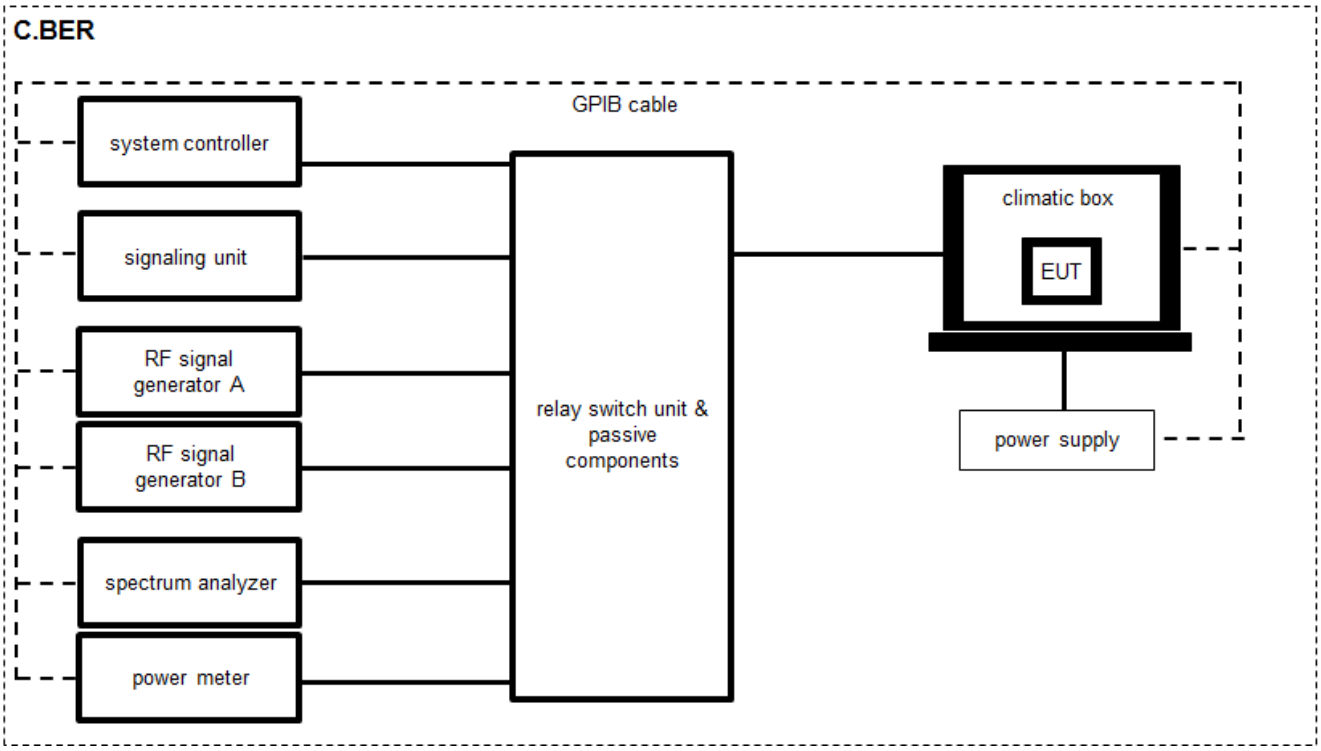
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
2	A, B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
3	A	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev	-/-	-/-
4	A	Highpass Filter	WHKX2.9/18G-12SS	Wainwright	1	300003492	ev	-/-	-/-
5	A, B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	31.01.2017	30.01.2018
6	A	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
7	A, B	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vIKI!	29.10.2014	29.10.2017
8	A	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
9	A, B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
10	A	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9709-5290	300000212	k	13.08.2015	13.08.2017

6.2 Conducted measurements C.BER system



OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	C	RF and Microwave Signal Generator up to 20 GHz	SMB100A	R&S	176183	300004853	k	24.09.2014	24.09.2017
2	A	Signal Analyzer 30GHz	FSV30	R&S	103170	300004855	k	30.01.2017	29.01.2019
3	A, B, C	USB-GPIB-Interface	82357B	Agilent Technologies	103170	300004852	ne	-/-	-/-
4	B	Temperature Test Chamber	VT 4002	Heraeus Voetsch	5856604682001 0	300003019	ev	03.09.2015	03.09.2017
5	C	Bluetooth Tester	CBT35	R&S	100635	300003907	k	01.02.2016	01.02.2018
6	B	Power Sensor	NRP-Z81	R&S	100010	300003780	k	27.01.2017	26.01.2019
7	A, B, C	Directional Coupler	101020010	Krytar	70215	300002840	ev	-/-	-/-
8	A, B, C	DC-Blocker	8143	Inmet Corp.	none	300002842	ne	-/-	-/-
9	A, B, C	Powersplitter	6005-3	Inmet Corp.		300002841	ev	-/-	-/-
10	A, B, C	RF-Cable	ST18/SMAm/SMAm/ 72	Huber & Suhner	Batch no. 605505	400001187	ev	-/-	-/-
11	A, B, C	RF-Cable	Sucoflex 104	Huber & Suhner	147636/4	400001188	ev	-/-	-/-
12	B	Open Switch and Control Unit and Power Sensors	OSP120 incl. B157	R&S	101274, 100877	300004825	ne	28.10.2016	28.10.2019

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
RF-Testing	ETSI EN 300 328 V2.1.1 (2016-11)	See table!	2017-07-31	-/-

Test specification clause	Test case	temperature conditions	power source voltages	Mode	C	NC	NA	NP	Remark
5.4.2	RF output power	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
		Low	Nominal	GFSK	☒	☐	☐	☐	
		High	Nominal	GFSK	☒	☐	☐	☐	
5.4.2	Duty cycle, Tx-sequence, Tx-gap, medium utilization	Nominal	Nominal	-/-	☐	☐	☒	☐	-/-
5.4.3	Power spectral density	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.4	Accumulated transmit time, freq. occupation and hopping sequence	Nominal	Nominal	-/-	☐	☐	☒	☐	-/-
5.4.5	Hopping frequency separation	Nominal	Nominal	-/-	☐	☐	☒	☐	-/-
5.4.6	Adaptivity	Nominal	Nominal	-/-	☐	☐	☒	☐	-/-
5.4.7	Occupied channel bandwidth	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.8	Transmitter unwanted emissions in the out-of-band domain	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.9	Transmitter unwanted emissions in the spurious domain (cond. + rad.)	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.10	Receiver spurious emissions (cond. + rad.)	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
5.4.11	Receiver blocking	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-

Note: C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

8 Additional comments

The Bluetooth® word mark and logos are owned by the Bluetooth SIG Inc. and any use of such marks by CTC advanced GmbH is under license.

Reference documents: Bluetooth® Core Specification (up to 4.2)

Special test descriptions: None

Configuration descriptions: TX tests: were performed with 37 bytes payload packets and static PRBS pattern payload.
RX/Standby tests: BT direct test mode enabled, TX Idle

Test mode:

☐ Bluetooth direct test mode enabled
(EUT is controlled via CBT)

☒ Special software is used.
EUT is transmitting pseudo random data by itself

Bluetooth LE standard capabilities:

- Max. allowed output power: 10 mW (+10 dBm)
- channel separation 2 MHz
- used freq. range 2402-2480 MHz
- tested channels: lowest: 2402 MHz (Ch 0)
  middle: 2440 MHz (Ch 19)
- highest: 2480 MHz (Ch 39)
- Modulation types: GFSK
- Bandwidth appr. 1MHz

EUT parameters during TX tests:

Mode: BT LE test mode
Hopping: off
Packet Type: Longest supported
Modulation: GFSK

EUT parameters during RX tests:

Mode: BT LE test mode, Receiver mode
Hopping: Off

9 EUT classification:

Type of equipment:

- ☒ stand alone equipment
- ☐ plug in radio equipment
- ☐ combined equipment

Modulation types:

- ☒ Wide band modulation (none hopping – e.g. DSSS, OFDM)
- ☐ Frequency hopping spread spectrum (FHSS)

Adaptive equipment:

- ☐ Yes, LBT-based
- ☒ Yes, non-LBT-based
- ☐ Yes (but can be disabled)
- ☐ No

Antennas and transmission 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.

10 Measurement results

10.1 Antenna gain

Measurement:

The antenna gain of the system is calculated by the difference of radiated power in EIRP and the conducted power of the module.

Measurement parameters	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	3 MHz
Video bandwidth	3 MHz
Trace mode	Max hold
Test setup	See sub clause 6.2 – A (conducted) See sub clause 6.1 – B (radiated)
Measurement uncertainty	See sub clause 11

Limits:

No restriction!

Results:

T_{nom}	V_{nom}	lowest channel	middle channel	highest channel
Conducted peak power [dBm] Measured with GFSK modulation		-2.1	-1.8	-2.4
Radiated peak power [dBm] Measured with GFSK modulation		2.1	2.3	2.7
Gain [dBi] Calculated		4.2	4.1	5.1

10.2 RF output power

Measurement:

The Output power measurement is used to detect the maximum power of a device under test. The measurement is performed according to the EN specification 5.4.2.

Measurement parameters:

Instrument: Power Meter measuring average burst Power of a least 10 packets

Test setup	See sub clause 6.2 – B
Measurement uncertainty	See sub clause 11

Performed: ☒ Conducted

☐ Radiated (only if no conducted sample is provided)

Limits:

For adaptive equipment	20 dBm
For non-adaptive equipment	Declared by the supplier and shall not exceed 20 dBm

Results:

Test conditions		Maximum conducted burst power in 10 measured bursts [dBm]		
Hopping off		lowest channel	middle channel	highest channel
T_{nom}	V_{nom}	-1.6	-1.3	-2.2
T_{min}	V_{nom}	-0.8	-0.5	-1.4
T_{max}	V_{nom}	-2.5	-2.4	-3.1

P = max cond. burst power (A) + antenna gain (G) + beamforming gain (Y)

With:

Beamforming gain (Y) = 0 (SISO)

Result P [dBm] E.I.R.P (lowest channel):	-0.8 dBm + 4.2 dBi = 3.4 dBm
Result P [dBm] E.I.R.P (middle channel):	-0.5 dBm + 4.1 dBi = 3.6 dBm
Result P [dBm] E.I.R.P (highest channel):	-1.4 dBm + 5.1 dBi = 3.7 dBm

10.3 Power spectral density

Description:

The power spectral density is the mean equivalent isotropically radiated power (E.I.R.P.) density during a transmission burst.

Measurement parameters	
Detector	RMS
Sweep time	≥ 10s
Resolution bandwidth	10 kHz
Video bandwidth	30 kHz
Span	Start: 2400.00 MHz Stop: 2483.50 MHz
Trace mode	Max hold
Test setup	See sub clause 6.2 - A
Measurement uncertainty	See sub clause 11

Performed: ☒ Conducted

☐ Radiated (only if no conducted sample is provided)

Limits:

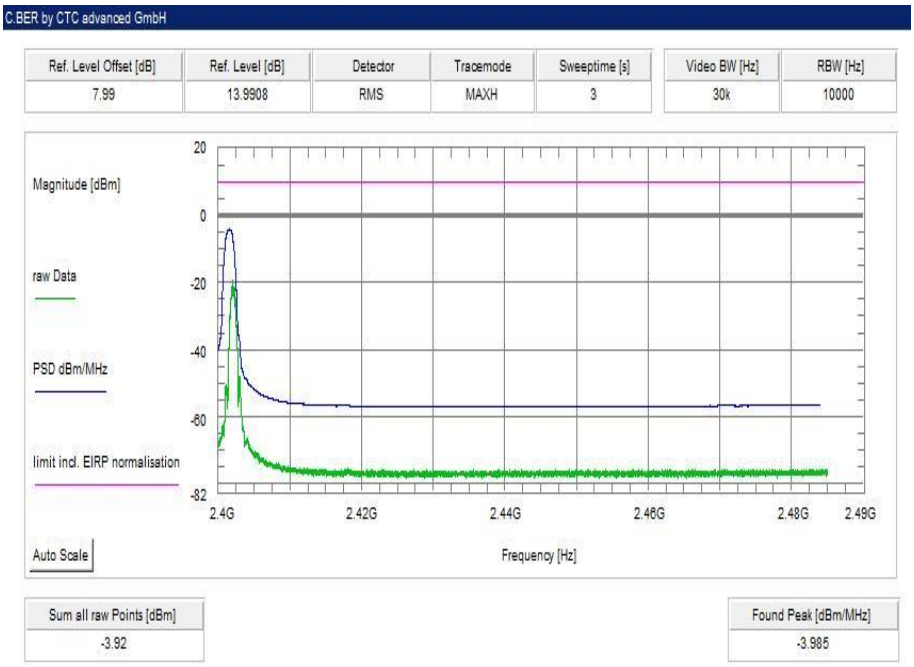
Under normal test conditions only (including antenna gain)	-20 dBW / 1 MHz 10 dBm / 1 MHz

Results:

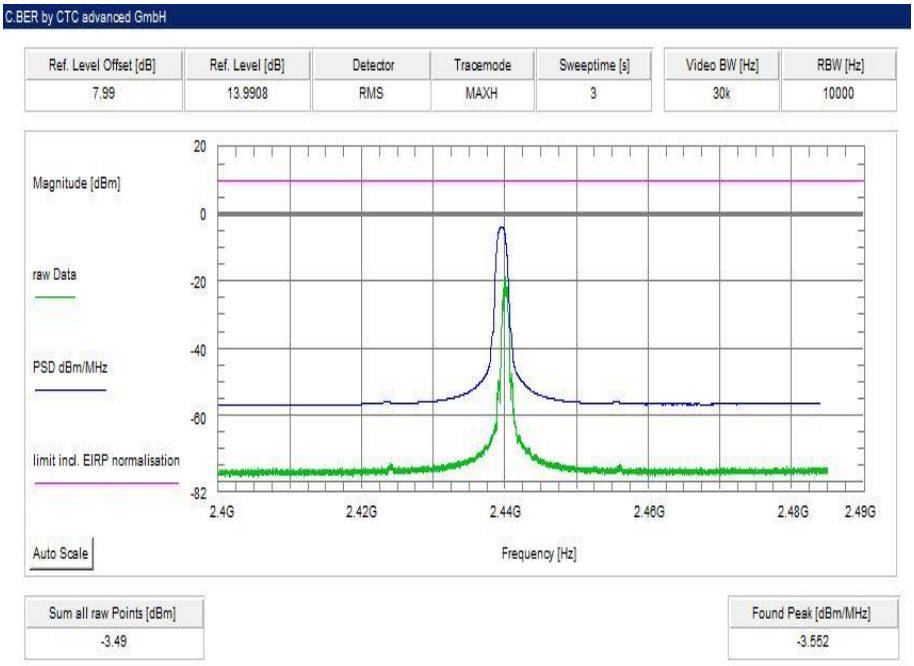
Test conditions	Measured power density		
T_{nom} V_{nom}	lowest channel	middle channel	highest channel
1) Power density (max peak) conducted [dBm/1MHz]	-4.0	-3.6	-4.2
2) Sum of all raw points [dBm]	-3.9	-3.5	-4.2
3) Max EIRP [dBm]	3.4	3.6	3.7
4) Correction factor (3-2)	7.3	7.1	7.9
Power density (max peak) radiated (1+4) [dBm/1MHz]	3.3	3.5	3.7

Plots:

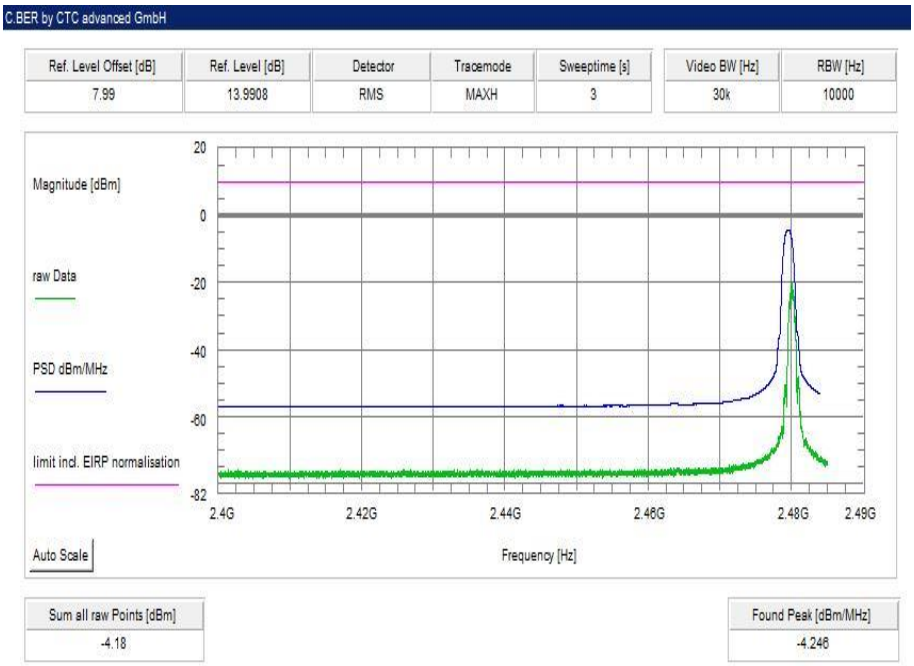
Plot 1: lowest channel



Plot 2: middle channel



Plot 3: highest channel



10.4 Occupied channel bandwidth

Measurement:
The occupied channel bandwidth is the bandwidth that contains 99 % of the power of the signal.

Measurement parameters	
Detector	RMS
Sweep time	1s
Resolution bandwidth	30 kHz
Video bandwidth	100 kHz
Span	3 MHz
Trace mode	Max hold
Test setup	See sub clause 6.2 - A
Measurement uncertainty	See sub clause 11

Performed: ☒ Conducted
☐ Radiated (only if no conducted sample is provided)

Limits:

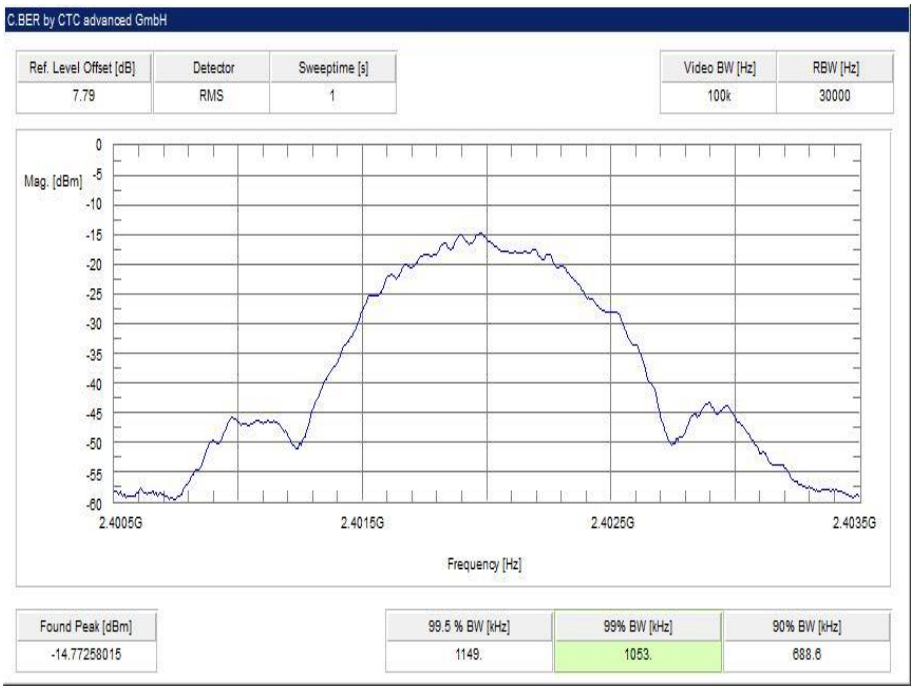
The occupied channel bandwidth shall fall completely within the band. For non-adaptive systems using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.

Results:

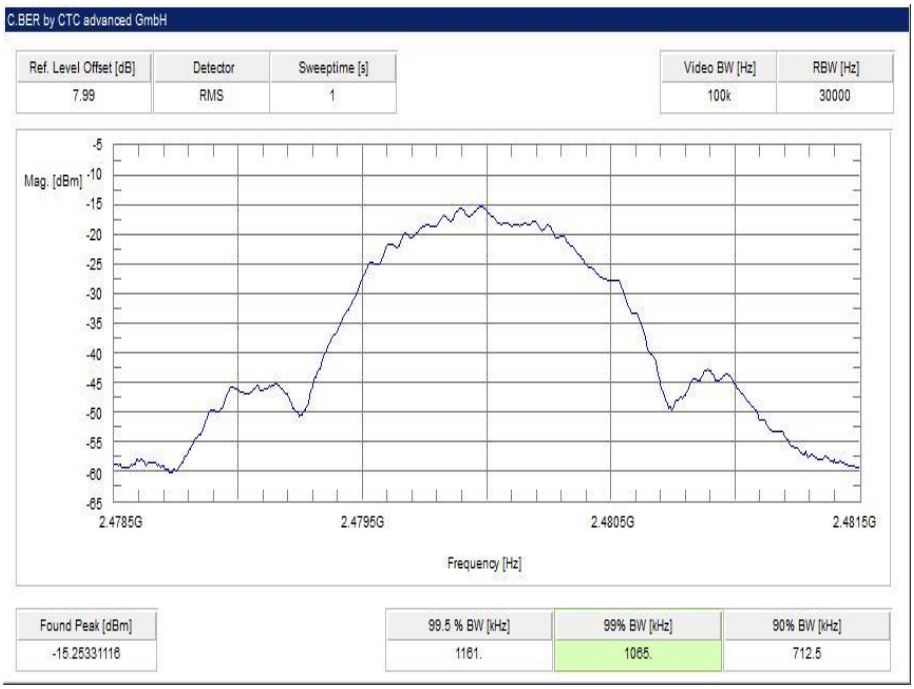
99% bandwidth [kHz]	
Lowest channel	Highest channel
1053	1065

Plots:

Plot 1: GFSK modulation, lowest channel



Plot 2: GFSK modulation, highest channel



10.5 Transmitter unwanted emissions in the out-of-band domain

Description:

Transmitter unwanted emissions in the out-of-band domain are emissions when the equipment is in transmit mode, on frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious.

Measurement parameters	
Detector	RMS
Sweep time	depending on packet length (min 120% of packet length)
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Span	Zero span
Trace mode	Video trigger
Test setup	See sub clause 6.2 - A
Measurement uncertainty	See sub clause 11

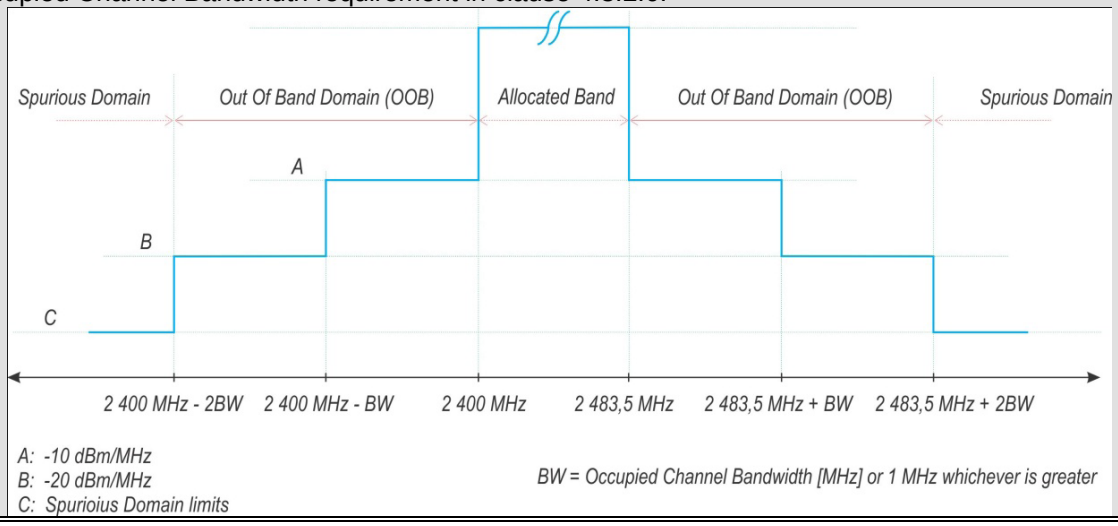
Performed: ☒ Conducted

☐ Radiated (only if no conducted sample is provided)

Limits:

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask.

NOTE: Within the 2400 MHz to 2483.5 MHz band, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.2.6.

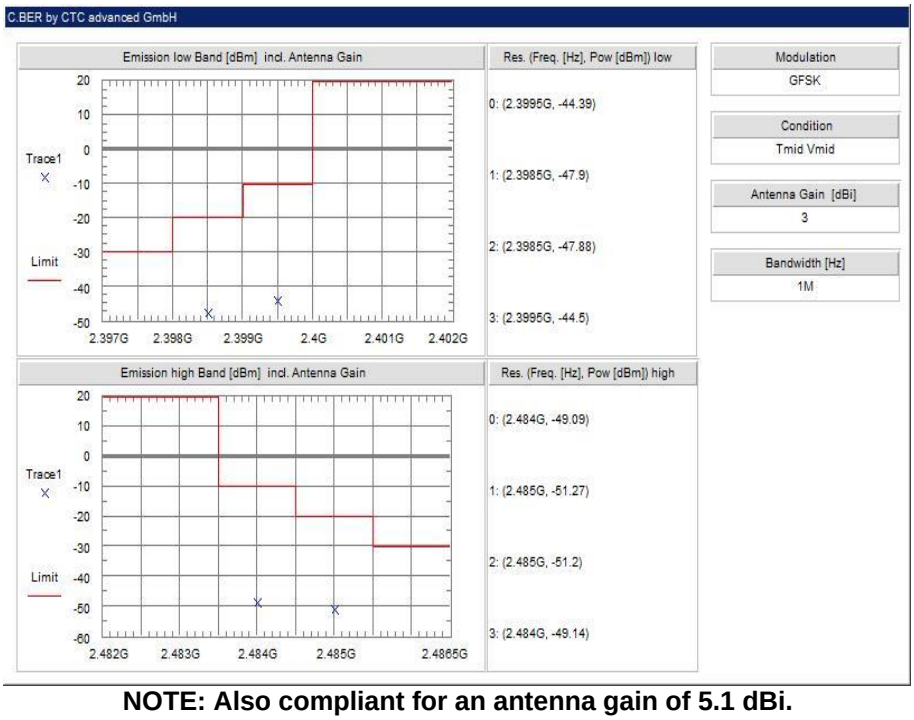


Results

Unwanted emissions [dBm] (including antenna gain)	
GFSK, channel BW see plots	
2400 MHz - 2BW to 2400 MHz – BW Limit:< -20dBm/MHz	compliant
2400 MHz - BW to 2400 MHz Limit:< -10dBm/MHz	compliant
2483.5 MHz to 2483.5 MHz + BW Limit:< -10dBm/MHz	compliant
2483.5 MHz + BW to 2483.5 MHz + 2BW Limit:< -20dBm/MHz	compliant

Plots:

Plot 1:



NOTE: Also compliant for an antenna gain of 5.1 dBi.

10.6 Transmitter unwanted emissions in the spurious domain

Description:

Transmitter unwanted emissions in the spurious domain are emissions outside the allocated band and outside the out-of-band domain when the equipment is in transmit mode.

Pre-scan:

Measurement parameters	
Detector	Peak
Sweep time	1s
Resolution bandwidth	Below 1 GHz: 100 kHz / above 1MHz
Video bandwidth	Below 1 GHz: 300 kHz / above 3MHz
Trace mode	Max hold
Test setup	See sub clause 6.2 – A (conducted) See sub clause 6.1 – A (radiated)
Measurement uncertainty	See sub clause 11

Any emissions identified during the sweeps in the pre-scan and that fall within the 6 dB range below the applicable limit, shall be individually measured using the procedure “retest”.

Retest:

Measurement parameters	
Detector	RMS
Measurement mode	Time domain power
Sweep time	500ms
Resolution bandwidth	Below 1 GHz: 100 kHz / above 1MHz
Video bandwidth	Below 1 GHz: 300 kHz / above 3MHz
Span	Zero span
Trace mode	Single sweep
Test setup	See sub clause 6.2 – A (conducted) See sub clause 6.1 – A (radiated)
Measurement uncertainty	See sub clause 11

Performed: ☒ Conducted
☒ Radiated

Limits:

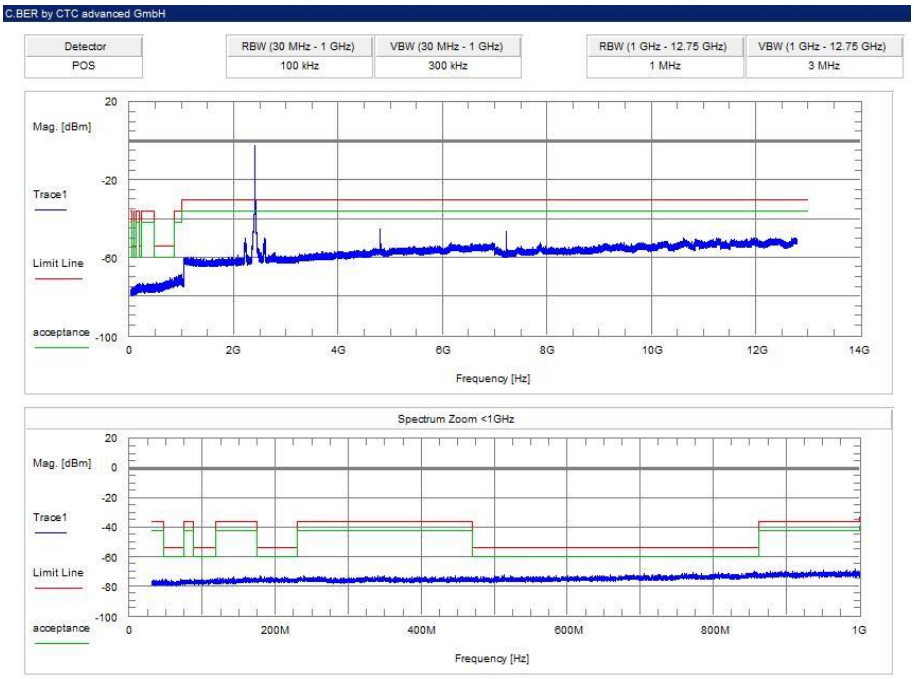
State	Max. spurious level		
	47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies ≤ 1000 MHz	All frequencies > 1000 MHz
Operating	4.0 nW (-54 dBm)	250 nW (-36 dBm)	1.00 µW (-30 dBm)
Receiver / Idle	2.0 nW (-57 dBm)	2.0 nW (-57 dBm)	20.0 nW (-47 dBm)

Results: conducted

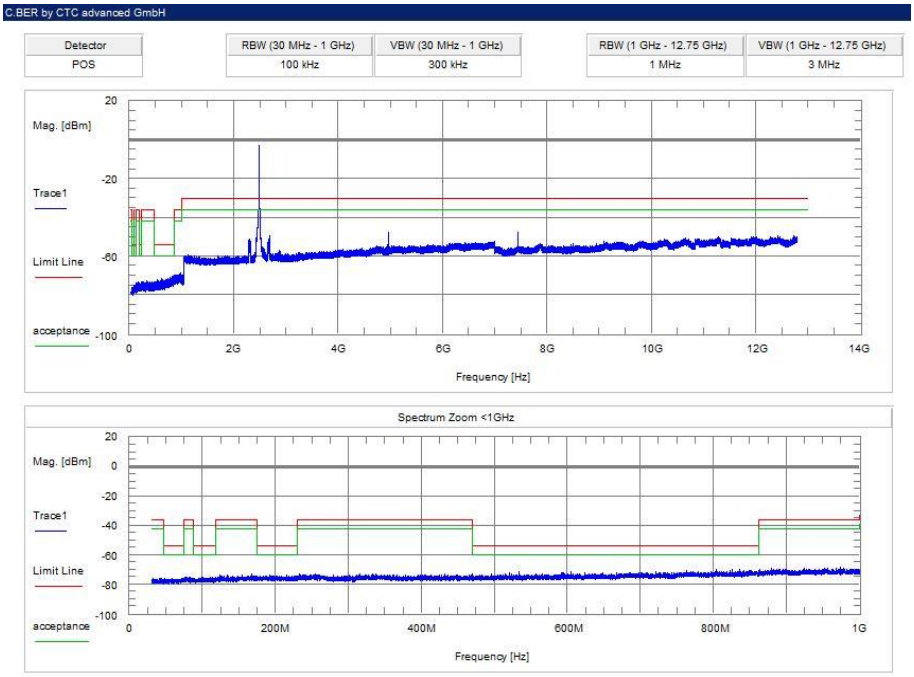
lowest channel			highest channel		
f [MHz]	Detector Peak/RMS	Level [dBm]	f [MHz]	Detector Peak/RMS	Level [dBm]
All detected peaks are more than 6 dB below the limit			All detected peaks are more than 6 dB below the limit		

Plots:

Plot 1: GFSK, lowest channel, positive peak



Plot 2: GFSK, highest channel, positive peak

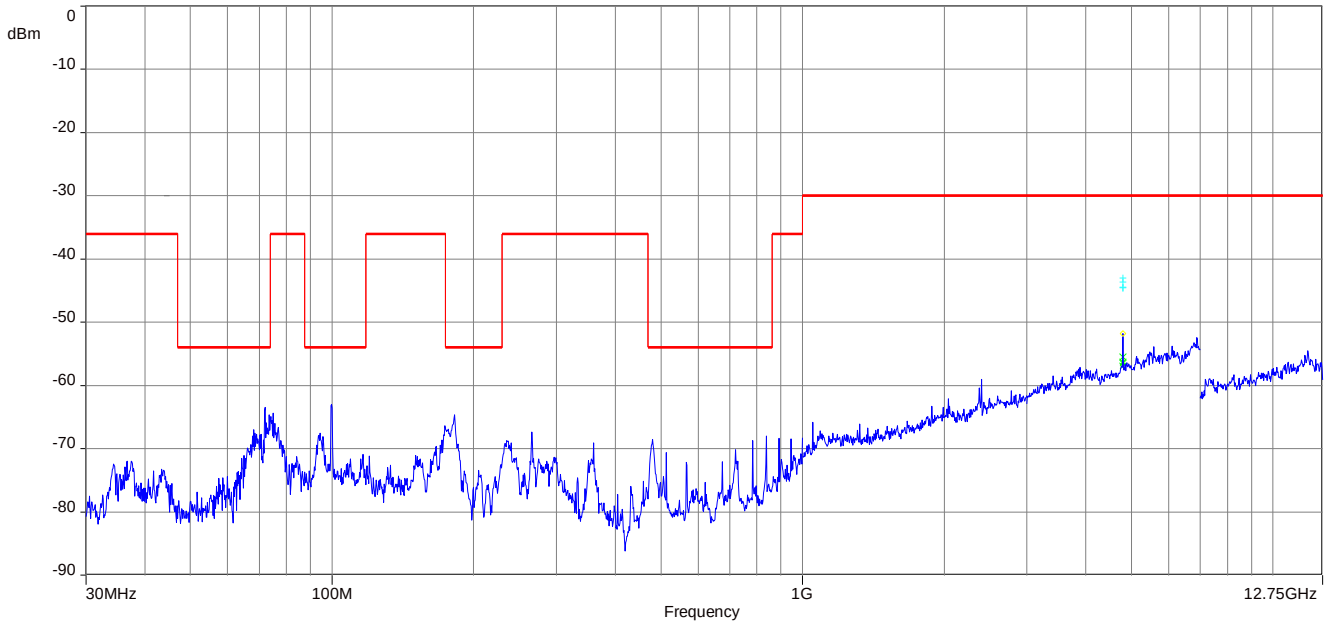


Results: radiated

lowest channel			highest channel		
f [MHz]	Detector Peak/RMS	Level [dBm]	f [MHz]	Detector Peak/RMS	Level [dBm]
All detected peaks are more than 6 dB below the limit			All detected peaks are more than 6 dB below the limit		

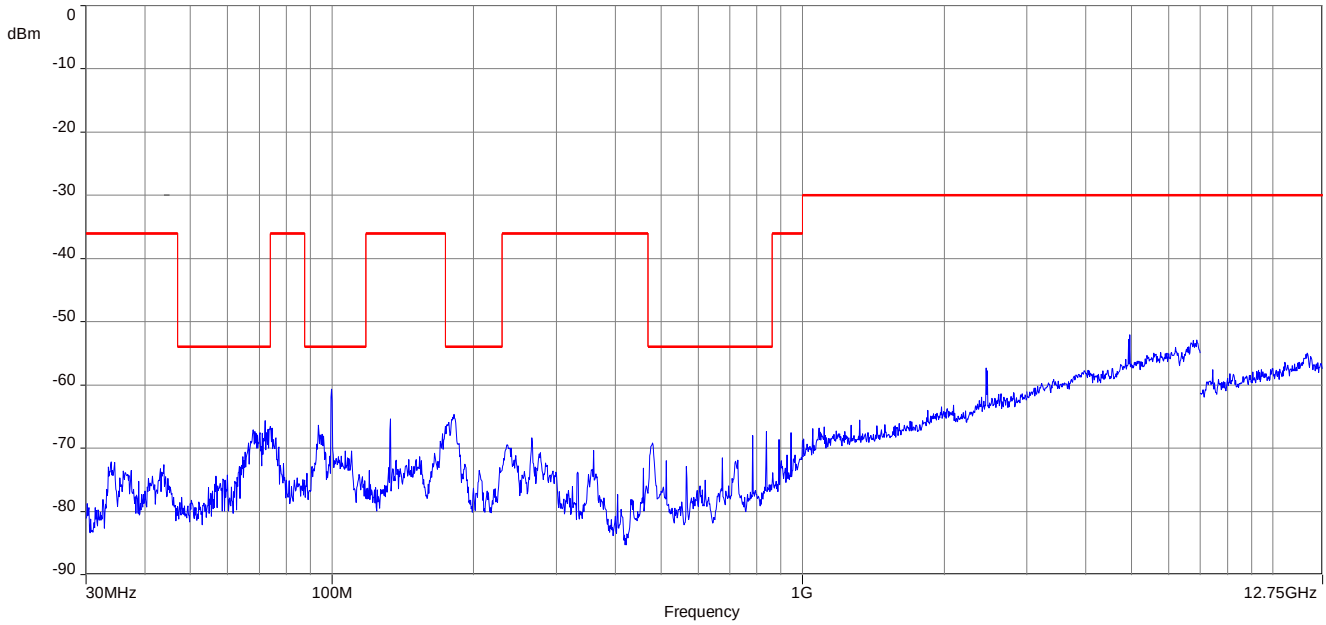
Plots:

Plot 1: 30 MHz to 12.75 GHz, lowest channel



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

Plot 2: 30 MHz to 12.75 GHz, highest channel



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

10.7 Receiver spurious emissions

Description:

Receiver/idle unwanted emissions in the spurious domain are emissions outside the allocated band and outside the out-of-band domain when the equipment is in receiver/idle mode.

Pre-scan:

Measurement parameters	
Detector	Peak
Sweep time	1s
Resolution bandwidth	Below 1 GHz: 100 kHz / above 1MHz
Video bandwidth	Below 1 GHz: 300 kHz / above 3MHz
Trace mode	Max hold
Test setup	See sub clause 6.2 – A (conducted) See sub clause 6.1 – A (radiated)
Measurement uncertainty	See sub clause 11

Any emissions identified during the sweeps in the pre-scan and that fall within the 6 dB range below the applicable limit, shall be individually measured using the procedure “retest”.

Retest:

Measurement parameters	
Detector	RMS
Measurement mode	Time domain power
Sweep time	30ms
Resolution bandwidth	Below 1 GHz: 100 kHz / above 1MHz
Video bandwidth	Below 1 GHz: 300 kHz / above 3MHz
Span	Zero span
Trace mode	Single sweep
Test setup	See sub clause 6.2 – A (conducted) See sub clause 6.1 – A (radiated)
Measurement uncertainty	See sub clause 11

Performed: ☒ Conducted
☒ Radiated

Limits:

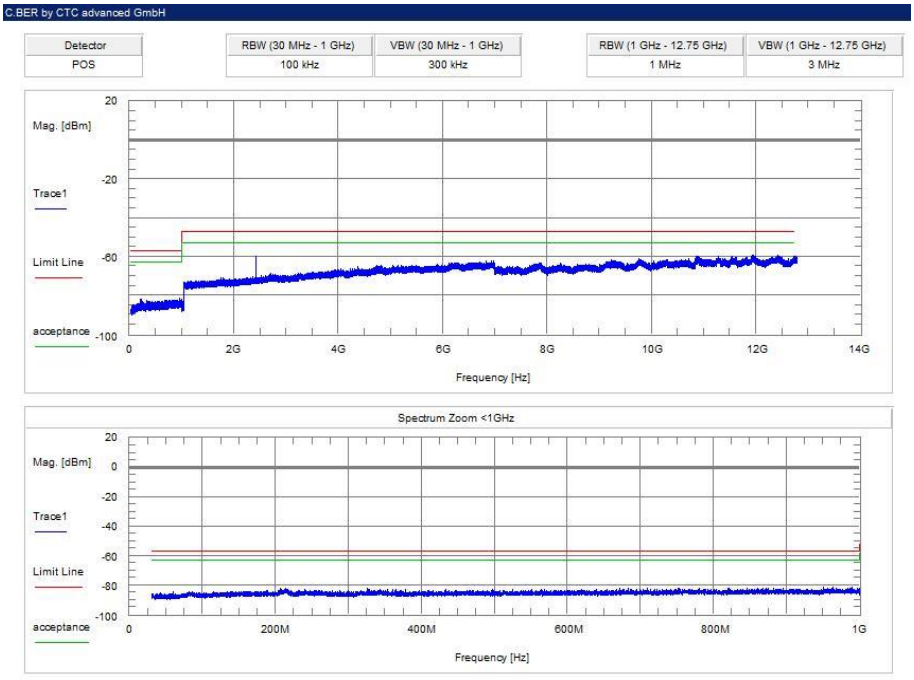
State	Max. spurious level		
	47 MHz to 74 MHz 87,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies ≤ 1000 MHz	All frequencies > 1000 MHz
Operating	4.0 nW (-54 dBm)	250 nW (-36 dBm)	1.00 µW (-30 dBm)
Receiver/idle	2.0 nW (-57 dBm)	2.0 nW (-57 dBm)	20.0 nW (-47 dBm)

Results: conducted

Receiver / idle mode		
f [MHz]	Detector Peak/RMS	Level [dBm]
All detected peaks are more than 6 dB below the limit.		

Plots:

Plot 1: Receiver

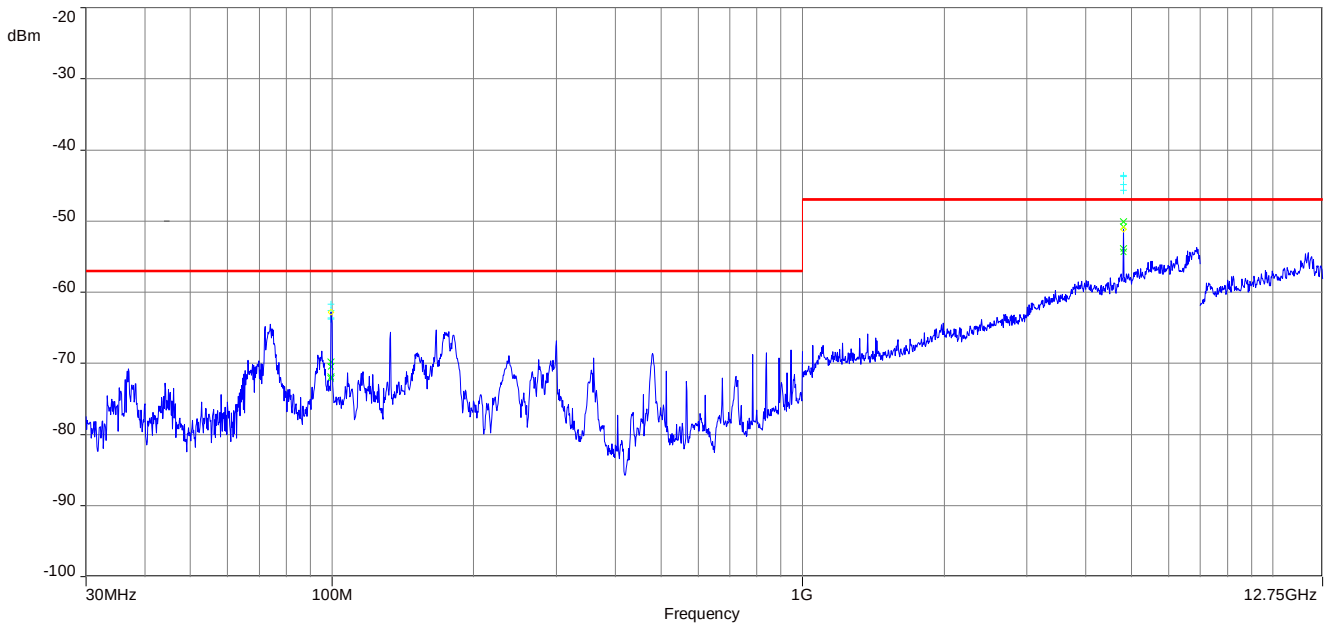


Results: radiated

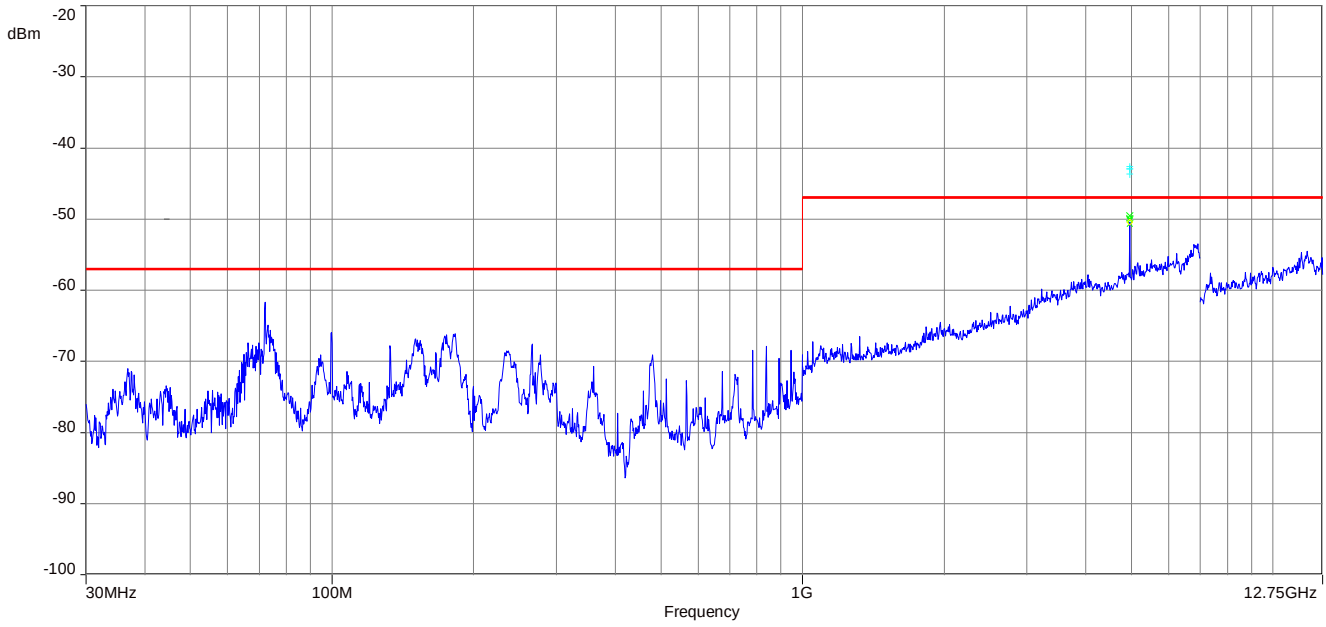
lowest channel			highest channel		
f [MHz]	Detector Peak/RMS	Level [dBm]	f [MHz]	Detector Peak/RMS	Level [dBm]
99.5	RMS burst	-69.9	4962	Peak	-42.6
4806	Peak	-43.6	4962	RMS burst	-47.1
4806	RMS burst	-49.0			

Plots:

Plot 1: Receiver, 30 MHz to 12.75 GHz, lowest channel



Plot 2: Receiver, 30 MHz to 12.75 GHz, highest channel



10.8 Receiver blocking

Description:

Receiver blocking is a measure of the ability of the equipment to receive a wanted signal on its operating channel without exceeding a given degradation in the presence of an unwanted signal (blocking signal) on frequencies other than those of the operating band.

The CBT is used as the signalling unit. Starting at a typical high signalling level (e.g. -70.0 dBm) the CBT is sending packets to the EUT. The PER is logged and the signalling level gets reduced in 1 dB steps until the PER is higher than 10%. This is the Pmin value which is used as described in tables 1-3 depending on the receiver category of the EUT.

Measurement parameters	
Test setup	See sub clause 6.2 – C
Measurement uncertainty	See sub clause 11

Performed: ☒ Conducted

☐ Radiated

Table 1: Receiver blocking parameters for receiver category 1 equipment:

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380.0 2 503.5	-53	CW
P_{min} + 6 dB	2 300.0 2 330.0 2 360.0	-47	CW
P_{min} + 6 dB	2 523.5 2 553.5 2 583.5 2 613.5 2 643.5 2 673.5	-47	CW
NOTE 1:	P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.		
NOTE 2:	The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.		

Table 2: Receiver blocking parameters for receiver category 2 equipment:

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380.0 2 503.5	-57	CW
P_{min} + 6 dB	2 300.0 2 583.5	-47	CW
NOTE 1:	P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.		
NOTE 2:	The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.		

Table 3: Receiver blocking parameters for receiver category 3 equipment:

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 12 dB	2 380.0 2 503.5	-57	CW
P_{min} + 12 dB	2 300.0 2 583.5	-47	CW
NOTE 1:	P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.		
NOTE 2:	The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.		

Limits:

	Channel	
	Lowest channel	Highest channel
Packet error rate limit	10% PER*	

*The manufacturer may declare alternative performance criteria as long as that is appropriate for the intended use of the equipment

Results: Tests according requirements for category 2 receiver equipment,

RX chan	PER	Psent	Prec	RXL[dBm]	Limit	IntFr.[MHz]	IntL [dBm]	verdict
2402000000	0.066%	1500	1499	-75	<= 10%	OFF	OFF	PASS
2402000000	0.133%	1500	1498	-76	<= 10%	OFF	OFF	PASS
2402000000	1E-00%	1500	1500	-77	<= 10%	OFF	OFF	PASS
2402000000	0.066%	1500	1499	-78	<= 10%	OFF	OFF	PASS
2402000000	0.066%	1500	1499	-79	<= 10%	OFF	OFF	PASS
2402000000	0.133%	1500	1498	-80	<= 10%	OFF	OFF	PASS
2402000000	0.066%	1500	1499	-81	<= 10%	OFF	OFF	PASS
2402000000	0.066%	1500	1499	-82	<= 10%	OFF	OFF	PASS
2402000000	0.066%	1500	1499	-83	<= 10%	OFF	OFF	PASS
2402000000	0.200%	1500	1497	-84	<= 10%	OFF	OFF	PASS
2402000000	0.266%	1500	1496	-85	<= 10%	OFF	OFF	PASS
2402000000	0.133%	1500	1498	-86	<= 10%	OFF	OFF	PASS
2402000000	0.466%	1500	1493	-87	<= 10%	OFF	OFF	PASS
2402000000	0.800%	1500	1488	-88	<= 10%	OFF	OFF	PASS
2402000000	2.000%	1500	1470	-89	<= 10%	OFF	OFF	PASS
2402000000	3.666%	1500	1445	-90	<= 10%	OFF	OFF	PASS
2402000000	7.466%	1500	1388	-91	<= 10%	OFF	OFF	PASS
2402000000	12.93%	1500	1306	-92	<= 10%	OFF	OFF	Ref. Sensitivity
.....								
2402000000	0.200%	1500	1497	-86	<= 10%	2380.0	-57	PASS
2402000000	0.200%	1500	1497	-86	<= 10%	2503.5	-57	PASS
2402000000	0.333%	1500	1495	-86	<= 10%	2300.5	-47	PASS
2402000000	0.266%	1500	1496	-86	<= 10%	2583.5	-47	PASS
.....								
.....								
2480000000	1E-00%	1500	1500	-75	<= 10%	OFF	OFF	PASS
2480000000	0.066%	1500	1499	-76	<= 10%	OFF	OFF	PASS
2480000000	0.066%	1500	1499	-77	<= 10%	OFF	OFF	PASS
2480000000	0.066%	1500	1499	-78	<= 10%	OFF	OFF	PASS
2480000000	0.066%	1500	1499	-79	<= 10%	OFF	OFF	PASS
2480000000	0.066%	1500	1499	-80	<= 10%	OFF	OFF	PASS
2480000000	0.133%	1500	1498	-81	<= 10%	OFF	OFF	PASS
2480000000	0.066%	1500	1499	-82	<= 10%	OFF	OFF	PASS
2480000000	0.266%	1500	1496	-83	<= 10%	OFF	OFF	PASS
2480000000	0.266%	1500	1496	-84	<= 10%	OFF	OFF	PASS
2480000000	0.466%	1500	1493	-85	<= 10%	OFF	OFF	PASS
2480000000	1.066%	1500	1484	-86	<= 10%	OFF	OFF	PASS
2480000000	1.666%	1500	1475	-87	<= 10%	OFF	OFF	PASS
2480000000	1.666%	1500	1475	-88	<= 10%	OFF	OFF	PASS
2480000000	3.466%	1500	1448	-89	<= 10%	OFF	OFF	PASS
2480000000	6.400%	1500	1404	-90	<= 10%	OFF	OFF	PASS
2480000000	14.26%	1500	1286	-91	<= 10%	OFF	OFF	Ref. Sensitivity
.....								
2480000000	0.333%	1500	1495	-85	<= 10%	2380.0	-57	PASS
2480000000	0.266%	1500	1496	-85	<= 10%	2503.5	-57	PASS
2480000000	0.400%	1500	1494	-85	<= 10%	2300.5	-47	PASS
2480000000	0.200%	1500	1497	-85	<= 10%	2583.5	-47	PASS

11 Measurement uncertainty

Measurement uncertainty	
Occupied channel bandwidth	±5 %
RF output power, conducted	±1.5 dB
Power spectral density, conducted	±3 dB
Unwanted emissions, conducted	±3 dB
All emissions, radiated	±3 dB
Temperature	±1 °C
Humidity	±5 %
DC and low frequency voltages	±3 %
Time	±5 %
Duty cycle	±5 %

12 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
GUE	GNSS User Equipment
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
GNSS	Global Navigation Satellite System
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz

Annex B Document history

Version	Applied changes	Date of release
-/-	Initial release	2017-07-31

Annex C Accreditation Certificate

first page	last page

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

CTC advanced GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

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

Funk
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 25.11.2016 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, 25.11.2016

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

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