

TEST REPORT

Test report no.: 1-0619/20-01-04



Testing laboratory

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Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)

The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-03

Applicant

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Manufacturer

Dialog Semiconductor BV

Het Zuiderkruis 53

5215 MV's Hertogenbosch / NETHERLANDS

Test standard/s

ETSI EN 300 328
V2.2.2

Wideband transmission systems; Data transmission equipment operating in the
2,4 GHz band; Harmonised Standard for access to radio spectrum

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: DA14681
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 handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:

Joerg Warken
Lab Manager
Radio Communications

Test performed:

Mihail Dorongovskij
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	3
4	Test environment.....	4
5	Test item	4
5.1	General description	4
5.2	Additional information	4
6	Description of the test setup	5
6.1	Conducted measurements Bluetooth system	6
7	Summary of measurement results	7
8	Additional comments	8
9	EUT classification.....	9
10	Measurement results	10
10.1	Receiver blocking.....	10
11	Measurement uncertainty	13
12	Glossary	14
13	Document history.....	15
14	Accreditation Certificate – D-PL-12076-01-03	15

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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2.2 Application details

Date of receipt of order:	2020-06-12
Date of receipt of test item:	2020-06-19
Start of test:	2020-06-19
End of test:	2020-06-23
Person(s) present during the test:	-/-

2.3 Test laboratories sub-contracted

None

3 Test standard/s

Test standard	Date	Description
ETSI EN 300 328 V2.2.2	2019-07	Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonised Standard for access to radio spectrum

4 Test environment

Temperature	:	T_{nom} +22 °C during room temperature tests T_{max} No tests under extreme temperature conditions performed. T_{min} No tests under extreme temperature conditions performed.
Relative humidity content	:	54 %
Barometric pressure	:	not relevant for this kind of testing
Power supply	:	V_{nom} 5.0 V DC by USB V_{max} No tests under extreme voltage conditions required. V_{min} No tests under extreme voltage conditions required.

5 Test item

5.1 General description

Kind of test item	:	Bluetooth LE chip
Model name:	:	DA14681
S/N serial number	:	Cond. 1707_00364
Hardware status	:	224-14-D
Software status	:	DA1468x_DA15xxx_SDK_1.0.14.1081
Firmware status	:	DA1468x_DA15xxx_SDK_1.0.14.1081
Frequency band	:	ISM band 2400 MHz to 2483.5 MHz
Type of radio transmission	:	DSSS
Use of frequency spectrum	:	
Type of modulation	:	GFSK
Number of channels	:	40
Channel bandwidth (B)	:	2 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

-/-

6 Description of the test setup

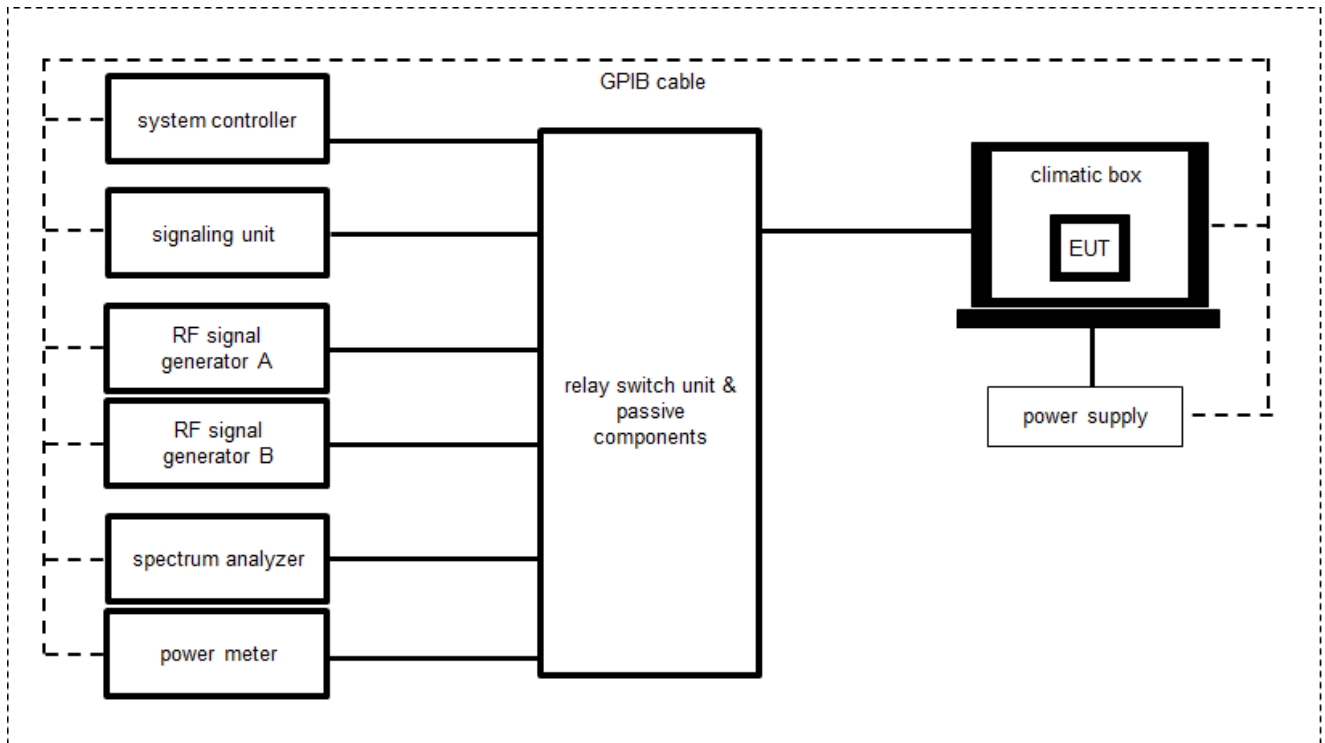
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements 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
vlk!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

6.1 Conducted measurements Bluetooth 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	A	Switch / Control Unit (including DC-Block, Splitter)	3488A	HP	-/-	300000929	ne	-/-	-/-
2	A	PC Laboratory 19"	Exone i3	Fröhlich + Walter	35230157A0370	300004646	ne	-/-	-/-
3	A	Signal Generator - 20 GHz	SMB100A	Rohde & Schwarz	176183	300004853	vIKI!	09.10.2017	08.10.2020
4	A	Spectrum Analyzer	FSV30	Rohde & Schwarz	103170	300004855	vIKI!	11.12.2018	10.12.2020
5	A	USB-GPIB-Interface	82357B	Agilent Technologies	MY54323070	300004852	ne	-/-	-/-
6	A	Tester Software C.BER	Version 5.0	CTC advanced GmbH	0001	400001379	ne	-/-	-/-
7	A	Wireless Connectivity Tester	CMW270	Rohde & Schwarz	100683	300005133	k	11.12.2019	10.12.2021

7 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	ETSI EN 300 328 V2.2.2 (2019-07)	See table	2020-06-26	Tests according to customer demand

Test specification clause	Test case	temperature conditions	power source voltages	Mode	C	NC	NA	NP	Remark
4.3.2.2 5.4.2	RF output power	Nominal	Nominal	1 Msps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
		Low	Nominal	1 Msps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		High	Nominal	1 Msps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.3.2.3 5.4.2	Power spectral density	Nominal	Nominal	1 Msps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
4.3.2.4, 4.3.2.5 5.4.3	Duty cycle, Tx-sequence, Tx-gap, medium utilization	Nominal	Nominal	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-
5.4.4	Accumulated transmit time, freq. occupation and hopping sequence	Nominal	Nominal	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-
5.4.5	Hopping frequency separation	Nominal	Nominal	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-
4.3.2.6 5.4.6	Adaptivity	Nominal	Nominal	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-
4.3.2.7 5.4.7	Occupied channel bandwidth	Nominal	Nominal	1 Msps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
4.3.2.8 5.4.8	Transmitter unwanted emissions in the out-of-band domain	Nominal	Nominal	1 Msps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
4.3.2.9 5.4.9	Transmitter unwanted emissions in the spurious domain (cond. + rad.)	Nominal	Nominal	1 Msps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
4.3.2.10 5.4.10	Receiver spurious emissions (cond. + rad.)	Nominal	Nominal	1 Msps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
4.3.2.11 5.4.11	Receiver blocking	Nominal	Nominal	1 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
4.3.2.12	Geo-location	Nominal	Nominal	-/-	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-

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 5.1
1-0619_20-01-04_log1_conducted.pdf

Special test descriptions: None

Configuration descriptions:

Bluetooth Low Energy	
Longest Supported payload (37 – 255 Byte)	Tx: 255, RX: 255
LE 1M PHY supported	Yes
LE 2M PHY supported	No
Stable Modulation Index supported (SMI)	No
LE Coded PHY supported (S=2)	No
LE Coded PHY supported (S=8)	No

Test mode: Bluetooth direct test mode enabled
(EUT is controlled via CBT/CMW)
 Special software is used.
EUT is transmitting pseudo random data by itself

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

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 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 due to the presence of an unwanted input signal (blocking signal) at frequencies other than those of the operating band and spurious responses.

Measurement parameters	
External result file	1-0619_20-01-04_log1_conducted.pdf Chapter EN300328 RX Receiver Blocking
Test setup	See sub clause 6.1 – A
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) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
(-133 dBm + 10 × log ₁₀ (OCBW)) or -68 dBm whichever is less (see note 2)	2 380	-34	CW
	2 504		
(-139 dBm + 10 × log ₁₀ (OCBW)) or -74 dBm whichever is less (see note 3)	2 300		
	2 330		
	2 360		
	2 524		
	2 584		
2 674			
NOTE 1:	OCBW is in Hz.		
NOTE 2:	In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P _{min} + 26 dB where P _{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.		
NOTE 3:	In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P _{min} + 20 dB where P _{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.		
NOTE 4:	The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.		

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

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × log ₁₀ (OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1:	OCBW is in Hz.		
NOTE 2:	In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P _{min} + 26 dB where P _{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.		
NOTE 3:	The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.		

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

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × log ₁₀ (OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
NOTE 1:	OCBW is in Hz.		
NOTE 2:	In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P _{min} + 30 dB where P _{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.		
NOTE 3:	The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.		

Limits:

	Channel	
	Low channel	High channel
Performance Criteria	10% PER or FER	

* For equipment that does not support a PER or a FER test to be performed, the minimum performance criterion shall be no loss of the wireless transmission function needed for the intended use of the equipment.

Result: Compliant (See log file for details)

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 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications 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/N₀	Carrier to noise-density ratio, expressed in dB-Hz

13 Document history

Version	Applied changes	Date of release
-/-	Initial release	2020-06-26

14 Accreditation Certificate – D-PL-12076-01-03

first page	last page
 <p>Deutsche Akkreditierungsstelle GmbH</p> <p>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</p> <p>Akkreditierung</p> <p>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: Telekommunikation</p> <p>Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 11.01.2019 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig bis 21.04.2021. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 33 Seiten.</p> <p>Registrierungsnummer der Urkunde: D-PL-12076-01-03</p> <p>Frankfurt am Main, 11.01.2019</p> <p>Im Auftrag: Dipl.-Biol. Uwe Zimmermann Abteilungsleiter</p>	 <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Standort Berlin Spittelmarkt 10 10117 Berlin</p> <p>Standort Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main</p> <p>Standort Braunschweig Bundesallee 100 38116 Braunschweig</p> <p>Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAkKS). Ausgenommen davon ist die separate Weiterverbreitung des Deckblattes durch die umseitig genannte Konformitätsbewertungsstelle in unveränderter Form.</p> <p>Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAkKS bestätigten Akkreditierungsbereich hinausgehen.</p> <p>Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abi. L 218 vom 9. Juli 2008, S. 30).</p> <p>Die DAkKS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.</p> <p>Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden: EA: www.european-accreditation.org ILAC: www.ilac.org IAF: www.iaf.eu</p>

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

<https://www.dakks.de/as/ast/d/D-PL-12076-01-03.pdf>

END OF TEST REPORT