
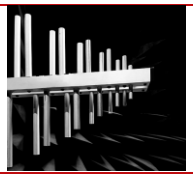
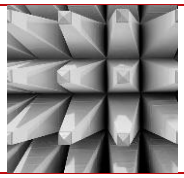

CETECOM™

CETECOM ICT Services

consulting - testing - certification ➤➤➤

TEST REPORT

Test report no.: 1-0129/15-01-02

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-00

Testing laboratory

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

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-00

Applicant

Hippih Ltd.
Diplomvej 372
2800 Kgs. Lyngby / Denmark
Phone: +45 29 27 90 20
Contact: Danny van der Poel

Manufacturer

Semecs s.r.o.
Hlavná 1797/62
SK-952 01 Vráble / SLOVAK REPUBLIC

Test standard/s

47 CFR Part 15	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

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

Test Item

Kind of test item:	**Advanced proximity alarm**
Model name:	**hipKey**
FCC ID:	**PYO-H120101**
IC:	**10625A-H120101**
Frequency:	2400.0 MHz to 2483.5 MHz DTS Band
Technology tested:	Bluetooth® LE
Antenna:	Integrated antenna
Power supply:	3.6 V DC by battery
Temperature range:	-20°C to +55°C

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

Test report authorised:

cn=Andreas Luckenbill, o=CETECOM ICT Services GmbH, ou=LUC-111202, email=andreas.luckenbill@cetecom.com, c=DE
2015.07.29 13:49:52 +02'00'

Andreas Luckenbill
Lab Manager
Radio Communications & EMC

Test performed:

David Lang
cn=David Lang, o=CETECOM ICT Services GmbH, ou=LNG-141031, email=david.lang@cetecom.com, c=DE
2015.07.29 11:56:31 +02'00'

David Lang
Lab Manager
Radio Communications & EMC

1 Table of contents

2 General information

2.1 Notes and disclaimer

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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:	2015-07-02
Date of receipt of test item:	2015-07-03
Start of test:	2015-07-07
End of test:	2015-07-10
Person(s) present during the test:	-/-

3 Test standard/s

Test standard	Date	Test standard description
47 CFR Part 15		Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 1	2015-05	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

3.1 Measurement guidance

Guidance	Version	Description
DTS: KDB 558074 D01	v03r03	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
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

4 Test environment

Temperature:	T_{nom}	+22 °C	during room temperature tests
	T_{max}	+55 °C	during high temperature tests
	T_{min}	-20 °C	during low temperature tests
Relative humidity content:		51 %	
Barometric pressure:		not relevant for this kind of testing	
Power supply:	V_{nom}	3.6 V	DC by battery
	V_{max}	4.2 V	
	V_{min}	3.5 V	

5 Test item

Kind of test item	**:**	**Advanced proximity alarm**
Type identification	**:**	**hipKey**
HMN	**:**	**-/-**
PMN	**:**	**hipKey**
HVIN	**:**	**hipKey**
FVIN	**:**	**-/-**
S/N serial number	**:**	**Rad. Not available!** **Cond. Not available!**
HW hardware status	**:**	**A04**
SW software status	**:**	**V2.0.0**
Frequency band	**:**	**2400.0 MHz to 2483.5 MHz DTS Band**
Type of radio transmission **Use of frequency spectrum**	**:** **:**	**DSSS (Advertising Mode)**
Type of modulation	**:**	**GFSK**
Number of channels	**:**	**40**
Antenna	**:**	**Integrated antenna**
Power supply	**:**	**3.6 V DC by battery**
Temperature range	**:**	**-20°C to +55°C**

5.1 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: 1-0129/15-01-01_AnnexA
1-0129/15-01-01_AnnexB
1-0129/15-01-01_AnnexC

6 Test laboratories sub-contracted

None

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 signalling equipment as well as measuring receivers and analysers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

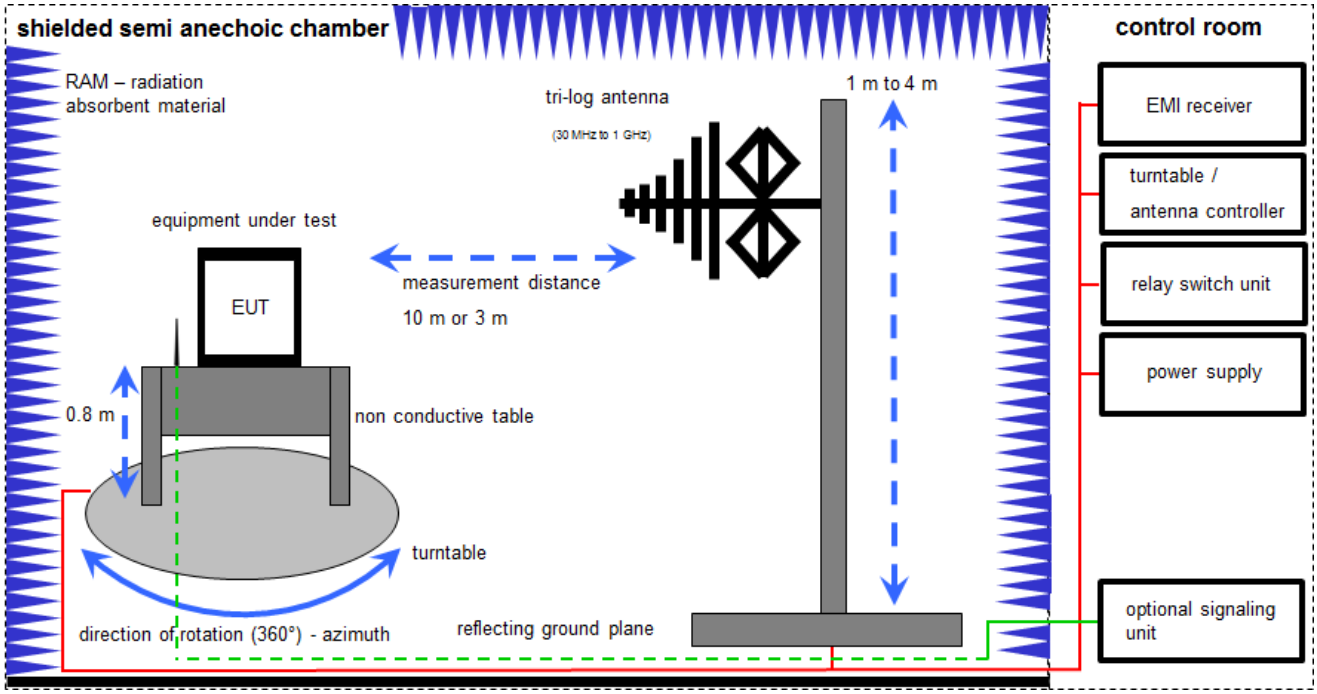
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63.4. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.4 and ANSI C63.10.



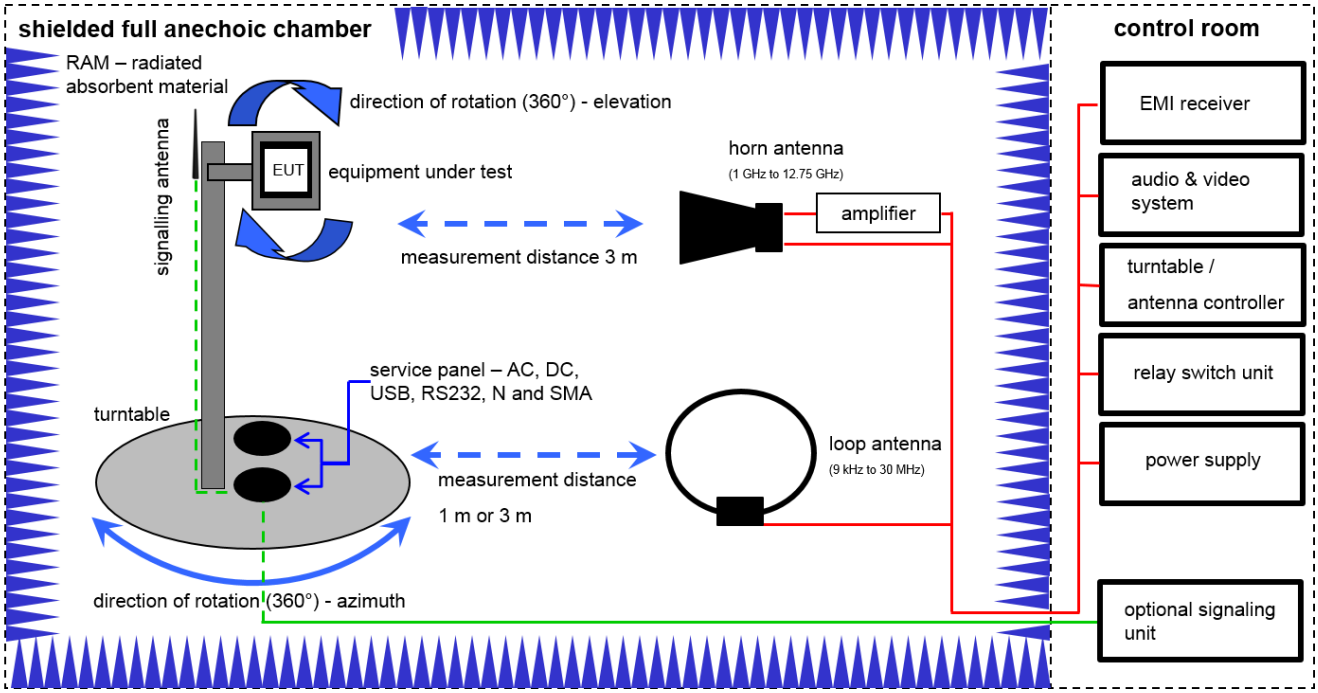
$SS = U_R + CL + AF$
(SS-signal strength; U_R-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
SS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dBµV/m] = 31.05 [dBµV/m] (35.69 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	k	19.07.2013	19.07.2015
2	A029	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev		
3	A029	Signal Analyzer 40 GHz	FSV40	R&S	101353	300004819	k	27.01.2015	27.01.2016
4	45	Switch-Unit	3488A	HP	2719A14505	300000368	ev		
5	45	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	26.01.2015	26.01.2016
6	45	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw		
7	45	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw		
8	45	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw		
9	45	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	22.04.2014	22.04.2016

7.2 Shielded fully anechoic chamber



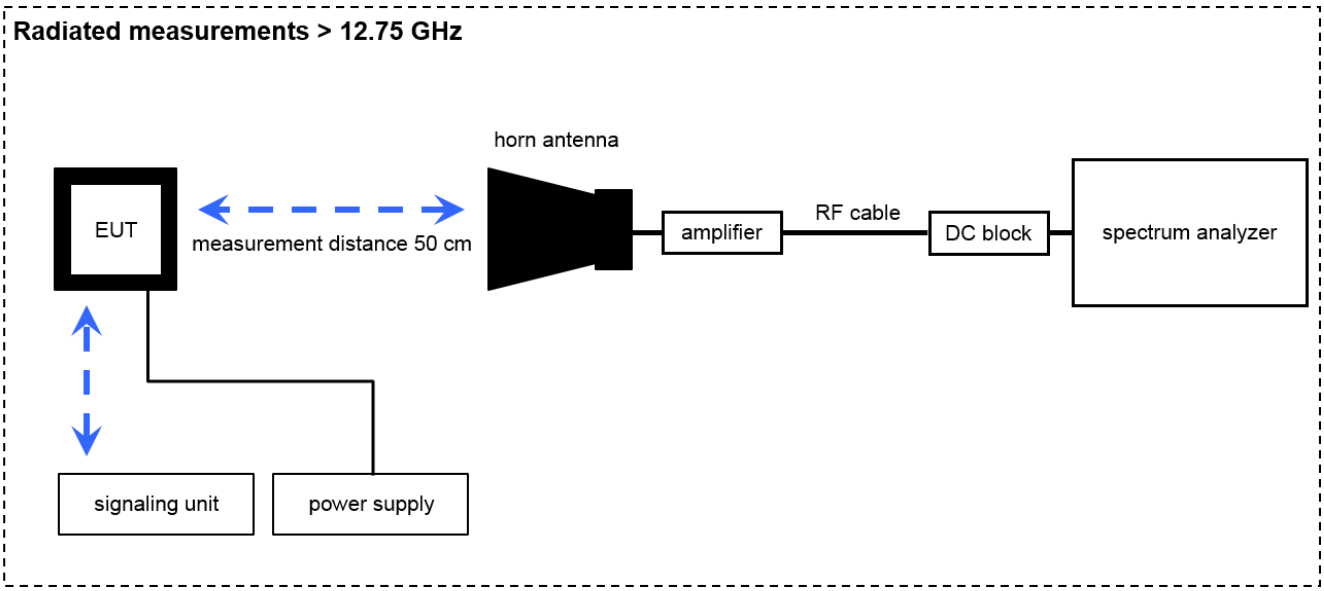
SS = U_R + CA + AF
(SS-signal strength; U_R-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:
SS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dBµV/m] = 37.1 [dBµV/m] (71.61 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vIKI!	20.05.2015	20.05.2017
2	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev		
3	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne		
4	90	Active Loop Antenna 10 kHz to 30 MHz	6502	Kontron Psychotech	8905-2342	300000256	k	24.06.2015	24.06.2017
5	90	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne		
6	90	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev		
7	90	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne		
8	90	MXE EMI Receiver 20 Hz to 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	06.03.2015	06.03.2016
9	90	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne		

7.3 Radiated measurements > 12.75 GHz



SS = U_R + CA + AF
(SS-signal strength; U_R-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

Example calculation:
SS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dBµV/m] = 16.64 [dBµV/m] (6.79 µV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A026	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	22.07.2013	22.07.2015
2	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	k	19.07.2013	19.07.2015
3	A029	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	22.01.2015	22.01.2016
4	A029	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev		

8 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
Antenna gain	± 3 dB
Carrier frequency separation	± 21.5 kHz
Number of hopping channels	-/-
Time of occupancy	According BT Core specification
Spectrum bandwidth	± 21.5 kHz absolute; ± 15.0 kHz relative
Maximum output power	± 1 dB
Detailed conducted spurious emissions @ the band edge	± 1 dB
Band edge compliance radiated	± 3 dB
Spurious emissions conducted	± 3 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

9 Sequence of testing

9.1 Sequence of testing 9 kHz to 30 MHz

Setup

- The equipment was set up to simulate a typical usage like descripted in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were 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.
- The measurement distance is 3 meter (see ANSI C 63.4) – see each test details
- The EUT was set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.5 meter.
- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement

- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axces (0° to 360°).
- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK (QPK / see ANSI C 63.4) detector
- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

9.2 Sequence of testing 30 MHz to 1 GHz

Setup

- The equipment was set up to simulate a typical usage like descripted in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were 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.
- The measurement distance is 10 or 3 meter (see ANSI C 63.4) – see each test details
- The EUT was set into operation.
-

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 to 3 meter.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions
-

Final measurement

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.
- The final measurement will be done with QP (Quasi-Peak / see ANSI C 63.4) detector with an EMI receiver
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

9.3 Sequence of testing 1 GHz to 12.75 GHz

Setup

- The equipment was set up to simulate a typical usage like descripted in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were 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.
- The measurement distance is 3 meter (see ANSI C 63.4) – see each test details
- The EUT was 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 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement

- The final measurement will be performed with minimum the six highest peaks according the requirements of the ANSI C63.4.
- According to the maximum found antenna polarisation and turntable position of the premeasurement the software maximizes the peaks by rotating the turntable position (0° to 360°). This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps). This procedure is repeated for both antenna polarisations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS (RMS / see ANSI C 63.4) detector
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

9.4 Sequence of testing above 12.75 GHz

Setup

- The equipment was set up to simulate a typical usage like descripted in the user manual or described by manufacturer.
- Auxiliary equipment and cables were 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.
- The measurement distance is 0.5 meter
- The EUT was set into operation.

Premeasurement

- The antenna is moved spherical over the EUT in different polarisations of the antenna.

Final measurement

- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and RMS (RMS / see ANSI C 63.4) detector
- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

10 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	CFR Part 15 RSS - 247, Issue 1	See table!	2015-07-29	Reduced test plan according customers specification.

Test specification clause	Test case	Guideline	Temperature conditions	Power source voltages	Mode	C	NC	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (4)	System gain	-/-	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
§15.247(e) RSS - 247 / 5.2 (2)	Power spectral density	KDB 558074 DTS clause: 10.6	Nominal	Nominal	GFSK	☐	☐	☐	☒	*1
§15.247(a)(2) RSS - 247 / 5.2 (1)	DTS bandwidth – 6 dB bandwidth	KDB 558074 DTS clause: 8.1	Nominal	Nominal	GFSK	☐	☐	☐	☒	*1
RSS Gen clause 4.6.1	Occupied bandwidth	-/-	Nominal	Nominal	GFSK	☐	☐	☐	☒	*1
§15.247(b)(3) RSS - 247 / 5.4 (4)	Maximum output power	KDB 558074 DTS clause: 9.1.1	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge - conducted	-/-	Nominal	Nominal	GFSK	☐	☐	☐	☒	*1
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance radiated	KDB 558074 DTS clause: 13.3.2	Nominal	Nominal	GFSK	☐	☐	☐	☒	*1
§15.247(d) RSS - 247 / 5.5	TX spurious emissions conducted	KDB 558074 DTS clause: 11.1 & 11.2 11.3	Nominal	Nominal	GFSK	☐	☐	☐	☒	*1
§15.209(a) RSS - Gen	Spurious emissions radiated below 30 MHz	-/-	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
15.247(d) RSS - 247 / 5.5 §15.109 RSS - Gen	Spurious emissions radiated 30 MHz to 1 GHz	-/-	Nominal	Nominal	-/-	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5 §15.109 RSS - Gen	Spurious emissions radiated above 1 GHz	-/-	Nominal	Nominal	GFSK	☒	☐	☐	☐	-/-
§15.107(a) §15.207	Conducted emissions below 30 MHz (AC conducted)	-/-	Nominal	Nominal	GFSK	☐	☐	☐	☒	*1

Note: C = Compliant; NC = Not Compliant; NA = Not Applicable; NP = Not Performed; *1 Reduced test plan according customers specification.

11 Additional comments

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

Reference documents: None

Special test descriptions: None

Configuration descriptions: TX tests: were performed with LE packets (37 byte payload) and static PRBS pattern.
RX/Standby tests: BT enabled, TX Idle

Test mode:

☐ Bluetooth LE Test mode enabled
(EUT is controlled over CBT)

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

12 Measurement results

12.1 System gain

Measurement:

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For normal Bluetooth® devices, the GFSK modulation is used.

Measurement parameters:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	3 MHz
Video bandwidth:	3 MHz
Span:	5 MHz
Trace-Mode:	Max hold
Used equipment:	See chapter 7.2
Measurement uncertainty	See chapter 8

Limits:

FCC	IC
Antenna Gain	
6 dBi	

Results:

T_{nom}	V_{nom}	lowest channel 2402 MHz	middle channel 2440 MHz	highest channel 2480 MHz
Conducted power [dBm] Measured with GFSK modulation		5.4	5.8	6.2
Radiated power [dBm] Measured with GFSK modulation		7.4	6.6	8.1
Gain [dBi] Calculated		2.0	0.8	1.9

Verdict: compliant

12.2 Maximum output power

Description:

Measurement of the maximum output power conducted and radiated. EUT in single channel mode.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	3 MHz
Video bandwidth:	10 MHz
Span:	10 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.2
Measurement uncertainty	See chapter 8

Limits:

FCC	IC
Maximum output power	
[Conducted: 0.125 W – antenna gain max. 6 dBi] Systems using more than 75 hopping channels: Conducted: 1.0 W – antenna gain max. 6 dBi	

Results:

Modulation	Maximum output power conducted [dBm]		
Frequency	2402 MHz	2440 MHz	2480 MHz
GFSK	5.4	5.8	6.2
Measurement uncertainty	± 1.5 dB		

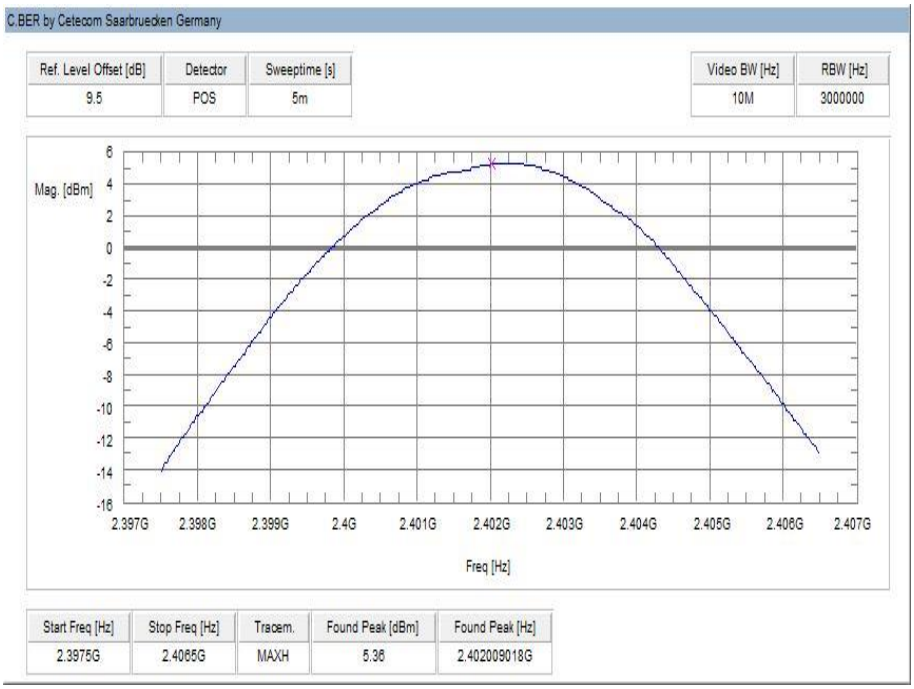
Modulation	Maximum output power radiated - EIRP [dBm]		
Frequency	2402 MHz	2440 MHz	2480 MHz
GFSK	7.4	6.6	8.1
Measurement uncertainty	± 3 dB		

*) - Values calculated with antenna gain

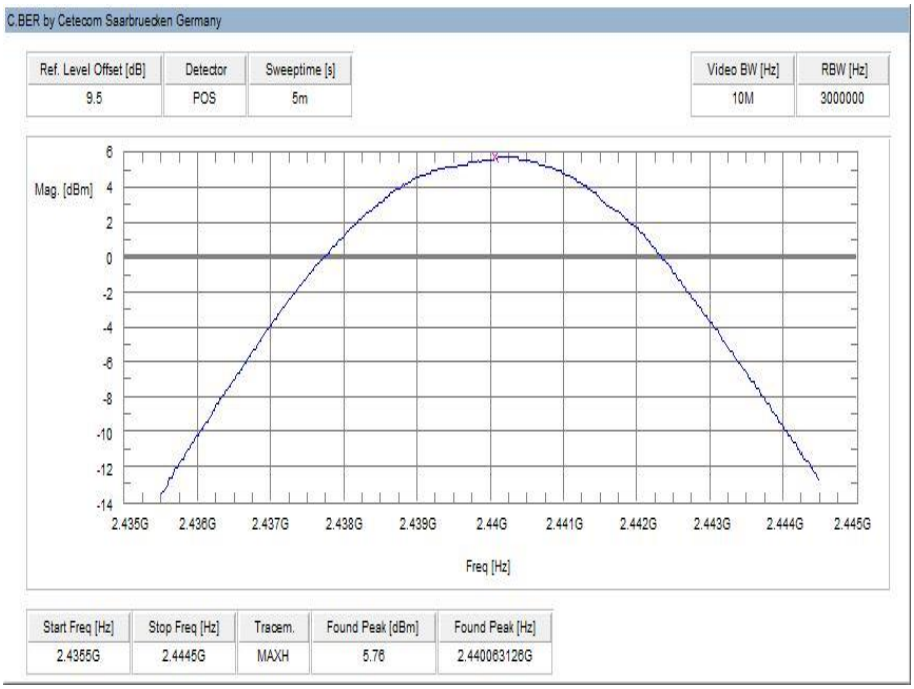
Verdict: compliant

Plots:

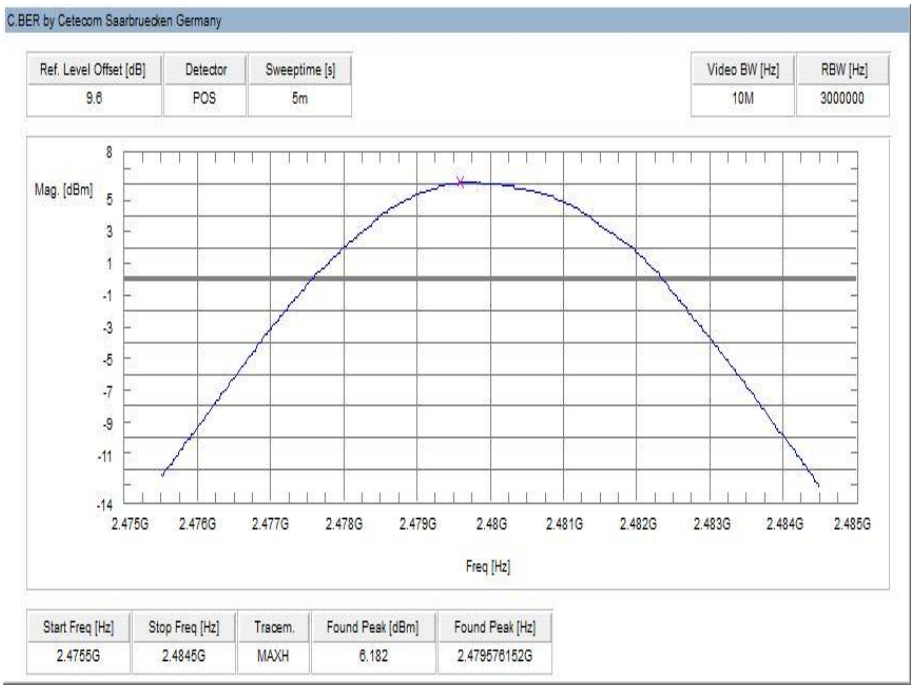
Plot 1: lowest channel



Plot 2: mid channel



Plot 3: highest channel



12.3 Spurious emissions radiated below 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit channel is channel 19. This measurement is representative for all channels and modes. If critical peaks are found channel 00 and channel 39 will be measured too. The measurement is performed in the mode with the highest output power. The limits are recalculated to a measurement distance of 3 m according the ANSI C63.10.

Measurement:

Measurement parameter	
Detector:	Peak / Quasi peak
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.2
Measurement uncertainty	See chapter 8

Limits:

FCC		IC
TX spurious emissions radiated below 30 MHz		
Frequency (MHz)	Field strength (dBµV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

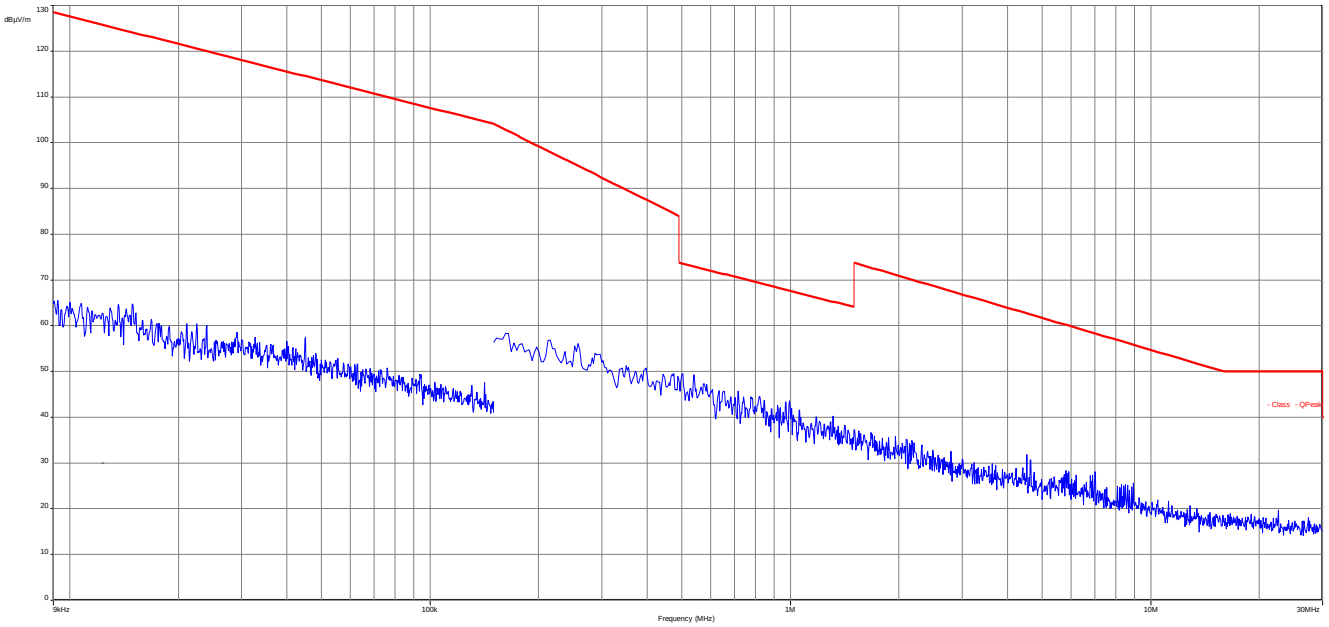
Results:

TX spurious emissions radiated below 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected emissions are more than 20 dB below the limit.		
Measurement uncertainty	± 3 dB	

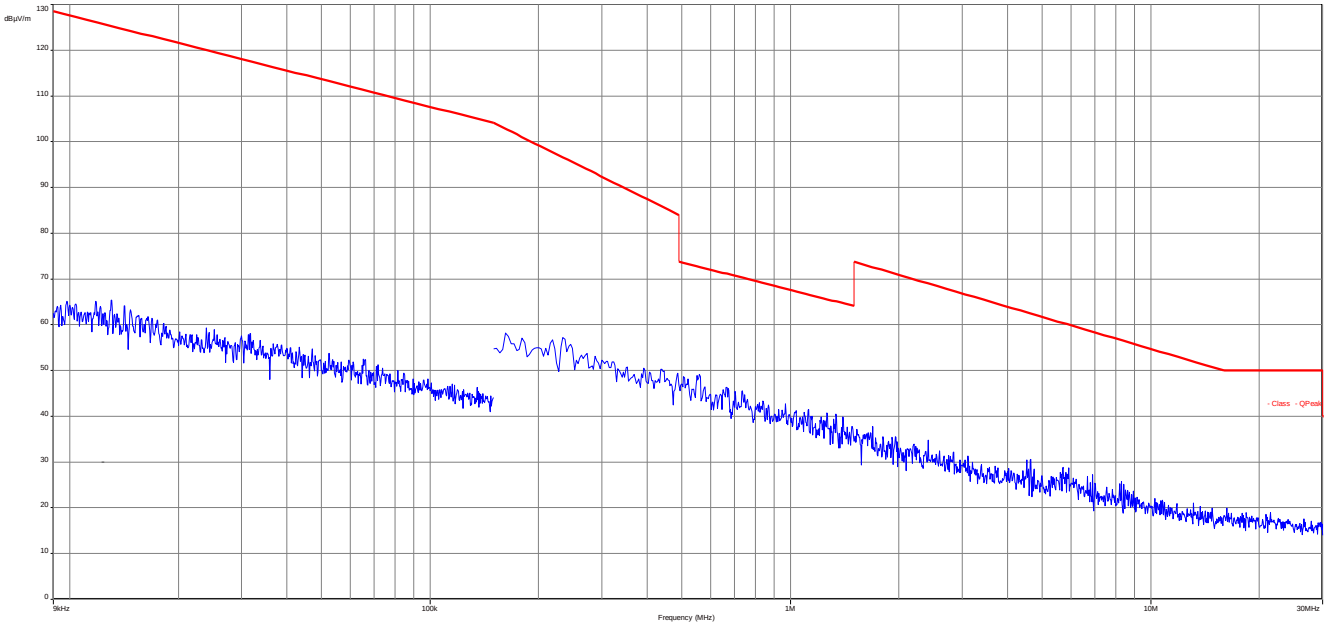
Verdict: compliant

Plots:

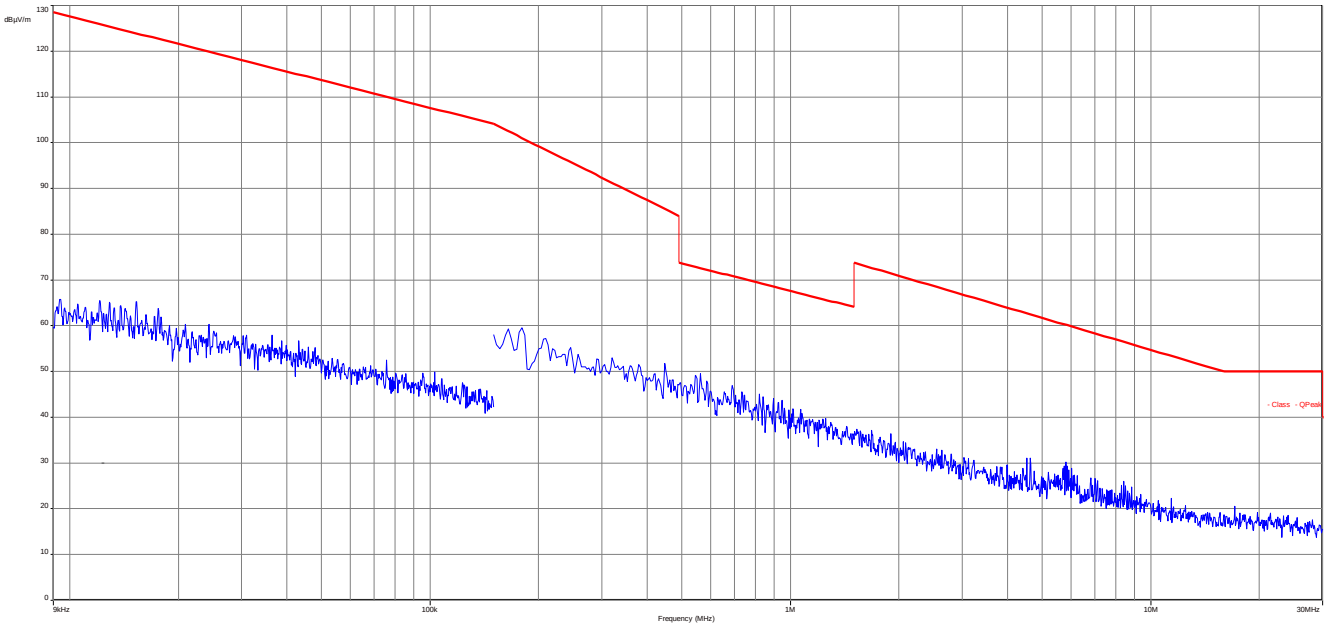
Plot 1: 9 kHz to 30 MHz, channel 00, transmit mode



Plot 2: 9 kHz to 30 MHz, channel 19, transmit mode



Plot 3: 9 kHz to 30 MHz, channel 39, transmit mode



12.4 Spurious emissions radiated 30 MHz to 1 GHz

Description:

Measurement of the radiated spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit channel is channel 00, channel 19 and channel 39. The measurement is performed in the mode with the highest output power.

Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	3 x RBW
Resolution bandwidth:	120 kHz
Span:	30 MHz to 1 GHz
Trace-Mode:	Max Hold
Measured Modulation:	GFSK
Used equipment:	See chapter 7.1
Measurement uncertainty	See chapter 8

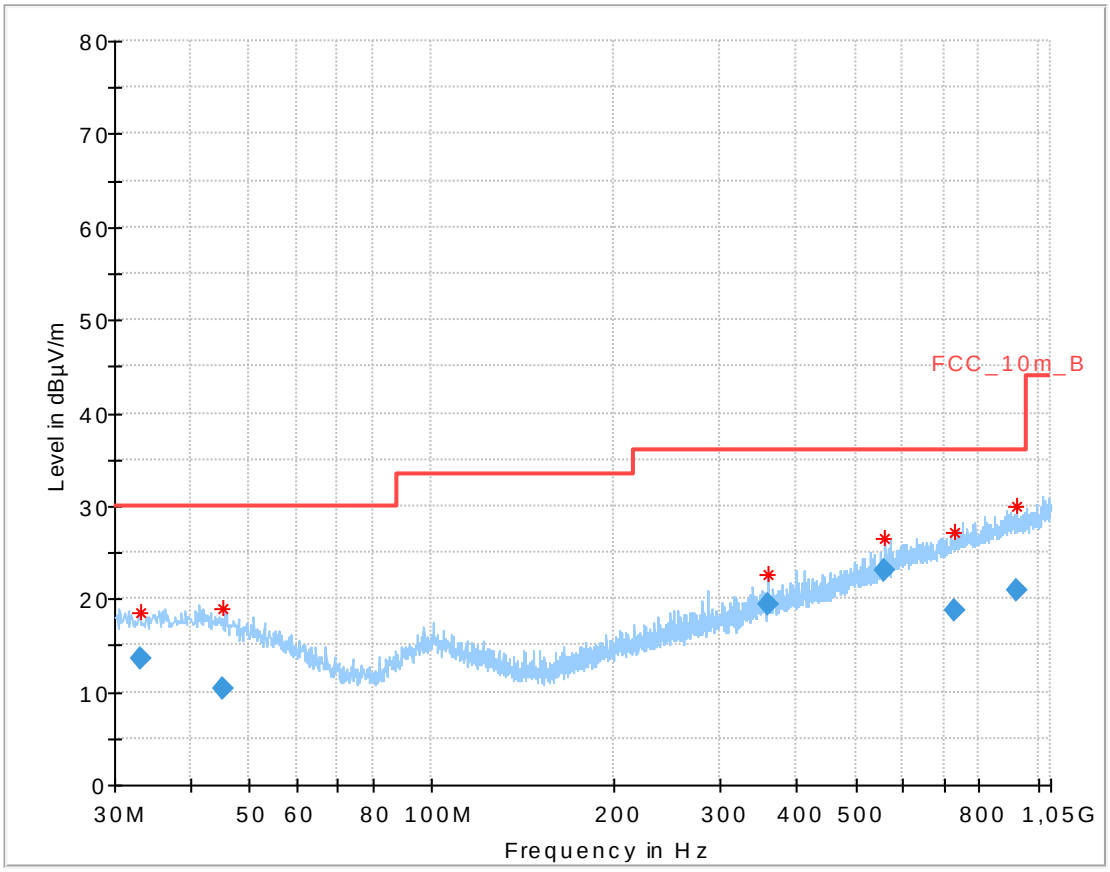
The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

Limits:

FCC		IC
TX spurious emissions radiated		
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 20 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)).		
§15.209		
Frequency (MHz)	Field strength (dBµV/m)	Measurement distance
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
Above 960	54.0	3

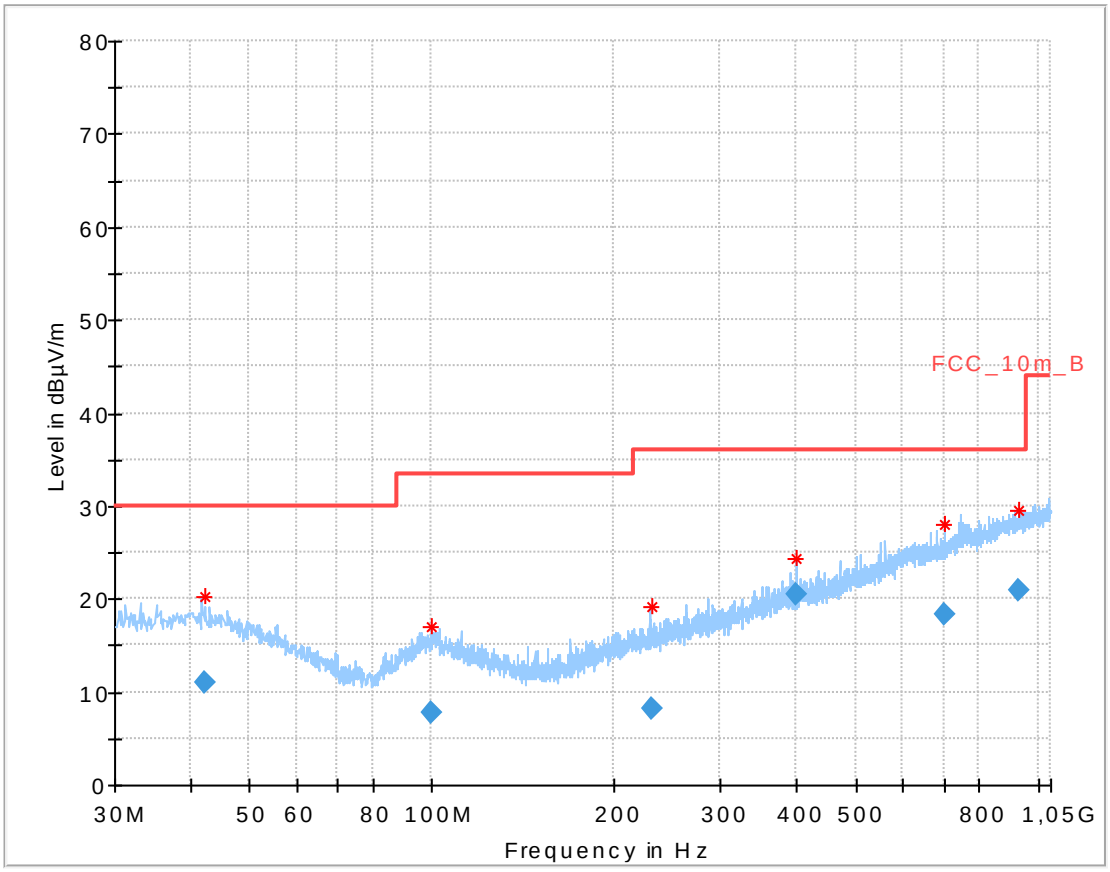
Plots: Transmit mode

Plot 1: 30 MHz to 1 GHz, TX mode, channel 00, vertical & horizontal polarization



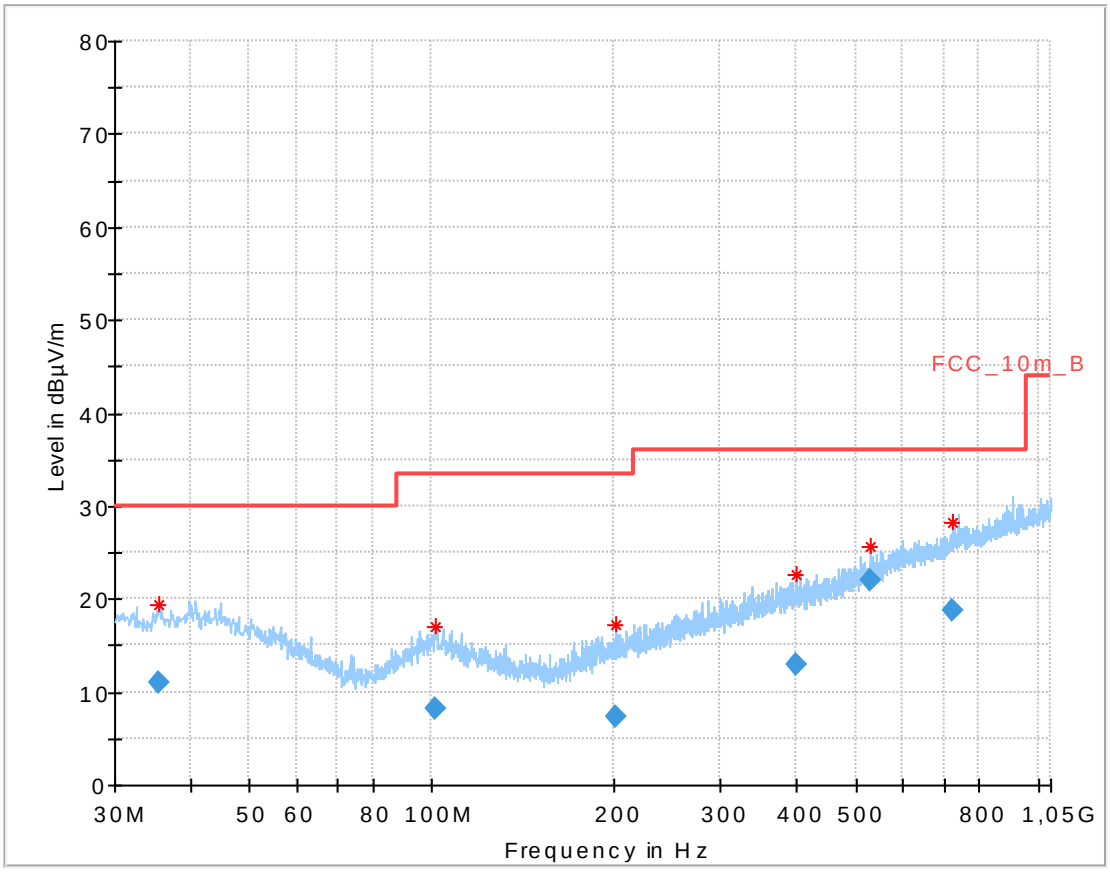
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.002400	13.63	30.00	16.37	1000.0	120.000	101.0	V	158	13.6
45.295050	10.26	30.00	19.74	1000.0	120.000	98.0	V	0	13.8
360.019350	19.43	36.00	16.57	1000.0	120.000	98.0	V	310	16.2
560.000700	22.97	36.00	13.03	1000.0	120.000	98.0	V	310	19.6
730.269900	18.82	36.00	17.18	1000.0	120.000	170.0	V	279	22.2
921.963000	20.81	36.00	15.19	1000.0	120.000	98.0	V	243	24.2

Plot 2: 30 MHz to 1 GHz, TX mode, channel 19, vertical & horizontal polarization



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.213600	11.05	30.00	18.95	1000.0	120.000	98.0	V	329	14.0
99.924150	7.68	33.50	25.82	1000.0	120.000	170.0	V	12	12.2
230.032650	8.28	36.00	27.72	1000.0	120.000	170.0	H	280	12.7
400.016550	20.56	36.00	15.44	1000.0	120.000	170.0	V	280	16.9
702.574050	18.27	36.00	17.73	1000.0	120.000	98.0	V	48	21.6
933.123300	20.90	36.00	15.10	1000.0	120.000	98.0	H	65	24.2

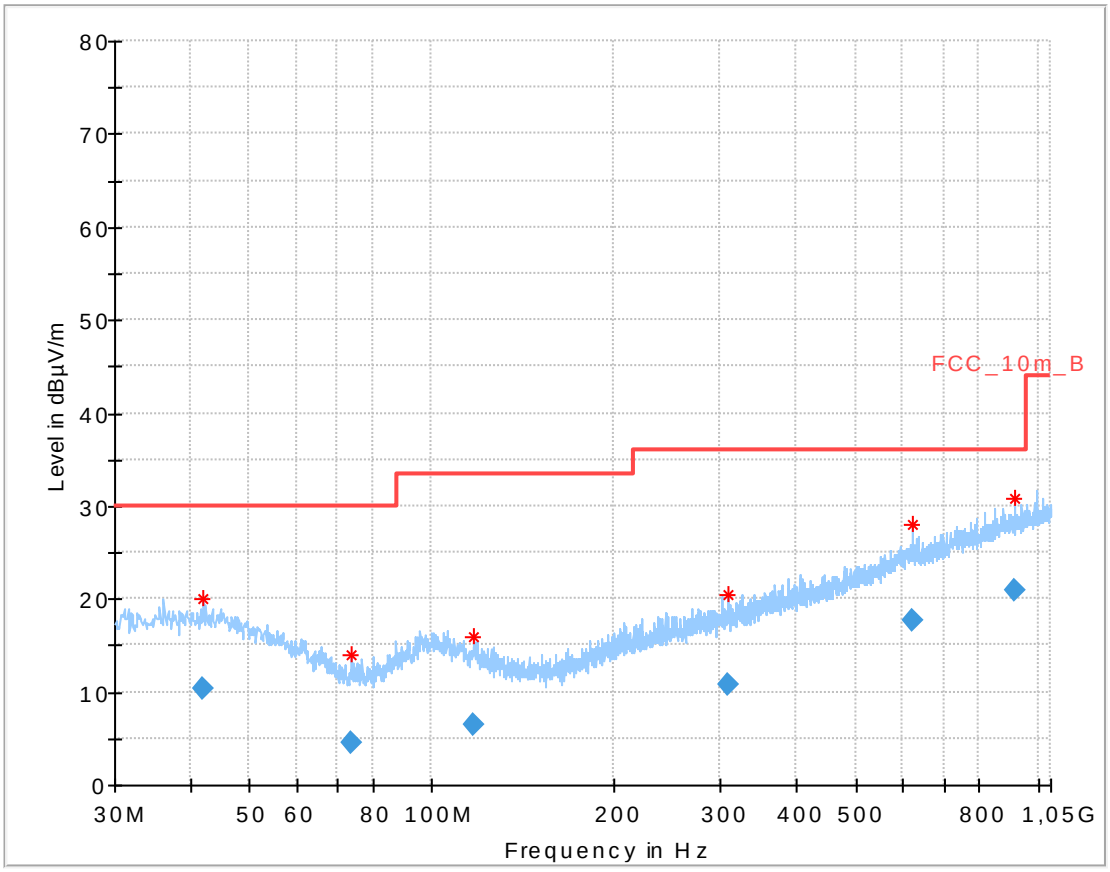
Plot 3: 30 MHz to 1 GHz, TX mode, channel 39, vertical & horizontal polarization



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
35.513550	11.08	30.00	18.92	1000.0	120.000	100.0	V	229	13.8
101.630250	8.18	33.50	25.32	1000.0	120.000	170.0	H	108	12.0
201.042600	7.32	33.50	26.18	1000.0	120.000	170.0	V	114	11.7
398.737800	12.91	36.00	23.09	1000.0	120.000	101.0	V	195	16.8
529.999350	21.91	36.00	14.09	1000.0	120.000	98.0	V	355	19.1
722.464800	18.72	36.00	17.28	1000.0	120.000	98.0	H	265	22.1

Plots: Receiver mode

Plot 1: 30 MHz to 1 GHz, RX / idle – mode, vertical & horizontal polarization



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.089550	10.32	30.00	19.68	1000.0	120.000	98.0	V	347	14.0
73.900200	4.49	30.00	25.51	1000.0	120.000	170.0	V	60	8.3
117.300000	6.53	33.50	26.97	1000.0	120.000	101.0	V	103	10.4
307.920150	10.87	36.00	25.13	1000.0	120.000	98.0	H	0	14.7
621.207900	17.62	36.00	18.38	1000.0	120.000	170.0	H	355	20.9
917.052300	20.89	36.00	15.11	1000.0	120.000	98.0	V	222	24.2

12.5 Spurious emissions radiated above 1 GHz

Description:

Measurement of the radiated spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit channel is channel 00, channel 39 and channel 78. The measurement is performed in the mode with the highest output power.

Measurement:

Measurement parameter	
Detector:	Peak / RMS
Sweep time:	Auto
Video bandwidth:	3 x RBW
Resolution bandwidth:	1MHz
Span:	1 GHz to 26 GHz
Trace-Mode:	Max Hold
Measured Modulation:	GFSK
Used equipment:	See chapter 7.2 and 7.3
Measurement uncertainty	See chapter 8

The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

Limits:

FCC		IC
TX spurious emissions radiated		
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 20 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)).		
§15.209		
Frequency (MHz)	Field strength (dBµV/m)	Measurement distance
Above 960	54.0	3

Results: Transmitter mode

TX spurious emissions radiated [dBµV/m]								
2402 MHz			2440 MHz			2480 MHz		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
4804.1	Peak	39.5	4880.0	Peak	44.7	4959.7	Peak	43.4
	AVG	-/-		AVG	-/-		AVG	-/-
12152.5	Peak	45.6	12056.4	Peak	45.4	11901.8	Peak	45.3
	AVG	-/-		AVG	-/-		AVG	-/-
19228.1	Peak	39.3	19532.1	Peak	38.9	19828.1	Peak	39.1
	AVG	-/-		AVG	-/-		AVG	-/-
Measurement uncertainty			± 3 dB					

Verdict: **compliant**

Results: Receiver mode

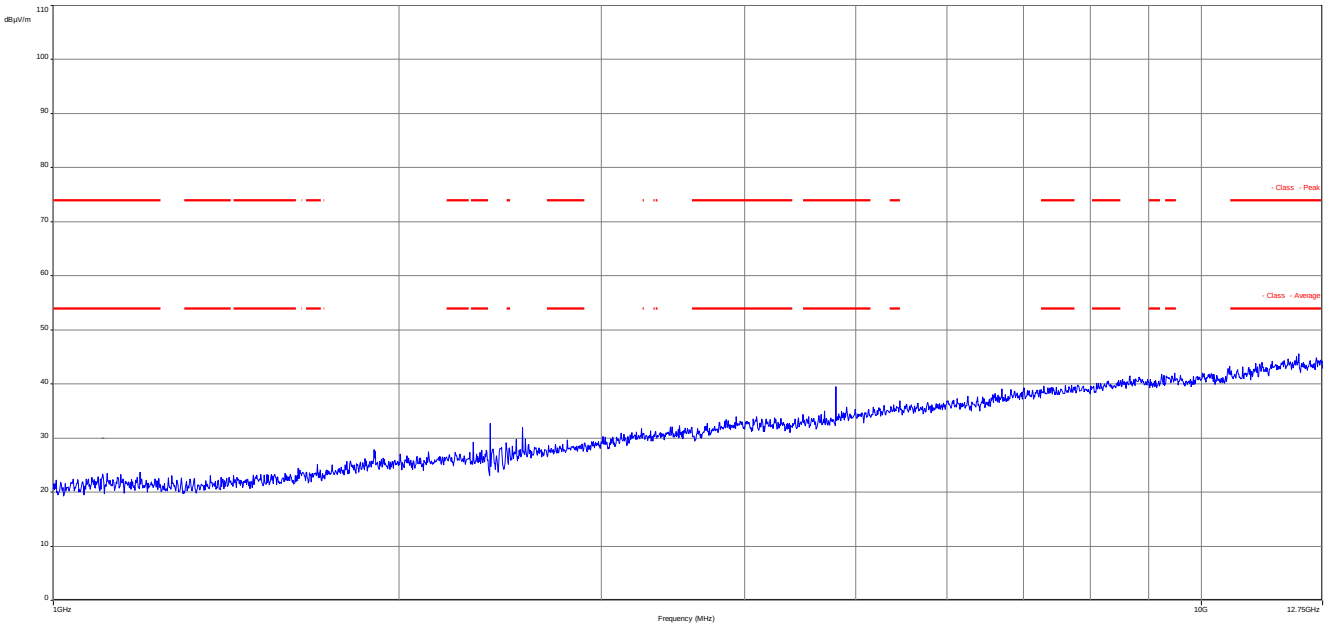
RX spurious emissions radiated [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
12040.9	Peak	50.3
	AVG	-/-
19828.1	Peak	39.4
	AVG	-/-
Measurement uncertainty	± 3 dB	

Verdict: **compliant**

Note: The limit was recalculated with 20 dB / decade (Part 15.31) for all radiated spurious emissions 30 MHz to 1 GHz from 3 meter limit to a 10 meter distance. (40dB/decade for emissions < 30MHz)

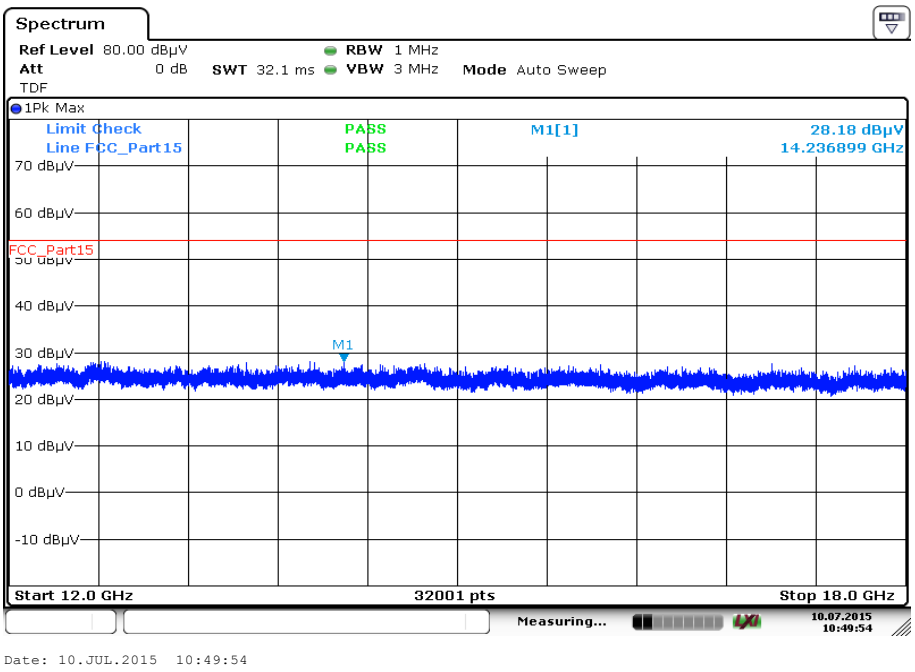
Plots: Transmitter mode

Plot 1: 1 GHz to 12.75 GHz, TX mode, channel 00, vertical & horizontal polarization

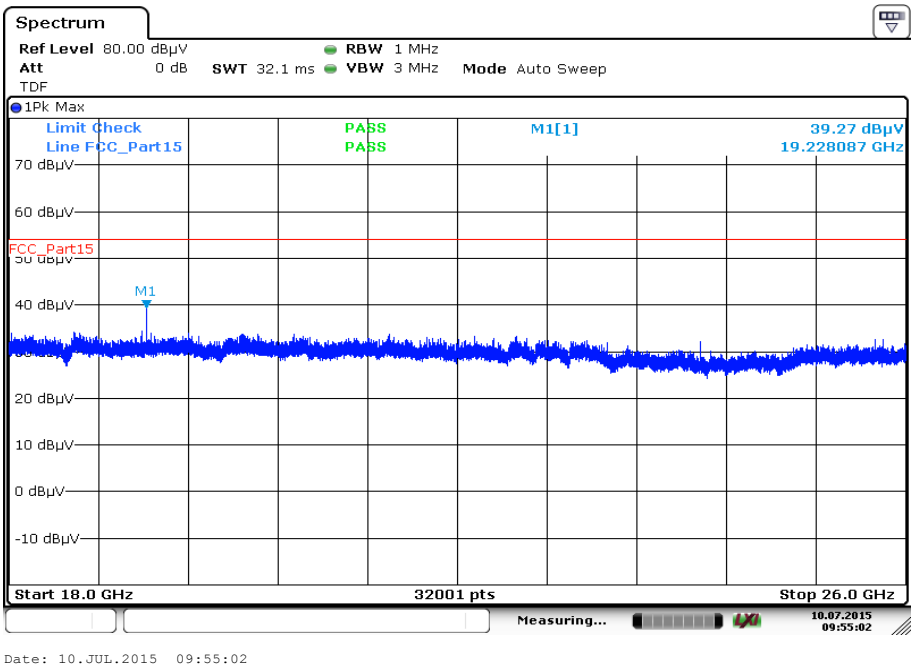


The carrier signal is notched with a 2.4 GHz band rejection filter.

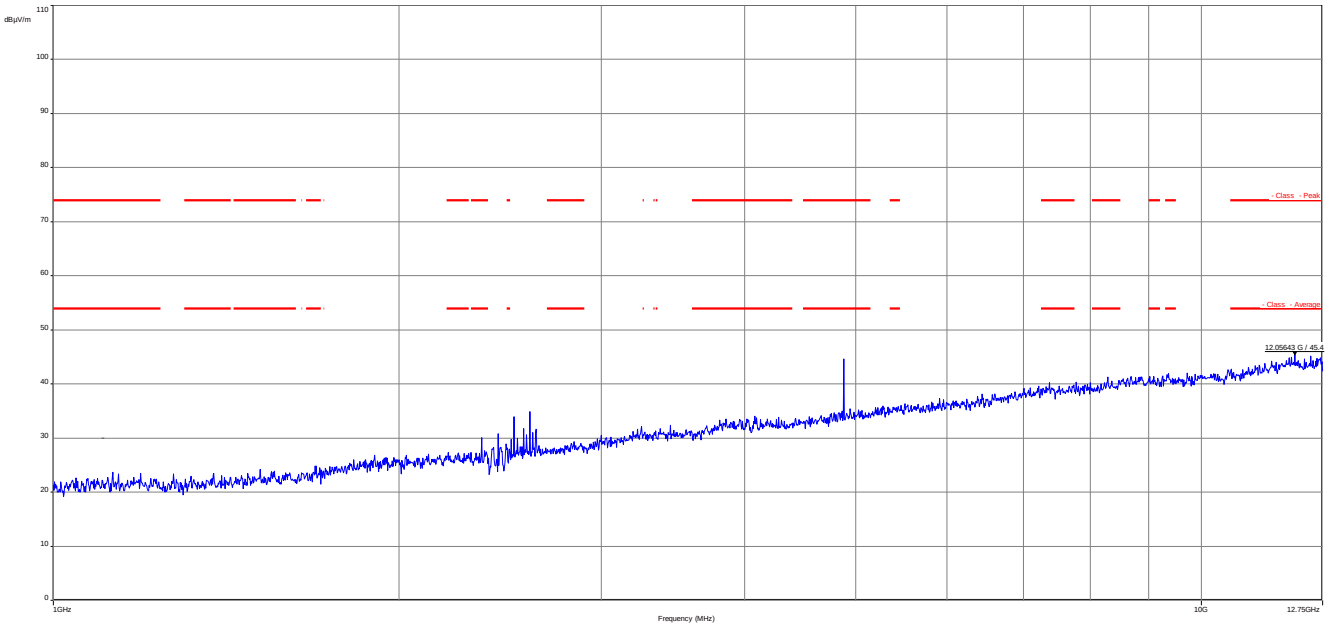
Plot 2: 12.75 GHz to 18 GHz, TX mode, channel 00, vertical & horizontal polarization



Plot 3: 18 GHz to 26 GHz, TX mode, channel 00, vertical & horizontal polarization

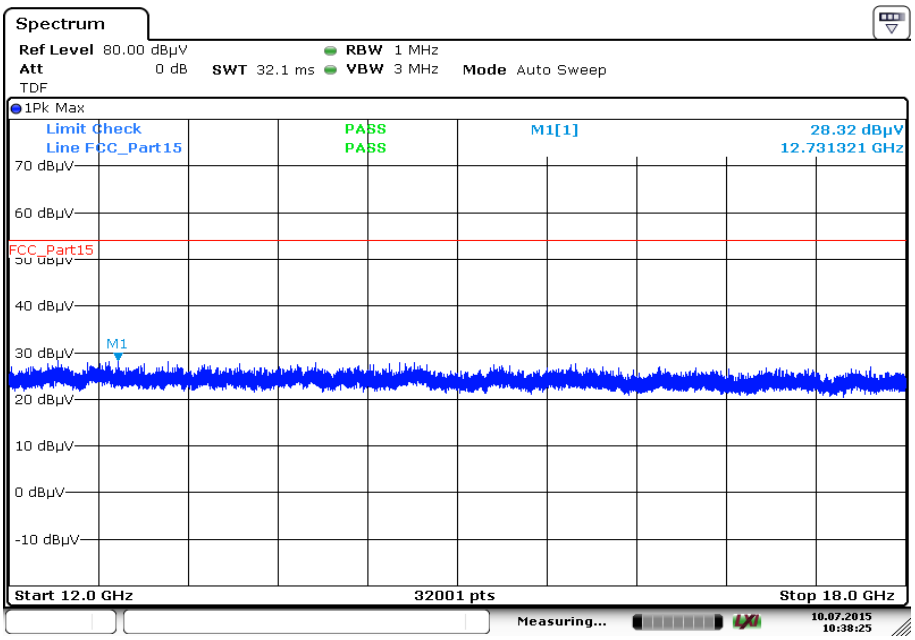


Plot 4: 1 GHz to 12.75 GHz, TX mode, channel 19, vertical & horizontal polarization

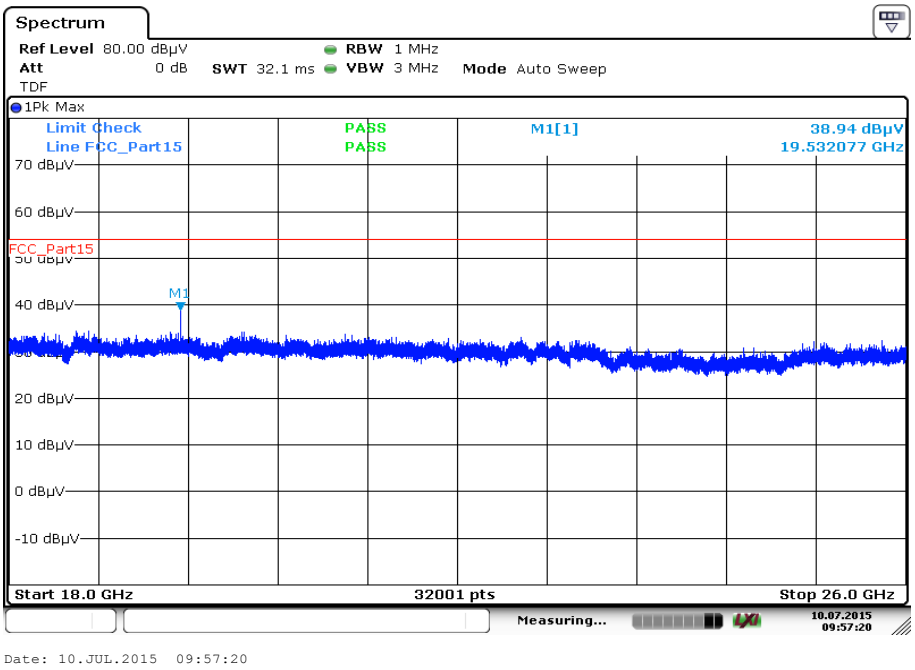


The carrier signal is notched with a 2.4 GHz band rejection filter.

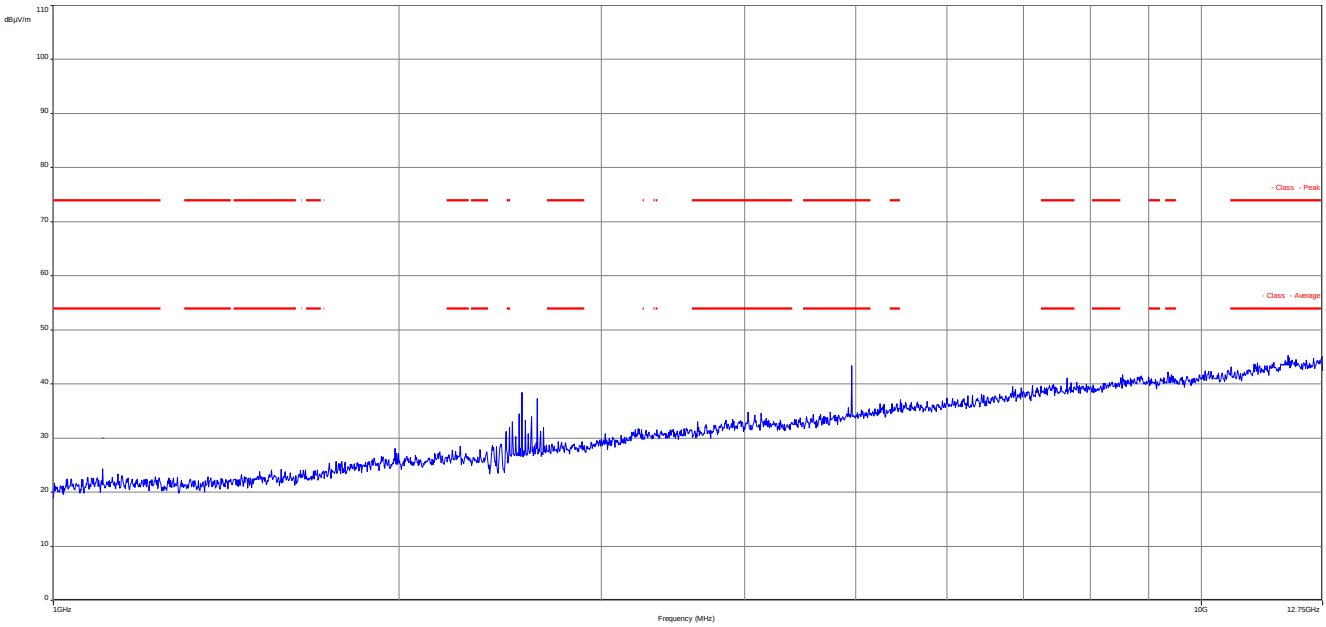
Plot 5: 12.75 GHz to 18 GHz, TX mode, channel 19, vertical & horizontal polarization



Plot 6: 18 GHz to 26 GHz, TX mode, channel 19, vertical & horizontal polarization

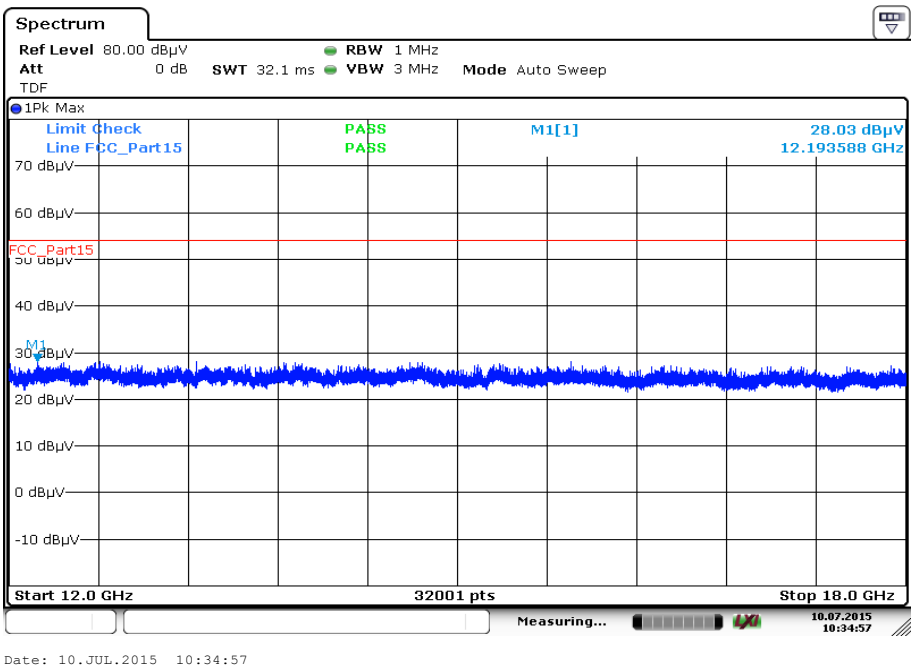


Plot 7: 1 GHz to 12.75 GHz, TX mode, channel 39, vertical & horizontal polarization

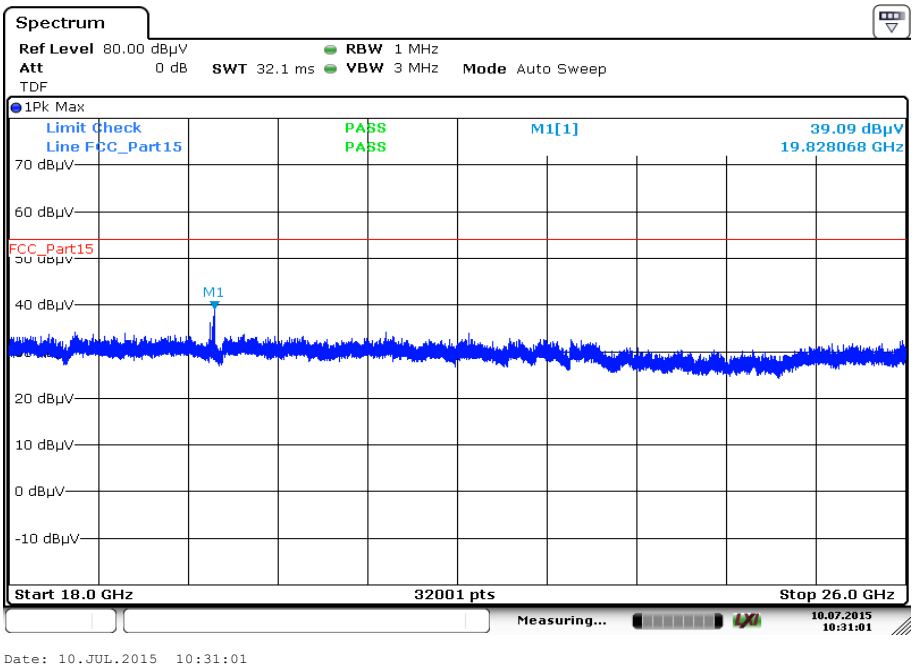


The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 8: 12.75 GHz to 18 GHz, TX mode, channel 39, vertical & horizontal polarization

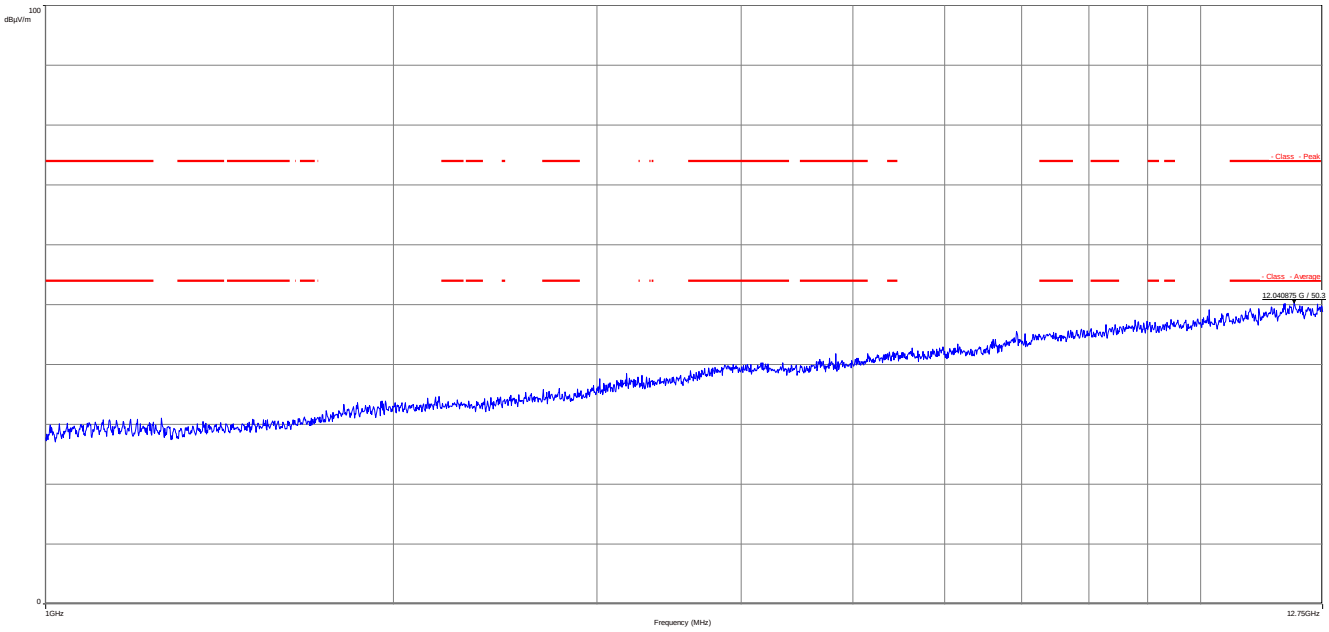


Plot 9: 18 GHz to 26 GHz, TX mode, channel 39, vertical & horizontal polarization

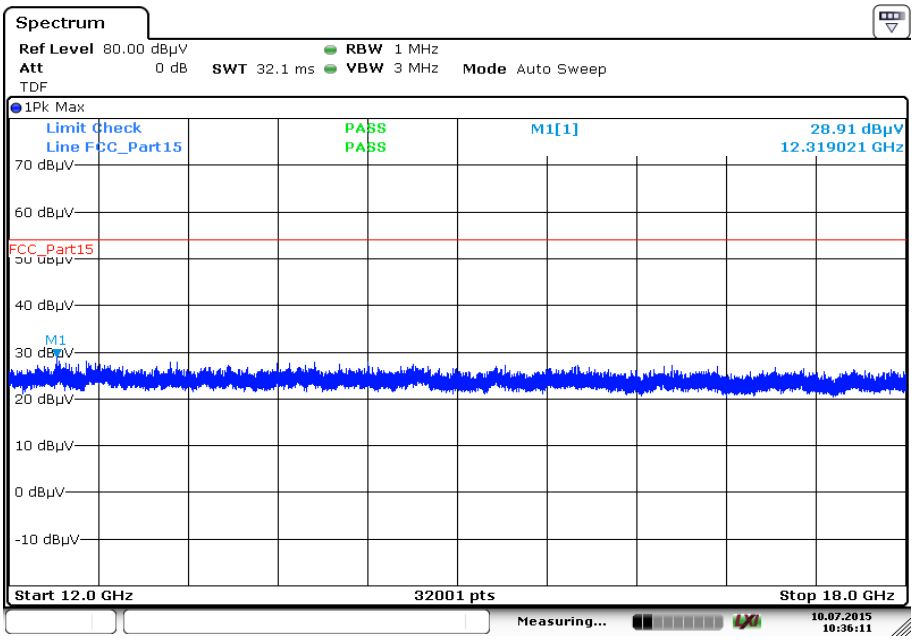


Plots: Receiver mode

Plot 1: 1 GHz to 12.75 GHz, RX / idle – mode, vertical & horizontal polarization

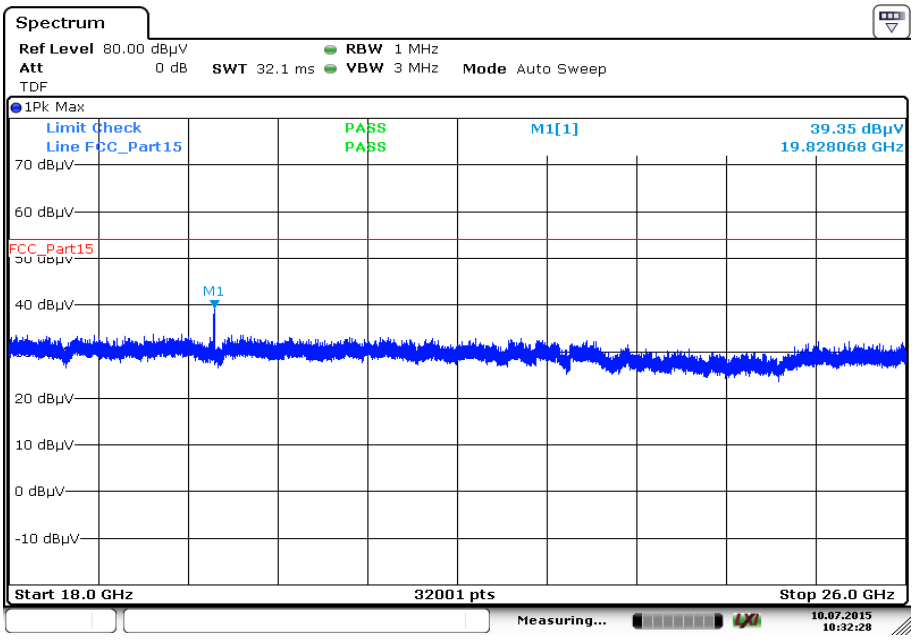


Plot 2: 12.75 GHz to 18 GHz, RX / idle – mode, vertical & horizontal polarization



Date: 10.JUL.2015 10:36:11

Plot 3: 18 GHz to 26 GHz, RX / idle – mode, vertical & horizontal polarization



13 Observations

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

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2015-07-29

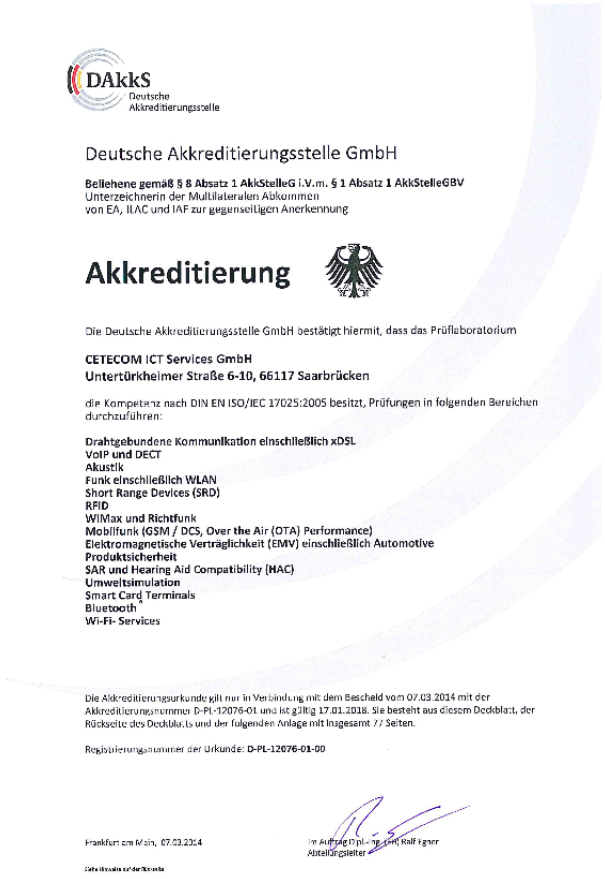
Annex B Further information

Glossary

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

Annex C Accreditation Certificate

Front side of certificate



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RFID
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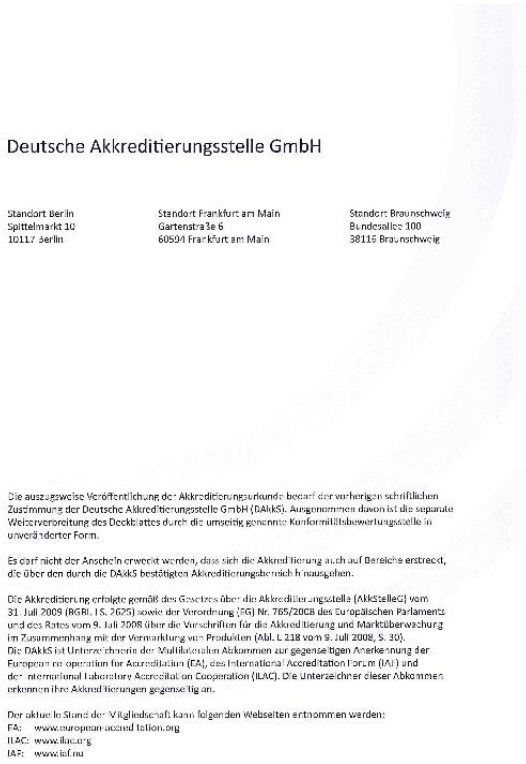
Frankfurt am Main, 07.03.2014

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

Back side of certificate



Deutsche Akkreditierungsstelle GmbH

Standort Berlin
Spittelmarkt 10
10117 Berlin

Standort Frankfurt am Main
Gartenstraße 6
60594 Frankfurt am Main

Standort Braunschweig
Bundesallee 100
38116 Braunschweig

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